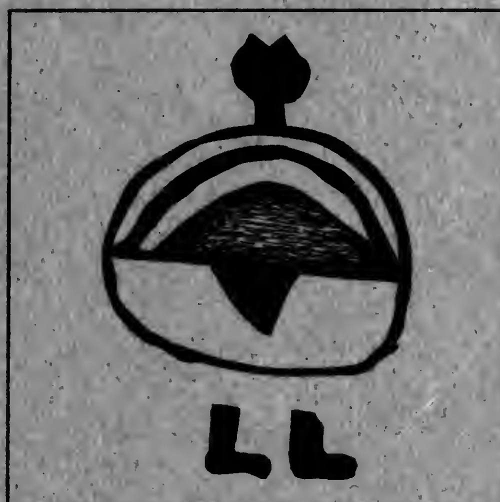
STRESS AND WARFARE AMONG THE KAYENTA ANASAZI OF THE THIRTEENTH CENTURY A.D.



JONATHAN HAAS
WINIFRED CREAMER

Fieldiana
Anthropology, new series, no. 21
Publication 1450
August 31, 1993

FIELD MUSEUM OF NATURAL HISTORY, CHICAGO

STRESS AND WARFARE AMONG THE KAYENTA ANASAZI OF THE THIRTEENTH CENTURY A.D.

Field Museum Press Anthropology Books

Foote Canyon Pueblo, Eastern Arizona, by John B. Rinaldo

The First Peary Collection of Polar Eskimo Material Culture, by James W. VanStone

The Simms Collection of Southwestern Chippewa Material Culture, by James W. VanStone

Indian Trade Ornaments in the Collections of Field Museum of Natural History, by James W. VanStone

A Late Pre-Hispanic Ceramic Chronology for the Upper Moquegua Valley, Peru, by Charles Stanish

Material Culture of the Blackfoot (Blood) Indians of Southern Alberta, by James W. VanStone

Stress and Warfare Among the Kayenta Anasazi of the Thirteenth Century A.D.

JONATHAN HAAS

Curator
Department of Anthropology
Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, Illinois 60605-2496

WINIFRED CREAMER

Assistant Professor of Anthropology
Northern Illinois University
DeKalb, Illinois 60115

Fieldiana
Anthropology, new series, no. 21
Publication 1450
August 31, 1993

FIELD MUSEUM OF NATURAL HISTORY, CHICAGO

This book was set in Palatino and printed and bound by the Allen Press in the United States of America. Design by Pannell + Oliver. Edited by Dana Fos.

Library of Congress Catalog Card Number: 93-70978

ISSN 0071-4739

Cover illustration: "Batwoman." Redrawn from the petroglyph by Becky Hammond. The location of the petroglyph on the back wall of Batwoman Cave is shown on page 102.

CONTENTS

ILLUSTRATIONS

ACKNOWLEDGMENTS

Any multiseason research project such as the one reported here owes its success to support from many institutions and individuals. Our summers in the Four Corners were made memorable by many of the people we met. Those who are not named here are no less important to us, and we thank all those who gave us a hand, a piece of information, or an encouraging word during those halcyon days.

The Harry Frank Guggenheim Foundation generously supported fieldwork in northeastern Arizona in 1984 and 1985. Then-Director of the Guggenheim Foundation, Floyd Ratliff, and Executive Director Karen Colvard were enthusiastic in their encouragement and advice. The National Geographic Society supported research on cliff dwellings in 1986 (grant no. 3377-86). The Long House Archaeological Field School (L.H.A.F.S.), sponsored by the University of Denver, contributed to the 1984 and 1985 field seasons. The School of American Research provided logistical and financial support and laboratory space for the project from 1984 to 1989. To Doug Schwartz and Jane Kepp we extend our appreciation for long-term encouragement, advice, and logistical backing.

This research could not have been carried out without the cooperation of the Navajo Nation and the Director of the Navajo Nation Archaeology Department, Anthony L. Klesert. The Bureau of Indian Affairs, Window Rock, also facilitated our research under permit ARPA-85-007.

The project field camp was located at Navajo National Monument each year, and our stay was facilitated by the National Park Service staff at NNM, especially superintendent Steve Miller, rangers John Loliet and Norberto Ortega, and directors of maintenance Bob Patterson and John Laughter.

We cannot begin to thank Bill and Ginny Cowles for their enthusiasm, fresh insights, and support. Robert and Margo Linton also provided support for the project and withstood an adventurous trip to the field site. One person who put enthusiasm and effort into the project and who is not able to review the product is the late Paul Logsdon, aerial photographer extraordinare. Paul flew over the research area for us, defying frightening crosswinds, and making photographs of many of the focal sites mentioned in the text. We miss his courtly and gentle good nature, we miss his expertise, and we miss him very much.

Legwork on the project was especially demanding as our research design designated tops of hills and mesas as survey areas. We appreciate the efforts of our field crews from each season, with special thanks to Marvin Jackson and Wilson Smith. Andy Christenson, Alan Dulaney, Steve Glass, Lori Rhodes, and Powys Gadd served as crew chiefs for different aspects of the survey portion of the project. Powys also visited often and gave us welcome cheer, boundless energy, and a fundamental commitment to the archaeological enterprise. We cannot overestimate the contribution made to the project by Jeff Dean and Lex Lindsay. They visited in the field, introduced us to Long House Valley and Tsegi Canyon, argued with us late into the night about Kayenta prehistory, and helped in many, many other ways. We could not have carried out this project without their assistance.

Crew chiefs Lori Rhodes, Brooke Plastino, and Jay Reszka led the field crews working in Long House Valley. Laboratory work was facilitated by Mark Oldknow and Tony Thibodeau, and artifact photos were taken by Rod Hook and John Weinstein. Katrina Lasko and Zbigniew Jastrzebski drew the illustrations.

Many people have read the manuscript and offered advice and counsel. Some of it we have taken, some we have not. These include Jerry Levy, J. Jefferson Reid, Jeff Dean, George Gumerman, Jane Kepp, and Jim VanStone. Many others have read parts of the manuscript in various stages of production and we thank all of them individually and collectively.

I

TRIBES AND TRIBAL FORMATION

This is a monograph about the relationship between warfare and the formation of tribal-type polities among the prehistoric Anasazi of the southwestern United States. It presents the results of archaeological research conducted in northeastern Arizona between 1983 and 1986. The project was initiated to begin to address the question of whether or not tribes may have existed in prehistoric, precontact situations. In 1975, Morton Fried argued that "tribes" as they were described in the ethnographic record were artifacts of colonialism. He then inferred that the entire tribal form of organization was an artifact of colonial contact and did not represent a native stage in a unilinear model of cultural evolution (see also Fried, 1983). Fried's examples, however, were all drawn from postcolonial situations and needed to be tested in a precolonial context—through the archaeological record.

Although most tribal models were presented in the 1960s and Fried's critique was published in 1975, the issue of tribal formation and organization is of ongoing interest and importance in anthropology and archaeology. In *Between Bands and States,* Susan Gregg (1991) has recently argued that archaeology must take an active role in addressing the question of tribes. "The key characteristics of tribes must be delineated; the role that tribal-type social organizations play in human social organization must be determined; and the conditions under which tribes have appeared must be identified" (Gregg, 1991:445).

In reviewing the archaeological literature for evidence of tribal formation, there were a number of cases in different parts of the world. Voss (1980), for example, found evidence for the emergence of tribes in northwest Europe during the Neolithic (see also Gibson & Geselowitz, 1988), and Tuck (1971a, b) documented the evolution of an Onondaga tribe in the late prehistoric/early historic period in New York (see also Englebrecht, 1974, 1978). In the southwestern United States, a survey conducted by Jeffrey Dean, Alexander

J. Lindsay, Jr., and William Robinson (1978) in Long House Valley in northeastern Arizona documented changes in settlement that corresponded closely with what would be expected in the development of a tribal polity (Creamer & Haas, 1985). Basically, Dean et al. (1978) found clusters of interacting villages coming together politically and economically in the context of what appeared to be conflict or war.

To begin looking at how and why a tribal type of organization might evolve in a prehistoric context before any possibility of colonial pressures, additional archaeological survey and excavation were initiated in the area of Long House Valley. The project focused on Long House Valley itself and a surrounding area of about 25 km in radius in the heartland of the Kayenta branch of the Anasazi culture. The work was designed to elucidate the nature of prehistoric tribal organization, the factors affecting the process of tribal formation, and the possible role of warfare in tribal development.

The specific focus of the research was on the period from A.D. 1250 to 1300, known as the Tsegi Phase of the Kayenta cultural sequence. This was a time of tremendous change throughout the entire Anasazi area, with new settlement patterns, new kinds of sites, new artifact types, and marked changes in social relations. Thus, the time and the place were set for an investigation of the formation of tribal polities in the prehistoric past.

Tribal Organization

The concept of "tribe" has long held a position of honor in anthropology. References to this or that "tribe" abound in the literature, and the label "tribe" has been assigned to one of the major stages in various schemes of cultural evolution. Generally, the term has been used to refer to bounded groups of culturally similar peoples. A tribe usually transcends the individual village by bringing multiple communities together in a larger regional polity. At an evolutionary level, this culture type is seen as lying somewhere between the loosely knit "band" and the politically centralized "chiefdom" (Adams, 1975; Sahlins, 1968; Service, 1971; Steward, 1955; Gregg, 1991; cf. Barth, 1969; Friedman & Rowlands, 1978; Lewis, 1968; Johnson & Earle, 1987). While the concept has been widely used and accepted in the discipline, there has been considerable debate over the nature of the tribal polity and the question of how tribes come into existence.

Discussions of how and why tribes develop rest to some extent on the concept of "tribe" itself. Just what is a tribe? Overview discussions of tribal organization in ethnography and cultural anthropology are graying today. As the field moves away from broad theories of evolutionary stages, there is a reluctance to try and build explicit models of specific "types" of societies or even to revise existing models. Yet the concept abounds in virtually every major journal of the discipline, and there seems to be some level of common understanding of what anthropologists mean when they talk about "tribes." Looking back in the literature, the most explicit discussions of the basic concept of "tribe" appeared in the late 1960s and early 1970s. Recognizing that these discussions are inevitably dated in terms of current anthropological thought, they nevertheless give a general idea of what anthropologists refer to with the label "tribe."

In one of the fullest presentations of a tribal model, Service (1971:101–108; see also Adams, 1975:225–228) sees the tribe as a network of social units or communities bound together by a series of pantribal sodalities. These sodalities may be either kin-based (e.g., clans, kindreds, segmentary lineages) or non-kin-based (e.g., age-grade systems, warrior societies, religious associations). In all cases, however, their function is basically the same: They provide a means for culturally uniting individuals from different social or residence units. Residents of different communities, for example, who belong to the same clan are culturally joined together. Furthermore, the communities united by such clan ties, along with other sodality relationships shared by the respective members, would constitute the tribe in the Service model. This network of sodality relationships not only serves to unite the communities together as a tribe, but also operates to distinguish the member units of the tribe from other outside units. The formation of the tribe in this sense involves the formation of a cultural boundary, though the nature of this boundary is not clarified by Service.

A second model, offered by Sahlins (1968, see also 1972), sees the tribe as a "pyramid of social groups" (1968:15) in which the parts are not necessarily subordinate to one another but play different roles in the social system. Thus, for example, at the basic level of the household, certain kinds of activities are carried out. At the next level of the clan or lineage, there is another set of activities, another set at the village level, and so on, with the "tribal" level being the most inclusive functional unit at the apex of the pyramid. In this model again there is the implication that since the tribe acts as a discrete functional unit at one level, it is a culturally bounded unit, just as in the Service and Adams model. However, Sahlins does state that at the tribal level, the unit may be tied into a "wider, intertribal field" (1968:15; see also Johnson, 1978, 1982).

In comparing the two models of tribe, it is apparent that they are not mutually exclusive. Instead, each places emphasis on different kinds of variables in depicting the tribal form of organization. In the first, emphasis is placed on the network of social relationships, whereas in the second, it is on the hierarchy of functional roles.

The Formation of Tribes

There has been active recent debate over the formation of tribes, and the issues are more clear-cut (Whitehead, 1989). Generally, there are two different ideas about how and why tribes evolve: a "traditional" model that originated in the ethnographic evolutionary models of Service, Adams, and Sahlins, and an alternative model offered more recently in archaeology (Braun &

Plog, 1980, 1982; Braun, 1984; Plog & Braun, 1983; Bender, 1985; Upham, n.d.; Voss, 1987). The traditional explanation assigns a primary causal role to warfare in the evolution of the tribe. Basically, it is argued that in the face of population growth related to the beginnings of plant domestication, groups found themselves in competition over land and other resources. In response to these conditions, groups that joined forces with one another would be better able to compete for scarce resources. Out of this competitive milieu, there emerged a new form of polity, a decentralized network of villages applied together in the face of external competition—the tribe.

> There is nothing in this demographic situation [population growth] alone which would necessarily lead to a tribal form of organization; probably the earliest growing societies simply divided and spread. With competition, however, the larger and better consolidated would prevail, other things being equal. Here again external offense–defense requirements may well have been the selective factors, signifying as they do the importance of alliance and solidarity. (Service, 1971:101; see also Harner, 1970:70)

The process of tribalization in this view clearly involves consolidation and coordination of different units, but the process also takes place within the context of competition and conflict or warfare. Again, to quote Service:

> The external policy of tribes is usually military only. Usually, too, the military posture is consistently held; that is, a state of war or near-war between neighboring tribes is nearly perpetual. Tribal warfare by its nature is inconclusive. Ambush and hit-and-run raids are the tactics rather than all-out campaigns, which cannot of course be economically sustained by a tribal economy and its weak organization. True conquest, furthermore, would be self-defeating, for the productivity of a defeated tribe would not be great enough to sustain the conquerors. Objectives seem to be booty . . . or to drive the enemy out of a favored zone or prevent him from expanding. (1971:104; see also Adams, 1975:228; Carneiro, 1970, 1978; Sahlins, 1968:17)

Thus, while warfare is seen as central to the process of tribal formation, its rule is one of inducing consolidation through cooperation rather than conquest. The unified tribe then emerges as a discrete political entity separated from its neighbors by hostile (or potentially hostile) relations.

A second model that has recently been applied to explain the formation of tribes, argued most fully by Braun and Plog (1980, 1982; see also Bender, 1985), also places emphasis on cooperation. However, in this case, it is argued that the process of tribal consolidation will occur in response to any number of social and/or environmental "risks" (Braun & Plog, 1982:506–508). Conceivably warfare could be one of those "risks," but it is not seen as a primary causal variable in tribal formation. Basically, Braun and Plog take issue with the notion that resource shortages and other environmental problems will necessarily lead to competition and conflict. They argue instead that, in the face of such problems, there is more likely to be an intensification of cooperative interaction and alliance between local communities.

> For example, other things being equal, an increase in population density or a reduction in the scale of residential movement would leave coresidential units with increasingly smaller areas for direct exploitation. Under many environmental conditions, such a constriction of the area available for direct exploitation would increase the spatial and temporal variance in productive yields among neighboring coresidential units. Such increased local unpredictability in yields would present a potential increase in risk to each local community. If this increasing local unpredictability occurs within an already existing social network, we would expect to see an increase in the social connectedness within that network. That is, where lines of cooperation and communication already exist, increased local environmental unpredictability should lead to increased demand on these lines of integration. Except under the most extreme circumstances (e.g. see discussions in Dirks [1980] and in Winterhalder [1980]), sustained increases in such demands should lead to increased formalization of the existing lines of integration, as a consequence of the processes of selection discussed earlier. (Braun & Plog, 1982:508)

Thus, for Braun and Plog, tribal polities form as a consequence of increased cooperation, integration, and communication between communities.

This view differs from the traditional model in a number of ways. First, in downplaying the role of warfare, the interaction between tribal groups in Braun and Plog's model is significantly different from the competition and conflict envisioned in the more traditional model. Specifically, in the former model, not only is the expectation of intertribal conflict lacking, but there may well be an increase in certain kinds of positive interactions between tribal units (e.g., ritual exchange), as one tribal group establishes alliance relationships with other tribes (Braun & Plog, 1980).

Furthermore, in the more traditional model, the formation of tribes involved not only increased integration (Service's pantribal sodalities) and coordination (Sahlin's structural hierarchy), but also formation of some kind of social boundary around the "tribe." This kind of boundary formation is a logical outgrowth of the emphasis on the importance of warfare in tribal formation. In a cooperative model, however, the process of boundary formation is quite distinct from the intensification of integration and coordination (Braun & Plog, 1982:505; Bender, 1985:55). Accordingly, tribal polities can develop in the absence of the formation of concrete bounded tribes. This view requires a third model of what the "tribal" unit might look like. In a sense then, it might be possible to have a "tribal" *form* of organization without having a discrete social unit that might be readily identified as a bounded *tribe*.

Tribe as an Evolutionary Stage

There has been a recent argument in the archaeological literature against the analytical use of the concept of tribe. This argument harks back to the Boasian critique of the 19th century evolutionary models of Tylor and Morgan. Basically, it is argued that by focusing on certain "essential" elements in defining a tribal form of organization, the anthropologist winds up lumping wildly disparate cultures into one evolutionary type and avoids rich diversity for the sake of evolutionary uniformity (Leonard & Jones, 1987; Dunnell, 1980; Plog & Upham, 1983; Upham, n.d.; Braun, 1991). Leonard and Jones (1987), in particular, blanket all the evolutionary stage models with the same criticism:

> Invariably, applications of the model are conceived at a scale much too inclusive and indiscriminating for culture change to be monitored, and, in fact, the model serves to obscure change at the scale at which it primarily occurs (i.e., consider the material variation and culture change that goes unnoted with the punctuated *stages* of evolution and that the model demands). (1987:200)

This type of generic argument against evolutionary stages such as "tribe" or "chiefdom" are really arguments against cultural typologies. By placing societies in broad stages or types, it is argued, the unilineal evolutionists miss the continuous range of variability found in the ethnographic and archaeological record. Ultimately, however, this boils down to a classic debate between "lumpers" and "splitters" and constitutes a spurious argument against the evolutionary models and the different specific stages. While it is true that such models and stages gloss over a great deal of cultural diversity, they were never developed to account for diversity. They were developed to account for certain broad patterns of similarity that can be observed cross-culturally in the record of human societies. Any typology, be it for ceramics, house forms, or politics, is developed to answer certain questions about the phenomenon under study. Anthropology, fortunately, has moved beyond the point of trying to "discover" certain true, immutable types that are applicable in all circumstances and for all purposes.

In the case of the different evolutionary models, the various stages or cultural types, such as tribe, have been generated to account for cross-cultural patterns in the evolution of specific aspects of cultural systems. Both Service (1971) and Adams (1975), for example, look at evolutionary patterns in terms of social integration and centralization of the different parts of the system, whereas Fried's model of political evolution looks at evolutionary patterns in terms of access to resources, status, and power. These different models produce different explanatory arguments about the evolution of cultural systems and quite different evolutionary stages. They are not, however, contradictory to one another. They are simply focusing on different parts of the system.

This is no different from having one ceramicist develop a typology of vessel form and function to learn about room use while another develops a typology of design elements to learn about social relationships. Neither typology is right or wrong and neither can be reasonably criticized for not encompassing the full range of ceramic variability. The typologies were developed with different questions in mind and serve different purposes for the analyst.

In none of the evolutionary models is it argued that there is a lack of diversity within broad levels. Rather, it is argued that if one looks cross-culturally at certain aspects of the cultural system, there are patterns of similarity, and there is an evolutionary relationship among these patterns. In the case of the current project it is argued, following Service, Adams, and others, that "tribe" is a valid evolutionary type that can be effectively used to analyze well-integrated but decentralized regional systems of communities. Such tribal systems represent an evolutionary development out of an antecedent pattern of unintegrated, independent band communities, and they precede the centralized regional systems of chiefdoms.

Problem Domains

In comparing the different models of tribes and tribal formation, a number of problem areas come into focus. First, in all of the models, the process of tribal formation is seen as involving increased interaction and solidification of bonds between separate social units. Beyond this level of agreement, questions remain about the nature and strength of those bonds. Are emergent tribal units held together by an essentially homogeneous web of sodality relationships? Or are individuals and communities involved in a hierarchy of relationships that vary in function and intensity as one goes from the household up to the tribal levels? Braun and Plog demonstrate that inter-community relationships intensify in the face of common risk, but they do not show how communities or social units actually interact in a tribal polity. It is quite likely, of course, that different cultures will have different patterns of interaction; however, without information on the nature of such interaction in prestate aboriginal groups it will be impossible to generate anything more than a hypothetical model of tribal organization.

A second problem domain concerns the causal variables contributing to the process of tribal formation. The ethnographers argue for warfare, while the archaeologists would broaden the field by subsuming warfare under the more general term of environmental "stress" or "risk." Braun and Plog convincingly argue that tribal polities can and do evolve in the absence of warfare; however, they do not address how warfare *may* play a role in the process of tribal formation. In fact, a comparison of Braun and Plog's theoretical model of tribal formation with the ethnographic evolutionary models leads to an alternative hypothesis regarding tribes and warfare. Namely, warfare acts to solidify existing unbounded tribal networks into concrete bounded tribes. In other words, warfare need not play a causal role in the intensification of social networks, but it may be a necessary variable in the formation of boundaries around those networks.

Some empirical data to support this hypothesis may be drawn from the prehistoric Iroquois (Englebrecht, 1974; Tuck, 1971a,b; Whallon, 1968), but these data are suggestive at best, and the hypothesis is clearly in need of explicit testing with a more comprehensive data base (Englebrecht, 1978; Trigger, 1981). At the same time, it must be recognized that warfare itself may arise in response to or in combination with other forms of environmental "stress," such as demographic pressures or environmental degradation. Consequently, to fully understand how tribal polities form, a wide range of changes in the environment of the evolving society must be considered, even when warfare *is* present.

A third problem area is related to the second, specifically, how does the process of boundary formation relate to the process of intensification or interaction? Braun and Plog point out that while often confused, these are not one and the same process. Consequently, if interaction increases with increased risk, then questions still remain about how and why boundaries may form around interaction networks. While the warfare hypothesis was mentioned above, it might also be hypothesized that intensification of intratribal links might progress to such a point that a de facto boundary was formed around the tribal unit. Such an event might be predicted when a group of communities was subjected to a qualitative and relatively permanent increase in the level of environmental stress.

Beyond these basic questions of how and why tribal boundaries form, there are further questions related to the nature of such boundaries. Since no one argues that a tribal boundary eliminates all interaction between the tribe and outside groups, the question becomes one of how much interaction there is, and what form that interaction takes. If warfare is the primary vehicle of boundary formation, the intertribal interaction might be expected to be predominantly military. Input from outside groups would then be most likely to take the form of captives and material resources. On the other hand, if environmental stress is a primary vehicle for boundary formation, then intertribal interaction might be predicted to be cooperative. In such a case, input from the outside might take the form of limited trade or exchange of either scarce or luxury resources. Again, answers to questions about the formation and nature of tribal boundaries require collection of specific kinds of information from prehistoric societies.

In examining these interrelated problem domains archaeologically, we do not expect to "prove" any of the individual models of tribal organization or formation. Rather, we hope to distinguish the components of the different models having the greatest utility in explaining the process of tribal formation, and provide a more comprehensive empirical foundation for understanding the tribal form of organization under pristine, prestate conditions.

Summary

During the 13th century, the Kayenta Anasazi in northeastern Arizona underwent a basic change in social organization. From nonhierarchical, dispersed villages, they formed larger clusters of cooperating communities with some communal economic, ideological, and political activities. They looked like what we might expect for a prehistoric tribal type of organization. Archaeological evidence from the region may make it possible to elucidate the factors that contributed to the shift that occurred during the Tsegi Phase, A.D. 1250–1300.

Central to the study of tribe formation is a consideration of the role of warfare as a catalyst to the other factors causing stress on the regional population. Anthropological theories of societal change have long focused on the role of conflict in forging new configurations of settlement, economy, and ideology. In the case of the Kayenta Anasazi, integration of society appears to have persisted in the face of increasingly adverse environmental and economic conditions during the latter half of the 13th century, bringing the potential role of warfare into the arena of study.

The emergence of tribal polities represents a critical stage in the evolution of cultural systems. It marks the time when village autonomy is transcended as people join in larger political networks. There is an increase in cultural diversification as tribal communities pull together internally and pull apart from other similarly organized communities. Varying relationships develop between the emerging tribal groups based on some combination of cooperation, competition, and conflict. The cultural system overall becomes more complex, with tighter integration within the tribes and decreased integration between tribes. The study of the process of tribalization therefore offers potential insights into the beginnings of political aggregation, diversification, interaction, and integration.

Below we explore the formation of prehistoric tribes in the American Southwest, in an effort to gain a greater understanding of some of the foundations of the evolution of political systems across cultures and time. An effort has been made to take in a large area and to use both traditional and nontraditional field methods. Though our net may be cast broadly, the data returned clearly show that regional studies such as this one yield the variety of information that is needed to address complex questions.

2

BACKGROUND AND METHODOLOGY

The southwestern United States offers an optimal laboratory for investigating the process of the formation of tribal polities in a prehistoric, precolonial context. There are several reasons for focusing on the Southwest for such an analysis. First, there is better chronological control for the prehistoric period in the Southwest than for virtually any other world area. Tight chronological control is critical to a study of tribal development because different phases of the process may occur within the span of a single generation. Second, at least for parts of the Southwest, there is an incomparable record of the past environment. Working with tree rings, pollen, and hydrology, scholars have reconstructed detailed records of past precipitation, erosion, groundwater fluctuation, and patterns of short- and long-term temporal and areal variation (Gumerman, 1988).

This kind of detailed paleoenvironmental record is important for assessing the potential role of external or environmental stress in the process of tribal formation. Third, the large amount of previous archaeological work conducted in the Southwest provides a solid cultural foundation for the study of how tribes may form. The basic time-space frameworks have already been worked out and can be used as a starting point rather than an initial research objective. Finally, there are extant tribal groups in the Southwest, such as the Hopi and Zuni, that have deep historical roots extending back into prehistory.

The Kayenta Anasazi

With the Southwest as a broad laboratory, archaeological research was initiated in one specific culture area, that of the Kayenta Anasazi, to begin addressing central questions about the nature of tribal organization and the causal forces behind the process of tribal formation (fig. 2-1). Again, there

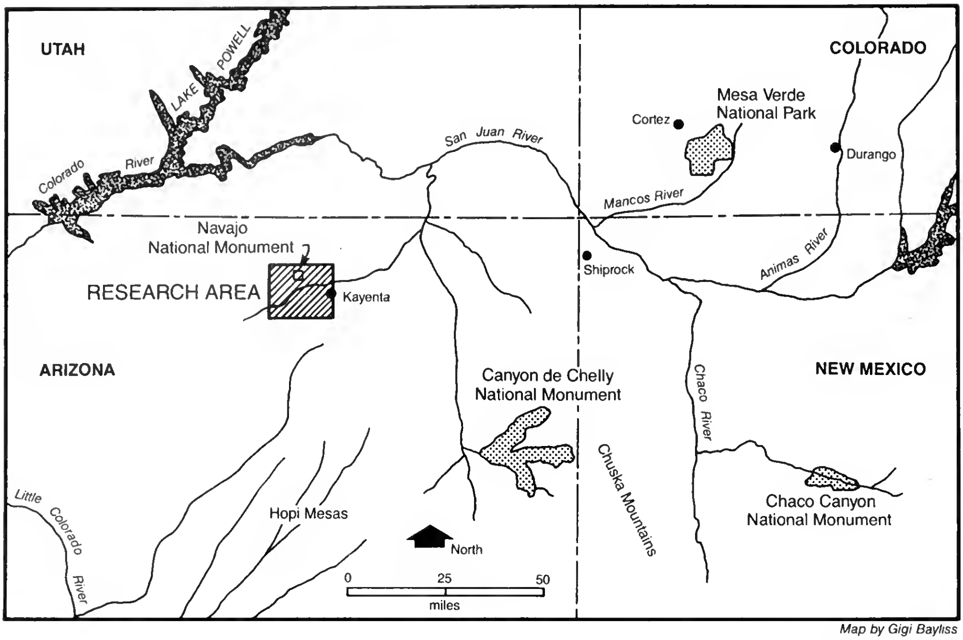


Figure 2-1. Map of the Four Corners region showing the general location of the research area.

are several reasons for concentrating on the Kayenta Anasazi, who occupied what is today northeastern Arizona. First, a combination of tree-ring dates and well-analyzed pottery types provides for highly refined dating of Kayenta sites. This is true not only for excavated sites, but also for unexcavated sites discovered in the course of survey. Surface ceramics, in particular, allow the dating of Kayenta sites to within 50 years for most of the occupation sequence, and to within 25 years for the last century of occupation (Dean et al., 1978:29; Gumerman, 1988).

The second reason for working in the Kayenta area is that numerous archaeological projects in the Kayenta area have provided a rich background for current problem-oriented research into tribal formation. Among the projects in the Kayenta area are the survey and excavation of the Rainbow Bridge–Monument Valley Expedition (Beals et al., 1945; Hargrave, 1935; Christenson, 1983), the Glen Canyon Project (Lindsay, 1969; Lindsay et al., 1968), the Black Mesa Archaeological Project (Gumerman & Euler, 1976; Gumerman et al., 1972; Powell, 1983; Plog & Powell, 1984; Plog, 1986; Powell & Gumerman, 1987), and the Black Mesa Railroad Corridor Project (Swarthout et al., 1986). Together, these projects have fleshed out the broad outlines of Kayenta prehistory from the first millenium B.C. to regional abandonment in A.D. 1300 (Haas, 1989).

Finally, because of the large amount of work done over the past two decades in the Kayenta region, the reconstructed paleoenvironmental record is among the best in the Southwest. Past environmental variability in the Kayenta

Figure 2-2. Aerial photograph of Long House Valley, facing southwest. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

region has been assessed through a variety of paleoenvironmental studies, including analyses of tree rings, pollen, and hydrology. Intensive chronostratigraphic analysis of more than 50 independently dated stratigraphic sections in floodplain deposits provides detailed reconstructions of changes in alluvial groundwater levels and of alternating episodes of floodplain aggradation and dissection (Euler et al., 1979). Fluctuations in alluvial water tables coupled with aggradation or erosion would have had major consequences for the Anasazi inhabitants of the Kayenta region, who subsisted mainly by farming valley bottoms. Dendroclimatic analyses document annual variations in precipitation from A.D. 680 to 1970 (Dean & Robinson, 1977) that would have affected yearly crop yields. Access to these high-resolution paleoenvironmental data allows immediate investigation of the role of environmental stress in the development of political systems in the valley.

Taking the region of the Kayenta Anasazi as a study area, research was designed and implemented in 1983–1986 to gain insights into the nature of tribal organization in a prehistoric setting and to address questions about the possible role of warfare and environmental stress in the formation of tribal-type polities. The focus of this research was on one small valley, Long House Valley, in the center of the Kayenta heartland. Long House Valley is a small wedge of land (75 sq km) nestled between Black Mesa on the south and the Shonto Plateau and Tsegi Canyon system on the north (fig. 2-2). The eastern edge of Long House Valley is delimited by Marsh Pass, which marks the mouth of the Tsegi Canyon system to the north and leads out into Kayenta Valley to the east. To the west, a string of hills separates Long House Valley from Klethla Valley. Long House Valley provided an ideal location to begin the investigation of the process of tribal formation.

Long House Valley

In 1978, Alexander J. Lindsay, Jeffrey Dean, and William Robinson completed a 100% survey of Long House Valley and recorded 551 prehistoric sites dating from ca. 2500 B.C. to A.D. 1300 (Lindsay & Dean, 1971; Dean et al., 1978). The evolving pattern of settlement that emerged from this survey looked on the surface like what might be expected to appear in a case of prehistoric tribal formation (Haas, 1980; Creamer & Haas, 1985). Although the history of occupation in the valley is complex and interesting, the time of immediate interest for the present project is the Pueblo III period, from A.D. 1100 to 1300, during which the archaeological and environmental data indicate the emergence of a tribal polity under conditions of stress.

At the beginning of this period, between A.D. 1100 and 1150, the residents of Long House Valley were living in numerous small villages of two to ten rooms for one to four families. Some of these villages had kivas (ceremonial structures) while others did not. Sites from this period were distributed fairly evenly along the edges and across the floor of the valley (fig. 2-3). Although exact population estimates are not available, the relative population density in the valley was higher than in previous centuries, though not at a maximum, which came in the 13th century (Dean et al., 1978; Effland, 1979). The environment in A.D. 1100 across all of northern Arizona was quite favorable for subsistence horticulture, with a relatively high water table, high annual precipitation, and near the top of a cycle of soil aggradation (Dean et al., 1985).

With regard to social relationships, the Long House residents shared the same material cultural assemblage as people residing in other parts of the Kayenta region. There are indications that ceramics and the raw materials for making stone tools were being exchanged between valleys at this time (Green, 1983, 1986; Garrett, 1986). There is, however, no sign of any type of systematic interaction or coordination either between villages within the valley or between the valley residents and residents of neighboring valleys. Warfare and conflict are not manifested in any way in the settlement pattern or the burial population. Overall, the available data base from the Kayenta heartland at the beginning of the 12th century does not point to a supravillage tribal organization.

Beginning in approximately A.D. 1150, the environment in northern Arizona began to change and the local population changed with it. There was a drop in the alluvial groundwater levels, a major short-term drought, and the start of a period of soil degradation caused by erosion (Dean et al., 1985).

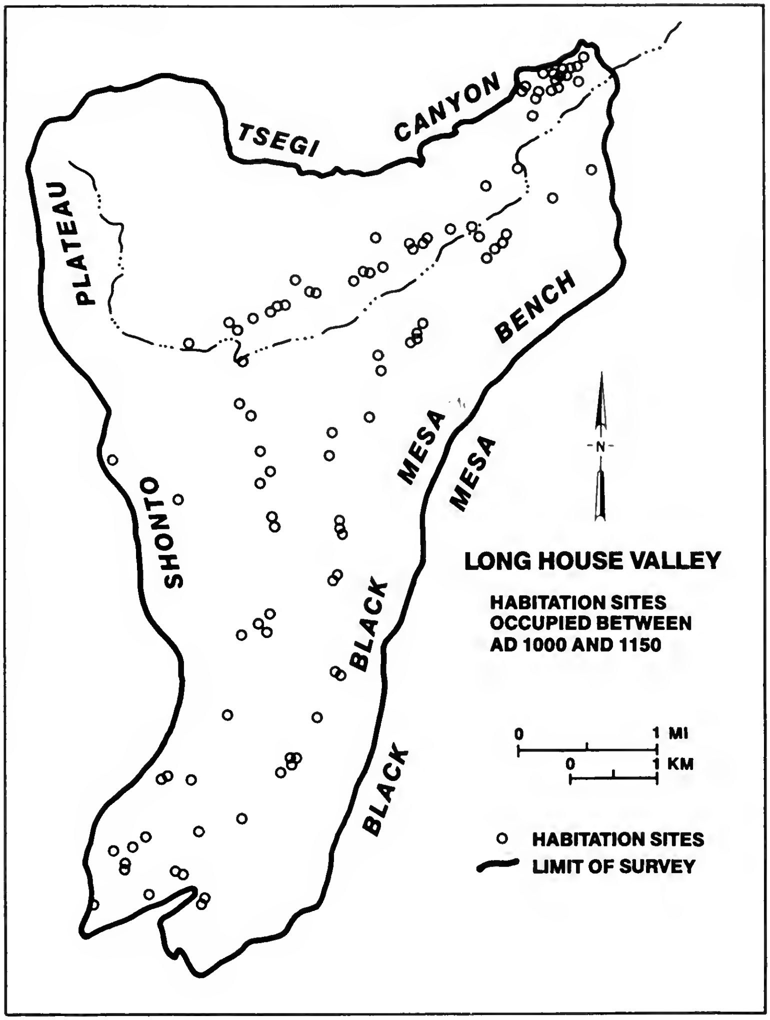


Figure 2-3. Map of Long House Valley in the period A.D. 1000–1150 (adapted from Dean et al., 1978).

In response to these environmental shifts, portions of the Kayenta region were abandoned completely. Black Mesa, immediately to the south and east of Long House Valley, was always marginal for horticulture, and with the drop in precipitation and the water table, the residents of this area were completely gone by A.D. 1150 (Powell, 1983).

Between A.D. 1150 and 1250 there was a substantial shift of the population toward the northern half of the valley (fig. 2-4). This would have increased the population density locally, though the total population in the valley as a whole did not go up substantially during this period. As in the previous period, the villages remain small, and there are no overt indications of the emergence of a discrete tribal type of organization uniting the villages within the valley or bringing together the Long House residents with residents of neighboring valleys.

At the same time, as inferred from the increased densities and clustering of villages in the northern half of the valley, there would have been increased interaction, coordination, and/or cooperation in the distribution and utilization of limited field systems. As with previous periods, there are no signs of either competition or conflict between the valley residents, nor signs of warfare with people outside the valley. However, the shift of the population out of the southern half of the valley resulted in the beginning of a de facto physical boundary between Long House residents and the people living in Klethla Valley to the south and east. The fact that Black Mesa to the south and west was also completely abandoned at this time further extended the physical boundary around the Long House population.

In the latter half of the 13th century, there was continued degradation of the environment with increasing loss of arable land due to erosion and a dropping water table. The fall in the water table would have dried up many stable sources of drinking water as well, and while precipitation was variable annually, another major drought occurred in the 1260s (Dean, 1969). These environmental trends were accompanied by dramatic cultural changes among the Kayenta Anasazi of northeastern Arizona beginning in roughly A.D. 1250.

Within Long House, population had increased, probably through immigration, to a maximum for the valley. The abandonment of the southern half of the valley was complete, and the population came to reside in five discrete clusters of villages (Effland, 1979; Dean et al., 1978) (fig. 2-5). Furthermore, for the first time, there appeared a clear differentiation between residential villages. Specifically, each of the clusters consisted of a single "focal" village of 75 to 400 rooms around which there were 2 to 13 smaller "satellite" villages of 2 to 25 rooms. Four of the five focal communities also had reservoirs for the collection and storage of water. Each of the focal villages, in addition to being much larger than the satellites, is distinguished by the presence of long, "spinal" roomblocks with cored, double-faced masonry, and by open plaza areas (Dean et al., 1978:33). The focal villages also mark the first possible indication of conflict or warfare in the Kayenta region.

All five focal sites were situated in defensible positions on a hilltop, knoll, or isolated cliff, overlooking the land around the satellite sites in the cluster. The focal communities were also located to afford a clear line of sight with each of the others and with all the primary access routes leading into the valley. The visual network of focal sites also indicates there was some degree of unification within the valley as a whole. These focal sites then provide the first indication of both warfare and possible tribal integration in Long House Valley.

Taken as a whole, the existing survey and paleoenvironmental data for Long House Valley and the Kayenta region in general indicated at the beginning of the present project that this would be a good area to assess models

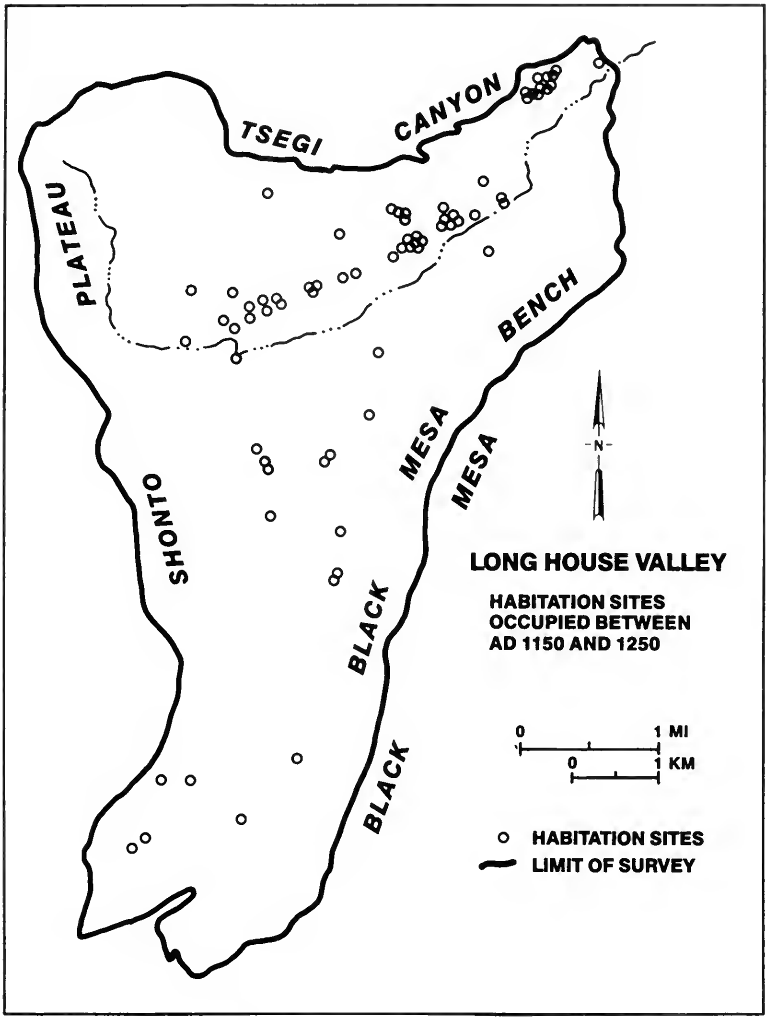


Figure 2-4. Map of Long House Valley in the period A.D. 1150–1250 (adapted from Dean et al., 1978).

of tribal organization and tribal formation. There were signs of increased *interaction* in the clustering of villages and communal facilities; *integration,* as seen in the visually interlocking network of sites; a *functional hierarchy,* manifested in the focal and satellite villages; the *environmental stress* of drought and erosion; and the defensive posture of the focal sites, which pointed to a possible pattern of *warfare.*

The initial survey data of Dean et al. (1978) from Long House Valley offered tantalizing but inconclusive insights into tribal organization and development in a prehistoric context. Substantial questions remained to be answered through examination of the sites and new, problem-oriented field research. Key problem areas centered on integration and conflict. On the integration

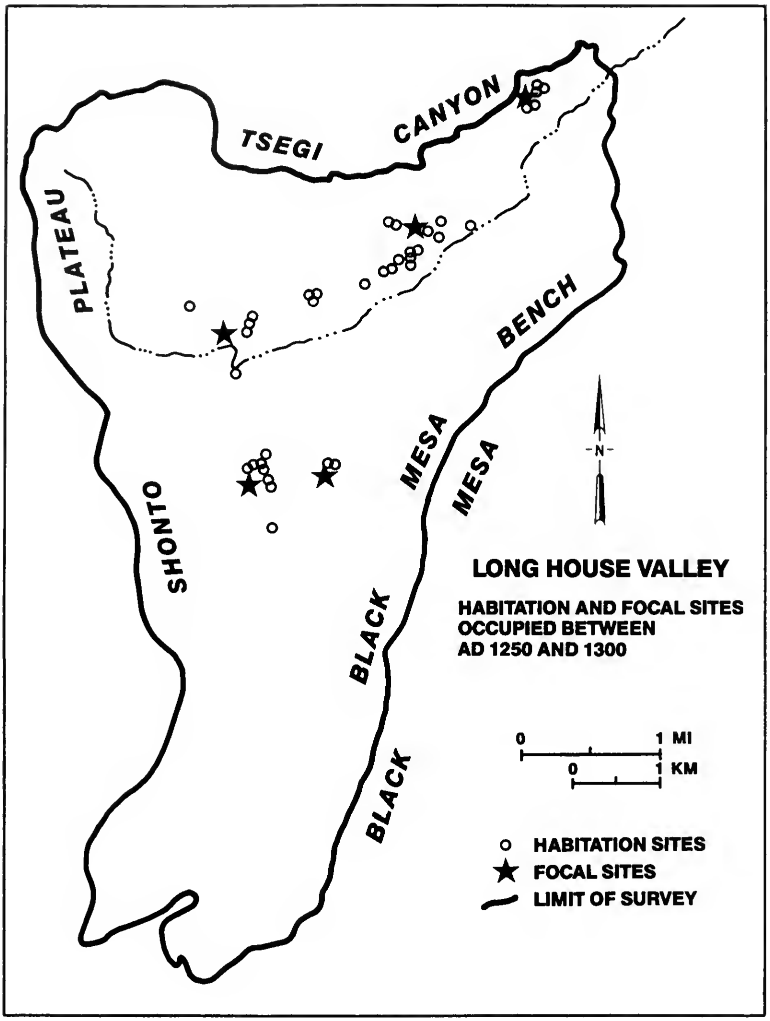


Figure 2-5. Map of Long House Valley in the period A.D. 1250–1300 (Tsegi Phase) (adapted from Dean et al., 1978).

side, there were questions about the nature of political relationships within Long House Valley and between the valley and its neighbors. What was the nature of the relationship between the focal sites and the satellite sites? Were these two site types functionally different or did they differ only in size? Were the satellites homologous units, or were there structural differences between them? Were there specific sodalities holding together the different units within the Long House Valley system? On the conflict side, there were questions about the possible role of warfare in shaping the development of the Long House Valley polity. Was the environment the primary driving force behind the observed changes in the 13th century, or was warfare an intermediary causal factor? Was there a bounded Long House Valley polity or were they united with neighboring valleys in the Kayenta region? If there was conflict in the Kayenta region in the 13th century, was it intraregional or between the Kayenta and neighboring culture groups in the Mesa Verde or Hopi areas to the north and south?

Answers to these questions about the nature and evolution of tribal organization in the Kayenta heartland required the collection of new data from the field. Questions about integration required specific data from sites within the valley, to give insights into possible differences in site organization and function. Questions about conflict required information about a broader range of sites both within and outside the valley to give insights into the possible nature, extent, and importance of warfare in Long House Valley and surrounding areas.

Methodology

In addressing the issue of tribal formation in prehistory, it is necessary to operationalize a number of different concepts such that they can be recognized and assessed in the archaeological record. Specifically, the concepts of "interaction," "functional hierarchy," "integration," "boundaries," "environmental stress," and "warfare" must be operationalized.

Interaction

In the general models of tribal formation, there will be an increase in interaction, or connectedness, between the members of an emerging tribal unit. Measuring the degree of interaction can be done by looking at patterns of information exchange between individuals or groups and at manifestations of cooperative activities. Systematic analysis of information exchange in prehistoric societies is relatively new in archaeology and has focused primarily on an analysis of variability of style in artifactual production and decoration. It has been argued specifically that stylistic variability in ceramics and lithics serves to communicate messages about such things as group affiliation, ownership, religious ideology, or maker of the artifact (Binford, 1972; Braun, 1977; Braun & Plot, 1982; Graves, 1981; Hodder, 1982; Plog, 1980, 1983; Wobst, 1977). The exchange of stylistically variable artifacts, therefore, between individuals or social groups is a mechanism of communication or information exchange as much as it is an economic transaction between exchange partners.

While the basic theory of information exchange, coupled with Braun and Plog's specific predictive model, offers one methodological avenue for using stylistic variability to measure social connectedness, a second avenue also merits investigation. In contrast to the information exchange model, an "interactional" or "sociological" model of style holds that stylistic similarities and differences are a reflection of the intensity of interaction between the markers of the artifacts (Graves, 1981; Voss, 1980; Washburn, 1978; see also Hill, 1970; Longacre, 1970; cf. Friedrich, 1970; Hodder, 1979). The more people interact or the greater the degree of social "connectedness," the greater the degree of similarity in stylistic elements. Following this interactional model, the process of tribalization should be characterized by an overall decrease in design variability and a general pattern of stylistic homogenization in the tribal unit.

While the information exchange and interactional models of stylistic variability appear to offer opposing predictions for the patterns of stylistic variability expected in the process of tribalization, in reality they may complement one another. In particular, it is quite possible that some stylistic attributes may follow the expected patterns of the interactional model, and other *kinds* of attributes may follow the expected patterns of the information exchange model (Braun, 1983; Plog, 1983; Voss, 1980). Thus, in using stylistic variation as a means of examining interaction and social connectedness in emerging tribal societies, both possible patterns must be taken into consideration.

Another means of examining changing patterns of interaction in the process of tribalization is through an analysis of evidence for cooperative activities. The increased connectedness predicted for tribes should be characterized by greater degrees of cooperation between the member units of the tribal unit. Thus, there should be more joint activities carried out at all levels of the tribe, including households, kin units, communities, subtribal units, and the tribe itself.

Internal cooperation within a tribe may also be manifested in the economic and social interdependence of the various tribal units. With the high level of integration predicted for tribal forms of organization, social and economic responsibilities may be consolidated and assigned or assumed by different parts of the tribal unit. Social consolidation for ceremonial or political activities is to be expected as a means of explicitly uniting and integrating the member units of a tribe. Such social consolidation is exhibited by communal or shared ceremonial architecture and possibly other kinds of communal activity areas not directly related to the mode of production—for example, formal plazas or nonreligious communal buildings ("town halls").

Consolidation of economic responsibilities can be expected as an adaptive response in emergent tribes, given that tribes are argued to arise in response to severe environmental stress and/or intensified competition and conflict with neighboring groups. Under such conditions, limited pooling of resources and labor as well as small-scale specialization would enhance the economic viability and competitive position of the tribe as a whole. Pooling of resources and labor may be manifested archaeologically in communal storage facilities, small-scale communal labor projects such as field preparations, water control devices, or defensive walls and fortifications. The economic specialization in tribes can be expected to be limited to the production of craft items such as ceramics and lithics. Specialization in construction activities, warfare, or the production of food would not be expected in these decentralized, nonhierarchical societies, where surplus production serves to ensure long-term survival rather than the support of discrete social strata of craftsmen, warriors, laborers, and the economic elite. This level of specialization stands in contrast to the large-scale labor specialization and class formation characterizing more complex, politically centralized societies. Economic specialization in the prehistoric tribe would be marked by the concentration of specific productive tools in the burials or residences of a small minority of the population. The large majority of the residences and burials, on the other hand, should not be marked by major economic differences or artifactual indications of specialization.

In the Kayenta region, existing survey and excavation data indicated a number of patterns of interaction in the period from A.D. 1100 to 1300. In terms of ceramic designs, Kayenta pottery throughout this entire period was characterized by remarkable homogeneity. Pottery samples from one end of the Kayenta region to the other were virtually indistinguishable from one another in terms of patterns of design and in terms of the sequences of changes in designs over time. This homogeneity by itself is a strong indication of significant interaction between the component communities of the Kayenta region (Haas, 1989). No stylistic analysis has been done, however, to indicate the kinds of interaction patterns discussed by Braun and Plog.

Within Long House Valley itself, the changing settlement pattern during this period is indicative of changing patterns of interaction. At the beginning of the period, the villages were spread evenly over the valley floor, with no direct evidence of interaction. By the Tsegi Phase, the villages are in distinct clusters, and within these clusters the bigger focal sites have plazas, large communal structures, and reservoirs. All of these characteristics fit the expected pattern of increased economic and social interaction.

Integration

In the ethnographic models, integration is, in fact, a particular kind of interaction that is manifested primarily in the form of sodalities in tribal-type societies. The sodality relationships hold the parts of a tribe together and serve to distinguish it from other tribal units. Thus, there should be specific patterns manifested in the archaeological record of tribal societies. Although sodality relationships might be marked by stylistic variability in ceramics or lithics, burials and ceremonial architecture offer potentially more fruitful and less ambiguous avenues for detecting sodalities archaeologically. In regard to burials, it is possible that sodality membership may be marked by the inclusion of specific objects or types of burial furniture. Different age grades, warrior societies, religious societies, or clans, for example, may have material or symbolic correlates that could be buried with an individual at the time of death. At the same time, certain types of sodalities, particularly clans and religious societies, can be expected to have either sodality-specific architecture or distinctive architectural features that distinguish one sodality from another (see, e.g., Dozier, 1970; Eggan, 1950; Ellis, 1979; Hoebel, 1978; Ortiz, 1969).

The predicted pantribal network of sodalities seen in the ethnographic tribal model should be manifested archaeologically in a number of different patterns. First, at the level of the community, there should be a number of different sodalities present in each independent community. For example, four or five different clans or age grades might be represented in each community of a tribal system. (Clans and age grades are used here only to illustrate the patterns of sodality relationships that may be expected. In actuality, both clans and age grades may be quite difficult or impossible to recognize archaeologically.) Second, a similar range of sodalities should be present at all of the communities. Thus, the same four or five clans or age grades should be found at all of the communities of the tribe. Third, there should be limited variability in sodalities at the tribal level as a whole. Continuing the example, the total number of clans or age grades found at the tribal level should not significantly exceed the total number of clans or age grades found at any individual community. Concomitantly, there should be an absence of markers of unique or community-specific sodalities (clans or age grades).

Existing evidence of sodalities in the Kayenta region is at best indirect. In looking at the surface indications of other kivas in Long House Valley and at kivas excavated elsewhere in the Kayenta area, we find that the Tsegi Phase witnessed a great proliferation of kiva types (Dean, 1970; Lindsay, 1969; Lindsay et al., 1968). Within Long House Valley alone, there are examples of round, oval, square, rectangular, D-shaped, and keyhole-shaped kivas. Although the function of these kivas is not known, in modern Western pueblos kivas are associated with kinship groups and/or religious societies (Eggan, 1950).

If the Kayenta kivas were indeed associated with kinship or religious groups, and if different shapes represented different kinds of groups, then the proliferation of kiva types in the Tsegi Phase would signal a marked increase in the number of these groups cutting across Kayenta society. These are, of course, big "ifs"; however, the appearance of multiple kiva types in the Tsegi Phase is a fact, and one that needs explanation. Why would so many different types of kivas arise in the Kayenta area in the Tsegi Phase? One parsimonious answer is provided in Service's evolutionary model, where it is argued that tribal formation involves the development of a network of pantribal sodalities holding together the different communities and social units within the tribe. The development in the Tsegi Phase of different types of kivas within the same residential clusters is an expectable archaeological manifestation of such a pattern of sodality development.

Along this same line, it is relevant to note that there is a much higher ratio of kivas to rooms in the small satellite sites than in the focal sites. In Long House Valley, for example, there are no indications of a single kiva among the 400 rooms of Long House Ruin, and signs of only two kivas each at Tower House, Fireside, Otherside, and Organ Rock Ruin, each of which has 75 to 200 rooms. In contrast, there are one or two kivas at almost every satellite site with only 3 to 25 rooms total. This kiva distribution indicates that certain kinds of ceremonial activities are more common at the satellite sites than at the focal sites. While this may not be directly related to sodalities, it is another indication of increased interaction within the clusters.

Functional Hierarchy

The functional hierarchy characteristic of tribal polities in the ethnographic record should have fairly clear-cut manifestations archaeologically. Each of the levels of the hierarchy has responsibility for the accomplishment of different kinds of tasks. An analysis of artifacts and architecture, therefore, should reveal specific activities that are carried out jointly by the member units of each hierarchical level. Consequently, there should be certain kinds of activities that are carried on predominantly at the household level, such as sleeping, eating, or cooking; activities that are carried on at the suprafamilial kin group level, such as storage, farming, or food processing; activities that are carried on at the community level, such as construction or architectural maintenance; activities that are carried on at the multicommunity or subtribal level, such as water control or ceremonial behavior; and finally activities that are carried out at the tribal level, such as defense and offense. The precise nature of such a functional hierarchy should change from one tribe to another, as may the activities carried out at each level. However, if the model is an accurate one, there should be evidence of distinct organizational levels and of distinct activities carried out at each. Again, it should be stressed that evidence for a functional hierarchy may well be found accompanied by evidence for pantribal sodalities, as the two are not mutually exclusive patterns of organization.

The most obvious manifestations of a functional hierarchy in the Kayenta region are to be seen in the emergence of the five distinct site clusters in Long House Valley and in the differentiation of the focal sites from the satellite sites. The clusters represent a new settlement unit above the level of the individual village. The two different site types reflect in turn a functional differentiation, with communal facilities and reservoirs concentrated in focal sites and religious structures more commonly associated with satellite sites. The survey data also indicated another possible functional level above the clusters, as manifested in the line-of-sight connections between the focal sites. To the extent that this visual "network" reflected coordinated communication and interaction between the clusters, it could be interpreted as another functional level within a valley-wide community hierarchy.

Boundaries

Boundaries around a tribal unit may be either physical or social, and they may exhibit greater or lesser degrees of permeability. A physical boundary may be marked by the geographical separation and isolation of the tribal unit. The limits of an island, for example, might demarcate the limits of a tribe, as might the sides of a valley or simply a broad band of unoccupied land. An artificial boundary might also be created by the tribal unit itself, in the construction of a defensive perimeter around the tribal residences and productive land. Such a perimeter might be marked by defensive walls, lookouts, and/or fortifications.

Indications of physical boundaries around a tribal unit need to be confirmed by evidence of corresponding social boundaries. It may be the case, for example, that residents of neighboring islands or valleys, while physically separate, are socially united into a larger unit. The formation of distinct social boundaries in the course of tribalization should be marked by a substantial decrease in interaction with external groups. As the member units of a tribe increase their internal connectedness, their ties with outside groups should decrease accordingly. Such a decrease in external interaction could be seen archaeologically in a substantial decrease in imported resources and trade goods. Immigration into the tribal area should also come to a halt as ties with the outside decline. (It should be noted, however, that tribal warfare is frequently marked by wife-stealing, and as a result, foreign women may be "imported" into a tribe that is otherwise socially bounded. Such an event should be manifested archaeologically by a limited intrusive assemblage of artifacts in a single household and in direct association with a much more comprehensive native or local assemblage.)

Concomitant with the decline in ties with the outside, the tribal unit should become internally differentiated from other units around it. This process of self-identification of a tribe, often seen ethnographically in the emergence of a tribal name, may be seen archaeologically in tribal identification markers, such as specific stylistic attributes in ceramics, pictographs, burial practices, religious paraphernalia, or items of dress or jewelry. There should also be a general tendency toward material homogenization in a socially bounded tribal unit. With a decrease in interaction with the outside, there are fewer sources of introduced variation and innovation and a greater likelihood that the member units of a tribe will resemble each other more than they will any of their foreign neighbors.

The available data from the Kayenta region were not particularly useful for making inferences about possible boundaries within or between the region. Broad survey data across the entire northern Southwest indicate that the Kayenta people were certainly interacting with their neighbors, as Kayenta pottery is found frequently as a "tradeware" in many outside areas. Interestingly, relatively little foreign tradeware is found in the Kayenta region, though other kinds of materials are abundant, including obsidian, turquoise, and shell imported from the outside (Haas, 1989). Within the Kayenta region, no surveys have been conducted that would indicate whether or not there may have been intraregional boundaries.

Environmental Stress

Environmental stress on human populations may result from variability in climate, changes in hydrologic or erosional factors, or overexploitation of natural resources, including land. Looking at possible environmental stress in the archaeological record involves analysis of ecofacts—botanical, pollen, and dendrochronological samples—and pedological analysis of the soil. It is expected from Braun and Plog's model that the actual process of tribalization would be preceded or accompanied by environmental changes that introduced new sources of risk or stress into the local ecosystem.

As noted in the brief summary of Long House Valley prehistory, there is clear evidence of environmental stress in the Kayenta region, beginning in about A.D. 1150. Various paleoenvironmental data indicate a drop in precipitation, cyclical droughts, and increased erosion during this period. The direct impact of this stress will be discussed later in this monograph.

Warfare

Although this monograph is ultimately about the process of tribal formation, a seemingly disproportionate amount of attention is given to warfare. This is because for the Kayenta area, at any rate, warfare seems to be a primary causal variable leading to the development of tribal-type polities in the 12th and 13th centuries. Warfare, however, is only part of the process, and it must be placed in the context of a wider evolutionary trajectory in order for its role and significance to be understood.

It is difficult to generate a common, cross-cultural definition of warfare that can be applied to all types of societies, and anthropologists have offered numerous definitions over the past century. Ferguson (1984), after comparing a number of different kinds of definitions, offered a broad definition to include a range of behaviors: "war can be described as follows: organized, purposeful group action, directed against another group that may or may not be organized for similar action, involving the actual or potential application of lethal force" (1984:5). In contrast to "advanced" forms of warfare found in chiefdoms, states, and other complex societies, tribal warfare is relatively simple. Staged, formal "battles" are less likely in tribal warfare, and there will not be large numbers of fatalities. Rather, tribal warfare may be expected to consist primarily of small-scale sporadic raiding with limited physical contact. The objectives of such raids would be wife-stealing, limited acquisition, and general destruction of an enemy's resources (Service, 1971).

Clearly, raiding of this sort will not leave a dramatic mark on the archaeological record. Nevertheless, there should be some signs that a prehistoric tribal group was either engaged in some form of conflict with foreign groups or was at least concerned about potential conflict. The latter may be objectified in the construction of defensive features, such as walls or moats, or the deliberate selection of defensible site locations. Deliberate selection of such locations may be inferred when ready access to resources, water, or arable land is sacrificed in exchange for elevation, difficult access, unrestricted or strategic vistas, or physical protection from attack. "Defensible" localities are those that can be protected from entrance by outsiders. These may include geographical features of the landscape that limit access, such as hilltops, mesa tops with steep escarpments and few access routes, steep-sided ridges, inaccessible caves, narrow spits of land surrounded by water or a steep drop-off, or any location that is amenable to controlled entrance.

"Defensive" sites may also be in "defensible" locations, but in addition such sites will have specific cultural features, such as perimeter walls or artificially restricted access routes, explicitly designed to defend the site from attack. Constructed defenses may be applied to any site, whether or not it is in a naturally defensible position. These include walls, palisades, deadfalls, moats or ditches, retractable ladders, windowless or slit-window structures, and generally large-scale construction. Indirect defenses include interior wells, reservoirs, and the stockpiling of food and resources. Line-of-sight visibility between neighboring villages provides another kind of defense mechanism in that it provides for communication between allies in case of attack. Thus, if one community comes under assault by an enemy group, if they have line-of-sight visibility with neighboring communities, they can signal for support and reinforcements.

It is likely that under conditions of endemic warfare, a number of defense mechanisms will be employed together, with a combination of natural and constructed defenses. Specifically, during such periods, we would expect sites consistently to be constructed in defensible locations that could be protected from raids. There should also be open lines of visible communication between close neighbors, and within a larger system of communities some villages should command views of the main geographical access routes into the area.

Turning from site-specific kinds of archaeological evidence for warfare, it should also be possible to distinguish, at least on a general level, the scope of the conflict (in terms of who was fighting whom) and the scale of the conflict. If the conflict is relatively small scale—between individual villages—we should find individually protected defensive sites, each attempting to protect a water source, plots of farmland, and stored foodstuffs. Under such conditions, the settlement pattern should be relatively dispersed, with some buffer zone, or no-man's-land, separating the field systems of the individual villages.

If the conflict has a wider scope, with enemies located at some distance from one another, then the defenses might not be focused on the individual villages but, rather, on defensible "central places," where common goods could be stored and protected. Such central places might also serve as defensive redoubts to which the population could retreat in the face of a threatened attack. Under such conditions of more distant enemies, the buffer zone would be much wider and would surround clusters of friendly or allied villages. Alliances themselves point to large-scale warfare (see Ferguson, 1984), as villages unite defensively in the face of a commonly perceived outside enemy. Such alliances might be detected archaeologically in the form of joint regional defensive systems, with sites strategically placed to oversee primary access routes into the area. There may also be increased exchange of resources between allied villages, as a means of cementing the alliance relationships, and decreased trade between the alliance villages and outside, potential enemy villages. Alliance might also be marked stylistically by distinctive design motifs in the ceramics and other art forms.

In addition to the indirect indicators of conflict seen in the defensive measures taken by villagers, conflict between neighboring settlements or regions should also have a direct manifestation in the archaeological remains. Arson or the deliberate burning of structures would be another indication of raiding and conflict. Although it may be difficult to detect *deliberate* burning in the archaeological record, tribal warfare should result in increased burning of sites, in general, and differential burning of storage facilities, since one of the goals of raiding is destruction of the enemy's resource base (see Zier, 1976).

Attacks aimed at destroying the goods of others would be reflected in a pattern of burned storage rooms as opposed to living rooms (where fires commonly occurred as accidents). Some evidence of combat would be unavoidable, such as a significant number of broken forearms ("parry fractures") among the population, skull fractures, marks of scalping, and the taking of trophy heads. The frequency of deaths of young adult males, between the ages of roughly 18 and 35, should be higher in the presence of tribal warfare; however, warriors are also often accorded special burial and thus may actually appear in lower frequencies in the regular community burial population. Warriors may be given separate cemeteries (e.g., Arlington Cemetery), or they may be accorded special consecration distinct from the rest of the population (e.g., the Plains practice of placing the warrior dead in trees). Warriors might also be buried with an increased frequency of weaponry. Finally, the initiation of warfare should result in an increase in weaponry generally. While weapons used for hunting in tribal societies might just as well be used against one's enemy, there should be an overall increase in the frequency of weapons in times of war.

Within the Kayenta area specifically, it is necessary to distinguish the possible archaeological manifestations of warfare from material consequences of the population responding to the stress and pressures imposed by the degrading environment in the 12th and 13th centuries. Thus, for example, increased and protected storage facilities cannot be seen as evidence of warfare, since the people would have tried to store more food in the good years to offset the scarcity of bad years. They also would have made a greater effort to protect those food resources from damage from the environment and natural predators. At the same time, while increased storage and protection of food resources can be attributed to environmental pressures, deliberate placement of the storage facilities in militarily defensible positions cannot be attributed to those same pressures. Likewise, it can be expected that in times of heavy erosion of arable land, as was the situation in the 12th and 13th centuries, the people would have moved their villages away from even the smallest plots of arable soil. Again, however, when the people explicitly selected defensible locations for their villages, rather than simply moving to any of the myriad nonarable locations nearby, we must appeal to warfare, and not just the environment, for an adequate explanation.

Warfare in the Southwest

Before discussing the research into tribal formation in Long House Valley, it is helpful to review the evidence for conflict and war in the broader arena of the Anasazi region as a whole. Warfare is a frequently cited but seldom studied phenomenon in the prehistory of the American Southwest (see Wilcox & Haas, 1991, for an overview of evidence for warfare throughout the Southwest). Archaeologists have turned to warfare as one possible explanation of the abandonment of large portions of the northern Southwest at the end of the 13th century (Cordell, 1984), and recently warfare has been mentioned in the context of sporadic "defensive" sites that have been noted in parts of Utah, Colorado, New Mexico, and Arizona between A.D. 1200 and 1300 (Dean et al., 1985; Gumerman, 1984; Mackey & Green, 1979; Lightfoot, 1984; Martin & Plog, 1973; see also Danson, 1957; Farmer, 1957; Woodbury, 1959). Despite frequent references to warfare and defense in the literature, little research has been directed at systematically examining the origins and nature of prehistoric warfare in the archaeological record of the Southwest.

Gumerman (1984:107) summarizes the general state of knowledge about warfare in the Southwest in addressing possible causes of the abandonment of the Colorado Plateau:

> Intuitively, these "defensive" sites, along with some burned sites and very rare evidence of cannibalism, suggest that warfare was an important factor in the population movement [abandonment]. The warfare hypothesis, however, has not been tested rigorously. The Anasazi always utilized cliff shelters and seldom is there evidence in burial populations of violent, man-inflicted death. . . . There is also the possibility of internecine warfare. . . . However, little archaeological evidence exists for internecine warfare. Proponents of this hypothesis rightly ask what kind of evidence would one expect; the hypothesis is not easily testable in archaeological context because a different, potentially hostile culture would not be identifiable in the archaeological record.

In the Kayenta area in particular, most scholars in the past have recognized defensive attributes at some sites and at least consider the possibility that there may have been warfare in the region in the 13th century (see Dean, 1969, 1986; Lindsay, 1969; Ambler, 1985; Ambler & Sutton, 1989; Ryan, 1977).

But while there is an awareness that the Kayenta region along with the rest of the northern Southwest may have witnessed some conflict in the 13th century, the nature and intensity of the conflict are not well documented and are poorly understood. There is also no recognition of the potential importance of warfare in population movements, settlement patterns, and eventual abandonment of the entire Anasazi region.

Jeffrey Dean, for example, one of the leading scholars of the Kayenta Anasazi, has noted the defensive possibilities of many of the cliff dwellings in Tsegi Canyon: "Some attributes of cliff dwellings suggest that they may have served defensive purposes, either as fortified villages or as refuges in times of strife" (1986:14). Yet he also dismisses warfare as a significant variable in any of the major events of the 13th century in the Kayenta region. Specifically, Dean has argued that warfare did not play a causal role in the aggregation of the population and the appearance of much larger pueblos in the 13th century; in the large-scale movement of villages from the canyon floors up into the protected cliff dwellings in the canyons; and in the abandonment of the area in approximately A.D. 1300 (Dean, 1969, 1986; Dean et al., 1978). He notes, "evidence from the Tsegi permits rejection of disease, the so-called Great Drought of 1276 to 1299, and conflict with enemy groups as primary factors in the final Kayenta Anasazi withdrawal from the area" (1969:195). Instead, Dean suggests, "[t]he most important consideration here is the interaction of the culture of the people actually living in the canyon with specific environmental factors" (1969:195).

The dismissal of warfare and the appeal to strictly environmental variables are logical outgrowths of the history of archaeological research in the Southwest. Since the 1940s, when tree-ring dating was developed for the region, archaeologists have relied on the climatological and chronological data that tree-ring analyses produce in interpreting survey and excavation data (Dean, 1969; Dean & Robinson, 1977). For the Kayenta/Tsegi Canyon area, for example, Dean (1967, 1969) conducted exhaustive tree-ring dating of cliff dwellings and sites in Long House Valley. Studies indicate that severe arroyo cutting and drought occurred during the 13th century, a pattern that has been confirmed elsewhere in the northern Southwest at that time (Dean et al., 1985). With such a firm and conclusive data base on the past environment of the ancient Anasazi, it has not been unreasonable to correlate environmental changes with observable cultural changes and to posit a causal relationship between them. However, the data obtained from the present research project demonstrate that warfare was much more prevalent than had been previously recognized and point to a more complex causal relationship between the environment and the observed cultural changes.

Defense in Long House Valley

In the course of this project, the five Long House Valley focal sites recorded in the survey of Dean et al. were Long House Ruin, Organ Rock Ruin, Tower

Figure 2-6. Looking northeast from Fireside toward Tower House. Arrow points to a notch in the talus slope between the two sites.

House, Fireside Ruin, and Otherside Ruin. Names of ruins used in this report are those either given to the sites in the course of this project or assigned by previous investigators in the area. In some cases, published site names—for example, Long House or Organ Rock—have been used elsewhere to designate other sites. Rather than give such sites new names, however, we have kept the names that have already been established in the literature for the Kayenta sites. In assigning new names for sites as part of this project, we have tried to avoid the use of names already in use for sites in other areas. We have also tried to use names that may be descriptive of a distinctive site feature but that are not loaded with explicit or implicit connotations. In many cases we have followed in the time-honored Southwest tradition of mild humor, as in site names such as "Heltagito" (Breternitz, 1959).

Aside from their distinctive internal features, these focal sites represent the clearest sign of defense in the valley. All five sites are situated on defensible hilltops or prominences, and each is located so as to be able to see all of the other four. In one case, where a talus slope of Black Mesa obstructed the natural view between two focal sites, a deep notch was cut in the slope to create a line of visibility between them (figs. 2-6, 2-7). Together, the five focal sites hold commanding views of all access routes into the valley: Organ Rock Ruin overlooks Marsh Pass, and Fireside Ruin and Otherside Ruin both stand watch over the south flank of the valley leading out to Klethla Valley.

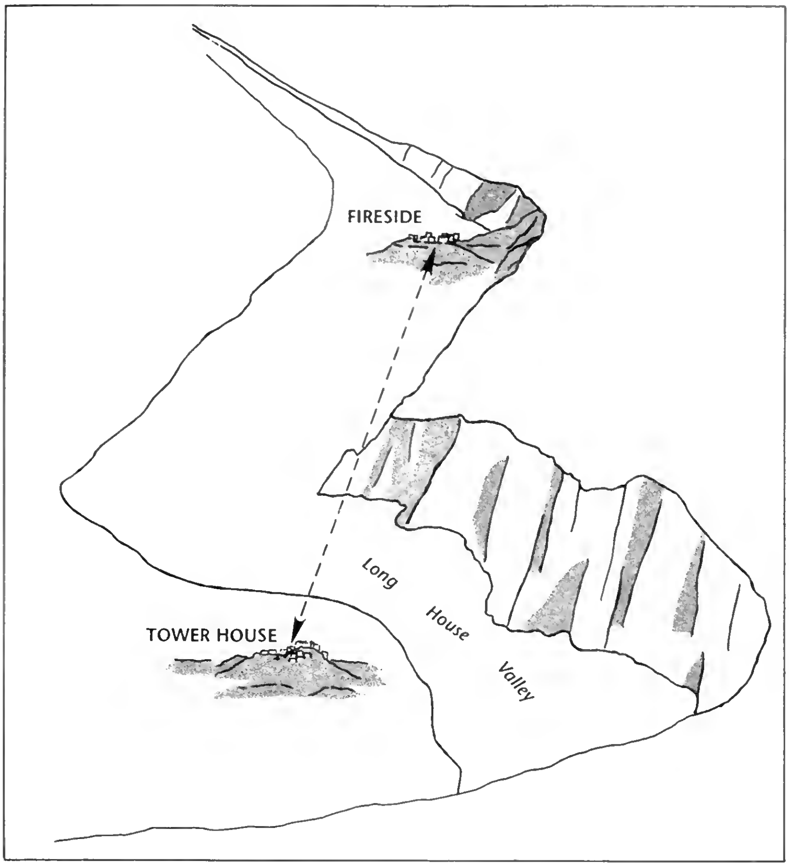


Figure 2-7. Line-of-sight connection between Fireside and Tower House (not to scale).

Long House Ruin (LHV108), the largest focal site, includes over 400 rooms spread over one-half hectare of rocky slope above the valley floor (fig. 2-8). Surface remains at Long House reveal that access into the village could be gained only by way of two access corridors on either side of the site, and both of these were blocked prehistorically by cross walls. Rooms were arranged in tiers around a two-story-high "spinal" roomblock, the "pueblo of orientation" (see Lindsay, 1969), which traverses the crest of the hill at the northern edge of the site. There is a dam and reservoir on the east edge of the site that catches runoff from the sandstone above. Due to the porosity of the local sandstone, it is unlikely that this reservoir could have held water permanently. The nearest source of permanent water was probably a spring in the bedrock behind the site.

The pueblo of orientation at Long House is approximately 30 m in length, and it had few doors and no interior cross walls (fig. 2-9). While its function is unclear at this time, communal storage of food resources is the most likely

Figure 2-8. Aerial photograph of Long House Pueblo, facing northeast. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

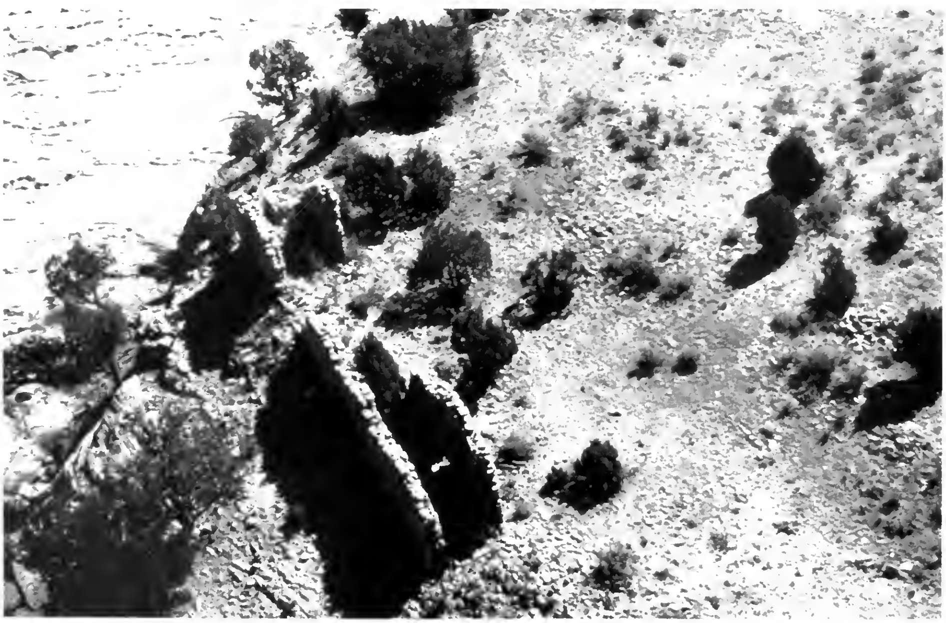


Figure 2-9. Aerial photograph looking down on "pueblo of orientation" at Long House Pueblo. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

Figure 2-10. Aerial photograph of the isolated mesa upon which Organ Rock Ruin is located. This view shows the east cliff of the mesa, which was the source of the "Organ Rock" name given to the site by the Rainbow Bridge–Monument Valley expedition. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

explanation for such a large and open structure. The size of the building itself also indicates communal construction, and it could have served for storage at least for focal site residents if not for inhabitants of the entire Long House site cluster, which includes five additional satellite sites.

Another focal site, Organ Rock Ruin (LHV404) overlooking Marsh Pass,

Figure 2-11. View facing south toward the back side of Tower House. The pueblo of orientation is on top of the rock outcrop.

is perched in a spectacular position on top of an isolated 200-m-high sandstone cliff (fig. 2-10). The only means of access to this site (and its satellites) is by way of a steep talus slope followed by a vertical 15-m climb up steps and hand- and toeholds through a narrow crack in the cliff edge. There is no water on top of the cliff (though site residents did build at least one reservoir to catch runoff from the bedrock) and negligible arable land. The nearest source of water is Laguna Creek, which is 200 m down and several hundred meters to the east. There is arable land surrounding the base of the cliff and more on the alluvial terraces of the canyon bottom. Roomblocks were constructed in several locations across the top of the cliff. There is an L-shaped block of rooms by the reservoir composed of about 75 rooms, and at least three other clusters of rooms were recorded, including a pueblo of orientation with double-faced walls, trash areas, and a group of mealing bins. Entry to the site was restricted to a single narrow and steep passageway, making the Organ Rock Ruin extremely inaccessible and highly defensible even in the absence of any recorded constructed defenses.

Tower House (LHV14) is located on a knoll with steep-sided arroyos on either side (fig. 2-4). Pecked steps and grooves in the stone face of the knoll provided access to the rear of the site, though there is relatively open access to the front of the site today. It is likely, however, that the front three sides of the village were blocked prehistorically by the construction of walls. On the highest part of the knoll stands the pueblo of orientation with wall remnants over 2 m tall, and, as at Long House, this room is long and unbroken by cross walls. It is on the northern side of the site, where it was built on the edge of a sheer-sided rock outcrop. The entire knoll upon which the village was built is bedrock, and several room floors and kivas were cut into the rock itself. With room walls blocking the more easily accessible south side and with a sharp cliff edge on the north side, Tower House, like Long House and Organ Rock, was in a defensible position.

As mentioned, the line of sight from Tower House to Fireside was artificially created prehistorically by means of a notch cut into the obstructing talus slope. Through this "V" it was possible to see back and forth between the highest points of these two focal sites. The overt effort to establish visibility indicates that visual contact or communication by signaling between the focal sites in the valley was of great importance to the residents and points to cooperation and alliance among the people of the valley.

Fireside (LHV137) is located on the summit of a steep-sided colluvial ridge extending perpendicularly away from the escarpment of Black Mesa. The site consists of a long pueblo of orientation along the north edge of the village, with several additional roomblocks enclosing small plazas (and possibly kivas). This is the only focal site where a reservoir has not been located, and yet there is no natural source of water within 2–3 km of the village. The elevated position of the hilltop makes this site defensible from the valley floor below, and there is a large roomblock obstructing access from the ridge extending off Black Mesa to the east. The site is also strategically located at the southern end of the occupied portion of the valley (during the Tsegi Phase), with an open view for several kilometers to the south toward the hills separating Long House Valley from Klethla Valley.

Directly across the valley floor from Fireside is Otherside (LHV159), a large L-shaped pueblo on a hilltop on the northwest flank of the valley. Otherside also has a pueblo of orientation on its north side, with a large central plaza, a number of roomblocks, and a heavy scatter of trash downhill from the pueblo of orientation. The site is bordered by arroyos on both the north and south and by a steep drop-off on the east side. The reservoir is in the arroyo to the north. Though there are no specific defensive features, the hilltop position of the village places it in a defensible position, and there is good visibility to the other Long House Valley focal sites from this location. As with Fireside, Otherside stands watch over the southern access route into Long House Valley from the direction of Klethla.

Aside from their individual characteristics, the five focal sites together point to a commonly perceived concern with defense by the residents of Long House Valley. The sites' inhabitants could all communicate back and forth with one another, and they jointly held commanding views of all primary access routes into the valley. The sites are also all placed in topographically defensible positions, and defensive features as well as visibility appear to have taken precedence over access to both water and arable land. The residents of Long House Valley do seem to have been concerned about raiding or other forms of attack from outside the valley. But on the basis of the sites recorded by Dean and his colleagues, several questions remained unanswered. It was unclear who the people of Long House Valley were afraid of, and whether this was a very localized and idiosyncratic incidence of people defending themselves against real or perceived enemies or part of a much larger pattern of regional conflict and war.

3
EXCAVATION IN LONG HOUSE VALLEY

To begin answering questions about the nature of political interaction in Long House Valley during the Tsegi Phase (A.D. 1250–1300), excavations were initiated at a number of sites. Two satellite sites were targeted for excavation, LHV72 and LHV73, both in the cluster associated with the Tower House focal site (fig. 3-1). The purpose of these excavations was twofold: to determine whether or not these two sites were functionally similar to one another in terms of the range of activities carried out by the occupants, and to determine possible patterns of interaction between the two adjacent communities. Complementing the intensive excavations at these two sites, testing was carried out at two focal sites, Long House and Tower House, and at two additional satellite sites associated with the Long House cluster. These test excavations were designed to provide information about similarities and differences between focal sites and satellite sites, and between satellite sites from different clusters. Finally, the excavations within the valley provide a comparative base for assessing similarities and differences between the Long House Valley occupation and the occupation of adjacent valleys. This intervalley comparison allows us to make concrete inferences about cultural boundaries around the Long House Valley polity and the nature of interaction between Long House Valley and other areas.

The two sites chosen for excavation, LHV72, named the Brown Star Site (NA10,829), and LHV73, named the Potential Site (NA10,830), both satellite communities of the Tower House cluster (Effland, 1979), are located at the far western edge of the cluster. They are both small, with four rooms and a kiva at LHV72 and eight rooms and two kivas at LHV73. They are located only 50 m from each other, and on the basis of surface ceramics, later confirmed by dendrochronological dates, were both occupied during the early part of the Tsegi Phase (ca. A.D. 1243–1280) (see tables 3-1, 3-2). The two sites are then representative of one component in the Long House Valley socio-

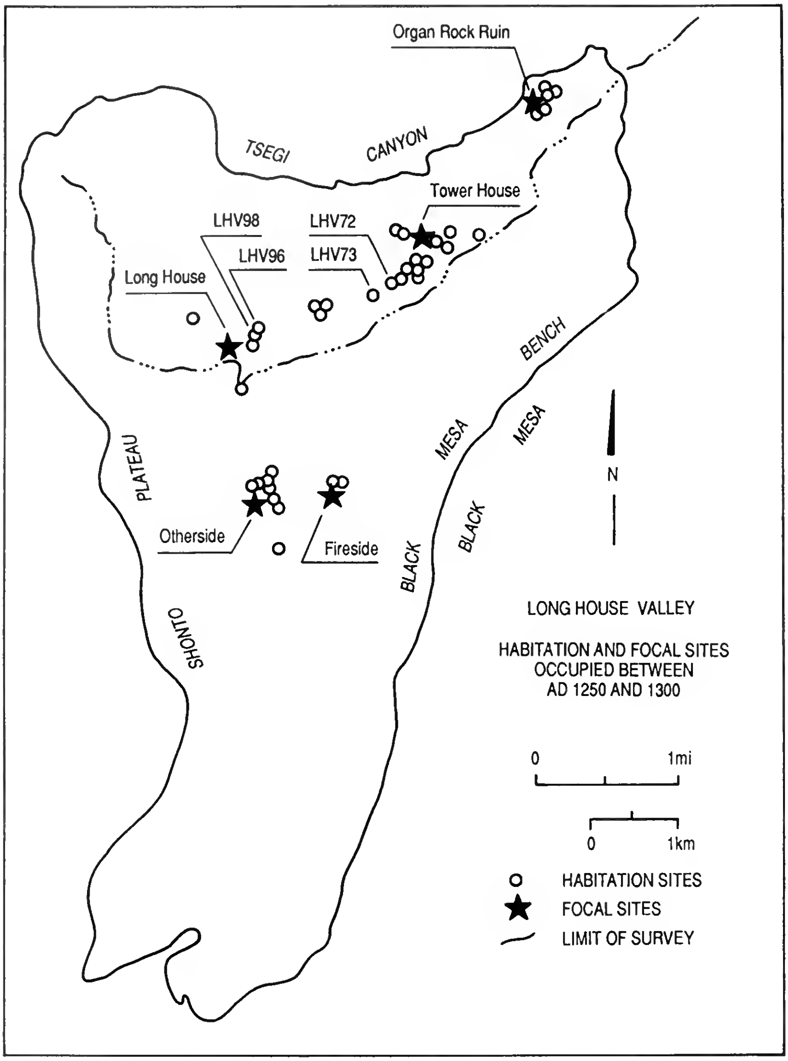


Figure 3-1. Map of the Tsegi Phase occupation (A.D. 1250–1300) showing the location of sites worked on in the course of the project.

political system, the satellite site, and provide a good sample for investigating patterns of interaction and variability within the valley. Excavations were conducted to reveal similarities and differences between the two contemporaneous sites in terms of ceramics, kiva characteristics, storage patterns, and the range of activities carried out at each. Details on the excavations at LHV72 and LHV73 are contained in Appendix A.

TABLE 3-1. Tree Ring Dates from LHV72

Provenience	Date
Structure 1, Layer 2, ash lens	1228fp–1272vv
Structure 1, SW½, Layer 2	1193fp–1243v
Structure 1, SW½, Layer 2	1193fp–1243B
Structure 1, SW½, Layer 2	1204fp–1243vv
Structure 3, NE½, Level V	1193fp–1256vv
Structure 3, SW½, Layer 4	1178fp–1243rB
Structure 3, fill of mortar bowl in floor	1008fp–1136vv
Fill of mortar bowl to south of Structure 2	1192fp–1237vv

Summary of LHV72

LHV72 (figs. 3-2, 3-3) was a small habitation site occupied during the Tsegi Phase in Long House Valley. Based on tree-ring dates, the site was probably constructed in the 1240s and occupied at least into the 1270s. Activities carried out at the site included food preparation, indicated by the mealing complex, and ceremonial activities in the kiva. Periodic remodeling and reflooring efforts were carried out, resulting in the conversion of a room with a jacal wall into an all-masonry room.

No evidence of burning was uncovered during the investigation of domestic rooms. The burned areas found in rooms were evidence of fires built within the room, not of conflagration. Though few in number, the burials

TABLE 3-2. Tree Ring Dates from LHV73

Provenience	Date
Structure 7, upper hearth	1110fp–1208vv
Structure 7, upper hearth	1177fp–1253vv
Structure 7, upper hearth	1095fp–1173vv
Structure 7, upper hearth	1070fp–1160vv
Structure 7, upper hearth	1125fp–1193vv
Structure 9, NW½, Level VI	1136fp–1245vv
Structure 9, hearth	1213fp–1271vv
Structure 9, hearth	1187fp–1257vv
Structure 9, SE½, Layer 2	1199fp–1248vv
Plaza, W½, Level IV	832fp–921vv
Plaza, W½, Level IV	1129fp–1206vv
Plaza, W½, Level IV	802fp–948vv

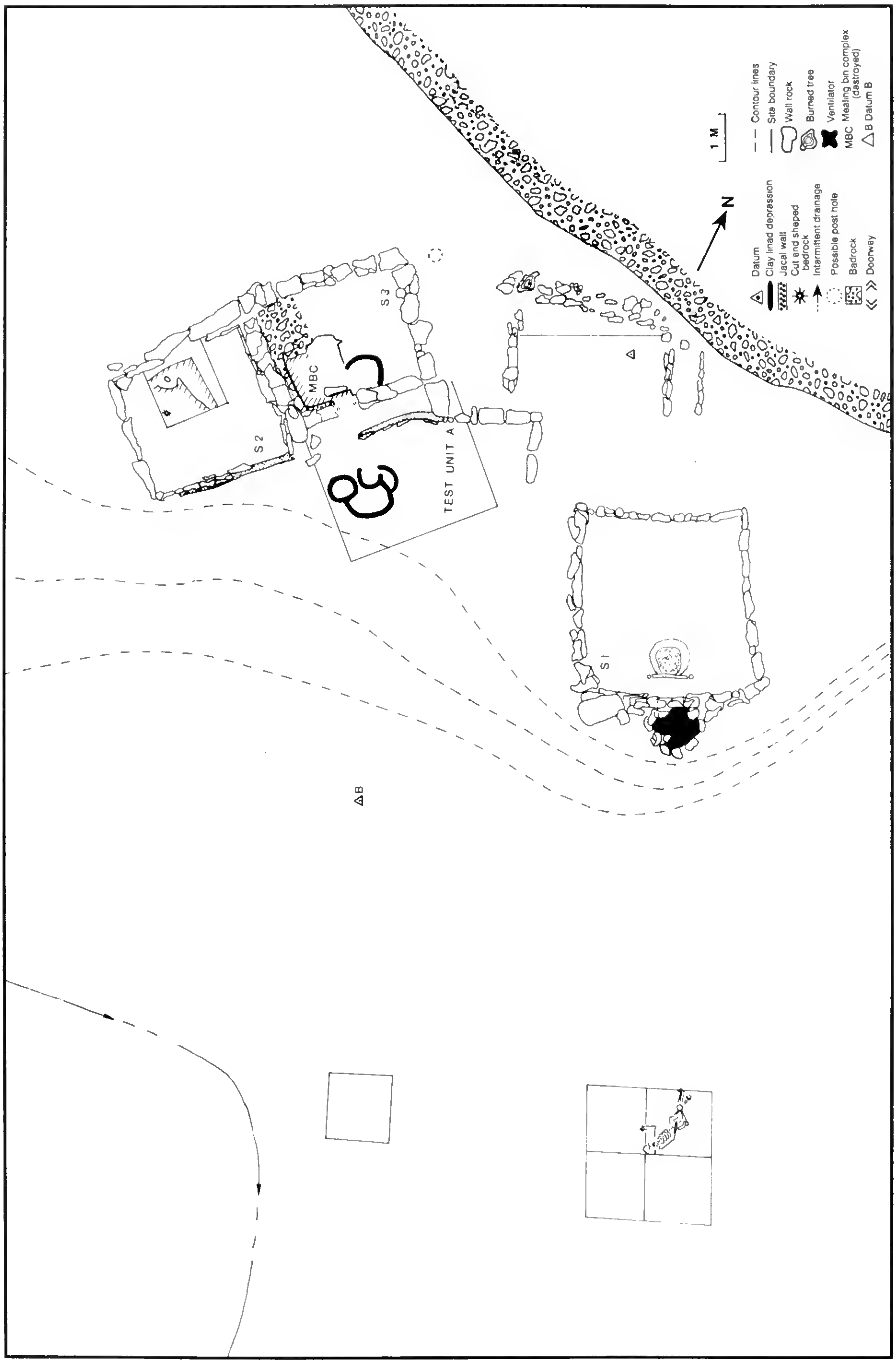


Figure 3-2. Schematic map of LHV72, the Brown Star Site.

Figure 3-3. The general environmental location of LHV72.

recovered from the site point to differential treatment of male and female individuals. An older adult female was interred in a burial pit with numerous grave objects, while a male was interred with cranium missing, in a contorted position, and with a projectile point in the vicinity of the pelvis. The projectile (fig. 3-4) point is not characteristic of the Kayenta Tsegi Phase.

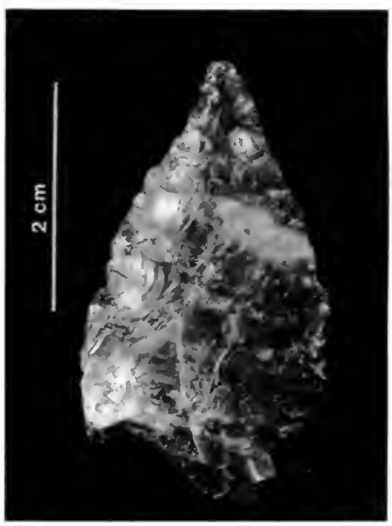


Figure 3-4. Projectile point found with Burial 2 at LHV72.

Summary of LHV73

On the surface, LHV73 (figs. 3-5, 3-6) looked like an example of a small Tsegi Phase pueblo, C-shaped, with eight rooms that were divided into two living units of four rooms each. Excavation of the site showed that this interpretation was substantially incorrect in the physical layout of the site. The C-shaped portion of the site includes seven rooms, one of which, Structure (S.) 9/10, is double the size of rooms at this site and elsewhere in the valley. An eighth room set apart from the roomblock, which was thought to be a rectangular kiva, contained the remains of a mealing bin com-

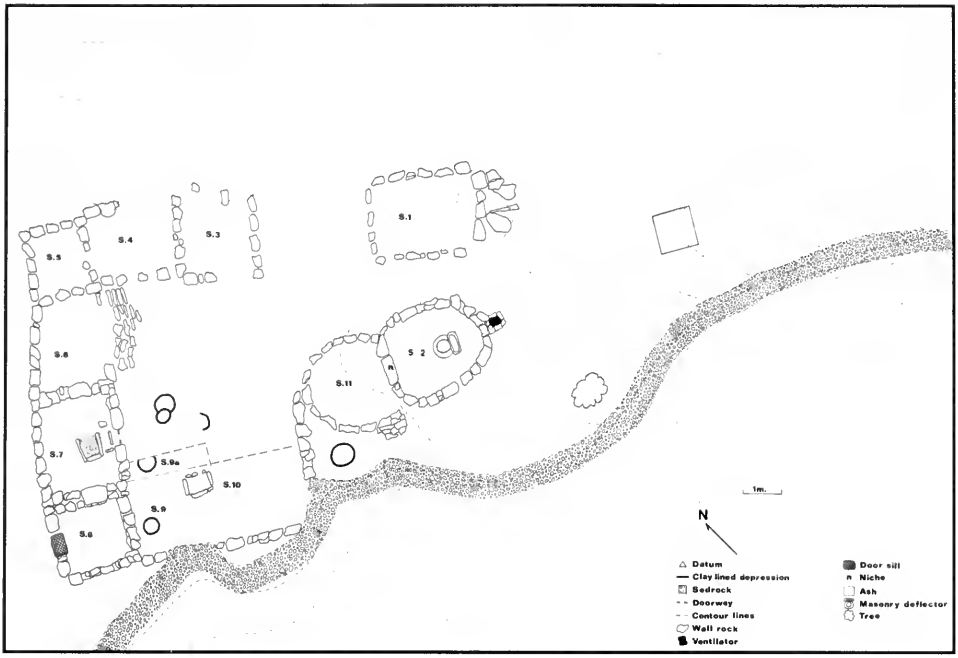


Figure 3-5. Schematic map of LHV73, the Potential Site.

Figure 3-6. The general environmental location of LHV73.

TABLE 3-3. Comparison of Ceramics from LHV72 and LHV73

	Plainware		Whiteware		Orangeware		
Site	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
LHV72	1,457	1,380	353	396	580	614	
LHV73	6,054	6,131	1,802	1,759	2,765	2,731	
Totals	7,511		2,155		3,345		13,011

Chi-square = 13.29. df = 2. P = 0.005–0.001. Obs. = observed, Exp. = expected.

plex and was probably used as a work area for grinding corn. An oval kiva turned out to be two oval kivas, one partially superimposed over the other.

However, the function of the rooms at the site does correspond to use by two clusters of people, either two families or an extended family. There are two living rooms, S. 7 and S. 9/10, and the other rooms, S. 3, S. 4, S. 5, S. 6, and S. 8, appear to have been storerooms, as they contained no interior features. The grinding complex in S. 1 could have been used cooperatively by all residents, as could the kiva.

Intersite Comparisons

One of the clearest contrasts between LHV72 and LHV73 is in the kivas at each site. The kiva at LHV72 is rectangular, while that at LHV73 is oval. The two sites are in close proximity to each other and might be assumed to have similar structures, but this is not the case. It is difficult to assess the full significance of the kiva shapes, but it can be inferred that there were some substantial differences in the ceremonial affiliations of the people in the neighboring communities. At the same time, the pattern of room construction and the general composition of the artifactual assemblages are quite similar. Specifically, the ceramic and nonceramic artifacts found at each site are typologically indistinguishable from each other. However, there are some significant differences in the relative frequencies of ceramic types at the two sites (table 3-3). LHV72 has more than expected plainwares and less than expected whitewares and orangewares, while LHV73 has the opposite pat-

TABLE 3-4. Comparison of Ceramics from LHV72 and LHV73 by Percentage

Site	Plainware	Whiteware	Orangeware
LHV72	61%	15%	24%
LHV73	57%	17%	26%

TABLE 3-5. Ceramics at LHV96, LHV98, Long House, and Tower House

Ceramic Category	LHV96 (3 Pits)	LHV98 (2 Pits)	Long House (7 Pits)	Tower House (5 Pits)
Plainware				
Kiet Siel Gray	470	80	1,348	422
Moencopi Corrugated	75	131	321	429
Tusayan Corrugated	26	40	59	48
Unknown corrugated	0	5	8	1
Total	571	256	1,736	900
Whiteware				
Kayenta B/W	7	20	50	27
Tusayan B/W	45	55	200	99
Flagstaff B/W	0	2	2	2
Sosi B/W	7	7	25	4
Dogoszhi B/W	5	5	15	10
Black Mesa B/W	3	1	13	2
Kana'a B/W	1	1	1	2
Unidentified B/W	65	55	125	109
Undecorated whiteware	84	116	202	159
Total	217	262	633	414
Orangeware				
Kiet Siel Polychrome	7	3	33	8
Kayenta Polychrome	0	5	9	2
Tusayan Polychrome A	120	130	300	194
Tusayan Polychrome B	15	27	49	27
Unknown polychrome	5	6	9	6
Kiet Siel B/R	2	0	16	1
Tusayan B/R	36	26	136	56
Unidentified B/R	6	5	31	22
Tsegi B/O	3	3	21	7
Tsegi Orange	175	170	410	162
Orange with red slip	40	3	134	68
Total	409	406	1,148	553
Totals	1,197	924	3,517	1,867

tern. At the same time, it should be pointed out that when calculated as percentages of the whole assemblage, the distribution of the three wares at the sites is very similar (table 3-4).

With a few exceptions, there are similar nonceramic artifactual assemblages at the two sites. The exceptional artifacts found at LHV72 include a stone "fire dog" and two small stone cylinders with no immediately apparent function. At LHV73, exceptional artifacts include two large floor polishers,

TABLE 3-6. Comparison of Ceramics from Sites in Long House Valley

	Plainware			Whiteware			Orangeware			
Site	Obs.	Exp.	%	Obs.	Exp.	%	Obs.	Exp.	%	Total
LHV72	1,457	1,278	61	353	429	15	580	683	24	
LHV73	6,054	5,681	59	1,802	1,906	17	2,765	3,034	25	
LHV96	571	640	48	217	215	18	409	342	34	
LHV98	256	494	28	262	166	28	406	264	44	
Long House	1,736	1,881	49	633	631	18	1,148	1,005	33	
Tower House	900	999	48	414	335	22	553	533	30	
Totals	10,974			3,681			5,861			20,516

Chi-square = 435.95. df = 10. $P = <0.001$.

an axe, two abraders, a maul, two loomblocks, three sharpening stones for bone tools, a bone needle, and several miscellaneous ground stone objects of unknown function. The greater diversity found at LHV73 may well be due to the greater size of the collection, rather than to a greater diversity of activities at the site. However, the presence of two loomblocks and a bone needle at LHV73 does indicate cloth-working activities at this site that are not present at LHV72.

Test Excavations at Other Sites

In addition to the intensive excavations at LHV72 and LHV73, four other sites in Long House Valley were tested to provide comparative ceramic samples from focal sites and satellite sites associated with other clusters. Because LHV72 and LHV73 are part of the Tower House cluster, Tower House was one of the focal sites selected for sampling. Then, to balance the data from the Tower House cluster, additional testing was conducted in the Long House cluster. Long House Ruin itself was tested along with LHV96 and LHV98, two small adjacent satellites at the west side of the cluster. At each site, two to seven 1- × 1-m test pits were excavated in 20-cm artificial levels, and all material was screened through ¼-in. mesh screen. The distribution of the ceramics is given in Table 3-5.

A comparison of the distribution of the major ware categories at the four sites tested and the two sites excavated indicates that there were significant differences in almost all cases between the observed and expected frequencies (table 3-6). However, when relative frequencies of the wares are considered, some general patterns appear. There is confirmation that when compared to other sites in the valley, LHV72 and LHV73 share a similar pattern of the distribution of the different wares. Similarly, LHV96, Long House, and Tower House share a similar distribution pattern. In contrast, LHV98, with a much lower relative frequency of plainwares and higher frequencies of whitewares

TABLE 3-7. Tsegi and Pre-Tsegi Phase Black-on-White (B/W) Ceramics in Long House Valley

	LHV72		LHV73		LHV96		LHV98		Long House		Tower House	
B/W Era	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Tsegi Phase B/W	78	67	675	88	52	77	75	82	250	82	126	86
Pre-Tsegi Phase B/W	39	33	92	12	16	23	16	18	56	18	20	14

and orangewares, stands out as unique in the sample of sites tested in the valley. There is clearly no pattern of similarity demarcating the satellite sites in general, nor a pattern distinguishing the focal sites from the satellite sites. Based on the limited testing at LHV96 and LHV98, Long House and Tower House, we are unable to offer an explanation for the observed patterns of ceramic assemblages in these sites.

Beyond the general patterns seen in the distribution of the various wares in the different sites, there is another pattern that should be noted in terms of the relative frequencies of specific whiteware types at the different sites. Whitewares in the Kayenta region are often used as the primary technique for dating sites on the basis of surface remains. Because each of the different types has been independently dated through dendrochronology, they can be used to assign specific absolute dates when found on the surface of a site. The excavated data from Long House Valley, however, require some modification in the use of whitewares for dating.

Two whiteware types in particular, Kayenta Black-on-white and Tusayan Black-on-white, are commonly used to distinguish sites dating to the Tsegi Phase, A.D. 1250–1300. Other Black-on-white types, such as Flagstaff, Sosi, or Dogoszhi, are used in dating earlier sites. However, the data from Long House Valley indicate that the earlier types are consistently found on sites that are known to date exclusively to the Tsegi Phase. The relative frequencies of Tsegi Phase types and pre-Tsegi Phase types (collectively) are given in Table 3-7. LHV72, for which there are good tree-ring dates of A.D. 1246–1272, actually has the highest percentage of pre-Tsegi Black-on-white pottery with 33.3%, while the other five sites have percentages ranging from 12.0 to 23.5.

The implication of these data is that all of these sites, including the two focal sites of Long House and Tower House, were constructed and occupied exclusively in the Tsegi Phase. Thus, even though earlier ceramics are found with some frequency on these sites, they do not necessarily indicate earlier occupations.

Conclusions

Taken as a whole, the excavation data from Long House Valley provide only limited insights into the possible formation of tribal-type polities in the

Kayenta heartland during the Tsegi Phase. Although some functional differences between focal sites and satellite sites could be determined from surface survey, further differences were not manifested in the artifactual assemblages obtained from very limited testing.

4

KAYENTA AND KLETHLA VALLEYS

The settlement pattern data from Long House Valley, described in Chapter 2, provided the first indication of the emergence of a pattern of warfare in the 13th century in northeastern Arizona. The aggregation of the population into much larger villages and tight settlement clusters and the movement up onto hilltops and prominences indicated an overt concern for attack from the outside. To obtain a more comprehensive picture of the nature and development of conflict in the Kayenta heartland, additional research was initiated in neighboring areas. Since Long House Valley is in a unique position in the middle of a natural east–west corridor across northern Arizona, the defensive posture taken by the valley's residents may have been a highly localized response to their vulnerable geographic position. At the same time, we know that across the northern Southwest, the period between A.D. 1150 and 1300 was a time of decreased precipitation, increased erosion of arable land, a lowered water table, and cyclical droughts (Euler et al., 1979; Dean et al., 1985). If such environmental conditions did result in intergroup conflict, then Long House Valley would have been part of a much larger regional pattern of warfare, as the residents of the northern Southwest responded to the common environmental pressures. Finally, since the villages and field systems in the Valley were much too close together for there to have been internal fighting and raiding among the Long House Valley residents, who were their enemies? Were they worried about an attack from their immediate neighbors, or was the threat coming from much farther away, outside the Kayenta region?

To begin addressing these issues, new archaeological investigations outside Long House Valley to the east in Kayenta Valley and to the west in Klethla Valley were undertaken in 1984 and 1985 (fig. 4-1). Additional survey was conducted in 1986 in the Tsegi Canyon system to the north (Chapter 5). To the south, Black Mesa was abandoned by A.D. 1150 (Powell, 1983) and thus does not directly enter the picture of events occurring in the 1150–1300 period (though it is highly likely that some residents of Black Mesa would have moved into Long House Valley and neighboring valleys in the first half of the 12th century).

The fieldwork in the open valleys on either side of Long House Valley was specifically designed to clarify the apparent pattern of Kayenta warfare in three ways:

1. Was the defensive pattern seen in Long House Valley unique, or was there instead a more widespread, regional pattern of defensive sites and warfare?
2. Were the Long House Valley residents concerned about attack from their immediate neighbors or about more distant enemies?
3. Were the Long House Valley residents a separate political entity with their own bounded alliance network, or were they part of a larger multivalley "tribal" alliance?

The Kayenta and Klethla Valley surveys were explicitly designed to address these questions.

If the Klethla and Kayenta valleys were found to lack the pattern of focal sites in defensible locations, then the Long House Valley defensive system could be interpreted as a unique response to the central location of Long House Valley in a trans-Plateau pathway. On the other hand, if a similar pattern was found in the neighboring valleys, then concern over defense occurred over a much wider area and warfare can be inferred to have been occurring at a regional rather than local level. Likewise, if the line-of-sight visual network in Long House Valley was found to be linked to similar networks in the neighboring valleys, then it could be argued that the Long House Valley residents were part of a larger alliance system extending beyond the geographic boundaries of the one small valley. A link between the valleys would also indicate that the conflict was probably not occurring between neighboring communities; rather, the people of adjacent valleys joined in communication would have been concerned with common enemies in outside areas. Conversely, warfare between valleys—internecine Kayenta warfare—should have been marked by a clear break in the defensive networks of neighboring valleys.

Geographic Information Systems and Archaeological Survey

To maximize the effectiveness of fieldwork, in terms of both cost and time, we turned to computer technology to select a sample of each valley for survey. Using a Micro-Terrain Information System, a geographic information system developed to aid archaeologists in locating specific environmental features (Kvamme, 1983), we were able to produce a computer-generated map of the research area that pinpointed potentially defensible locations and

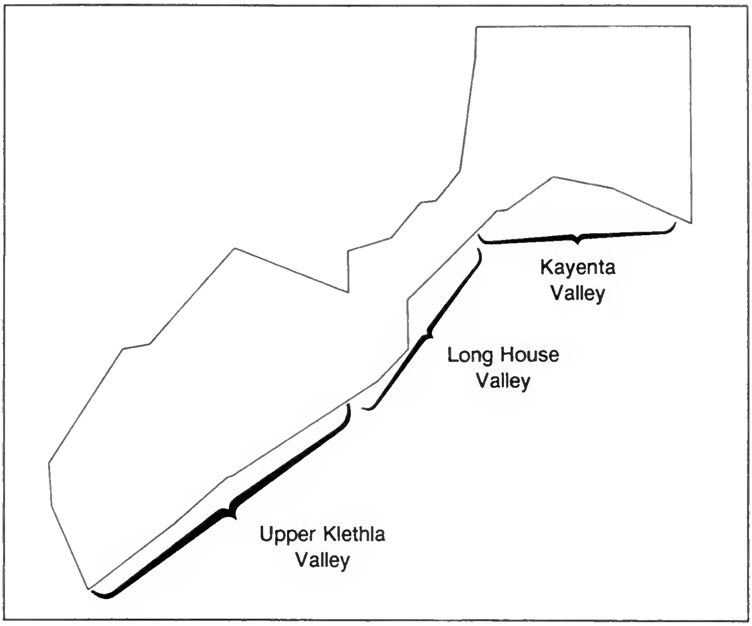


Figure 4-1. Outline of total survey project area.

indicated intervisibility between such locations (see Appendix B for a detailed discussion of the program developed). The topographic characteristics of the known defensible hilltop sites in Long House Valley were used as a baseline, and all hilltops and elevated areas in the Klethla and Kayenta Valley survey areas sharing those characteristics of relief and limited access were compiled on a set of maps. The computer was also used to generate a cross-list of intervisibility between each of these defensible locations. (In laymen's terms, the computer put itself, figuratively, on top of each hill and then listed what other hills could be seen.) This intervisibility list included the possible points of visibility between each of the neighboring valleys, so we could determine possible patterns of intervisibility between Long House, Kayenta, and Klethla.

The hilltops and elevated areas, designated high probability target areas (HPTAs), were transferred onto U.S. Geological Survey topographic maps for use in the field. A total of 627 HPTAs in the Klethla and Kayenta valleys were marked by the computer. Of these, 233 were ultimately surveyed. Included within this sample were *all* HPTAs that allowed visual contact between different valleys. In addition to the HPTAs, a sample of nondefensible areas—essentially the open flats on the valley floors—were also targeted for survey. Each of the sample areas, designated low probability target areas (LPTAs), was 1 sq km. Eleven LPTAs, five in Klethla Valley and six in Kayenta Valley, were surveyed. These LPTAs were surveyed as a cross-check and control on the HPTAs and to locate possible "satellite"-type communities.

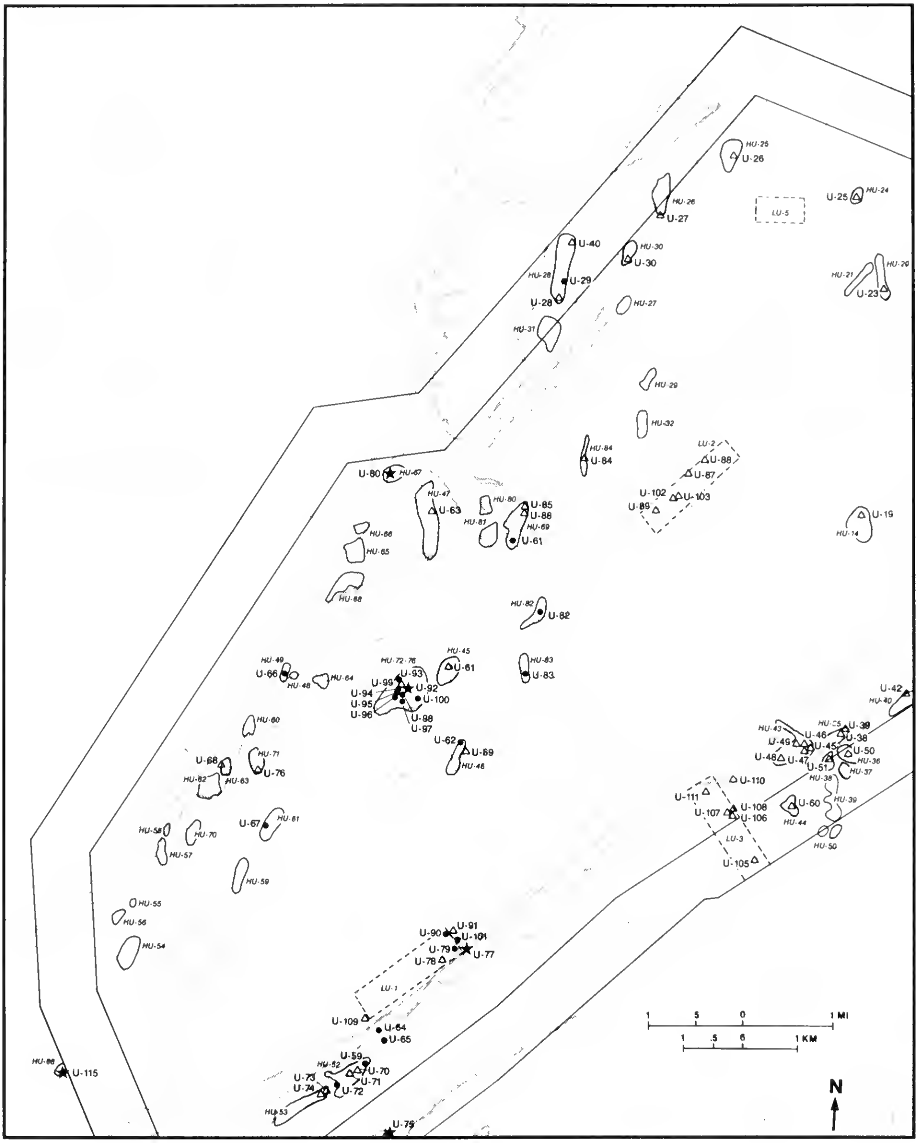


Figure 4-1a. Southwestern sector of survey project area showing the high and low probability target areas surveyed and the sites discovered and recorded.

★ FOCAL SITES
• OTHER TSEGI SITES
Δ ALL OTHER SITES

U UPPER KLETHLA VALLEY
L LAGUNA CREEK DRAINAGE
LV LONG HOUSE VALLEY
HL HIGH PROBABILITY TARGET AREA (LAGUNA CREEK DRAINAGE)
LL LOW PROBABILITY TARGET AREA (LAGUNA CREEK DRAINAGE)
HU HIGH PROBABILITY TARGET AREA (UPPER KLETHLA VALLEY)
LU LOW PROBABILITY TARGET AREA (UPPER KLETHLA VALLEY)

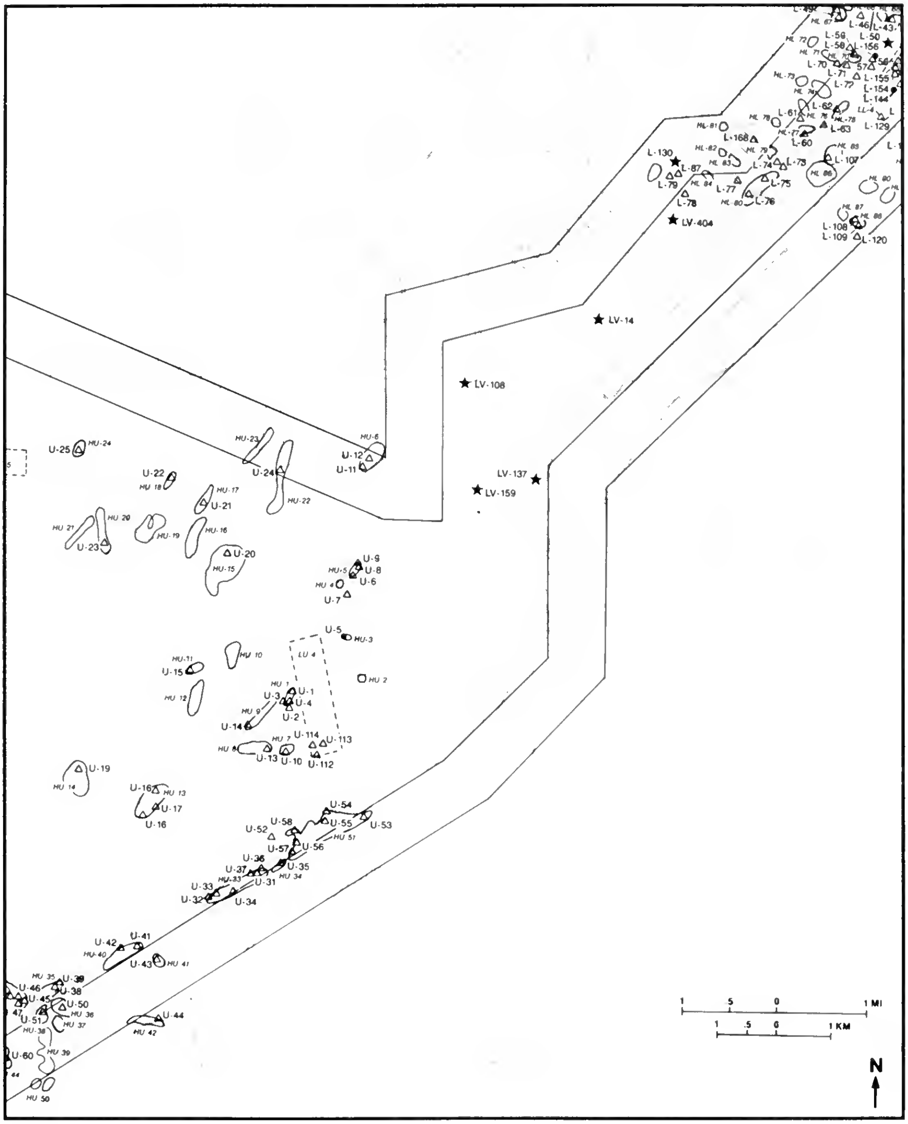


Figure 4-1b. Central sector of survey project area.

While the overall number of LPTAs is low, the actual acreage covered by survey compared to that of HPTAs is not dissimilar (figs. 4-1a–c).

Kayenta Valley

Kayenta Valley rises from about 1750 m in elevation at the town of Kayenta to 1850 m at the base of Skeleton Mesa (fig. 4-2). The research area investigated in 1985 extended from Marsh Pass at the southwest corner of the valley to the town of Kayenta, a distance of about 20 km. Using the computer techniques discussed above, an area of over 300 sq km was targeted for sample

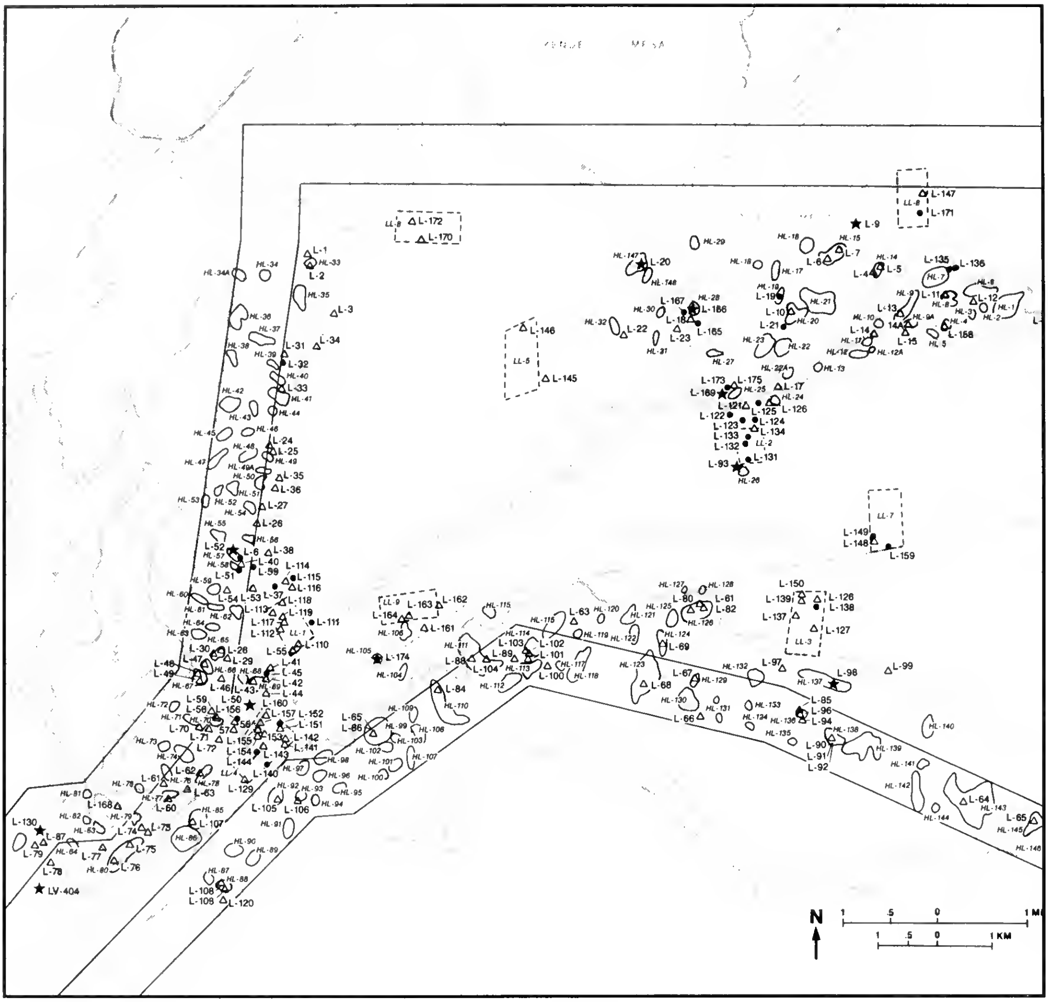


Figure 4-1c. Northeastern sector of survey project area.

surveys in 1985. Survey teams investigated the escarpments of Skeleton, Tyende, and Black mesas that border the valley on the west, north, and south, respectively. Hilltops and prominent points across the valley floor were also selected by the computer program for survey. Overall vegetation and climate are similar in this area to Klethla and Long House valleys. Goals for the Kayenta Valley were the same as those for the Klethla survey: to see whether or not the settlement pattern change noted for the Tsegi Phase in Long House Valley extended east through Kayenta Valley out toward Monument Valley. If Kayenta Valley was found to have a similar kind of defensive settlement pattern, it would be important to know if Long House Valley focal sites could be seen from focal sites in Kayenta Valley and if a visibility network existed among focal sites in Kayenta Valley.

A total of 149 HPTAs were surveyed, as were 6 LPTAs, and 175 sites were recorded. Ninety-seven of these dated on the basis of surface ceramics to the

Figure 4-2. Aerial photograph of Kayenta Valley, facing northeast. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

periods prior to A.D. 1100, and 110 sites, over half those recorded, dated to between A.D. 1100 and 1300. The other sites ranged from Archaic through Pueblo II. Tsegi Phase sites included 40 sites or site components and ranged in size from trash scatters to 150 or more rooms.

Ten focal sites were located. These are all on hilltops or other prominent isolated features and possess a range of defensible and defensive features. In general, the characteristics of these ten sites are similar to the focal sites of Long House Valley, some having open plaza arrangements, pueblos of orientation with cored, double-faced masonry, with reservoirs, walled entrances, and perimeter walls. All of the focal sites in Kayenta Valley were also located in defensible locations. All were located on HPTAs, on geographical features identified by the computer program as analogous to the focal sites in Long House Valley. Of the other 31 smaller, satellite-type sites dating to the Tsegi Phase, 8 were in defensible locations, and 23 were in nondefensible locations, usually close to water sources or on cultivable land. Sixteen of those nondefensible sites were within 300 m of a focal site identified by the survey, forming an overall settlement pattern similar in all respects to that found in Long House Valley.

Two of the focal sites recorded in 1985 were located on isolated hills out on the valley floor. The site of Moqui Rock (LCD-169) is on an isolated sandstone knob south of Tyende Mesa and west of the town of Kayenta at the confluence of Laguna and Parrish creeks (fig. 4-3). Known locally since

Figure 4-3. Moqui Rock, facing west. Ruin covers virtually all the upper surfaces of the rock outcrop.

early this century, the site has been largely destroyed by visitors. What remains is the heavily rubble-strewn remains of a very large pueblo with reservoirs, a rock-cut kiva, and a number of room outlines and viga holes carved into the rock of the hill itself. The settlement was perched on the top of the rock outcrop and extended partway down the sides. A double-faced stone wall, part of the pueblo of orientation, was located high on the south side of the site. Access to the site was by way of a narrow crack in the rock marked with hand- and toeholds on the north side of the site. It is possible today to climb directly into the south side of the site, but, because of large-scale deterioration of the architectural remains, it is impossible to determine whether this side of the pueblo was walled or open aboriginally. The highly restricted route on the north side, however, would indicate that access into the pueblo was probably limited in all directions. The concentration of structures well above the surrounding farmland and above the lowest slopes of the knob suggests that the site was defensive. There are large areas of clear bedrock down below the outcrop that certainly would have been habitable prehistorically, and an occupation here would not have used up any valuable arable land. If the inhabitants merely wished to be off land suitable for cultivation, we might expect the bulk of rooms to have been built on the low stone slopes of Moqui Rock rather than on the upper portions of the steep-sided outcrop. From Moqui Rock, visibility is excellent to most of the other focal sites. Of the other focal sites in the valley, only Six Foot Ruin is

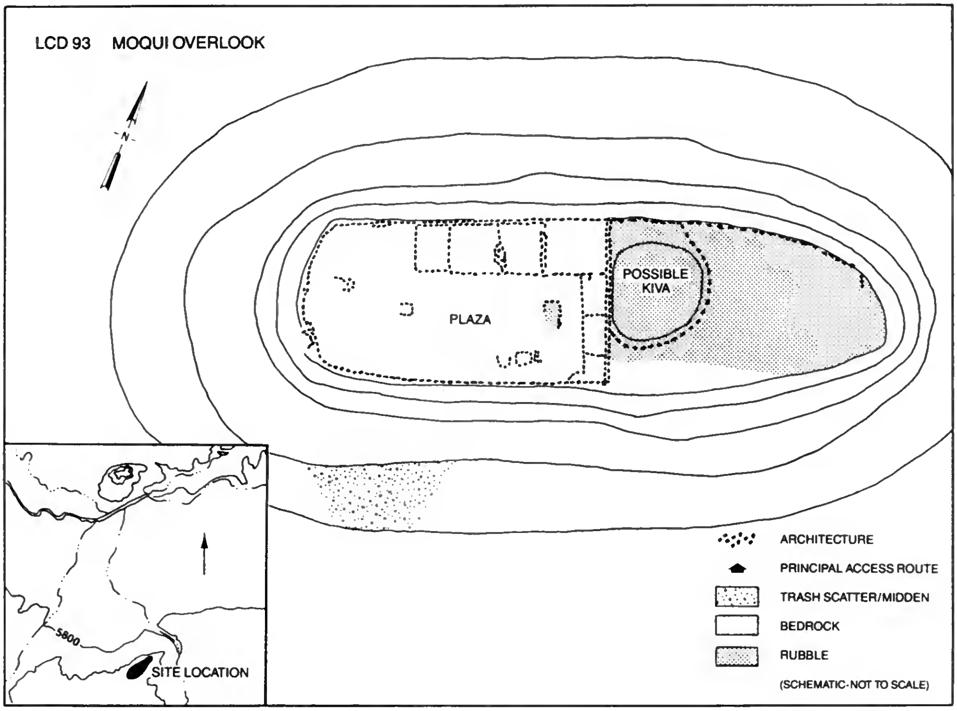


Figure 4-4. Map of Moqui Overlook.

not visible from Moqui Rock. (As noted below, Six Foot Ruin is located in the mouth of Tsegi Canyon and is not part of Kayenta Valley proper.)

Moqui Overlook (LCD-93) is the other site located on the valley floor (fig. 4-4). This site is a completely walled 40–50-room pueblo on a low hill across Laguna Creek from Moqui Rock. The two sites are separated by about 1 km. The pueblo itself is U-shaped, with a perimeter wall around the exterior enclosing the rooms and a small plaza area. A kiva depression is located just outside the wall. The main block of the pueblo has a double-faced wall along the north side. From this location there is clear visibility to six of the other Kayenta Valley focal sites. This site differs from the others in that the location is exposed and the low sides of the hill are not particularly difficult to climb; however, it offers good visibility of wide stretches of arable land below, and it was culturally protected by the construction of a perimeter wall. Thus, Moqui Overlook lacked some of the naturally defensible attributes of the other sites, but the residents took overt steps to make the village deliberately defensive.

Four focal sites are located at the base of the escarpments that border Kayenta Valley on three sides. Kinpo (LCD-50) includes 100–125 rooms with double walls along the roomblocks at the west edge of the site (fig. 4-5). The site was constructed on a sandstone outcrop just above the valley bottomlands. A wash leading into Laguna Creek runs along two sides of the site,

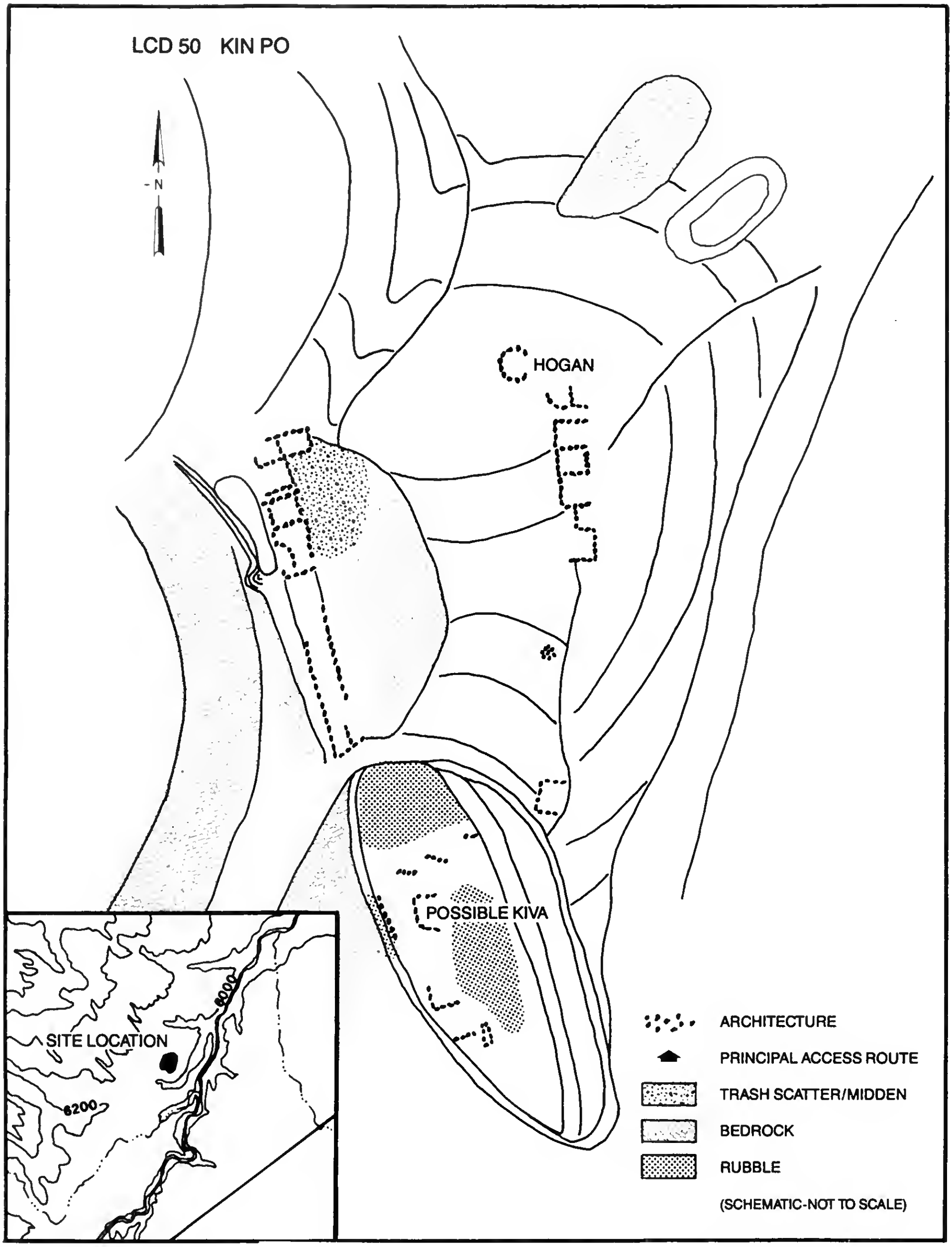


Figure 4-5. Map of Kinpo.

and the creek itself is within 200 m. Access to the site is from the northeast, as the steep sides of the outcrop and the walls of the creek limit access on the east and south. The west side of the site was walled, and the highest portion of the site may have had a perimeter wall as well. No reservoir was located in the vicinity of this site, though bedrock pools are common in this

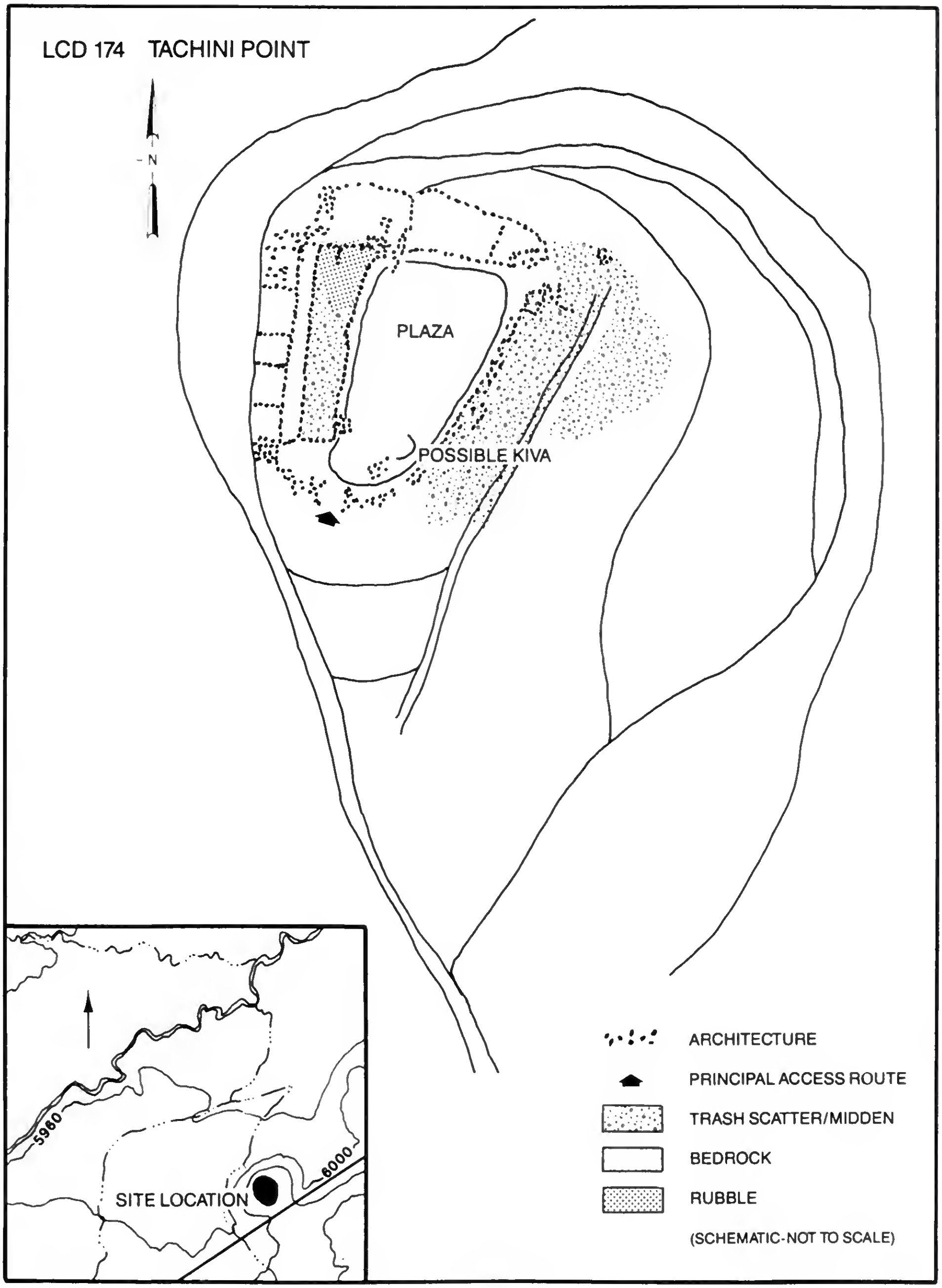


Figure 4-6. Map of Tachini Point.

part of the valley and could have been employed as water catchment basins. Visibility from this site was clear to five of the other Kayenta Valley sites.

Tachini Point (LCD-174; also known as Gnat Hill) is a site similar to Moqui Overlook. Located on a spur extending out from Black Mesa (fig. 4-6), it is

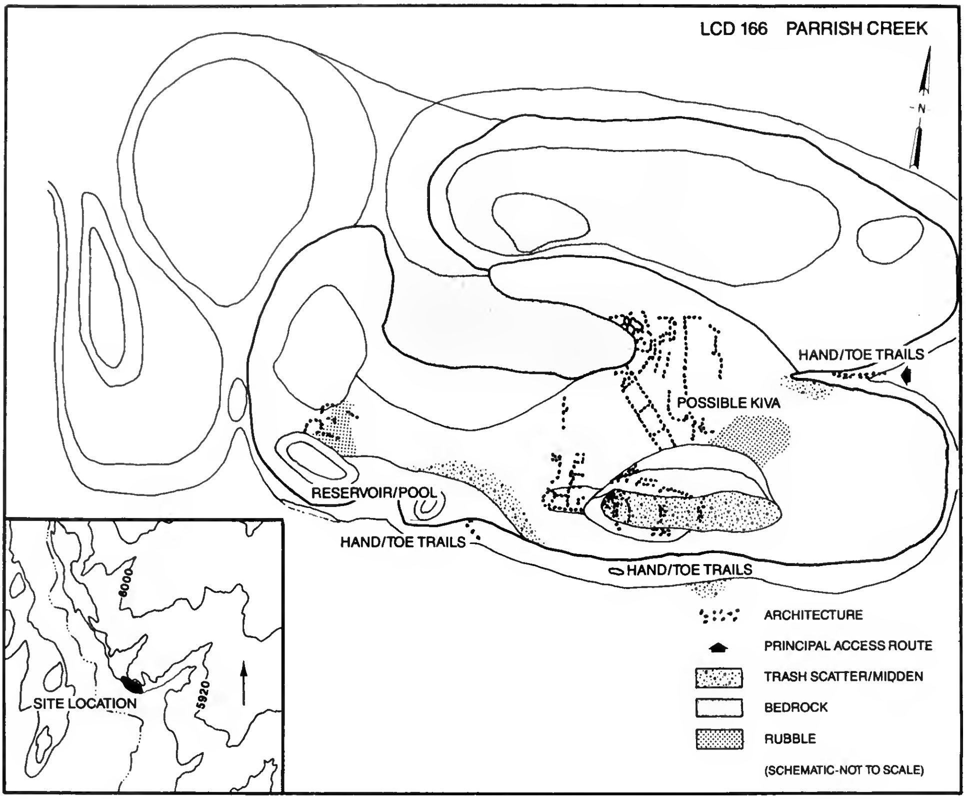


Figure 4-7. Map of the Parrish Creek Site.

composed of roomblocks in a U-shape around a small plaza area and may originally have been rectangular, completely enclosing the plaza. The exterior of the site appears to have been walled, with an entrance on the south or southwest side. From Tachini Point, visibility extends to most of the other focal sites and, significantly, back to the Organ Rock Ruin in Long House Valley. This is particularly important because Tachini Point links Long House Valley with Kayenta Valley through visibility between these two sites. In addition to its pivotal position in intersite visibility, Tachini Point's defensive features are primarily its location on a steep-sided, narrow ridge and the perimeter wall. Unfortunately, construction of a modern highway across the southern side of the ridge upon which the site sits prevents us from ascertaining whether or not there was a wall limiting access to the site area. Byron Cummings is reported to have excavated at Tachini Point (Jeffrey Dean, pers. comm.), but there is no record of these excavations (Turner, 1962).

The Parrish Creek Site (LCD-166) is located on a sandstone outcrop along the southwest edge of Tyende Mesa (fig. 4-7). There are 60 to 100 rooms at this location, with the pueblo of orientation at the site's highest point. Most of the rooms are arranged in tiers across a sloping sand pocket within this irregularly shaped rock formation. The site appears to have been facing

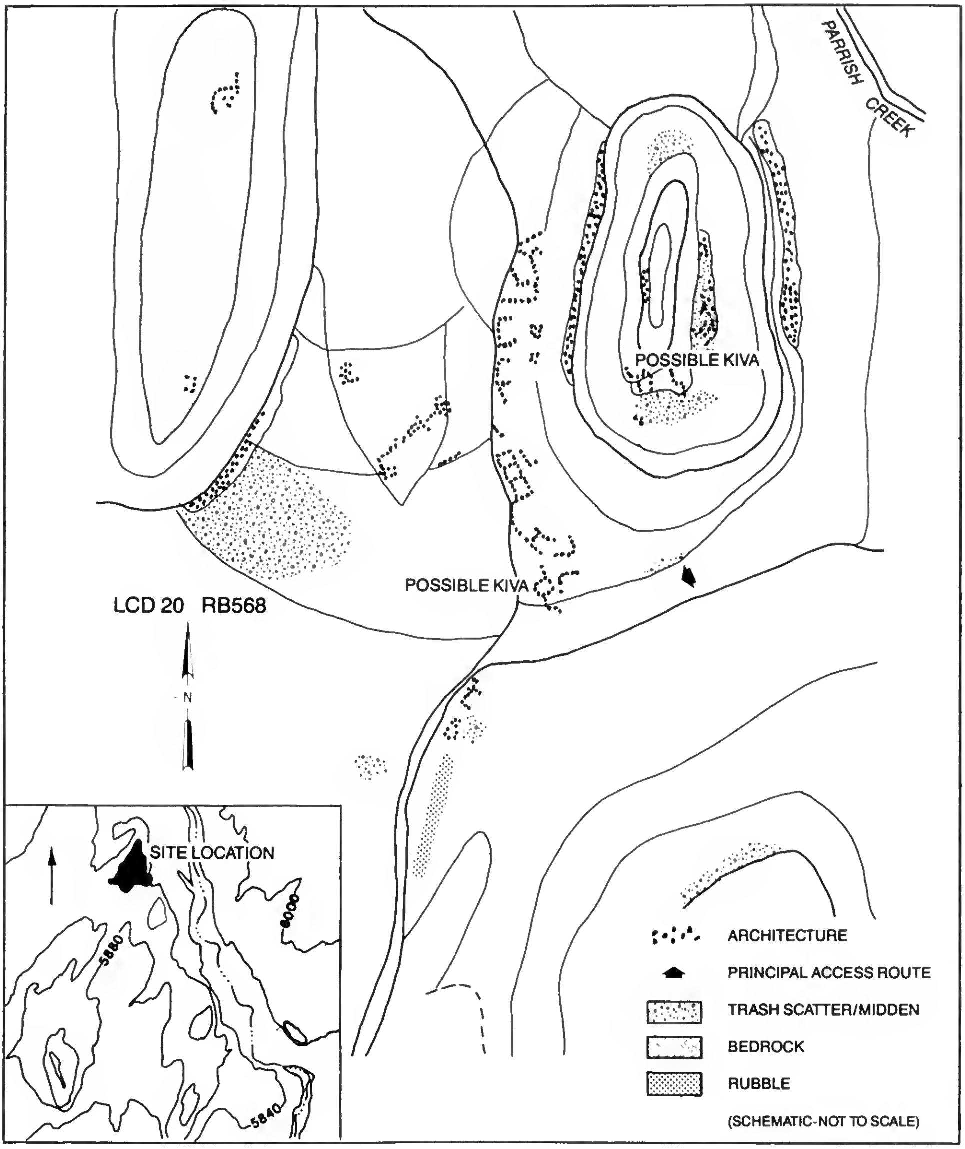


Figure 4-8. Map of RB568.

Parrish Creek, presently 200 m to the south across low dunes. Hand- and toeholds ascend a tall sandstone "chimney" at one side of the site. This chimney is a prominent feature of the landscape and can be easily seen from the surrounding areas. Another access route climbs from the creek's floodplain at the east edge of the site to the roomblocks. This route is walled at its lowest point. Much of the site would have been hidden from view within the sand pocket; however, a small knob covered with rubble forms the highest part of the site and would have been easily visible from a distance.

Figure 4-9. RB568, facing northeast. The entire outcrop is covered with remains of the Tsegi Phase ruin.

Several room floors were cut into the rock of the knob and a room was constructed on its highest point. Concealment could not have been of primary concern to the site's occupants; however, a wall of large sandstone blocks restricted access to the site from the west, and another wall limited access from the east. Rock pools above the site on sandstone outcrops of Tyende Mesa may have been used for water catchment, although no clear remains of reservoir construction were recorded. It is likely that Parrish Creek would have provided a stable source of water for the site residents. Satellite sites of Parrish Creek are numerous and close by. There are three sites within 200 m of the north, south, and east edges of the site, each located on level sandy areas that would have been suitable for cultivation. Visibility from this site is limited to sightings up and down Parrish Creek, to Moqui Rock and to RB568.

The site of RB568 was first located and partially excavated by the Rainbow Bridge–Monument Valley Expedition (RBMV) between 1935 and 1938 (fig. 4-8) (Beals et al., 1945). The site had over 100 rooms arranged over a level area southwest of Parrish Creek. The roomblocks were constructed out from a sandstone knob, which was covered with architecture when the site was occupied. Floors were pecked into the surface of the knob from bottom to top, as was at least one kiva (fig. 4-9).

Burials held the primary interest of the RBMV excavators, and 50 interments were recovered. Recent analysis of this material revealed patterns of particular interest to the present project. There was a disproportionately low number of adult males among the burial population from RB568. There were half as many males (four) as females (nine) in the group 35–50+ years, and there were no males identified in the 18–35 age group (seven females were identified) (Crotty, 1983:28). This suggests that males were given alternative burial treatment, a pattern that would be consistent for a culture at war in which warriors would be buried apart from the rest of the population.

Focusing as they did on burials, the RBMV investigators did not note the defensive features present at RB568. George Brainerd, the principal excavator, noted:

> Site RB 568 was selected [for excavation] for a number of reasons. It appeared to be a large and rich site, and its extensive architectural remains were in the open, a fact that distinguished it from the much better-known cave ruins. (Beals et al., 1945:72)

Some note was made of the extent of the rooms on the knob at the northeast corner of the site, and though no direct mention of defense was made, the characteristics are consistent with defensibility:

> . . . the bluff to the east showed unusual features characteristic of at least three sites of this immediate area and time period. There was evidence of ten niches cut into the steep sandstone slope of the bluff. . . . Footholds led up to the ends of some of them. . . . Two of them had groups of "loom holes" at either end. It is suggested that these niches are the remains of rooms perched on the cliffside, supported in front by a stiltlike wall. . . . Such rooms occur elsewhere in cave dwellings dated shortly after this site. . . . There were also several surface rooms on the bluff, including two on the summit, which rises fifty feet above the main ground level of the village and one hundred feet above the floor of the neighboring canyon. These two rooms may well have served as a lookout. It is hard to guess why the inhabitants of the village built rooms in such inconvenient and windy locations. (Beals et al., 1945:82)

Overall, it appears that RB568 was a focal site related to others in the vicinity. Pueblo of orientation double-faced masonry was part of a roomblock constructed toward the west side of the site, possibly RBMV's Group III. Though no evidence of a reservoir was located, reservoirs have been reported (Dean, pers. comm.), and the site is very near Parrish Creek, which flows most of the year. The site's location is secluded, like the Parrish Creek site. Although blown sand prevented a determination of whether or not there may have been a defensive wall protecting all or part of the site, the steep sides of this natural outcrop would have made it virtually impregnable to attack from below. From RB568 there is a clear line of sight to the nearest focal sites,

Figure 4-10. Aerial photograph, facing northwest, of the mesa top upon which Table Top Ruin is located. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

Parrish Creek and Moqui Rock, and to four of the other seven Kayenta Valley focal sites.

Table Top Ruin (LCD-98) is located on an isolated narrow mesa top adjacent to the escarpment of Black Mesa (fig. 4-10). The site is on what is probably the most defensible location anywhere in the valley. The extremely steep sides of the mesa rise 165 m off the valley floor. Once these sides are scaled, a visitor is faced with a 4–10-m-high cliff wall around the entire circumference of the mesa top. It took the project survey crew 2 days to find a way to negotiate this cliff face. They eventually did find a single route of access into the site, through a narrow crack in the face of the cliff beneath the mesa top.

The site itself consists of 50 to 100 rooms in roomblocks clustered toward the center of the mesa top (fig. 4-11). A series of interconnected and dammed rock pools formed a reservoir with a controllable outlet over the side of the cliff. The pueblo of orientation is constructed in the center of the site, near a circular opening in the mesa top that was artificially enlarged and may have served as a kiva. The nearest land suitable for cultivation is at the base of the mesa, and the nearest source of permanent or stable water is several kilometers away. Visibility from the site is excellent, and six of the other Kayenta Valley focal sites can be seen.

Two other focal sites within the Kayenta Valley proper, Rabbit Ears (LCD-9) and Happy Valley (LCD-52), were discovered by the survey crews. Rabbit

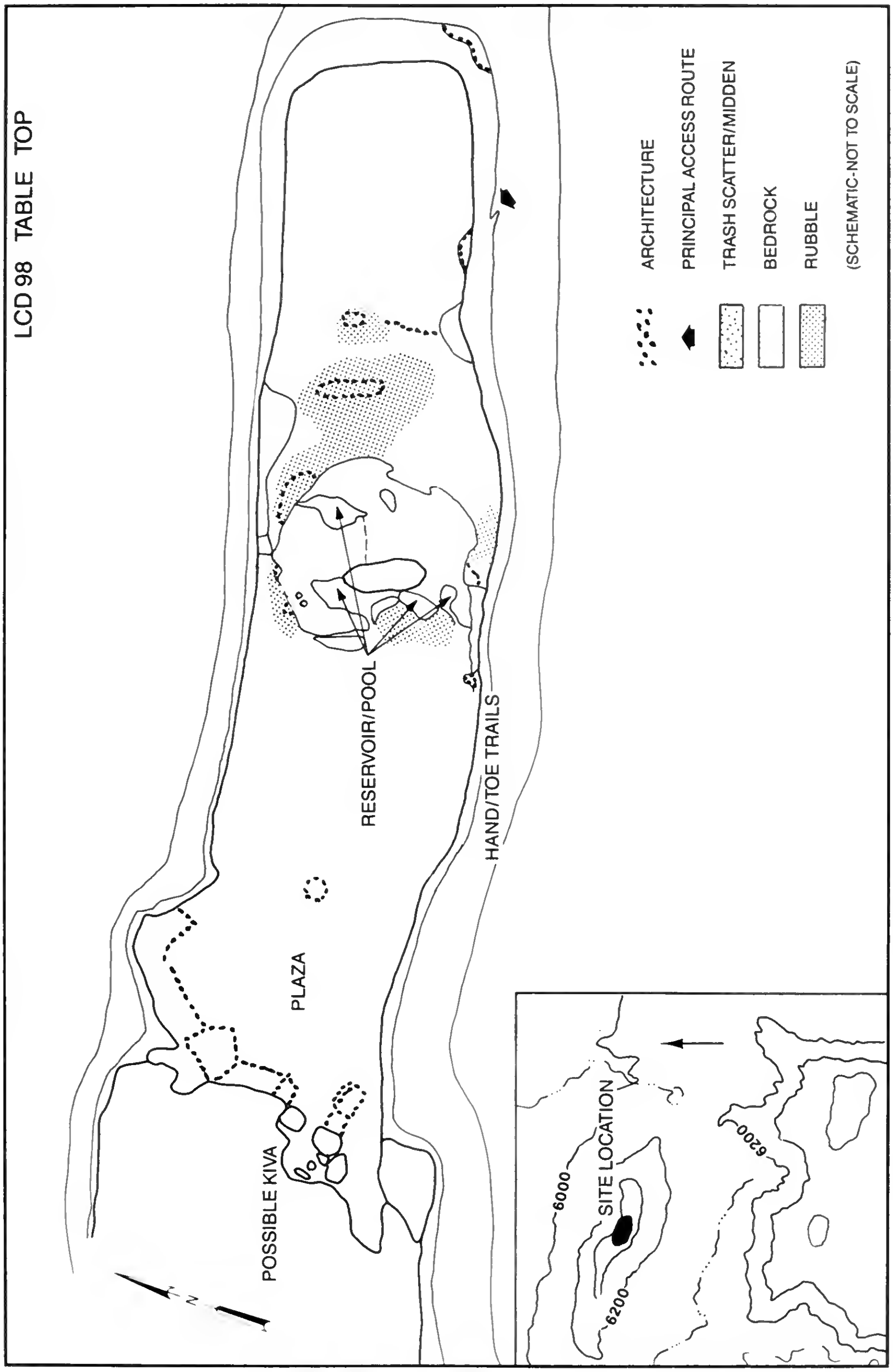


Figure 4-11. Map of Table Top Ruin.

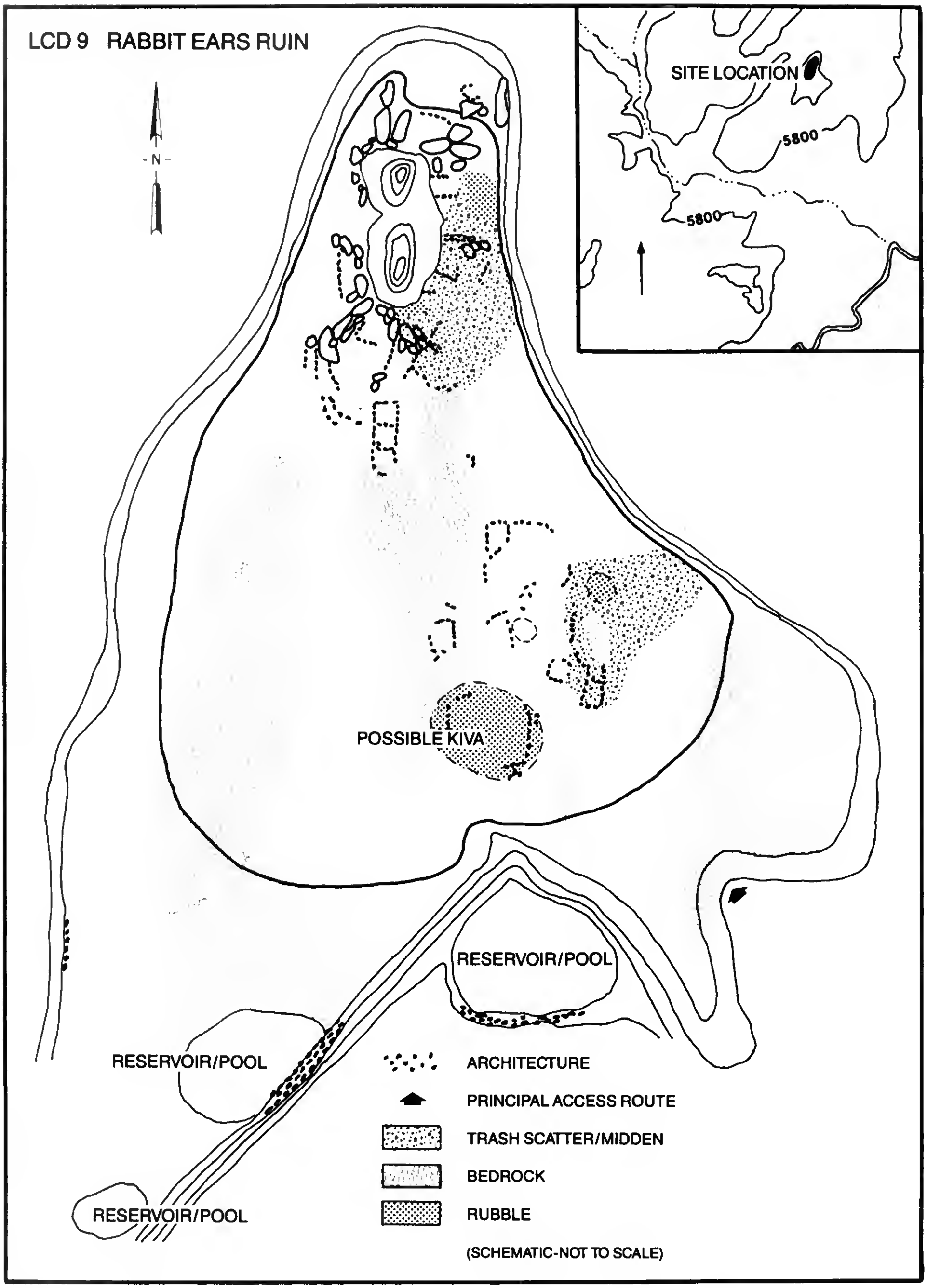


Figure 4-12. Map of Rabbit Ears Pueblo.

Figure 4-13. The monolithic "rabbit ears" around which Rabbit Ears Pueblo is clustered. The large upright stones are a distinctive landmark on the horizon and are visible from a great distance to the east and west.

Ears, at the north edge of the research area, overlooks Monument Valley to the north and east and Tyende Mesa to the south (fig. 4-12). This site consists of two clusters of rooms, one set around the base of two 10-m-high sandstone monoliths that give the site its name, and the other out on the flat area of the mesa top. The mesa is easily defensible, in that the top is surrounded by sheer cliff walls. Access is limited to three narrow and very steep cracks, which today can be scaled only with the use of log ladders. The top of the mesa is relatively extensive, approximately 300 × 500 m, most of which is exposed bedrock. Along the south edge, three rock pools have been converted into reservoirs by the construction of stone walls across the low end. Sections of wall have been constructed along the edge of the mesa near the access routes, as well.

This site can be recognized easily from a distance by the V-shaped "rabbit ears" monoliths (fig. 4-13). Visibility from the site into Monument Valley is excellent, and it is possible that Rabbit Ears served as a gateway or point of communication with groups to the north and east in Monument Valley, an area not yet well studied (see Neely & Olson, 1977). Rabbit Ears also can be seen from Moqui Rock, Moqui Overlook, and Table Top, and it is likely to have been the northernmost outpost of the Kayenta Valley system of focal sites.

Happy Valley is located along the escarpment of Skeleton Mesa, 265 m above the floor of Kayenta Valley (fig. 4-14). Like Rabbit Ears, the site can

Figure 4-14. The "flatirons" upon which Happy Valley Pueblo is located. Site is on the right-hand outcrop. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

be identified from a great distance by the unusual and distinctive rock formation on which it is located. Access to the site is strictly limited to one major route, which is walled in at least two places, crosses a steep bedrock slope via pecked hand- and toeholds, and skirts the edge of a 100-m cliff. Several smaller Tsegi Phase satellite sites are located along the slope leading to the main focal site area. Happy Valley, the largest site of this cluster, is located at the very highest point of the hilltop (fig. 4-15). Sheer cliffs drop 20–40 m around three sides of the site, broken only by narrow cracks. Three of these cracks provided the alternate access routes to the upper ruin. In each case, these cracks were nearly vertical and could be climbed only through the use of cut hand- and toeholds in the rock. A wall, 1–2 m in height at the top of each crack, further restricted access into the site. Rather than serving as primary access routes into the site—all three exit to the west, where there are only barren hills and the escarpment of Skeleton Mesa—these seem more to have been auxiliary exit routes away from the main site area.

Roomblocks, some with at least two stories of rooms, were arranged in terraces in sandy pockets at the peak. The nearest cultivable land would have been at the base of the hill, 265 m below. Rock pools and a reservoir several hundred meters down the slope of the hill provided the nearest

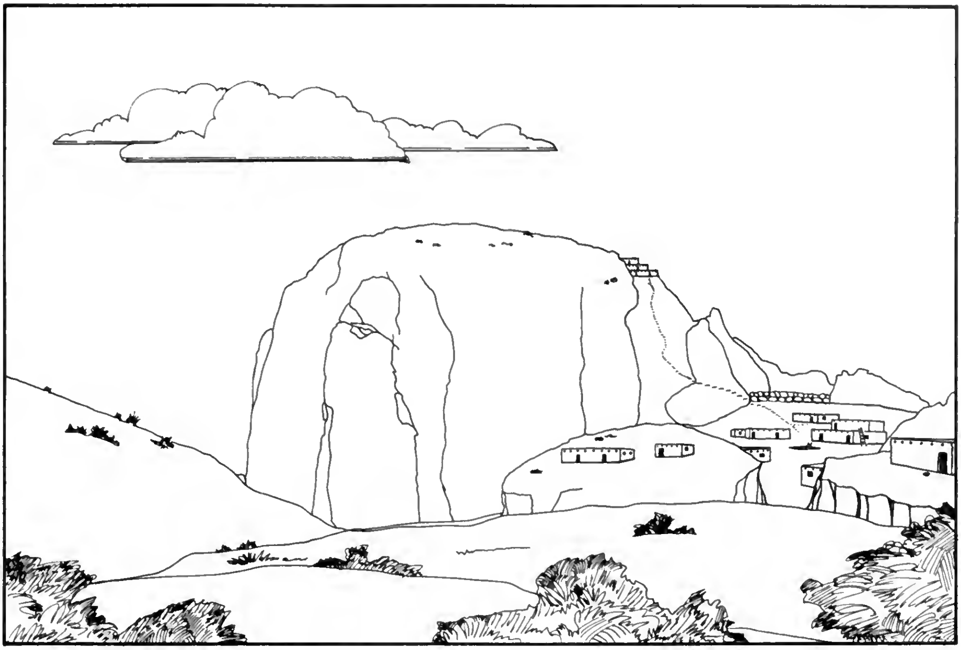


Figure 4-15. Artist's reconstruction of the Happy Valley community located around the rock outcrop.

source of water. Visibility from this site extends into Monument Valley and to all but two of the other Kayenta Valley focal sites.

The remaining focal site, Six Foot Ruin (LCD-130), is not located in Kayenta Valley proper but in the mouth of Tsegi Canyon, where the canyon opens into Marsh Pass (fig. 4-16). The site is on a small mesa that projects from the escarpment of Skeleton Mesa, on the north side of Laguna Creek, directly across from Organ Rock Ruin. Access to the site requires climbing a long sloping hill, traversing around the base of a cliff on the edge of Skeleton Mesa, crossing a narrow saddle, and climbing through a narrow crack in the rock cliff. As with Rabbit Ears and Table Top, the mesa top of Six Foot Ruin is set off by a 4–10-m-high cliff around the circumference. The 60 rooms and kiva cover much of the top of the mesa, with some rooms built right to the edge of the cliff and the others dotting the rest of the mesa (fig. 4-17). It could not be determined whether or not the entire cliff edge was surrounded by a defensive wall, but there remain today sections of a wall built along at least parts of the cliff edge. Curiously, portions of this wall are constructed in areas where it would have been impossible to scale the cliff face without technical climbing gear. Preservation of structures at Six Foot was the best of any site visited, with sections of the pueblo of orientation standing 2 m high (thus the site name). A possible reservoir was located on the mesa top as well. The view from this site extends to the Organ Rock Ruin focal site

Figure 4-16. Aerial photograph of the small mesa upon which Six Foot Ruin is located (foreground). Note its proximity to Organ Rock across the canyon bottom. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

in Long House Valley and over the south end of Tsegi and Wildcat canyons. Although none of the other focal sites in Kayenta Valley are visible from Six Foot, it is tied into the Long House/Kayenta system by its visual link with Organ Rock Ruin. Like Rabbit Ears, Six Foot may have served as a connector or point of communication by signaling with groups that lived in the canyons, tying them into a communication system that extended from Long House Valley and Kayenta Valley into the canyons and toward Monument Valley.

Subsequent to the Kayenta Valley survey, field crews discovered yet another major focal site even farther up into Tsegi Canyon beyond Six Foot (fig. 4-18). This site, Wildcat Canyon Ruin (LCD-176), directly links the outside valley systems with the complex of cliff dwellings in the canyons. Wildcat Canyon Ruin has direct visual links with Six Foot and Organ Rock Ruin and, on the other side, looks directly down on Swallow's Nest Cave, the first of the cliff dwellings in the canyon. Wildcat Canyon Ruin is typically situated on top of a small mesa, rising 200 m up from the canyon bottom. Access again is by way of a narrow crack in the upper sheer cliff wall. Upon gaining the top of the mesa, one must walk across a narrow saddle to get to the site area. Prehistorically, two separate walls were constructed across this saddle to restrict access. The site itself consists of over 200 rooms, including a pueblo of orientation, spread over the north end of the mesa. There is no

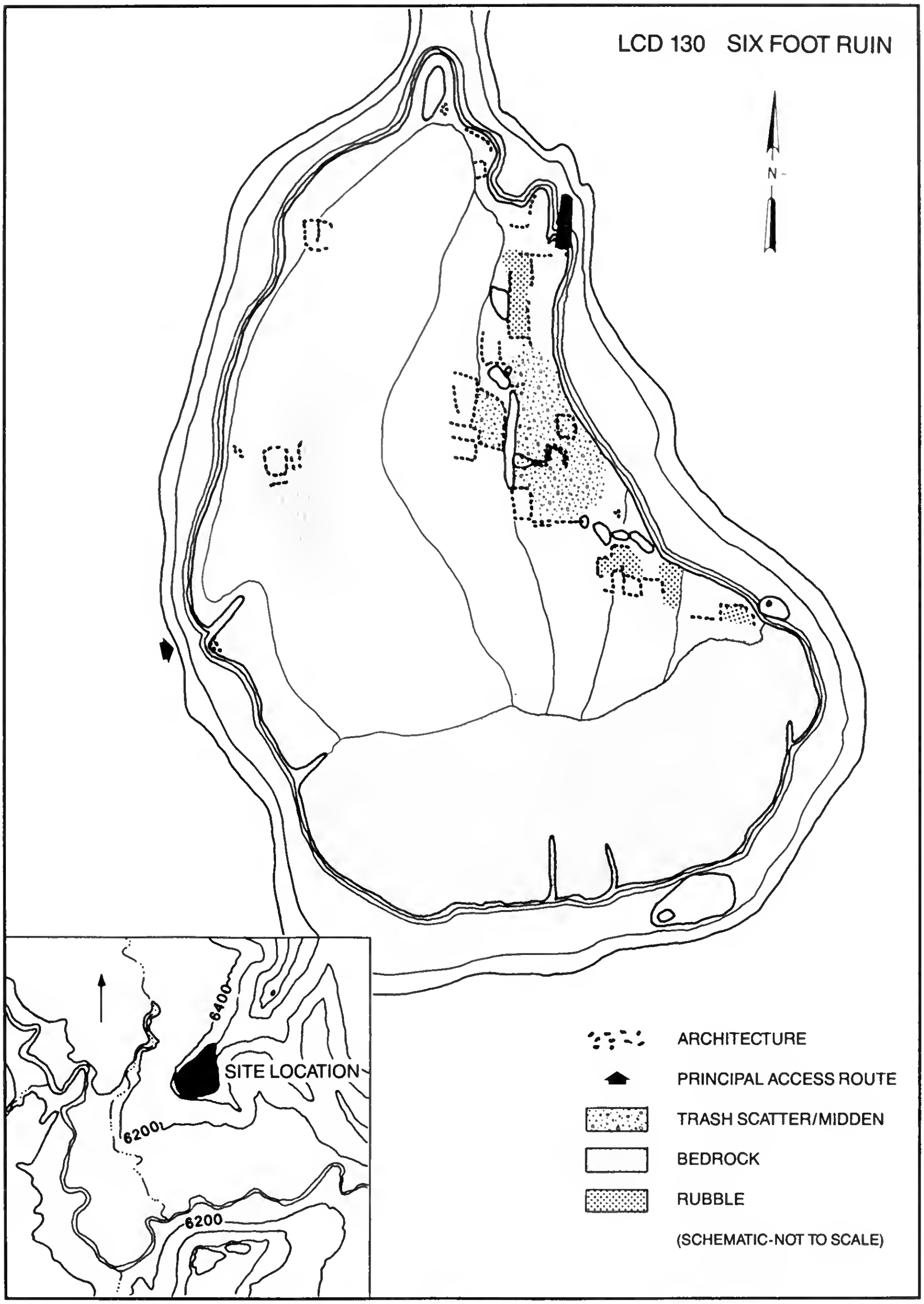


Figure 4-17. Schematic map of Six Foot Ruin.

Figure 4-18. Aerial photograph, facing north, showing the general location of the Wildcat Canyon Ruin mesa within Tsegi Canyon. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

reservoir associated with the site, though it is likely that Laguna Creek, immediately below the site, would have served as a permanent source of water.

It should be pointed out that with 200 rooms at Wildcat Canyon Ruin, 60 rooms at Six Foot Ruin, and 200 to 300 rooms at Organ Rock Ruin and its satellites, there would have been 400 to 600 people living within about a 2-km radius of the mouth of Tsegi Canyon. Given that there were only 500 to 600 occupied rooms in the canyons proper during the Tsegi Phase, the new survey data now indicate that there were almost as many people living right at the mouth of the Tsegi Canyon system as lived in all of the site canyons put together.

Klethla Valley

Like Long House Valley to the east, the floor of Klethla Valley lies at an elevation of approximately 2061 m. From the low hills separating Long House Valley and Klethla Valley, the 1984 research area extended 22 km to the west, where Klethla Valley and the Shonto Plateau begin to merge. Within the research area, Klethla Valley is clearly defined by the steep escarpment of Black Mesa on the south and by the hills, mesas, and sandstone outcrops of Shonto Plateau on the north (fig. 4-19). Annual precipitation averages about 280 mm, and the predominant vegetation is pinyon–juniper forest on the

Figure 4-19. Aerial photograph of Klethla Valley, facing south. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

valley slopes and a combination of sagebrush and rabbitbrush on the valley floor (Dean et al., 1978:27–28). The survey was conducted to see if there was a network of focal sites in Klethla similar to that found in Long House Valley, and to see if the Long House Valley focal sites were visually linked with contemporaneous sites in Klethla. The survey was concentrated in the upper (eastern) end of Klethla where it abuts the lower reaches of Long House Valley. The research area investigated in 1984 extended over 200 sq km. A total of 84 HPTAs were surveyed along with 5 LPTAs of 1 sq km. A total of 290 sites were recorded (fig. 4-1). Of these, 82 dated prior to A.D. 1100, 32 dated to the period A.D. 1100–1300, and 1 proto-Hopi site was located. More than one-quarter of the sites recorded dated to the 200-year period being investigated; the rest spanned over 3,000 years.

Twenty-three sites dating to the Tsegi Phase were recorded, and the pattern of site types and locations mirrors in some ways that found in Long House Valley. Five of the sites were much larger than the others and had similar characteristics to the Long House Valley focal sites, with the open plazas, and a "pueblo of orientation" having cored, double-faced masonry. Eleven of the Tsegi Phase sites, including two focal sites, were in nondefensible locations. All of these sites were located near dunes suitable for dry farming, and one, UKV-72, was associated with several man-made catchment basins and check dams. The remaining 12 sites from this period were all located in defensible positions. By and large, the sites in Klethla Valley conform to the

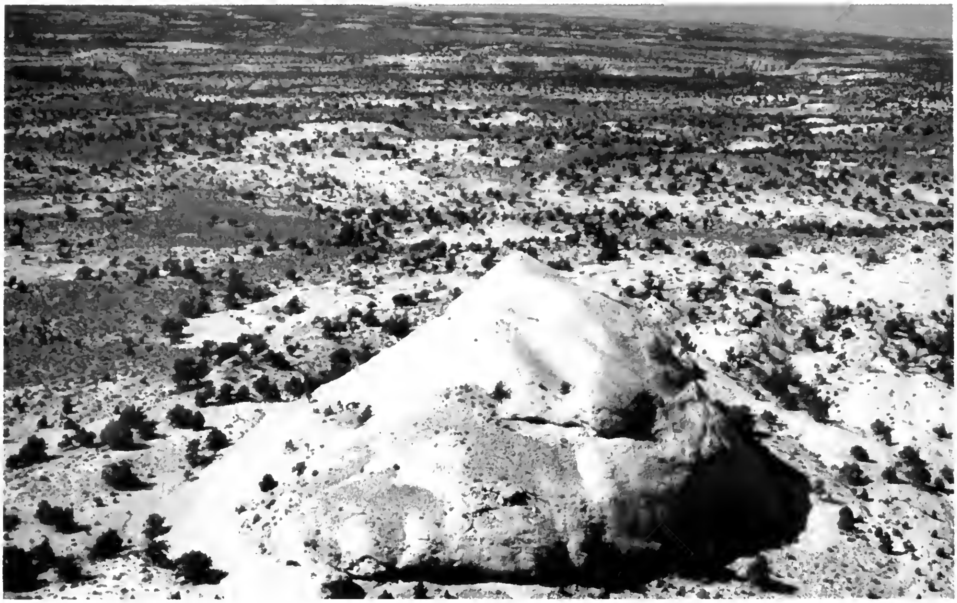


Figure 4-20. Aerial photograph, facing north, of the rocky outcrop upon which Hoodoo Heaven Ruin is located. Architectural rubble covers the end of the outcrop in the foreground of the photograph. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

pattern of defensively located focal sites surrounded by much smaller satellite villages.

Twelve Tsegi Phase sites are in defensible locations on hilltops, cliffs, or other geographic promontories that restrict access. Some of these sites also possess overtly defensive features such as walls across access routes, access limited to a single walled corridor, and hand-and-toe trails leading to the tops of nearby high rock outcrops suitable for lookout or signaling stations. These sites range in size from one or two roomblocks of four rooms each to focal sites of 100 or more rooms. They are often also associated with reservoirs, or bedrock pools to catch rain and runoff.

Four of the 12 defensible sites are actually satellites of the large focal site, Hoodoo Heaven (UKV-92), which is located on the irregular sloping sides of a large solid sandstone outcrop rising 25 m above the valley floor (fig. 4-20). Double-coursed masonry was employed in the construction of at least one structure, though this may have been a kiva rather than the pueblo of orientation found in other focal sites. There is only one access route up onto the outcrop, and there is an architectural wall built across this single route. The surrounding land is suitable for cultivation, and the areas that would have been fields can all be observed from the uppermost section of the site. A number of catchment basins occur in the bedrock around the site, and in addition, at the highest part of the site there is a reservoir in a natural declivity

Figure 4-21. Aerial photograph, facing west, of Alan's Fort Ruin, showing the location of the outcrop in the wash. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

in the bedrock that was artificially dammed with prehistoric trash dating to the Tsegi Phase.

Two other focal sites share a number of characteristics with Hoodoo Heaven. The first, Alan's Fort (UKV-80), is in a spectacularly defensible location (fig. 4-21). This site is perched on an isolated sandstone butte at the confluence of two major branches of Shonto Wash. Sheer cliffs drop 24–46 m to the dunes in the wash on all sides. There is a panoramic view of the surroundings, and the two other defensive focal sites, Valley View and Hoodoo Heaven, are visible. Access is limited to hand- and toeholds pecked into the face of the cliff on the east wall of the outcrop. (It took our survey crew two days to find this hand-and-toe trail. It is interesting to note that a previous survey expedition had recorded a large early site at the base of the butte but had not made it up on top to find this Tsegi Phase ruin.) An alternative access route into the site via a cleft in the rock was blocked by a wall. The top of the butte is approximately 100 × 300 m and is covered by a scatter of at least 20 roomblocks, including a pueblo of orientation with double-coursed masonry. In addition to the variety of structures on top of the butte, there is a possible reservoir, indicated by the remnants of a wall and a silted-up area behind it. The dunes at the base of the site would have been suitable for farming and easily surveyed from above. A large Pueblo II (A.D. 900–1100) pithouse village is located at the base of the butte, and presumably both groups would have employed the same lands for agriculture, though

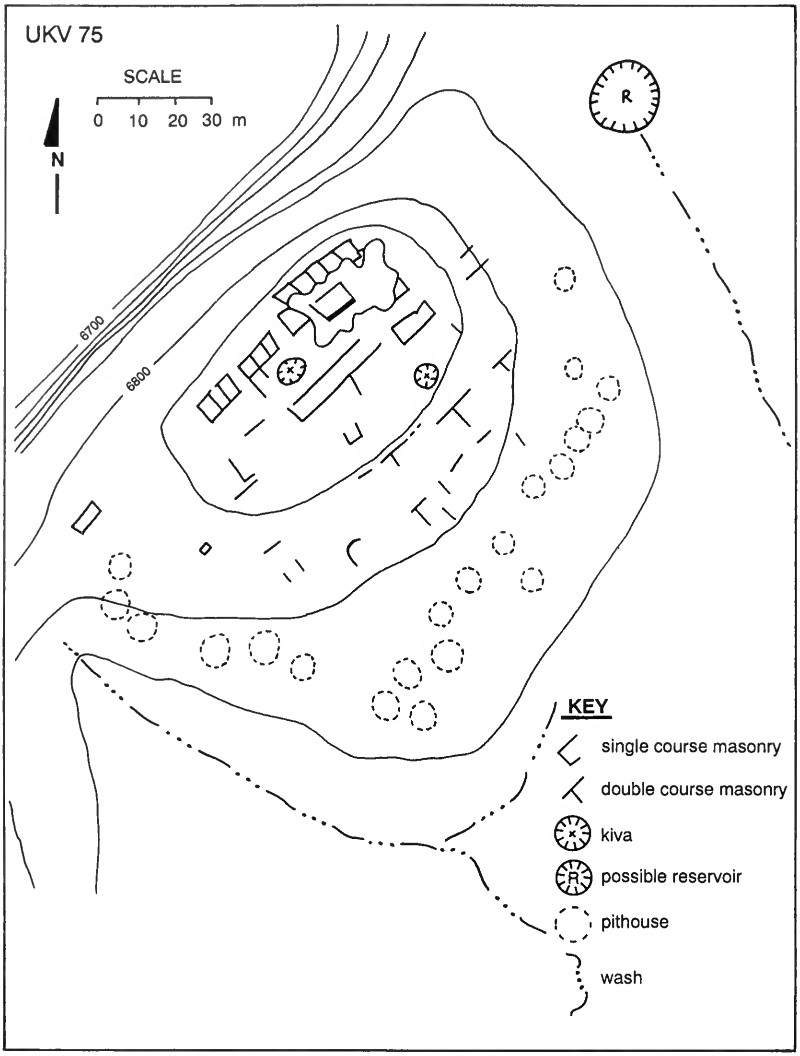


Figure 4-22. Schematic map of Valley View Ruin.

the earlier occupants of this location appear to have been more comfortably situated in terms of proximity to water and fields.

The other focal site, Valley View Ruin (UKV-75) (fig. 4-22), is located on the opposite side of the research area from UKV-80. It is on the front edge of the Black Mesa escarpment, 185 m above the valley floor. From this site all the other Tsegi Phase focal sites and most of the other Tsegi Phase defensive and nondefensive sites can be seen, along with most of Klethla Valley and prominent points on Black Mesa. Valley View Ruin includes over 100 rooms constructed at the edge of a steep cliff. The double-coursed pueblo of orientation is located on the highest point of the site, associated with a large kiva, and in the location having the greatest visibility of the surrounding region. Access to the site is restricted by the climb up the face of the cliff from the north. To the south, there is a narrowing of the drainage in which the site is located, partially limiting access from that direction as well. This southern part of the site also appears to have had pithouse structures. There is no natural source of water in the immediate vicinity of the site, and the survey crew was unable to locate an artificial reservoir to serve the community's water needs. There is also no land for cultivation in the vicinity of Valley View Ruin, and the residents would have had to have traveled 500 m or more to the nearest arable land.

Overall, the defensible Tsegi Phase sites in the Klethla Valley are characterized by locations that have extremely difficult access, often with most access routes blocked by walls or masonry structures. From these sites visibility is excellent over the surrounding area and includes intervisibility with other focal sites and overview of satellites and agricultural fields. Although there is not the universal pattern of intervisibility of focal sites found in Long House Valley, the Klethla Valley sites are all linked at least indirectly, and they are close enough together to infer that they were all part of a single valley-wide network.

Two large sites, Thief Site (UKV-77) and Kin Klethla (UKV-115), do not fit within the broader pattern of defensibly located focal sites. Both were situated out in the open on the valley floor. Each site had a single long masonry roomblock visible on the surface, and these masonry roomblocks appeared to be analogous to the pueblo of orientation roomblocks found at other focal sites. The two sites also fit within the size range of the focal site type, being 3 and 6 ha in area, respectively, and have a number of much smaller contemporaneous sites in the immediate area. In contrast to other focal sites, however, the residential architecture surrounding these spinal roomblocks consisted not of aboveground masonry rooms but of semi-subterranean pithouses. Although large Tsegi Phase pithouse villages do not appear in Long House Valley, they are known for other parts of the Kayenta area (Hobler, 1974; Lindsay, 1969; see also Gumerman, 1969). Both the ceramics and the tree-ring dates from excavations at Thief Site confirm that the period of greatest activity at the site was the Tsegi Phase (Swarthout et al., 1986:296). It thus seems reasonable to infer that these two represent an alternative form of focal site. Whether the differences represent functional variation, ethnic diversity, or something else cannot be determined on the basis of a surface examination.

Of greater significance to the present project, however, is the fact that these sites were not positioned on defensible topography. Both were in open, exposed positions lacking any natural features of defense, though they did have visual contact with each other and with other focal sites, due to the openness of Klethla Valley around the sites. Given that other Tsegi Phase focal sites in Klethla are clearly defensive, the seeming indefensibility of these sites is somewhat incongruous. Furthermore, if these two sites truly lack defensive features, then the threat of raiding and warfare might have been less than would be inferred if one looked only at the defensible focal sites on hilltops and cliffs.

However, while a site may not be immediately defensible, it may nevertheless be defensive. In particular, it is possible that Thief Site and Kin Klethla may have been protected by the construction of some kind of defensive palisade or brush structure around the outside perimeter of the occupation area. The possibility of a palisade at these sites is given credence by the fact that there is a post palisade going around the outside of the only Tsegi Phase pithouse village that has been excavated to date in the Kayenta region. At Neskahi Village (NA7719), a Tsegi Phase site in the Glen Canyon area, Lindsay (1969:259, fig. 34) found a ring of post holes encircling a D-shaped arrangement of pithouses and a long masonry roomblock (Lindsay, 1969: 259, fig. 34). Analogous to the situation, this pithouse village is not in a topographically defensible position, but it was protected culturally by the construction of a defensive feature.

Test Excavations at Thief Site and Kin Klethla

In order to ascertain whether or not there were defensive palisades or other features at Thief Site and Kin Klethla, limited test excavations were conducted at both sites in 1986. In both cases the testing was not adequate to provide a conclusive answer to this question.

Thief Site is located on a low knoll near the base of the Black Mesa escarpment in Klethla Valley. The site originally covered about 3 ha, and although a portion of the site was destroyed by railroad construction, over 75% of the site remains intact. The site itself consists of a roomblock of double-walled sandstone masonry, representing the pueblo of orientation. This roomblock is at the top of the knoll and is surrounded on the north, east, and south by pithouses. In all, the site included about 30 to 40 pithouses. Thief Site was tested between July 15 and August 1, 1986, in an attempt to determine whether or not defensive features such as a wall, brush fence, palisade, or ditch might have been in place around the outside of the occupied area (fig. 4-23). Four trenches were excavated on the site surface. Each trench consisted of a series of 1-×-2-m units, designed to maintain horizontal control of artifact provenience. Larger 2-×-2-m units were placed in areas where more extensive exposure was needed. Excavation was carried to the uppermost occupation level at the site, which dates to the A.D. 1250–1300 period, based on the abundant Tsegi Phase surface ceramics. Unfortunately, none of the tree-ring samples collected in the course of excavation provided dates.

Excavation units extended from outside the site's periphery, as determined by artifact scatter, and extended toward the site center, a sandstone masonry roomblock. Excavation revealed the outline of features, which were then mapped. Individual features were not excavated, however. Excavations in Trench 2 revealed the outline of a pithouse, the largest feature outline recorded. This was not excavated. Artifacts were collected from all excavated units. Approximately 174 sq m was excavated. Maximum depth of excavation averaged 30 cm below surface. Work concentrated along the northeast and southwest borders of the site. Occupation remains were scarce along the

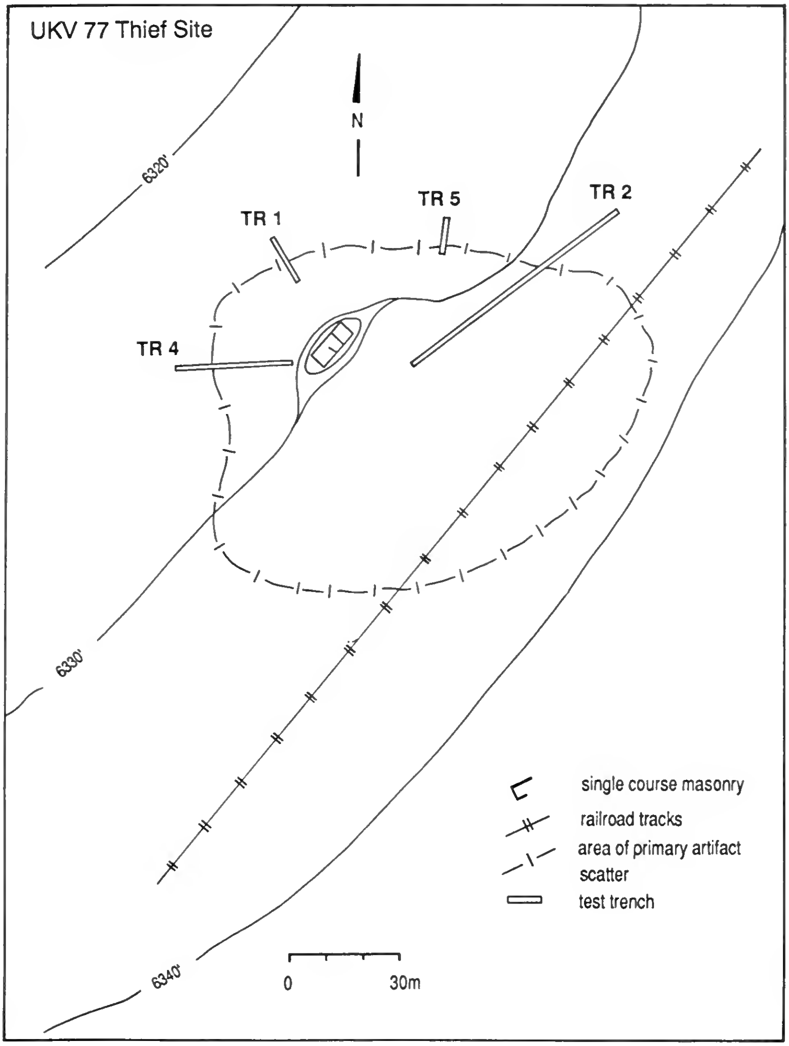


Figure 4-23. Schematic map of Thief Site.

northwest edge of the site, suggesting that the roomblock (oriented northeast–southwest) may have been the site boundary on that side. The southeast periphery of the site was removed by construction of the Black Mesa–Page rail line. Discussion of the archaeological materials recovered during salvage excavations at Thief Site at that time can be found in Swarthout et al. (1986: 262–313).

The testing at Thief Site was equivocal. No signs of a wall, brush enclosure, fence, post palisade, or ditch were encountered in spite of extensive efforts to discover perimeter features. There are several possible interpretations of the testing operations. The first and most obvious is that there was no defensive feature surrounding the site. The presence of such a feature at Neskahi Village, the only Tsegi Phase pithouse village excavated to date,

Figure 4-24. Aerial photograph of Thief Site. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

does not mean that all such villages will have analogous features. Second, there may have been a fence or palisade and it simply was not detected by the testing. The testing was relatively limited, and it was difficult to ascertain with any accuracy the location of the occupation limits at the site. Aerial photos of the site suggest that the site boundaries may have been farther from the site center than expected, with the test trenches positioned entirely within the site rather than on its periphery (fig. 4-24). Third, the site may have been protected by a defensive feature that would be difficult to locate archaeologically. Among the Yanomamo of Brazil, for example, the villages are surrounded by "walls" of heavy brush, which are difficult to penetrate without making a tremendous racket (Chagnon, 1983). Remains of loose wood and brush were found in one trench toward the outer limits of the occupied site area.

Although the testing did not turn up signs of a defensive wall, palisade, or ditch, it did confirm a pattern observed in the earlier salvage excavations associated with the construction of the railroad. Swarthout et al. (1986) reported that two of the three excavated Tsegi Phase pithouses had been heavily burned. Our testing at the site found evidence of one and possibly two more burned pithouses. Furthermore, in conducting the petrographic and refiring analyses of the ceramics from Klethla Valley, William Lucius singled out the material from Thief Site as having an unusually high incidence of heavily vitrified ceramics—indicating the possibility of widespread burning at the site. The combination of excavation and ceramic data points to the possibility of a conflagration at Thief Site in the Tsegi Phase.

The excavations at the second pithouse village, Kin Klethla (UKV-115), were equally ambiguous. This site consists of a sandstone masonry roomblock that extends across two sandstone outcrops surrounded by a large area of artifacts and pithouses. The two outcrops covered with surface architecture are at the northern edge of the site, in the most common location for the pueblo of orientation in other focal sites. The architecture on top of these two outcrops might be considered in a defensible position, but the surrounding broad area of occupation is on the flat valley floor. Low mounds of trash scatter are visible on the east side of the site and extend south from the southernmost knoll and hook to the east (fig. 4-25). The site as a whole dates to A.D. 1250–1300, based on ceramics and partially confirmed by a single tree-ring date of 1258vv from Trench B. Similar to Thief Site in location and organization, Kin Klethla did not fit the settlement pattern identified for contemporaneous sites of the same size. Kin Klethla is located on the level floor of Klethla Valley, while other sites dating to this period are located in hidden or inaccessible places. In size, this site is also comparable to the large focal sites in the valley. The artifact scatter extended about 50 m out from the base of the knoll. Within this area were two patches where no artifacts were recorded. The first of these is the area between the knolls and extending some 20 m downslope to the west. The other area was in the northern portion of the site, west of Trench A, a rectangular area roughly 18 × 24 m. In addition, there were a few artifacts scattered farther from the site center. It was not clear whether these were from the area being investigated or had washed in from an artifact scatter some 250 m farther west of the site. Pinflag survey on the east and south portions of the site indicated heavy trash scatter close to the knolls and in the area of built-up middens at the south end of the site. Artifact scatter extended about 100 m east and 110 m south of the site. No gaps in artifact scatter were recorded.

Work at the site consisted of making a site map, using pinflags to identify the relative density of artifacts on the site surface, and excavating three long trenches and several expanded broadsides. The trenches extended from areas of high-density to areas of low-density surface material. In order to determine the depth of the cultural material at the site and to try and define the limits of the main occupation area, a backhoe was used to extend Trench B down to sterile soil.

As at Thief Site, testing at Kin Klethla did not reveal any evidence of a defensive wall, palisade, or ditch going around the outside perimeter of the site. There were smaller arcs and lines of post holes discovered in the trenches and broadsides, but these were discontinuous and at most would have surrounded groups of structures rather than the entire site. The same alternative interpretations may be applied to this site as to Thief Site—namely, that there was no defensive feature, the testing missed the feature or features that may have existed, or the residents used something other than an ar-

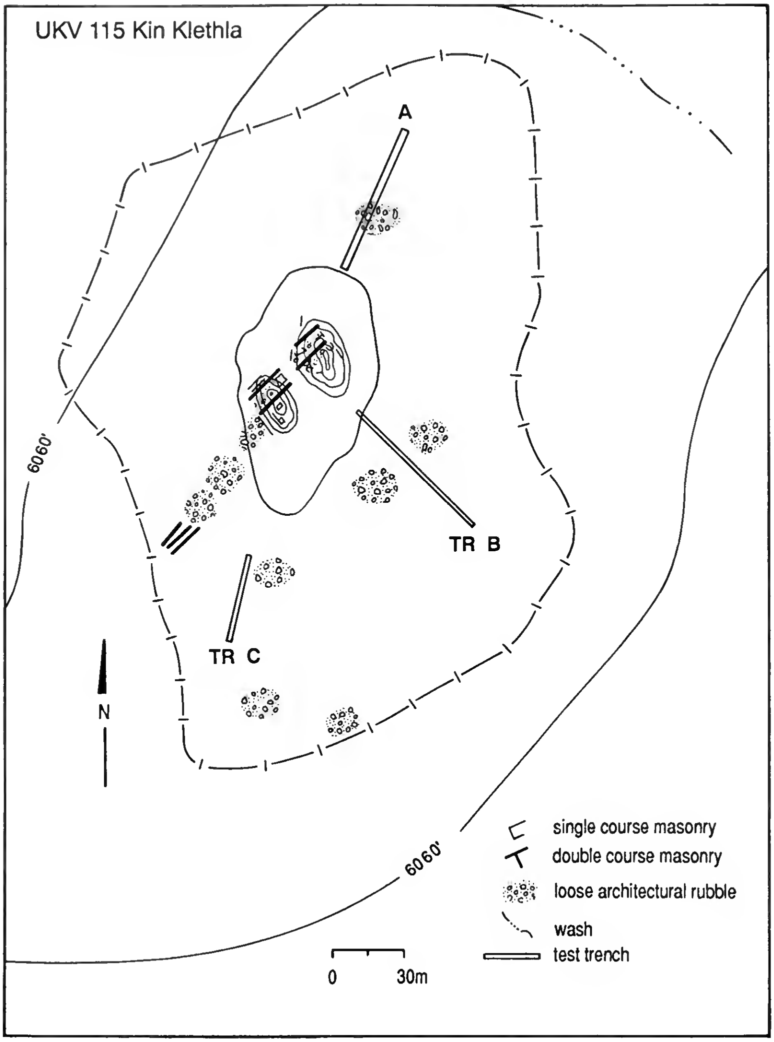


Figure 4-25. Schematic map of Kin Klethla.

chaeologically detectable wall, palisade, or ditch for defense. In this case, there is a somewhat greater likelihood that the testing missed the perimeters of the site. Subsequent aerial photographs show the occupation areas of the site more clearly than ground observation and also show that the test trenches may not have crossed the outside limits of the site (fig. 4-26).

One additional piece of data relevant to warfare was uncovered in the course of testing at Kin Klethla. Again, there was a similar pattern to that found at Thief Site, with burned rooms and burned areas on the surface. At Kin Klethla, the backhoe cut through one of the burned rooms, and there was an isolated human skull (probably female) in the fill of the room. The forehead of this skull had been bashed in, and there were two clear cut

Figure 4-26. Aerial photograph of Kin Klethla. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

Figure 4-27. Front of the isolated skull excavated from Kin Klethla, showing bashed-in forehead and one of the two cut marks.

Figure 4-28. Back of the isolated skull excavated from Kin Klethla, showing one of the two cut marks.

marks on the skull, one at the top and the other at the back (figs. 4-27, 4-28). The skull and the burning seen at the site point to some level of violence associated with the occupation and probable abandonment of the site in the second half of the 13th century.

The testing at Thief Site and Kin Klethla certainly did not confirm that the sites were protected by a wall, ditch, or post palisade like that found at Neskahi Village. At the same time, the work did not confirm the absence of such features. What the testing did confirm is that there were signs of extensive burning and, in one case, overt physical violence at these open, exposed sites. Unexpectedly, the two focal sites that were not found in defensible locations act to confirm the presence of warfare in the Kayenta heartland. The other focal sites in Klethla, Long House, and Kayenta valleys were in defensible locations difficult to attack, and indeed there were no visible signs of attack at these sites. The two contemporaneous open sites, however, were much more vulnerable to attack and do show signs of violence and of having been burned. Thus, the defensive settlement posture taken by most residents in the heartland may be seen as a successful adaptive strategy in the face of the direct threat of attack. This defensive posture may also help explain the general lack of evidence of much violence in the archaeological record for this period. In moving into the defensible site locations, the people protected themselves from attack and acted to reduce the overall level of actual violence.

Intervisibility Between Long House Valley and Klethla Valley

As part of the 1984 survey of Klethla Valley, the computer program also was used to identify all those locations in Klethla that could be seen from any one of the Long House Valley focal sites. Each of these points of visibility was then surveyed to look for signs of either occupation or other utilization during the Tsegi Phase. This subproject was conducted to determine whether or not the adjacent valleys may have been allied with one another in the face of common enemies or in conflict with one another in competitive response to the severe environmental conditions of the 13th century. If the two valleys were allied with one another, it was expected that the Long House Valley visibility network would have been interlinked with a similar network in Klethla. On the other hand, if they were in conflict with each other, a clear break was expected between the two networks.

The results of the survey confirmed the expected pattern for intervalley conflict: *There are no manifestations of Tsegi Phase utilization of any point in Klethla Valley visible from any of the Long House Valley focal sites* (or any other Tsegi Phase site, for that matter). Furthermore, there was a gap of over 15 km between the westernmost of the Long House Valley focal sites and the easternmost of the Klethla focal sites. There would thus appear to have been a wide "no-man's-land" between the two adjacent defensive systems. Given that there are substantial pre-Tsegi occupations in this eastern portion of Klethla Valley and ample arable land and water, this occupational gap between the two valleys might best be explained as a result of conflict between the two resident populations. However, it is also possible that the gap is a fortuitous artifact of topography or the lack of permanent water or good arable land during the Tsegi Phase.

To generate an alternative perspective on the nature of the relationship between Klethla, Long House, and Kayenta valleys, analyses were conducted of ceramics and lithics from all three valleys. The objective of these analyses was to determine the extent of possible economic interaction between the valleys by looking at the movement of ceramics and lithics back and forth. The full results of these analyses are given in Appendices B and C and are only briefly summarized here. In the lithic analysis, conducted by Margerie Green, there was a clear pattern of decreased movement of lithics between the valleys during the Tsegi Phase in particular and throughout the Pueblo III period in general. Klethla Valley residents came to rely increasingly on Klethla Valley lithic sources during the 12th and 13th centuries, and Kayenta Valley residents relied increasingly on Kayenta Valley sources. Long House Valley, without any local sources, relied increasingly on sources in Kayenta Valley. Thus the lithic analysis indicates that there was a decrease in inter-

TABLE 4-1. Ceramics at Thief Site and Kin Klethla

Ceramic Category	Thief Site	Kin Klethla
Grayware		
Kiet Siel Gray	2,823	4,671
Moencopi Corrugated	376	207
Tusayan Corrugated	133	13
Unidentified grayware	1	1
Total	3,333	4,892
Whiteware		
Kayenta B/W	53	401
Tusayan B/W	471	1,712
Flagstaff B/W	11	26
Sosi B/W	82	99
Dogoszhi B/W	76	202
Black Mesa B/W	16	16
Kana'a B/W	1	7
Shato B/W	1	1
Unidentified B/W	204	403
Undecorated whiteware	306	1,053
Total	1,220	3,919
Orangeware		
Kiet Siel Polychrome	1	13
Kayenta Polychrome	2	12
Tusayan Polychrome A	44	181
Tusayan Polychrome B	19	51
Unknown polychrome	4	4
Tusayan B/R	74	106
Unidentified B/R	2	35
Tsegi B/O	7	14
Tsegi Orange	66	189
Orange with red slip	84	354
Total	303	959
Totals	4,856	9,770

action between Klethla Valley residents and the valleys to the west and south, but no decrease in interaction between Long House Valley and the neighboring Kayenta Valley. The lithic distribution, therefore, parallels the pattern of intervisibility between the respective valleys.

The analysis of ceramic materials, conducted by William Lucius, revealed a different pattern. Rather than a decreased flow between Klethla and Long House, as seen in the lithics, there is some indication that the flow of ceramics increased in the Tsegi Phase. Based on an analysis of tempering material, it

TABLE 4-2. Frequency of Ceramic Wares at Long House Valley versus Klethla Valley

Ceramic Category	Long House		Klethla		Total
	Obs.	Exp.	Obs.	Exp.	
Graywares	10,974	10,489	8,225	7,990	
Whitewares	3,681	5,149	5,139	3,671	
Orangewares	5,861	4,158	1,262	2,965	
Totals	20,516		14,626		35,142

Chi-square = 3501.03. df = 2. $P = <0.001$.

appears that most of the whitewares found in Long House Valley in the Tsegi Phase may have been manufactured in Klethla Valley. A petrographic analysis of the ceramics found with the burials at RB568 in Kayenta Valley also indicates that 9 of 62 whole vessels examined had the volcanic ash temper (Larson, 1983). A source of this tempering material has been found in Klethla Valley (Geib & Callahan, 1985), and this is the common tempering material for pre-Tsegi Phase ceramics in Klethla. It is not, however, commonly found in pre-Tsegi ceramics in the other two valleys. From these data, Lucius inferred that there was probably specialized production of whitewares in Klethla Valley, and these wares were extensively traded to the residents of Long House and Kayenta valleys.

One possible caveat to this interpretation is that no survey has been conducted in Long House and Kayenta valleys to look for similar sources of volcanic ash temper. As the deposits located in Klethla Valley are found along the edge of Black Mesa, a geological feature common to all three valleys, it is possible that there are sources of petrographically indistinguishable material in Long House Valley and Kayenta Valley as well. A subsequent smaller-scale chemical analysis of ceramic from the research area (Stoltman et al., 1992) shows a broader picture than that obtained by Lucius. This study indicates that while the temper is similar in Tsegi Phase ceramics between the valleys, the composition of the paste is different. Thus, it appears that whether the temper was coming from one or several sources along Black Mesa, the pottery nevertheless was being locally made during the Tsegi Phase. Overall, the ceramic analysis presented somewhat equivocal results. It does not directly support the notion of decreased interaction between Klethla and Long House valleys in the 13th century.

Typological analysis of the ceramics gives some credence to the notion of specialized production of whitewares in Klethla Valley. Table 4-1 gives the distribution of types recovered from the testing operations at Thief Site and Kin Klethla, and Table 4-2 gives the comparison of the different wares for excavations at all the sites in Long House and Klethla valleys. These tables show that there are much higher than expected frequencies of whitewares in Klethla Valley and much lower than expected frequencies of orangewares, which corroborates the interpretation that whitewares were being made in Klethla and traded out. In turn, there was a reverse pattern in the distribution of the decorated wares in Long House Valley, with fewer than expected whitewares and more than expected orangewares. We know from Burial 1 at LHV72 that there were at least some potters in Long House Valley and that they were producing some orangewares (based on the discovery of hematite and red-firing yellow ochre with the burial). Similar potter's tool kits were found in six burials at RB568 (Crotty, 1983). Thus it is at least possible that Long House and Kayenta valleys were loci for the production of orangewares that then moved through an exchange relationship over into Klethla Valley.

5
TSEGI CANYON SURVEY

To complete a regional picture of settlement surrounding Long House Valley, an additional survey was conducted of caves and rockshelters in Tsegi Canyon of northeastern Arizona (fig. 5-1). The purpose of this survey was to record the features, location, and human occupation of these shelters to determine why some shelters were occupied by the ancient Anasazi residents of the canyon and others were not. Functional distinctions among sites were not made, since the data were all collected through survey and not confirmed by excavation. Numbers of rooms visible on the surface were the indicators used to group sites by size. Habitation sites, limited-use sites, resource procurement sites, ceremonial sites, or other categories of sites were not distinguished, for two reasons. There is often overlap between site "types," and it seemed preferable to avoid functional distinctions until excavation data can be used to verify functional differences among sites. Ultimately the research was designed to provide insight into whether or not a concern for warfare and defensibility may have been a factor in the selection of shelters for villages during the latest phases of occupation in the 13th century.

The issue of why the prehistoric Anasazi selected certain rockshelters for their villages dates back to the time of the initial exploration of the region by archaeologists. The early explorers often mentioned the fact that the cliff dwellings were strategically located near springs and often faced out to the south, thus staying cool in the summer and warm in the winter. There was also concurrence that the occupants of these cliff dwellings were concerned about attack from the outside and built their villages with an eye toward defense.

> Marauders might have raided the Kitsiel [Kiet Siel; fig. 5-2] cornfields, but they could not have dislodged the inhabitants. Even if they had succeeded in capturing one house but little would have been gained, as

Figure 5-1. Aerial photograph of the Tsegi Canyon system. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

> it was the custom of the Pueblos to keep enough food in store to last more than a year. In this connection the question is pertinent, While hostiles were besieging Kitsiel how could they subsist during any length of time? Only with the utmost difficulty, even with the aid of ropes and ladders, can one now gain access to some of these ruins. How could marauding parties have entered them if the inhabitants were hostile? The cliff-dwellings were constructed partly for defense, but mainly for the shelter afforded by the overhanging cliff, and the cause of their desertion was not due so much to predatory enemies as failure of crops or the disappearance of the water supply. (Fewkes, 1911:34; see also Cummings, 1953; Hargrave, 1935)

The common idea that warfare was one factor in the construction of cliff dwellings was an intuitive interpretation, largely based on the observation that many of the cliff dwellings were isolated and inaccessible. It was not until the early 1960s that anyone began to look systematically at the reasons behind the specific location of individual cliff dwellings. In a far-reaching study of 13th century Anasazi occupation in Tsegi Canyon, Dean (1967, 1969) analyzed the relationship between the environment and the cliff dwellings in the canyons. Using detailed information on chronology and past climate of the canyon system, Dean found that the residents of the area were making major adjustments to a deteriorating environment.

Figure 5-2. Kiet Siel Pueblo.

Throughout northeastern Arizona, the 13th century was a period of environmental hardship for the prehistoric peoples. This was a period of summer-dominant precipitation, progressive erosion of arable lands, a drop in the water table, and cyclical droughts (Dean et al., 1985; Harrill, 1982). The latter half of the 13th century was also a time of "low temporal and spatial climatic variability" across the Colorado Plateau (Dean et al., 1985:546), meaning that the entire area was suffering uniformly from the same detrimental conditions. Consequently, the residents of Tsegi Canyon and neighboring areas did not have the option of moving around to solve their environmental problems, nor could they rely on intraregional exchange of resources to meet their needs in times of shortages. They had to make do with the land and water resources available to them locally.

In response to these conditions, Dean argues, the people around Tsegi Canyon and in the adjacent open valleys retreated back into the canyons to the headwaters of the systems, where water would have been more available and erosion would have had less effect on the arable land:

> If the arroyo cutting proceeded by headward erosion, as it probably did, fields on the lower and middle reaches of the streams would be destroyed first. As the heads of the arroyos moved upstream, more and more farming areas would be rendered useless. The logical response to this threat would be to move further upstream to areas not yet affected by the arroyos. This seems the most logical explanation for the late influx

> of population into the hitherto sparsely populated Tsegi. The canyon was the last resort of the Kayenta farmers, short of restructuring their subsistence base. (1969:195)

As the population retreated back into the canyons to the headwaters of the arroyos, Dean argues, they moved into the large rock shelters where they could be near their fields, get protection from the elements, and have nearby sources of drinking water. In his final analysis, then, it is not necessary to look beyond the immediate environment to explain the construction of the large Tsegi Canyon cliff dwellings by the Kayenta Anasazi in the late 1200s.

New survey data and a reexamination of the cliff dwellings in Tsegi Canyon, however, reveal that environmental variables alone do not provide an adequate explanation of the 13th century settlement pattern in the canyon system. Two factors weigh against a strictly environmental explanation for the occupation of the cliff dwellings.

First, areas that Dean thought were abandoned in response to adverse environmental conditions were, in fact, occupied by substantial populations during the period from A.D. 1250 to 1300. As discussed in Chapter 4, surveys have revealed that the adjacent Kayenta and Klethla valleys were not abandoned as Dean assumed. Even within the canyon system, there was a large population living in the noncave sites of Organ Rock Ruin, Six Foot Ruin, and Wildcat Canyon Ruin right at the mouth of the canyon (Dean et al., 1978). Indeed, the population living within 3 km of the mouth of the canyon would have been almost equal to the entire canyon population living in cliff dwellings. Thus, the occupation of the cliff dwellings cannot be seen as the simple retreat of a beleaguered population to remnants of arable land in the headwaters of the canyons.

Second, our resurvey of the canyons indicated that the latter half of the 13th century witnessed not a movement upstream into the canyons, but within the canyons proper a wholesale movement into rockshelters. We found that prior to the 13th century, the majority of the canyon's population lived in numerous small, open-air sites on the flat terraces above the canyon floor. By A.D. 1250, however, all of these sites were abandoned and the entire canyon population resided in the large, protected rockshelters. If these rockshelters were optimal locations for residences, it is reasonable to expect that they would have been favored site locations throughout the canyon's occupation, and such is just not the case. Although some shelters have extensive earlier occupations, most of the shelters with the large late cliff dwellings were unoccupied prior to A.D. 1250. Six out of ten of the cliff dwelling sites analyzed by Dean (1969) were occupied only during the period from A.D. 1250 to 1300.

Overall, it appears that the 13th century occupation of the cliff dwellings of Tsegi Canyon cannot be completely explained by appealing only to the needs of the population for sheltered sites near water and arable lands. Other factors were influencing the decision of the people to move in unison into a few large rockshelters between A.D. 1250 and 1300. One factor in particular that fits the data on both the canyon cliff dwellings and the open valleys beyond the canyons is a concern with attack and defense.

As discussed earlier, outside the canyon system in the open valleys, there is a consistent pattern of the people moving from valley floor sites up to defensible locations on mesas, hills, and promontories at A.D. 1250—exactly the same time the canyon populations were moving into the cliff dwellings. Given this regional pattern of apparent conflict and defense in the open valleys, it is reasonable to ask whether or not defense may have been an important reason for the widespread movement into cliff dwellings in Tsegi Canyon in the 13th century. To begin answering this question, a sample survey was initiated in side canyons of the Tsegi Canyon system. The purpose of this survey was to examine the full range of rockshelters in the canyons to determine why the prehistoric Kayenta Anasazi built their cliff dwellings in particular rockshelters at different points in time.

The canyon survey was designed to evaluate the alternative explanations—environment vs. defense—for the large-scale movement of people into cliff dwellings in the Tsegi Canyon system in the middle of the 13th century. On the one hand, there is the argument that this movement was largely a response to the deteriorating environmental conditions of drought, lowering water table, and increased erosion. Faced with such conditions, according to Dean,

> [t]hey located their communities with reference to permanent water, proximity to farmland, and shelter. These factors produced the typical Tsegi Phase settlement pattern of sites located near the heads of short side canyons that opened onto the main canyon in areas where the latter is widened by the confluence of one or more tributaries. In these areas Tsegi Phase farmers could apply their agricultural technology to the best and most extensive farmland available in the narrow gorges. (1969:193)

From this argument, it can be predicted that in the Tsegi Phase the occupied rockshelters would have been selectively nearer the available sources of water and the largest tracts of arable land. With this kind of environmental model, it can also be expected that people would select those shelters offering better protection from the elements and larger shelters to house the growing population. With this model, the Tsegi Phase occupation should not differ greatly from the pre-Tsegi Phase occupation, though there might be even greater selection for access to water and land in the Tsegi Phase.

In contrast, with a model of warfare and concern for defense, there should be a significant difference between the Tsegi and pre-Tsegi occupations. If, as has been argued above, there was the initiation of extensive raiding and some level of warfare in the 13th century, the concerns of the canyon occupants would be quite different than they had been at earlier times. Access to land and water would be secondary considerations to defensibility. In this

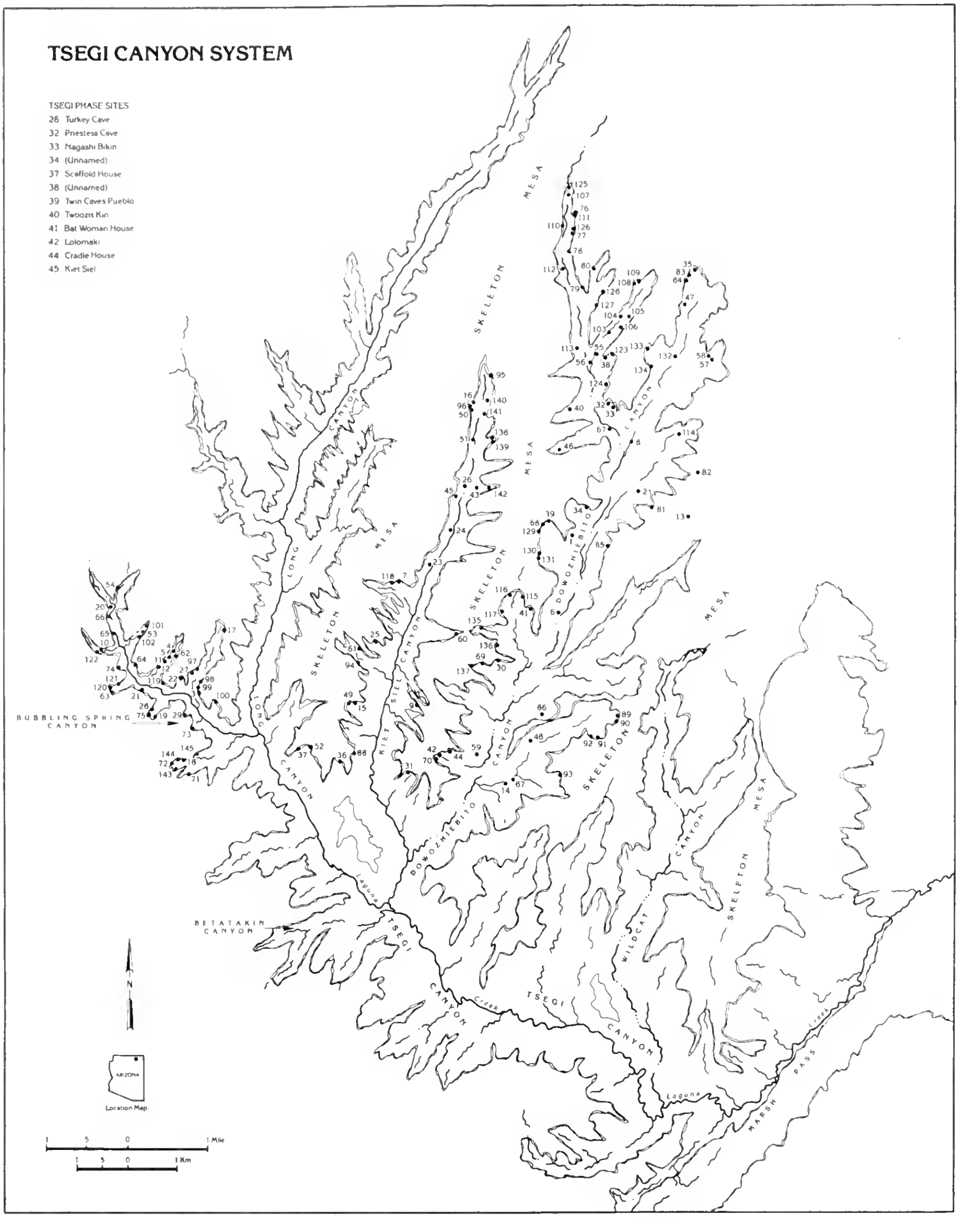


Figure 5-3. Map of the Tsegi Canyon system showing the location of the rock shelters surveyed and recorded.

model, the occupation of the rockshelters in the canyons was not a direct response to the need for water and land, but a search for a more secure retreat from attack. Consequently, we would expect that there would not be a pattern of overt selection of shelters closer to water and the largest tracts of arable land, nor would the people necessarily have chosen those shelters offering the best living conditions or protection from the elements. Rather, they would be moving into those shelters offering the greatest protection from attack—those shelters that were the hardest to get into, and those that could be defended easily.

To test these alternative explanatory models empirically, the survey focused on three side canyons in the larger Tsegi Canyon system: Dowozhiebito Canyon, Kiet Siel Canyon, and Bubbling Springs Canyon (fig. 5-3). Within each of the canyons, survey crews visited and recorded all accessible rockshelters regardless of size, condition, or evidence of prehistoric occupation or utilization. A total of 145 rockshelters were recorded by the survey crews. This does not represent a 100% sample of the three surveyed canyons, as there were some shelters to which we could not gain access without rappeling down from the clifftop. In the case of these unattainable shelters, the crew members negotiated to a position where they could see into the shelters with binoculars to look for any evidence of prehistoric utilization. In no case was there any sign that the shelters we could not reach had been used in any way by the Anasazi. It is also likely that the crews missed some small shelters that occur along the sandstone terraces along the cliff sides in the Kayenta Sandstone formation. A number of these small shelters were recorded, however, and it is reasonable to assume that they reflect the total population.

At each shelter the survey crew leader filled out a detailed form recording the different features. This form was designed to eliminate as much as possible variation among the crew leaders. As an additional precaution to ensure comparability among recorders, several shelters were recorded simultaneously by all three crew leaders. The results were subsequently compared and discussed to straighten out differences. Undoubtedly there were some differences in the way individual crew leaders recorded shelters; however, these differences should not affect the interpretation of the data recovered. Unoccupied shelters and shelters occupied in the pre-Tsegi and Tsegi times were evenly divided among the three crews, and the three surveyed roughly equivalent numbers of shelters in each of the three canyons. Thus, differences among canyons or between occupied and unoccupied shelters cannot be attributed to broad differences in recording teams.

Demography and Shelter Occupation

Before we turn to the attributes of the shelters themselves, the demographic profile of the canyon needs to be discussed. The Anasazi occupation of the Tsegi Canyon system continued from perhaps as early as A.D. 700 (Basketmaker II) (Ambler, 1985) up until the abandonment in A.D. 1300. Throughout this period, there was some occupation of rockshelters. However, in the latter half of the 13th century, the Tsegi Phase, there was a marked increase in the number of people living in shelters. The increase can be seen clearly in the number of rooms recorded in the occupied shelters. Within the survey area, there were 40 shelters occupied prior to the Tsegi Phase, and there were

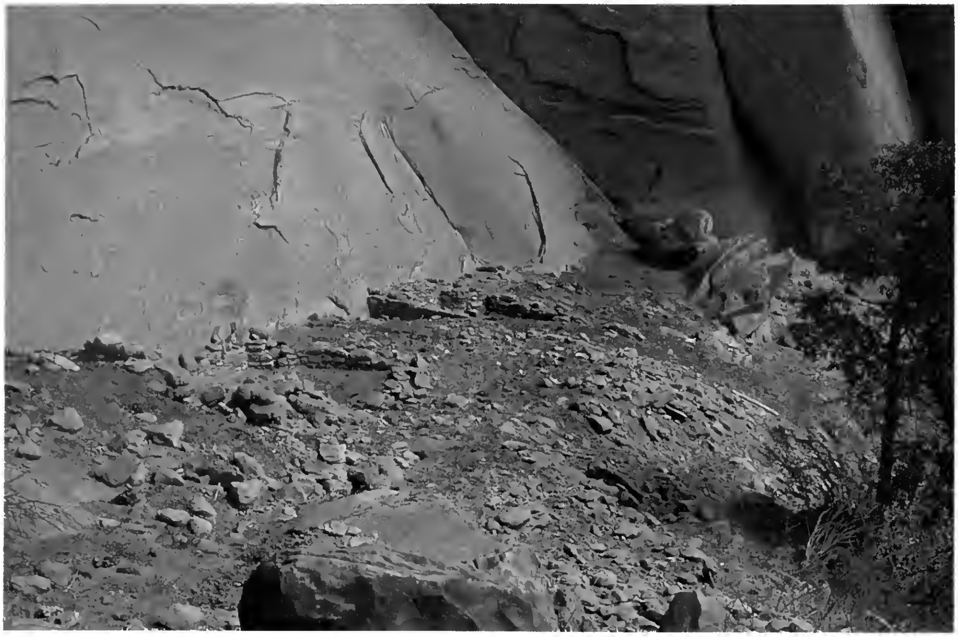


Figure 5-4. Turkey House, across the canyon from Kiet Siel.

355 pre-Tsegi Phase rooms recorded in all of these shelters. In the Tsegi Phase, 12 occupied shelters were recorded in the survey area, with a total room count of 465.[1]

There are an average of 10 rooms in each of the pre-Tsegi Phase shelters (fig. 5-4) and 39 rooms in those shelters occupied in the Tsegi Phase (fig. 5-5). Thus, there are more rooms in shelters and the shelter sites are much larger in the Tsegi Phase than in the earlier occupation in the canyon system.

Dean (1969) argued in the late 1960s that the sharp rise in population in the cliff dwellings was probably attributable to populations abandoning surrounding valleys and moving into the canyons. However, subsequent surveys showed that the valleys thought to have been abandoned indeed had large populations throughout the Tsegi Phase (Chapters 3 and 4). Furthermore, in the course of the present canyon survey, the crews recorded 36 open sites from all prehistoric time periods, and 10 (28%) of these were dated by ceramics to the middle Pueblo III period, or just prior to the onset of the Tsegi Phase. There were no open sites recorded with Tsegi Phase occupations. Thus, it appears there was a substantial resident population in

[1] Five of the recorded shelters were occupied in pre-Tsegi and Tsegi Phase times. For the purposes of the data presentation, these five shelters have been recorded twice and included in both the pre-Tsegi and Tsegi counts.

Figure 5-5. Twin Caves Pueblo.

the canyons just prior to the Tsegi Phase, and in approximately A.D. 1250 these people abandoned the open sites in favor of the rockshelters.

Along a similar line, Dean argued that the movement into the cliff dwellings represented a major shift in the population upstream in the canyons, following the receding arable soils. Yet more recent surveys have again shown that there were at least three large, open Tsegi Phase sites right at the mouth of the canyon with a combined total of over 450 rooms, all located in highly defensible positions. Taken together, the new survey data demonstrate that there was probably not a major influx of population into the canyons in the 13th century, and that the Tsegi Phase cliff dwellings represent a largely resident canyon population moving from open sites into rockshelters.

In looking at the occupation of rockshelters in the canyons, it therefore becomes critical to understand why the Tsegi Phase cliff dwelling communities were significantly larger than those in earlier periods. There are two aspects to this question. First, there is the issue of why the people aggregated in the second half of the 13th century; second, there is the issue of why they aggregated into specific shelters. From one perspective, it might appear that the people aggregated into particular shelters simply because those shelters were more attractive than other shelters. While this is undoubtedly true, it does not answer the question of why the aggregation took place only in the Tsegi Phase and not earlier. Furthermore, the aggregation seen in the canyons

TABLE 5-1. Distance (meters) to Nearest Spring

	0–100		101–500		>500		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	38	39	35	35	25	24	
Pre-Tsegi occupation	17	16	13	14	10	10	
Tsegi Phase occupation	5	5	5	4	2	3	
Totals	60		53		37		150

Chi-square = 0.78. df = 4. P = 0.95–0.90.

was part of a much larger pattern of aggregation in the 13th century all over the Kayenta region, in both the canyons and the open valleys. It is, therefore, of particular importance to determine the differences between the Tsegi Phase cliff dwellings and those occupied in earlier periods.

Water

In any part of the desert Southwest, access to drinking water would have been a major consideration for the prehistoric people. Within the Tsegi Canyon system, the question is not so much getting access to water per se, but the nature of the water source. There are three different kinds of water sources in the canyons: springs, seeps, and the spring-fed running water on the canyon bottoms. Springs are the best source of clear drinking water, though not all springs in the canyon system run all year, nor do all springs run every year. Springs generally appear either at the juncture of the Navajo and the harder Kayenta Sandstone formations, or bubbling up along the canyon bottoms at seams in the rock. Seeps, places where the soils are continually damp from oozing water, must be excavated and developed in order to extract drinking water. Seeps also tend to be even less reliable than springs in terms of providing a year-round source of water. The running water along the canyon bottoms is fed by numerous springs coming from both the cliff side and canyon-bottom sources. With multiple sources, the canyon-bottom water is probably the most consistent water source for the canyons as a whole. However, this water is often muddy, and there are sections of both Long Canyon and Dowozhiebito Canyon where water flows only erratically.

Data from the rockshelter survey indicate that all three sources of water were being exploited by the prehistoric residents of Tsegi Canyon. The data also demonstrate that access to springs was not an overriding concern in the occupation of particular shelters either in the Tsegi Phase or earlier. The distances to the nearest spring and to the nearest main canyon bottom are given in Tables 5-1 and 5-2. For seeps, the distance turned out to be insignificant, since only two caves were more than 100 m from a seep (one occupied in the Tsegi Phase and one unoccupied), and 93% of all shelters, both occupied and unoccupied, contained seeps. The prevalence of seeps in

TABLE 5-2. Distance (meters) to Main Canyon

	0–250		251–500		>500		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	23	30	30	28	45	40	
Pre-Tsegi Phase occupation	20	12	9	11	11	16	
Tsegi Phase occupation	3	4	4	3	5	5	
Totals	46		43		61		150

Chi-square = 10.23. df = 4. P = 0.05–0.025.

caves is not surprising, given that most of the caves were formed as a result of water seepage (Gregory, 1917). Thus, access to seeps was not a variable in site location.

In Table 5-1, it is apparent that there was no deliberate selection of shelters close to springs (under 100 m) either in the Tsegi Phase or in earlier times. Although there is a higher frequency of occupied caves close to springs, there is a higher relative frequency of all caves close to springs. In relation to distance to springs, then, the distribution of occupied caves at all time periods approximates a random pattern. With regard to distance to the watercourse of the nearest main canyon, however, there is a nonrandom selection of caves closer to the main canyon in the pre-Tsegi phases. In pre-Tsegi times, the number of occupied caves less than 250 m from the main canyon is much higher than expected, and lower than expected for distances over 250 m. In the Tsegi Phase, in contrast, there is a random distribution of occupied caves at all distances. Thus, prior to A.D. 1250, there was deliberate selection of caves in close proximity to the main canyon, whereas at the start of the Tsegi Phase in A.D. 1250 there was no pattern of selection of caves either close to or removed from the watercourse of the main canyon.

Arable Land

Arriving at a meaningful measure of arable land for the canyon system is extremely difficult (fig. 5-6). The landscape has changed considerably over the past two millennia. What may be arable land today may have been swampland 1,500 years ago and at the bottom of an arroyo 600 years later. Dean, however, infers the presence of wide expanses through most of the canyons on the basis of geological and soil research by Hack (1945) and Cooley (1962):

> Before the cutting of the Tsegi–Naha arroyo about 1300, the alluvial surface extended unbroken from canyon wall to canyon wall, and the water table was high, perhaps high enough to support a permanent stream that meandered across the canyon floor (Hack 1945:156; Cooley 1962:48, Fig. 18.1). Fields could have been planted throughout the canyon, with reliance for water being placed on the high water table or on

Figure 5-6. One of the fields currently being farmed by Navajo residents in the canyon.

> irrigation from flowing streams rather than on precipitation. If the stripping phase of the Tsegi–Naha erosion interval had already begun, flood-water farming would have been possible over broad areas. (Dean, 1969:16)

Using the idea that there was alluvial fill from side to side in all the canyons as the best available estimate of arable soil in prehistory, an attempt was made to measure approximately how much arable land was in the general vicinity of each shelter. There were problems, however, in determining a reasonable figure for the area of land around any given shelter. For example, a shelter in a small side canyon might not have any arable land within 2 km yet have ample arable land at the mouth of the side canyon. Also, because of the topography of the canyons, a shelter might be closer (as the crow flies) to arable land in a neighboring canyon than to land in its own canyon. However, access to the adjacent canyon would involve scaling up and down a 200-m-high cliff. To arrive at a common and comparable calculation of available arable land for each shelter, the juncture of the shelter's side branch with the main canyon was used as a starting point. From this junction, a calculation was made of the number of hectares of potentially arable land within a 1-km radius. The results of this calculation are given in Table 5-3.

These data point to a complex relationship between shelter occupation

TABLE 5-3. Arable Land (hectares)

Occupation	0–25		25–50		>50		Total
	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	
Unoccupied	34	27	28	36	36	35	
Pre-Tsegi Phase occupation	6	11	19	15	15	14	
Tsegi Phase occupation	1	3	8	4	3	4	
Totals	41		55		54		150

Chi-square = 10.01. df = 4. P = 0.05–0.025.

and arable land. For shelters with immediate access to 25 or less ha of land, there was a clear pattern of fewer than expected cliff dwellings in both pre-Tsegi and Tsegi times. This would appear to reflect a tendency on the part of the prehistoric populations to select against shelters lacking some minimal amount of arable land in the immediate vicinity. For shelters with direct access to 25–50 ha, in contrast, there was a significantly higher than expected frequency of cliff dwellings in Tsegi and pre-Tsegi times. This might initially appear to represent selection for those shelters with more land in the vicinity. However, this pattern did not continue for those shelters with access to the greatest amounts of land (more than 50 ha). While it might be expected that there also would be a higher than expected frequency of occupied shelters in the vicinity of the largest tracts of arable land, this was not the case in either the Tsegi Phase or earlier times. Occupied shelters in the vicinity of the largest amounts of arable land approximated the expected pattern for a random distribution. Overall, the data on land indicate that some minimal amount of arable land (somewhere between 25 and 50 ha) in the vicinity was desirable in the selection of shelters for occupation, but more than the minimum did not translate into greater desirability.

With regard to arable land, size of a population in an area may be more important than the physical number of occupied shelters in any given time period. Unfortunately, it is impossible to estimate the population size within any given area in the canyon system during the pre-Tsegi period. This is due to the fact that a majority of the population lived outside of the shelters, and these open areas were not thoroughly surveyed. For the Tsegi Phase, however, it is possible to calculate the number of hectares of arable land per room within 1 km of a particular shelter (table 5-4). For all shelters occupied in the Tsegi Phase there is an average of 1.1 ha of land per room. In terms of a possible relationship between site size and access to larger tracts of land, however, there is no apparent pattern. Sites with the most rooms did not have direct access to larger tracts of arable land, and in fact there was a marked tendency for larger sites to have less land per room than smaller sites. To some extent this pattern is an inevitable result of assembling more people in one place. However, there were large shelters occupied in pre-

TABLE 5-4. Arable Land (hectares per Room) in the Tsegi Phase

Site	No. Rooms	Ha	Ha/Room
C38	5	27	5.4
C10	6	42	7.0
R22	11	42	3.8
C2	16	34	2.1
R1	17	21	1.2
G24	20	44	2.2
G14	25	34	1.4
C3	30	34	1.1
C41	35	72	2.1
G18	60	56	0.9
R10	65	54	0.8
G29	154	27	0.2

Tsegi times with enough adjacent land to provide even the largest of the Tsegi Phase sites, Kiet Siel, with approximately 1 ha per room. Yet the shelters with access to the most land (over 75 ha) were all abandoned in the Tsegi Phase. Overall, the data on arable land indicate that while access to some land was an important criterion in the selection of shelters for occupation, there was not a preference for those shelters with the greatest amounts of arable land nearby.

Figure 5-7. Batwoman Cave, showing good southern exposure.

TABLE 5-5. Exposure by Quadrants

Occupation	North Obs.	North Exp.	East Obs.	East Exp.	West Obs.	West Exp.	South Obs.	South Exp.	Totals
Unoccupied	8	7	32	26	28	24	27	37	95
Pre-Tsegi Phase occupation	2	3	7	11	7	10	24	16	40
Tsegi Phase occupation	1	1	2	3	2	3	7	5	12
Totals	11		41		37		58		147

Chi-square = 10.26. df = 6. *P* = 0.25–0.10. (Values corrected for continuity.)

Exposure

Exposure, or the direction in which a shelter faced, is widely recognized as an important variable in the selection of certain shelters by prehistoric people. Generally, a shelter that faced to the south would be warmer in the winter, due to increased exposure to the sun, and cool in the summer, when the sun was more directly overhead. Shelters facing to the east and west would have variable daily temperatures, depending on the arc of the sun. North-facing shelters would generally be in the shade all year. The survey of shelters in Tsegi Canyon confirmed the importance of exposure in the selection of shelters for occupation.

To measure exposure, the recorder stood in the center of the cave and measured the directions to the right and left sides of the shelter. The exposure was then recorded as the center between the right and left directions (e.g., if the right was 97 degrees and the left 155 degrees, the exposure was recorded as 126 degrees). (Crews could not gain access into three caves, and there are no exposure directions for these caves.) For interpretation, the compass angles were converted into discrete directions (e.g., north, east, west, south). The results showed some trend in terms of the selection of south-facing exposure for all time periods (fig. 5-7). However, it should be pointed out initially that there are significantly more shelters facing south than any other direction and significantly fewer shelters facing north. This pattern can be attributed to the way in which caves are formed geologically, with the south-facing

TABLE 5-6. North versus South Exposure

Occupation	North Obs.	North Exp.	South Obs.	South Exp.	Totals
Unoccupied	32	24	63	71	95
Pre-Tsegi Phase occupation	4	10	36	30	35
Tsegi Phase occupation	1	3	11	9	12
Totals	37		110		147

Chi-square = 10.14. df = 2. *P* = 0.01–0.005.

Figure 5-8. Unoccupied cave with relatively poor protection from the elements.

sides of the canyon exposed to more frequent and marked changes in temperature and erosion.

For the initial stage of analysis, the shelters were divided among four equal quadrants, depending on their central direction: north = 316–45 degrees; east = 46–135 degrees; south = 136–225 degrees; and west = 226–315 degrees. The results of this analysis are given in Table 5-5.

With this broad division into four equal quadrants, there is a tendency for a somewhat greater than expected frequency of occupied caves in the south quadrant and a less than expected frequency of occupied shelters in the other three quadrants. The unoccupied shelters show the reverse pattern. However, these tendencies are not significant statistically, given the relatively small number of occupied sites. When the shelters are clustered into broader categories, the trend becomes more pronounced and statistically significant. In a second analysis, all the caves were divided into generally north-facing (271–360 and 0–90 degrees) and south-facing (91–270 degrees) arcs. This highlighted caves facing *generally* in a north or south direction. The results of this analysis are given in Table 5-6.

With the north and south arcs expanded, it can be seen that tendency to select south-facing shelters is magnified. In both pre-Tsegi and Tsegi times, there was a significant tendency for the canyon residents to live in shelters with a southern exposure. Overall, the data on exposure indicate that the direction in which a shelter was facing (or, more likely, the related pattern of solar heating) was an important variable in deciding whether or not a particular shelter was suitable for occupation. At the same time, the presence

Figure 5-9. Unoccupied cave with good protection from the elements.

of some shelters facing in directions other than south indicates that exposure, while important, did not always dictate the suitability of a shelter for occupation.

Protection from the Elements

In trying to assess the degree to which a shelter provided protection from the elements, several attributes were measured, including general level of protection and evidence of erosion or aeolian action inside the shelter. For an overall measure of protection, each shelter was ranked between 1 and 10 based on the degree to which the shelter roof shielded the interior from

TABLE 5-7. Overall Level of Protection Provided by the Shelter

Rank:	10		8–9		<8		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	57	56	23	24	18	18	
Pre-Tsegi Phase occupation	23	23	11	10	6	7	
Tsegi Phase occupation	6	7	2	3	4	2	
Totals	86		36		28		150

Chi-square = 2.77. df = 4. P = 0.75–0.5.

Figure 5-10. Cave showing aeolian deposition.

precipitation and the overhead sun: A 1 was given for no protection (fig. 5-8) and a 10 for full protection (fig. 5-9). The results of this measurement are given in Table 5-7.

In terms of the entire population of shelters, there is generally a random distribution of occupied shelters with regard to the relative degree of protection. In the Tsegi Phase, however, there are fewer than expected sites in high-protection shelters and more than expected in low-protection shelters. These data do not lead to the inference that there was deliberate selection of shelters with less protection in the Tsegi Phase, but they do indicate that there was no pattern of selection of those shelters providing the highest levels of protection at that time.

Beyond basic protection, the crews also recorded whether or not there

TABLE 5-8. Signs of Heavy Wind Erosion Inside Shelter

	Present		Absent		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	26	24	72	75	
Pre-Tsegi Phase occupation	9	8	31	31	
Tsegi Phase occupation	0	3	12	9	
Totals	35		115		150

Chi-square = 4.28. df = 2. P = 0.25–0.1.

Figure 5-11. Cave demonstrating serious erosion action.

were signs of extensive wind and water erosion in the shelter interiors. Some caves, for example, are positioned such that there are deep aeolian sand deposits in part or all of the cave (fig. 5-10). Other caves were located such that running water ran through a part of the cave either at present or sometime in the past (fig. 5-11). (In some cases, the course of the water had changed over time, and water no longer ran through a particular shelter but had clearly done so in the past.) The results of these measures are given in Tables 5-8 and 5-9.

For both of these variables, there are no strong patterns indicating that any of them had a strong influence on whether or not a particular shelter was occupied. For pre-Tsegi Phase sites the occupations are distributed ran-

TABLE 5-9. Signs of Water Erosion Inside Shelter

	Present		Absent		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	17	18	81	80	
Pre-Tsegi Phase occupation	8	7	32	33	
Tsegi Phase occupation	2	2	10	10	
Totals	27		123		150

Chi-square = 0.25. df = 2. P = 0.9–0.75.

Figure 5-12. Cave with a stable roof.

domly with regard to both variables. For the Tsegi Phase the sites are distributed randomly with regard to erosion, but no sites were found in shelters with signs of heavy winds. Although this latter pattern does not represent a significant deviation from the expected random distribution, it does indicate that there may have been some selection against shelters with internal winds and blowing sands.

Roof of the Shelter

The measurement of relative roof stability was based on the presence of significant spalling and/or recent rubble from roof fall on the floor of the cave (figs. 5-12, 5-13). The combined data on roof stability (table 5-10) indicate that there was no pattern of preference for or against stable roofs for shelter occupation in either the Tsegi Phase or pre-Tsegi times. The occupied and unoccupied shelters were distributed randomly between stable and unstable roofs.

Floor of the Shelter

Variability in the condition of the floors of the shelters was measured in terms of slope and the presence or absence of exposed bedrock. The slope of the floors in the shelters was measured in degrees with a compass. In looking at the distribution of unoccupied shelters and shelters occupied in

Figure 5-13. Cave with an unstable roof.

pre-Tsegi times, there is a pattern of having more than expected occupied shelters with flat or near-flat floors (10 degrees of slope or less) and fewer unoccupied shelters with such floors (table 5-11; figs. 5-14, 5-15). Thus, there was overt selection of shelters with flat floors for occupation sites. Table 5-11 also shows, however, that in the Tsegi Phase there was a random distribution of cliff dwellings in caves with flat and sloped floors. In the final decades of the canyon occupation, the slope of the floor does not appear to have been a variable influencing shelter selection. In fact, there are slightly more sites than expected in shelters with the steepest sloping floors.

This pattern is reinforced by the average floor slope of the occupied and unoccupied shelters. All the unoccupied shelters have an average floor slope of 16 degrees, pre-Tsegi shelters only 13 degrees, and Tsegi shelters 17 degrees.

TABLE 5-10. Stability of Roof

	Stable		Unstable		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	50	54	48	44	
Pre-Tsegi Phase occupation	25	22	15	18	
Tsegi Phase occupation	7	7	5	5	
Totals	82		68		150

Chi-square = 1.57. df = 2. P = 0.5–0.25.

Figure 5-14. Cave with a flat floor.

The shelters with Tsegi Phase occupations thus tend to have steeper floors than either the unoccupied shelters or those occupied in earlier times. The steepness of the floor slopes in major Tsegi Phase sites is illustrated in Dean (1969:88–89, 42–43), where he has cross sections of Betatakin and Kiet Siel showing houses constructed on slopes of 50 degrees or more. For such constructions, either flat areas were excavated into the bedrock or niches were carved in the bedrock for the wall basings. In the latter case, they either

Figure 5-15. Betatakin Pueblo, showing the extreme slope of the floor.

used the natural slope as a floor for a storeroom or leveled the slope artificially for living or workrooms.

With regard to exposed bedrock, there was a clear tendency toward the presence of areas of exposed bedrock in the occupied shelters (table 5-12). In pre-Tsegi periods this tendency is present but weak, while in the Tsegi Phase the pattern is strong. Eleven of 12 Tsegi Phase sites occur in shelters with areas of exposed bedrock. There are three possible reasons for the predominance of bedrock floors in occupied shelters. First, the inhabitants may have selected bedrock floors to provide stable supports for their walls. Second, in moving into a cave, the inhabitants would have cleared out the debris on the floor in the course of making and living in the rooms. Third, the increased frequency of bedrock floors in Tsegi Phase shelters in particular

TABLE 5-11. Floor Slope (degrees)

	0–10		11–30		>30		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	40	50	32	27	26	22	
Pre-Tsegi Phase occupation	29	20	8	11	3	9	
Tsegi Phase occupation	7	6	1	3	4	3	
Totals	76		41		33		150

Chi-square = 11.34. df = 4. P = 0.025–0.01.

TABLE 5-12. Exposed Bedrock Floor

	Present		Absent		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	36	45	59	50	
Pre-Tsegi Phase occupation	23	19	17	21	
Tsegi Phase occupation	11	6	1	6	
Totals	70		77		147

Chi-square = 13.36. df = 2. P = 0.005–0.001.

may be a function of the steepness of the floors in these same shelters. As noted above, Tsegi Phase sites are in shelters with steeper floors, and steeper floors tend to have more bedrock exposed (roof fall and aeolian deposits slide off a steeper floor).

Shelter Dimensions

The dimensions of each shelter were measured in terms of maximum height of the roof, front-to-back distance, side-to-side distance, and total floor space (figs. 5-16, 5-17). When clustered into groups, for all dimensions there was a random distribution of occupation in pre-Tsegi and Tsegi phases (tables

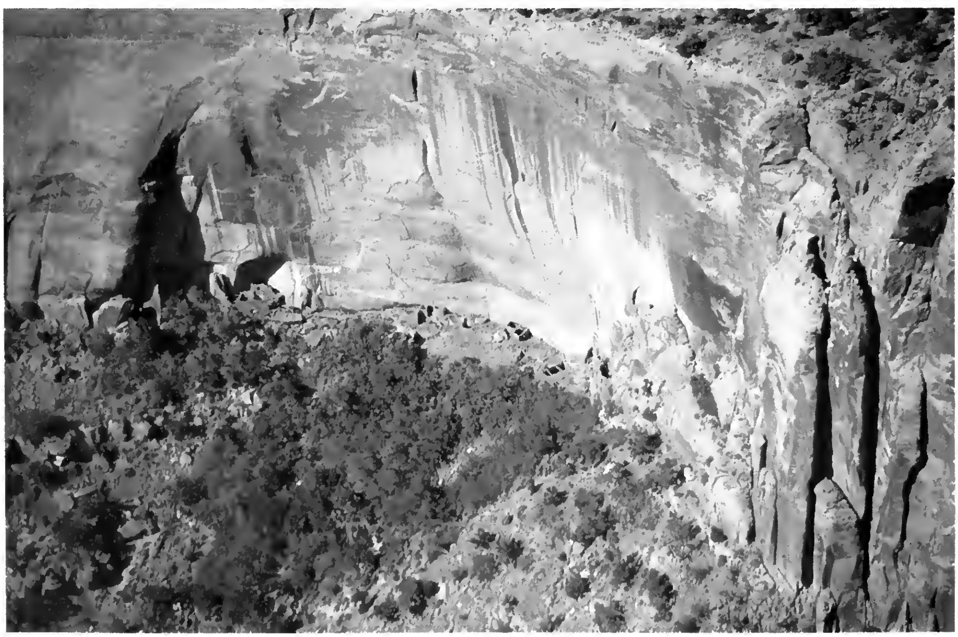


Figure 5-16. Aerial photograph of one of the larger caves in the survey area. (Courtesy of the School of American Research, Santa Fe, New Mexico: 1993. Photograph by Paul Logsdon.)

Figure 5-17. One of the smaller caves in the survey area.

5-13 through 5-16). There was no significant pattern of selection for either small or large, deep or shallow, high or low shelters during the prehistoric occupation of the canyon. When averaged, however, the pre-Tsegi occupations were in larger caves (average floor area = 871 sq m, n = 40) in terms of floor area than the unoccupied caves (average floor area = 716 sq m, n = 98) or those occupied in the Tsegi Phase (average floor area = 722 sq m, n = 12). Thus, there was some selection for larger caves in pre-Tsegi times, but not in the Tsegi Phase.

Access

A key factor in judging whether or not defensibility was a concern in the selection of some shelters over others in the Tsegi Phase is the relative

TABLE 5-13. Side-to-Side Dimensions (meters)

	0–50		51–100		101–150		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	38	36	29	29	31	33	
Pre-Tsegi Phase occupation	14	15	10	12	16	14	
Tsegi Phase occupation	3	4	5	3	4	4	
Totals	55		44		51		150

Chi-square = 0.83. df = 4. P = 0.95–0.90. (Values corrected for continuity.)

TABLE 5-14. Front-to-Back Dimensions (meters)

	0–10		11–20		>20		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	43	43	34	37	21	18	
Pre-Tsegi Phase occupation	16	18	18	15	6	7	
Tsegi Phase occupation	7	5	4	4	1	2	
Totals	66		56		28		150

Chi-square = 3.00. df = 4. *P* = 0.75–0.5.

TABLE 5-15. Total Floor Area (square meters)

	0–500		501–1,000		>1,000		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	54	52	18	21	26	25	
Pre-Tsegi Phase occupation	20	21	9	9	11	10	
Tsegi Phase occupation	6	6	5	3	1	3	
Totals	80		32		38		145

Chi-square = 3.36. df = 4. *P* = 0.75–0.50.

TABLE 5-16. Maximum Height of Shelter (meters)

	0–15		16–30		>30		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	33	35	29	29	36	35	
Pre-Tsegi Phase occupation	16	14	12	12	12	14	
Tsegi Phase occupation	4	4	3	4	5	4	
Totals	53		44		53		150

Chi-square = 0.68. df = 4. *P* = 0.975–0.95.

TABLE 5-17. Indirect Access

	≤5		>5		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	47	54	51	44	
Pre-Tsegi Phase occupation	32	22	8	18	
Tsegi Phase occupation	3	7	9	5	
Totals	82		68		150

Chi-square = 17.62. df = 2. *P* = <0.001.

Indirect access was measured on a subjective scale of 1 to 10 (see text).

Figure 5-18. Access route into Twin Caves Pueblo.

accessibility of the shelter (figs. 5-18 through 5-20). To measure access, however, two variables have to be considered: first, how hard is it to get up to the general vicinity of the shelter; and second, how hard is it to get directly into the shelter after one has gotten up to it. To measure the first variable, termed indirect access, the crews assessed the difficulty of getting to within 100 m of the shelter mouth from the nearest canyon bottom. Indirect access was measured on a subjective scale of 1 to 10. A shelter with indirect access of 1 opened directly out onto the first alluvial terrace immediately above the

Figure 5-19. Steve Glass climbing access route into Cradle House.

canyon bottom; a shelter with indirect access of 10 was at least 500 m horizontally and 150 m vertically from the canyon bottom and required some low-level technical climbing. For the second variable, direct access, the crews again used a subjective scale of 1 to 10 to assess the difficulty of getting into the shelter from the area immediately in front. It was possible to walk unobstructed into a shelter with direct access of 1, while a shelter rated 10 for direct access required midlevel or higher technical climbing.

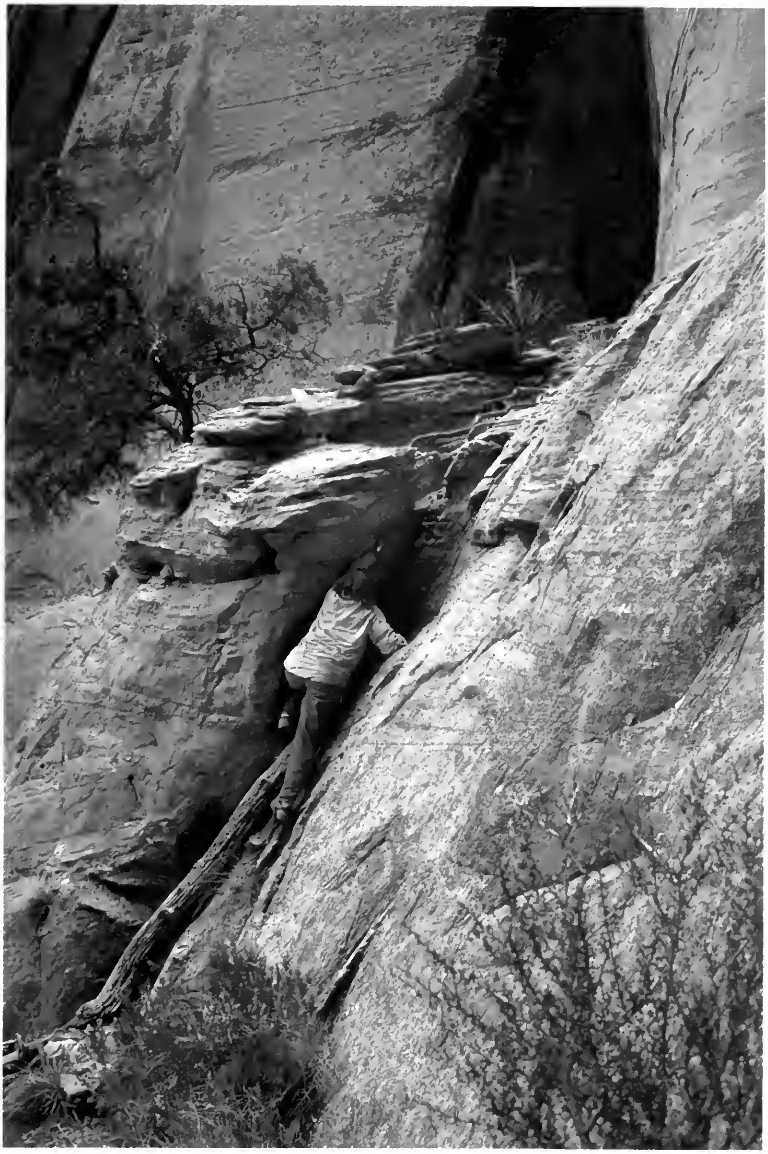


Figure 5-20. Dorothy Larsen climbing access route into Lolomaki. It could not be readily determined if the log in the access crack was aboriginal (doubtful) or historic (probable).

To fully evaluate the relative accessibility of a shelter, therefore, both variables have to be considered. One shelter, for example, might have easy access from the canyon bottom but be impossible to enter directly without ropes and ladders. Yet at another shelter one might be able to walk right in with no obstacles but have to climb up over three sheer terraces and travel 1,000 m to get up to the shelter from the canyon bottom. The results of the measurement of access are given in Tables 5-17 through 5-19.

TABLE 5-18. Direct Access

	≤5		>5		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	56	56	42	42	
Pre-Tsegi Phase occupation	25	23	15	17	
Tsegi Phase occupation	5	7	7	5	
Totals	86		64		145

Chi-square = 1.77. df = 2. P = 0.5–0.25.

Direct access was measured on a subjective scale of 1 to 10 (see text).

A clear pattern emerges from these data. Tsegi Phase sites are located in more inaccessible shelters, and pre-Tsegi Phase sites are located in more accessible shelters (figs. 5-21, 5-22). Particularly with regard to indirect access, in pre-Tsegi times, people were selecting shelters that were easier to get into, and in Tsegi Phase times, people were selecting shelters that were harder to get into. Indeed, when both direct and indirect access were considered, 11 of 12 Tsegi Phase sites were in more inaccessible shelters. Ten of the 12 were in shelters with direct or indirect access ranked at 7 or higher, and 5 were in shelters with direct access ranked at 10 (only 3 pre-Tsegi sites were in such inaccessible shelters). The pattern is also manifested when the average rank is figured for the access of the different shelters. For unoccupied shelters, the average rank of indirect and direct access is 5 and 5, respectively; for pre-Tsegi Phase occupations, it is 3 and 4, respectively; and for Tsegi Phase occupations it is 7 and 7, respectively.

Canyons

Three canyons were completely surveyed: Dowozhiebito, Kiet Siel, and Bubbling Springs (two shelters were recorded in Long Canyon and are not

TABLE 5-19. Indirect and Direct Access*

	≤5		>5		
Occupation	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	37	39	61	59	
Pre-Tsegi Phase occupation	21	16	19	24	
Tsegi Phase occupation	1	5	11	7	
Totals	59		91		150

Chi-square = 8.26. df = 2. P = 0.025–0.01.

* ≤5 = both indirect and direct access ranked 5 or less; >5 = either indirect or direct access ranked more than 5.

Figure 5-21. Access into Kiet Siel. The Park Service ladder visible in the left center of the photograph is approximately parallel to the prehistoric hand- and toeholds leading into the site.

Figure 5-22. Open access of large occupied cave in Bubbling Springs Canyon.

TABLE 5-20. Occupation by Canyon

	Bubbling Springs		Dowo-zhiebito		Kiet Siel		
Occupation	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Unoccupied	27	26	58	54	13	18	
Pre-Tsegi Phase occupation	13	11	14	21	12	7	
Tsegi Phase occupation	0	3	9	6	2	2	
Totals	40		81		27		148

Chi-square = 14.49. df = 4. P = 0.025–0.01.

included in this discussion). The occupation of these canyons varied significantly from the expected random pattern in pre-Tsegi and Tsegi times; however, the pattern of occupation reversed itself at the beginning of the Tsegi Phase. As can be seen in Table 5-20, in pre-Tsegi times, there are slightly more occupied Bubbling Springs shelters than expected, more occupied Kiet Siel Canyon shelters than expected, and fewer occupied Dowozhiebito shelters than expected. In the Tsegi Phase, Bubbling Springs Canyon is completely abandoned, there are more occupied shelters than expected in Dowozhiebito, and there are the expected number of occupied shelters in Kiet Siel Canyon. Thus, while in earlier times the canyon residents favored caves in Bubbling Springs and Kiet Siel canyons, in the Tsegi Phase they favored Dowozhiebito Canyon over the other two.

There are no readily apparent environmental reasons for strongly favoring any of the canyons today. All have multiple sources of water and large areas of arable land. Interestingly, however, of the three canyons, Bubbling Springs Canyon has significantly more arable land available per shelter than either of the other two canyons. For Bubbling Springs there is an average of 68 ha of arable land within 1 km of each shelter as opposed to only 34 ha for Kiet Siel Canyon and 32 ha for Dowozhiebito. Thus, the canyon data again confirm that access to arable land was not a critical criterion in the selection of shelters for occupation in the Tsegi Phase.

These canyon data combined with access provide further indication of the preference for inaccessible shelters in the Tsegi Phase. Specifically, the occupied shelters in Bubbling Springs were the most accessible in the Tsegi Canyon system. Bubbling Springs is much shallower than the other canyons and lacks the steep terraces between the canyon bottom and the cliffs. In this case, the edge of the cliff comes right down to the low alluvial terrace immediately above the creek bed, and the shelters are mostly located at the bottom of the cliff. This pattern stands in marked contrast to Dowozhiebito and Kiet Siel, where the base of the Navajo Sandstone cliffs is separated from the canyon bottom by several steep terraces. The averages for accessibility of shelters in the three different canyons are given in Table 5-21.

TABLE 5-21. Average Direct and Indirect Access of Occupied Shelters by Canyons

Site	Indirect	Direct
Bubbling Springs	1	3
Dowozhiebito	6	6
Kiet Siel	4	6

All of the occupied Bubbling Springs shelters could be readily approached from the canyon bottom, and all but one could be entered directly with no climbing. Yet in the Tsegi Phase, these readily accessible shelters, close to sources of water and arable land, were abandoned. The two other variables that correlate closely with Tsegi Phase sites—south-facing exposure (table 5-6) and presence of exposed bedrock (table 5-12)—occur in expected frequencies in Bubbling Springs shelters. In contrast, the shelters in Dowozhiebito have the most difficult access. Again, these data indicate that in the middle of the 13th century, the residents of the canyons left good caves with excellent protection from the environment and ready access in favor of isolated caves that were much more inaccessible.

Conclusions

The data from the survey of rockshelters in the Tsegi Canyon system reveal a complex and intriguing pattern of prehistoric occupation. As would be expected, no single variable dictated the habitability of a particular shelter. It is also difficult to assess exactly which variables were most important in the selection of any given shelter at any given time. One shelter, for example, may have been attractive to one group in A.D. 600 because it was close to water, whereas the same shelter may have been attractive to another group in A.D. 1250 because it had a good view. However, in spite of our inability to define specific reasons for the occupation of particular shelters, there were definite patterns in the occupation of rockshelters by the prehistoric occupants of the Tsegi Canyon system.

A number of patterns characterized the occupation of shelters in all time periods. One dominant positive correlation for occupied shelters in Tsegi and pre-Tsegi times was exposure. Throughout the prehistoric occupation in the canyons, the residents selected shelters that faced south. The warmth of the sun in the winter and the shade in the summer were clear factors in assessing the livability of a particular shelter. Exposure to the sun was not a decisive factor, however, since there were occupied shelters facing north, but it was an important factor in the decision-making process. In addition to selecting shelters with a southerly exposure, the prehistoric canyon residents also had some preference for shelters in the vicinity of a minimal amount of arable land—between 25 and 50 ha. There was not, however, a preference for shelters near the largest amounts of arable land. Finally, the occupants of the canyons in all time periods had a greater than expected tendency to occupy shelters with an exposed bedrock floor. As discussed above, there is not a ready explanation for this pattern, and it may be attributable to either a need for bedrock for wall basings, the cleaning out of occupied caves, or the steepness of specific shelters.

The other pantemporal patterns in the canyons were largely negative. The prehistoric people appear not to have considered a wide range of factors in selecting certain shelters for occupation. Among the factors that occurred randomly with regard to shelter occupation were access to springs and seeps, relative differences in the amount of protection provided by the shelter, stability of the shelter roof, and size of the shelter. In terms of the broader question about differences between Tsegi and pre-Tsegi occupations, it is important to draw attention to the fact that cliff dwelling sites distributed randomly with regard to the size of the shelters. Tsegi Phase sites did not occur in larger shelters, even though the Tsegi sites had almost four times as many rooms as those of earlier periods. In fact, on the average, the Tsegi Phase sites were in somewhat smaller shelters than the earlier cliff dwellings. Thus, the process of aggregation witnessed in the mid-13th century was not connected to the selection or occupation of larger caves. Beyond these broad positive and negative patterns, there are some interesting differences between the Tsegi and pre-Tsegi Phase occupations.

Prior to A.D. 1250, there are patterns manifested in the occupation of the canyon rockshelters: The earlier residents selected shelters that were closer to the main canyon, and they selected shelters with flat floors. Both of these patterns seem to be overtly logical in terms of why such shelters would be chosen for occupation. Shelters closer to the main canyon are closer to permanent water, arable land, and major transportation routes. Flat-floored shelters involve lower construction costs, more intrasite mobility, and less physical risk than shelters with sloping floors. The interesting thing about these patterns is not so much the preference for such caves in pre-Tsegi times, but the absence of a preference for such caves in the Tsegi Phase. During the period from A.D. 1250 to 1300, the residents of the canyons did not favor shelters closer to the main canyon branches, and they did not select flat-floored shelters more frequently than would be expected with a random distribution. The implication of this change over time is that variables other than floor slope and proximity to the main canyon became more important in the transition from pre-Tsegi to Tsegi times.

Turning to the final prehistoric occupation of the canyons, the single element where shelters occupied in the Tsegi Phase stand out from the expected random pattern and from the pre-Tsegi shelters is accessibility. Tsegi Phase cliff dwellings occur with significantly greater frequency in inaccessible shelters than would be expected with a random distribution; and in marked contrast, the pre-Tsegi Phase cliff dwellings occur with greater frequency in the more accessible shelters. *It was harder to get into Tsegi Phase* *sites and easier to get into pre-Tsegi Phase sites.* Furthermore, one entire canyon, Bubbling Springs, with a long history of early occupation and a plethora of readily accessible shelters, lacked a significant occupation in the Tsegi Phase.

Overall, in the latter half of the 13th century, there was a wholesale movement of the canyon population into rockshelters. In the course of this movement, the people followed some of the older patterns for the selection of shelters appropriate for occupation. They looked for shelters with a southerly exposure, some minimal amount of arable land in the immediate vicinity (approximately 1.1 ha per room), a suitable floor for building, and some minimal level of protection from the elements. They do not appear to have paid too much attention to the immediate availability of water, as water was available from multiple sources. There was also no overt effort to select either large or small shelters or shelters with flat floors, stable roofs, or the most protection. However, unlike their antecedents in the canyons, the Tsegi Phase population sought out more remote shelters with difficult access. The more accessible shelters and those close to the canyon floors, favored places in earlier times, were abandoned. The Tsegi Phase population also abandoned virtually all of the exposed open sites scattered along the terraced sides of the canyons. The pattern is one of retreat and the assumption of a defensive posture. The people of Tsegi Canyon were concerned about some threat from the outside, about the vulnerability of their homes and resources.

Do the canyon data provide any insight into the kind of threat worrying the people in the 13th century? At least indirectly, they do. The cliff dwellings are not marked by elaborate fortifications to defend the residences from a full frontal attack by an invading army. Also, for most caves, the primary source of water is outside the cave, which means the residents would be highly vulnerable in the face of a concerted attack or "siege." Thus, it would appear that any conflict in the canyons was not characterized by large, organized armies attacking villages over days or weeks. We suggest that the canyon residents were defending against the threat of short-term, rapid raiding by relatively small groups of aggressors.

It should also be pointed out that even a short-term siege was not a serious threat for the cliff dwellers, even though their sources of water were often outside the shelter. Sieges only work if the defending party cannot call on outside sources for reinforcements. In the canyons, there was a web of communication lines linking together all of the major cliff dwellings in the Tsegi Phase. Adjacent to or immediately across from each Tsegi Phase cliff dwelling, there is at least one hand-and-toe trail scaling the face of the canyon wall leading up to the top of Skeleton Mesa, thereby connecting each community with all of its neighbors. Consequently, if one community was threatened, messengers could quickly have been sent for help to neighboring communities within the canyons. In the open valleys around the canyons, a communication network, vital in the event of an attack, was provided by the line-of-sight contact between the focal sites. In the canyons, where it was not feasible to have visual contact between the inaccessible cliff dwellings, hand-and-toe trails provided the vehicle of communication. The importance of intervillage communication is illustrated by Hill's account of defensive strategy at the Pueblo of Santa Clara in New Mexico:

> There was little elaboration of defensive tactics. Guards were kept regularly posted to warn the village against marauding bands, and news of an approaching enemy party was sent by runners to neighboring Tewa villages. This often resulted in the arrival of reinforcements from other pueblos who argued with some validity that their safety lay in repulsing the attack before it might reach their own territory. (Hill, 1982:68)

Further insight into the relative intensity of warfare in the canyons in the latter half of the 13th century can be gained by considering the extreme inaccessibility of most of the Tsegi Phase sites. Dean, for example, comments on the inaccessibility of Twin Caves Pueblo: "It can be reached only after a hard scramble up loose talus followed by a steep rock face that would challenge a 'human fly' " (Dean, 1969:168). For Lolomaki, "[t]o reach the summit of the sandstone block [on which the site rests] one must scramble up a narrow crevice and inch his way around an overhanging boulder that blocks the cleft" (Dean, 1969:160). Lyndon Hargrave, one of the adventurous explorers with the Rainbow Bridge–Monument Valley expedition, describes encountering Cradle House: "No kiva was obvious but as the site was difficult to reach and the hour was late, little time was had for a thorough examination of the site" (Hargrave, 1935:32). (Significantly, there is no Rainbow Bridge–Monument Valley Expedition site number chalked on the back wall of Cradle House.) Gene Stuart, a writer for the National Geographic Society, describes the access into Kiet Siel:

> I had ample time to form my own opinion about Keet Seel's [*sic*] defensibility. Terrified, I had time to study the color and texture of the rock, to memorize each pattern in the grain of the wooden ladders. I paused to ponder wire knots. My vertical onslaught came in fractions of inches. I formed an opinion: One toddler with a long-stemmed lily could have held me at bay. (Stuart, 1988:110)

In the initial stages of the present project, we had a similar experience. After a structure was sighted in a shelter high on the wall of a side canyon, several unsuccessful efforts were made to find a reasonable access route. Finally, a crew chief with technical rock-climbing experience attempted the crack down below the shelter. Following a technical climb up through the crack and skirting around the open edge of the cliff face about two-thirds of the way up, he encountered the first hand- and toeholds. He was then able to follow these into the shelter, where he found not a single isolated storeroom but a hidden pueblo of 25 to 30 rooms. There were no signs in the site of anyone ever having visited it or recorded it in the 700 years since it was abandoned in A.D. 1300. As we suspected from the sherds down below, the site dated to the latter half of the 13th century—the Tsegi Phase.

Subsequently named Twoozis Kin, or Glass House, this site represents an extreme of inaccessibility within the Tsegi Canyon system. At the same time, it illustrates well the extremes to which the canyon residents went to protect their dwellings and resources in the late 1200s. Twoozis Kin faced to the north, it was not near a source of water, it was not near arable land, and the shallow shelter did not even provide great protection from the elements. The shelter did, however, offer great protection from any kind of attack from enemies down below. Defense is the only viable reason for the selection of this remote and highly inaccessible shelter (fig. 5-23). The occupation of this and the other shelters mentioned above gives some insight into the level of fear manifested by the residents of the canyons in the late 13th century.

The lofty, unapproachable shelters selected by the Kayenta Anasazi in the Tsegi Phase in some ways point to the threat of attack and overriding concern for defense in the selection of shelters for occupation. At the same time, the marked inaccessibility of these shelters made them virtually impregnable, given the level of technology at the time. With the slightest threat of attack, the noncombatant portion of the population could retreat to the cliff dwellings, withdraw any access ladders, and wait safely until help arrived, the enemy retreated, and the threat passed. Their homes and stored resources were virtually immune to raiding or attack. At almost every cave occupied in the Tsegi Phase, direct access was so difficult or restricted that a small force in the shelter would have been able to easily repel any kind of assault by forces armed with bows and arrows and clubs.

A final point that needs to be discussed is the vulnerability of the field systems. Although the rockshelters provided more than adequate protection for houses, people, and stored resources, there are no signs that the fields in the canyon bottoms were actively protected. No obvious "lookouts" were recorded, nor were there any signs of defensive fortifications being erected at the access routes into the canyons themselves. The apparent vulnerability of the fields and the lack of any overt effort to defend them would seem to indicate either that fields were not subject to attack or that they were defended on an ad hoc basis when threatened. Actually, there is some logic to the notion that the fields may not have been subject to attack. Raiding a field would only have been worthwhile at harvest time. However, harvest time comes fairly uniformly across the Colorado Plateau, and raiders going off to raid someone else's field would leave their own fields open to attack. Harvest time is also the time of the greatest abundance of food, and consequently the time with the least incentive to embark on a raid for food. Finally, raiding crops in fields is a highly inefficient strategy for procuring resources. The "booty"—maize—would have to be picked from the plants, thereby exposing raiders to retaliation for a longer period of time; furthermore, the green ears are in their husks and filled with moisture, which greatly increases their

Figure 5-23. Access into Twoozis Kin.

weight and decreases the amount of food that can be taken back. In a situation where conflict and raiding center on scarce food resources, it simply does not make sense to raid fields. It makes much more sense for raiding to take place in the winter or spring, when resources are more likely to be in short supply, and the enemy's crops have already been harvested, husked, and dried—ready for efficient capture and transport.

Warfare in the Tsegi Canyon system was not the omnipresent, violent struggle seen in such societies as the Yanomamo of South America or the

Nuer of Africa. Rather, across the Kayenta region in the 13th century, drought, a lowering water table, and expanding erosion would have resulted in widespread shortages of resources. The signs of malnutrition in the skeletal remains from this period (Ryan, 1977) attest to the severity of the resource shortages. It is within this context that warfare in the canyons must be viewed. Raiding would have taken place not within the context of a "warfare culture," with the objective being to kill, count coup, or capture women or slaves. Raiding would have been to capture resources, resources needed to keep one's family alive until the next harvest. Was this really "warfare" or simply some lesser kind of "low-level conflict"? If we take *Webster's* definition of warfare as "military operations between enemies," then there was warfare in the Kayenta area in the 13th century. The residents of the canyons did not abandon all their open-air sites, abandon their most accessible shelters, or abandon the natural wealth of Bubbling Springs Canyon in response to low-level conflict among friends. The people of the canyon were under the overt threat of physical attack, and they faced that threat with the utmost seriousness. The steps they took to counter the threat were dramatic. The cliff dwellings today stand in mute testimony to that drama of 700 years ago.

6

CONCLUSIONS AND BEYOND

In spite of the attention given to warfare during the previous discussion, this project was about the formation of tribal-type polities, and the conclusions relate to the issue of how and why tribes form in the absence of colonial influences. The focus of the research has not been on warfare per se, but on the effects of warfare on local political evolution. Key questions about the nature of tribal development in the heartland of the prehistoric Kayenta culture in northeastern Arizona center on the possible role of conflict and warfare in regional evolution.

The conclusions we are able to reach about the process of tribal formation in the Kayenta heartland are limited and lead to the inevitable new set of questions. At the same time, the survey and excavation in Long House Valley and neighboring areas have led to new insights into the nature of tribal organization and the evolution of tribal polities in a pristine, prehistoric setting. They have also provided a broad regional picture of a population exposed to intergroup conflict and adapting through a combination of alliance and defensive settlement.

Tribal Organization

In looking back to the original models of tribal organization, the project brought to light support for both the sodality network and the functional hierarchy. Evidence for specific sodalities is weak and is probably best manifested in the kivas found at LHV72 and LHV73. The kivas themselves are not particularly remarkable, and they do not inherently indicate sodalities. However, the fact that the kivas are only 50 m apart and fully contemporaneous, yet very different in form and construction, points to different ceremonial groups—the "oval kiva group" and the "square kiva group."

To wit, if the kivas are associated with male-centered activities (as is the case in the modern pueblos), the related sodality organization would be male-centered as well. This sodality organization then would be serving as a social device for uniting the males living in different residential clusters. Although there might be many functional and nonfunctional reasons for uniting the males of different communities together, a key consideration in tribal societies is warfare.

Ember and Ember (1971) have noted that a pattern of intercultural (as opposed to internecine) warfare tends to favor matrilocal postmarital residence. In such societies, warfare organizations, crosscutting the residential communities, can serve as a means of bringing together the men of the tribe for offense and defense. Staying within the bounds of speculation, it seems possible that the diverse kivas of the Tsegi Phase Kayenta Anasazi are the material manifestation of a warfare-related sodality network holding together the men in the social system for offensive and defensive purposes.

Moving back from speculative interpretation, the work in Long House and neighboring valleys provided additional insights into the nature of the political organization in the Kayenta heartland during the Tsegi Phase. Specifically, there is information about multiple levels in the "functional hierarchy" of organization. At the bottom of this hierarchy is the individual family unit, as manifested in the household clusters of living rooms and storerooms excavated at LHV72 and LHV73 and outlined in some detail by Dean for Betatakin and Kiet Siel in the canyons (Dean, 1969). Moving on from the family, it is apparent that similar ranges of activities were carried out at LHV72 and LHV73. With some relatively minor exceptions, both sites had the same kinds of artifacts and basically similar assemblages of ceramics. Other than residential proximity, the only real evidence of coordination or interaction at the village level is seen in the grinding rooms. Grinding rooms were excavated at both LHV72 and LHV73, and they are common features in the canyon cliff dwellings, where the pattern is one grinding room for two- to four-family household clusters (Dean, 1969). In terms of the tribal models, the individual sites such as LHV72 and LHV73 represent equal components at the village level of the functional hierarchy.

Unfortunately, we were unable to conduct extensive excavations at any of the focal sites in the valley. Thus, we were unable to determine whether or not there may have been significant differences in the artifactual assemblages of the two different kinds of sites. Additional information was gathered, however, on some of the distinctive features of focal sites. In most cases, these distinctive features point to communal functions for focal sites within the wider clusters. Specifically, communal functions can be seen in storage facilities, reservoirs, and defense. We knew initially that all the focal sites in Long House Valley had large, double-faced pueblos of orientation, and this pattern was found to characterize the focal sites in the neighboring valleys as well. While excavations were not conducted in any of these pueblos of orientation, a reasonable analogue can be found at the site of Kiet Siel in the canyon system. At Kiet Siel, there is a large, two-story block of six storerooms at the front center of the village that are not associated with any living room. The fact that these storerooms are not associated with a living room and their central position in the site point to a probable function as a communal storage facility. Given the central location and distinctiveness of the pueblos of orientation, it is therefore reasonable to infer a similar communal storage function for these features at focal sites. There is also a consistent pattern of communal water reservoirs at focal sites in the three valleys surveyed, with water storage facilities found with most of the large sites discovered.

The final communal function of the focal sites relates to their defensive position. With the exceptions of Kin Klethla and Thief Site, as discussed, all of the focal sites are in high, inaccessible, defensive locations. In many cases, however, the satellite sites of a particular cluster, such as LHV72 and LHV73 in the Tower House cluster, are on the open valley floor in indefensible locations. In the event of attack, therefore, the residents of the satellite sites would have to have relied on the protection provided by the nearby focal sites. The focal sites may thus have served the larger cluster community as defensive retreats.

The communal activities seen at the focal sites are evidence of the next level up in the functional hierarchy of a tribal type of political organization. Beyond the local community, there is a range of communal activities, including storage, water collection, and defense, occurring at the level of the cluster. In each case, these communal activities are probably related to emergency situations—drought or raiding—rather than to everyday activities, but they still point to a level of political organization above the individual village.

Taking the next step and looking beyond the cluster, the evidence for organization at the level of the valley can be seen in the placement of the focal sites and the establishment of the intervisibility network between these sites. In addition to being placed in individually defensive positions, the focal sites when taken together are strategically placed to oversee all the access routes into the valley. Groups traveling toward Long House Valley from any of the occupied areas to the north, east, and west would have been visible to the occupants of one of the focal sites long before they arrived. Whoever spotted such travelers, therefore, would have had ample time to communicate the impending visitors/raiders to the other residents of the valley. That such communication was important can be seen in the fact that deliberate steps were taken to ensure that all of the focal sites were intervisible with each other. The placement of the focal sites was not coincidental (as evidenced by the "V" cut between Tower House and Fireside), and it points to a level of organization beyond the cluster for the coordinated defense of the valley.

In summary, there are manifestations of four discrete levels in the hierarchy of organization within Long House Valley: the family or household, the village, the cluster, and the valley. Was there yet another level, beyond the valley? Did the residents of Long House Valley constitute a distinct and bonded tribal unit, or were they part of a larger tribal polity extending out into neighboring valleys and canyons? As can be expected when dealing with individual cultural systems as opposed to theoretical models, clear answers to these questions do not emerge from the survey and excavation data.

Looking out beyond the limits of the valley, we did find that the linked network of sites in Long House Valley is joined to a similar network of intervisible sites in Kayenta Valley, and it ties in to the cliff dwellings in the canyon (which in turn are linked by hand-and-toe trails over the cliffs). The link between the valleys and canyons, however, is by way of individual sites, and there was no indication that the residents of the neighboring valleys took any steps to establish communications between multiple villages. Then on the other side of Long House Valley, there is evidence of a physical boundary separating the valley residents from their neighbors in Klethla Valley. As noted in Chapter 4, there was a 15-km gap between the occupations of the two valleys in the Tsegi Phase. There is also no visual link between Long House Valley and Klethla Valley. This gap between Long House and Klethla Valley occupations fits an expected pattern for a boundary between tribal polities.

However, superimposed on the pattern of site intervisibility is a complex picture of economic interaction. In particular, lithics seem to parallel the visual links, in that they demonstrate an open flow of lithic materials from the Kayenta Valley area into Long House Valley, and a blocked flow between Klethla and Long House in the Tsegi Phase. Ceramics, on the other hand, show a very different pattern. There is evidence for specialization of production of whitewares in Klethla Valley and open distribution into Long House and Kayenta valleys, and the converse production of orangewares in Long House and Kayenta valleys. Thus, the ceramic data indicate some increased exchange and interaction between Klethla and Long House valleys, while the lithic data indicate decreased interaction, paralleling the data on site settlement and intervisibility.[1] Overall, then, there is evidence that the residents of Long House Valley appear to have been loosely allied defensively with their neighbors to the west and north but at the same time involved in some economic interaction with their neighbors to the east. The possible defensive alliance between Long House Valley, Kayenta Valley, and Tsegi

[1] After this manuscript had gone to press, new analyis of ceramics from the project area indicated the possibility of a different pattern of ceramic production and distribution. In Stoltman et al. (1992), the authors found that there are in fact differences in the paste of ceramics found in Long House and Klethla valleys. Thus, what was interpreted as a common source of production in Klethla Valley based on similar tempering material (and a source for that temper found along Black Mesa in the Klethla Valley) may actually be multiple centers of production using a common source of temper found in several outcrops along the Black Mesa escarpment. More survey and ceramic analysis will be needed to clarify this picture.

Canyon may signal yet another level in a functional hierarchy of tribal organization, but it may also be a looser link between essentially independent tribal polities.

The data from Long House Valley and surrounding areas point to a complex tribal type of organization with multiple levels in a functional hierarchy from the household to the valley (and possibly region). Alongside this functional hierarchy there are at least some signs of a web of ceremonial sodality units, as seen in the diverse Tsegi Phase kivas, helping to unify the different communities within Long House Valley. The valley is not surrounded by impermeable political or economic boundaries, but it is set apart from its neighbors both physically and in terms of levels of interaction. Was Long House Valley a tribe? We will beg the question. It certainly was at a tribal level of organization, but the data available are insufficient to say whether the valley population made up an autonomous political unit, a Long House Valley tribe, or was an integral part of a larger political unit extending across the region, a Kayenta tribe (see Plog, 1984).

Tribal Formation

Without a clear answer to whether or not Long House Valley constituted an independent tribe, there are nevertheless interesting questions to be addressed about the process of tribal formation. As discussed in the first chapter, the evolutionary process of tribal formation may not lead to the emergence of discrete, bounded tribes, but to the development of broad political networks based on patterns of intensified interaction. Although the data from the Kayenta heartland are inconclusive about the presence of discrete tribes, they do demonstrate a pattern of greatly increased interaction between communities in the latter half of the 13th century. In Long House Valley as our central example, not only were the people physically moving closer together at this time, but they also began participating in a variety of shared communal activities, including kiva functions, storage, water reservoirs, and defense. Thus, the archaeological record documents the process of tribal formation ongoing in the Kayenta heartland in the 13th century. What, then, are the driving forces behind this process? Two somewhat different theoretical models that have been offered to explain the process of the evolution of tribal polities respectively argue for warfare specifically and severe stress in general as causal factors, and the Kayenta data provide support for both positions.

In general outline it appears that environmental stress beginning in the second half of the 12th century led initially to social consolidation at the local level in the Kayenta area. Prolongation and intensification of environmental problems through the 13th century ultimately led to warfare, which in turn led to increased consolidation. The environmental problems suffered by the Kayenta population, mainly erosion and lack of adequate water, manifested themselves most explicitly in terms of malnutrition. The people did not have enough to eat. Their inadequate diet and nutritional deficiencies were manifested archaeologically in the skeletal remains of both adults and children.

In an attempt to cope with the deteriorating environment and the malnutrition, the Kayenta people came together both physically and socially. They moved together into more densely packed communities in the remaining oases of arable land and abandoned the areas rendered unusable by erosion, falling water tables, and decreased rainfall. Then, in the 13th century, the people took additional steps to counter the effects of the relentless environment. They constructed communal storage facilities, which could have provided a cushion or backup for the larger clusters of communities in periods of multiyear droughts. They also built and shared water reservoirs to catch and hold the scarce water when it did come in the form of torrential summer showers. In spite of these communal efforts, however, the skeletal remains bear silent tribute that they still did not have enough to eat. But the environment was not the only problem facing the Kayenta Anasazi, nor were communal interaction and cooperation the only options to be taken by a population faced with food shortages. Warfare is another factor that has to be taken into consideration in examining the evolution of the Kayenta political system.

Warfare as a factor in changing settlement patterns in the Kayenta area during the Tsegi Phase should be considered carefully. The survey data from the valleys and canyons show an overwhelming pattern of the Kayenta population taking deliberate and extreme measures to move into remote, inaccessible, and highly defensible locations. The very aggregation of the population into the large focal sites can probably best be explained as a defense measure, but the pattern is compounded by the fact that the large sites were so consistently placed in defensible positions.

Alternative explanations may be offered for the movement of the population into high redoubts, but none offers the parsimony of warfare. Specifically, it has been informally suggested that people may have moved their settlements into secluded spots in the Tsegi Phase in response to an ideologically derived need to hold their religious ceremonies in secret, away from the view of neighbors. This, however, is not an explanation at all, since it does not account for why there was such a sudden and drastic change in their ceremonial behavior. Why was it suddenly so important to have secret ceremonies in the Tsegi Phase when this was not a factor earlier? No answer is provided. Similarly, it has been suggested that people in the valleys may have moved up onto mesa tops because these locations were breezier and cooler in the summer and warmer in the winter. Although we did not test this particular notion, it suffers from the same problems as the strict environmental explanation for the movement into the cliff dwellings in Tsegi Canyon. If the mesa tops were somehow environmentally superior (cooler/warmer) to the valley floors for residences, then why did it take the Kayenta Anasazi 2,000 years to figure it out? It is much more reasonable to assume that if there were distinct advantages to living on mesa tops or in cliff shelters, these would have been the favored residential locations throughout the Kayenta occupation of the region.

Such incomplete environmental and ideological reasons for the mass movement of the population to inaccessible locations at A.D. 1250 do not help us understand why the Kayenta Anasazi behaved the way they did. Warfare, conflict, and raiding do help us understand this broad regional pattern. The Kayenta took conscious, deliberate steps to move their residences and stored resources to out-of-the-way, highly defensible locations because they were afraid of being attacked. They were responding to a direct, overt threat of raiding, resources stolen, and people killed or wounded.

It is reasonable at this juncture to ask how much actual conflict there was in the 13th century, and the answer is not readily apparent from the data available. There is evidence that at least one of the focal sites, Thief Site, was burned, and there was one isolated skull with signs of direct violence and another skeleton missing a skull. We did not find, however, mass burials of people killed violently (see, e.g., Wendorf, 1953:46; Palkovich, 1980:121–124; Bradley, 1987), or a comprehensive pattern of violence in known Tsegi Phase burial populations (Berry, 1983; Ryan, 1977; Ward, 1975). Yet the lack of direct physical violence in the existing data is not proof against a regular pattern of raiding and conflict. Several factors need to be considered in assessing the nature, intensity, and frequency of warfare activities in the Kayenta region during the Tsegi Phase.

First, there are some signs of violence, as noted. Some people, including women, were being attacked and wounded or killed. Second, in tribal warfare, it is rarely the case that an objective is killing lots of people; rather, the intent of the offensive party is either to procure resources, wreck havoc on crops and/or stored resources, humiliate the enemy, or demonstrate bravery (see Ferguson, 1984, 1990; Smith, 1938; Vayda, 1976). Thus, we would not expect to find lots of violent deaths in the burial record. Third, there is the intriguing case of the low frequency of males in the burial population recovered from RB568, with six adult males and 28 adult females identified. Along this same line it is interesting to note that there were only five adult males to ten adult females identified in the burial population at Inscription House, a large Tsegi Phase cliff dwelling in Navajo Canyon immediately northeast of Klethla Valley (Reed, 1967). These two substantial burial populations with significantly fewer adult males than females indicate the distinct possibility that in the latter half of the 13th century there were alternative burial practices for at least some of the adult males in the Kayenta heartland. If the males accorded alternative burial were in fact warriors, this would help explain the lack of evidence of violence in the burial record.

Fourth, the probable nature of Kayenta warfare also has to be considered in assessing the lack of evidence for extensive violence in the archaeological record. Although we have little direct evidence of the nature of warfare in the Kayenta region, the environmental conditions of the 13th century help to give some insight into what warfare might have been like on the Colorado

Plateau. With deteriorating environmental conditions resulting in resource shortages and malnutrition, raiding by parties of mobile warriors would have provided a means of capturing additional resources from another group of people. Targeting a small village such as LHV72 or LHV73 with only two or three resident males, a war party of five or six could efficiently steal quantities of stored corn and return home with it to feed their families. Killing the enemy would not have been a particularly productive goal, nor would stealing women or destroying fields. Violence in such raiding warfare would have come as a by-product of defense, rather than as a direct object of offense. This kind of economically oriented conflict, therefore, would not be expected to lead to large numbers of casualties and would not leave abundant signs of violence in the archaeological record.

Finally, the extreme defensive posture taken by the Kayenta in the Tsegi Phase would have operated to reduce the overall level of violence, as was discussed for the canyon cliff dwellings. Retreating to their hilltop redoubts and inaccessible rockshelters, the people would have been virtually impregnable to attack from the outside. With an extensive intervillage and intervalley communication system to warn of impending attack, there would have been time for all the residents of a particular residential cluster to move into a focal site or cliff dwelling, pull up access ladders, and post guards at the entryways. A defensive guard of warriors could have been posted below to protect crops and/or the satellite villages, but they would have been the only ones subject to physical attack. Thus, with the defensive settlement strategy taken by the Kayenta Anasazi, there is again no expectation of extensive physical violence.

Given the effective defensive settlement strategy and the general lack of evidence of violence, how much actual conflict was there in the Kayenta heartland during the Tsegi Phase? Probably not very much. Indeed, it is likely that there was more violence in the years immediately preceding the aggregation and movement into defensible sites in the second half of the 13th century. The major settlement reorganization in the 1250s and 1260s was a *reaction* to conflict, not simply a manifestation of conflict. The people did not take such extraordinary measures to protect themselves and their resources just because they thought they might be attacked. The threat of attack must have been a demonstrated reality for literally thousands of people across a wide region to band together in large communities and move their houses to high retreats, well removed from sources of drinking water and their fields.

A remaining question with regard to warfare in the Kayenta area concerns the enemy. If the people in the Kayenta heartland were concerned about attack, where was the attack likely to come from? Ambler and Sutton (1989) have recently suggested that hunting and gathering Numic speakers (Paiutes) were the enemy. There is, however, no evidence of any kind of such groups in the Kayenta area in precontact times. While Numic speakers cannot be ruled out as a possible source of attack against the Kayenta, they cannot be taken as a serious option until some evidence is found for their existence. Other than ephemeral hunting and gathering groups, there are several alternatives for the source of attacking groups in the Kayenta area.

The first possibility is that different groups of Kayenta were raiding each other. Such internecine raiding is known to have occurred historically among the Hopi (Voth, 1905; Courlander, 1982, 1987) and the Pueblo groups of the northern Rio Grande (Bandelier, 1892; Hill, 1982). Within this possibility it seems unlikely that the residents of Long House Valley were raiding each other. Between clusters there is often no more than 100 m between residences, and the fields would have all been immediately adjacent to one another. It also seems unlikely that Long House Valley and Kayenta Valley residents were raiding each other. Again, their residences are quite close to one another, and there were established visual links between the two valley systems. Klethla Valley, on the other hand, is a possible source of enemies for the Long House Valley residents. The two valleys were separated by a 15-km no-man's-land, as might be expected in the case of conflict between the two populations. Furthermore, the apparent exchange of ceramics between the two valleys does not weigh against intervalley conflict. There are ample cases in the ethnographic record of warring groups continuing to engage in extensive economic interaction.

Looking outside the Kayenta area for sources of enemies, there is evidence in other areas for the appearance of a defensive settlement strategy and conflict in the second half of the 13th century. A tour across the broad Four Corners region finds that in the Homolovi area to the south, southern Utah to the north, Canyon de Chelly to the southeast, and Hovenweep and Mesa Verde to the northeast, the people were consistently moving into inaccessible rockshelters and highly defensible hilltops and mesas all at exactly the same time—A.D. 1250 to 1300 (see Wilcox & Haas, 1991, for a summary of the evidence for warfare in the Southwest). The warfare seen in the Kayenta area in the Tsegi Phase appears to have been endemic throughout the entire northern Southwest at this time period. All of these other areas are within two or three days' walk of the Kayenta heartland and, thus, well within the raiding range of tribal groups. Consequently, these different Anasazi culture areas were all potential sources of enemies to raid the Kayenta and to be raided by them in turn.

Returning to the avenues of tribal formation, the data from the Kayenta region indicate that warfare was a central variable in the development of political organization in the prehistoric tribal polities. The warfare itself appears to have arisen in response to environmental conditions as an adaptive strategy for procuring extra resources in times of scarcity. The warfare in turn reinforced the ongoing process of integration at the local level. As the population in Long House Valley moved together in the 13th century and developed communal storage and water reservoirs in response to the adverse environmental conditions, they were also responding to adverse social conditions. They adapted to the threat of raiding and conflict by aggregation into much larger communities, by placing these communities in strategic defensive locations, and by establishing a communication network between these communities. The conflict may also have served to unite adjacent valleys (Long House Valley, Kayenta Valley, and Tsegi Canyon) into a loose defensive alliance based again on a communication network. Altogether, warfare in the Kayenta region, stimulated by the environment, played an integrative role in the development of the prehistoric tribal polities in the second half of the 13th century.

Further development of the Kayenta polities was adumbrated by the complete abandonment of the region at the end of the 13th century. There are no tree-ring dates in the region later than the 1280s, and all available evidence indicates that virtually the entire resident population was gone by A.D. 1300. The causes of abandonment were undoubtedly a combination of environmental and social factors. The relentless environment did not provide enough water for the crops, and erosion continued to eat away at the arable land. At the same time, war restricted the population to the occupation of a relatively few defensible locations. With their mobility limited by defensive considerations, there was less opportunity to pursue a long fallowing cycle in moving from one field system to another. Restricted mobility then would have further intensified the exploitation of the shrinking plots of arable land. Over time, drought, erosion, and conflict combined to make life untenable for the subsistence farmers of the Kayenta heartland, and they left. They were joined in their exodus by almost all the other peoples in the northern Southwest who succumbed to similar pressures to abandon the entire region by the beginning of the 14th century.

Where the Kayenta went after abandoning their homeland is another project. They did, however, leave behind a legacy of a valiant culture struggling in war and in peace to survive in the harsh yet beautiful land of the northern Southwest.

LITERATURE CITED

Adams, R. N. 1975. Energy and Structure: A Theory of Social Power. University of Texas Press, Austin, 353 pp.

Ambler, J. R. 1985. Navajo National Monument: An Archaeological Assessment. Archaeological Series No. 1, Northern Arizona University, Flagstaff, 115 pp.

Ambler, J. R., and M. Q. Sutton. 1989. The Anasazi abandonment of the San Juan Drainage and the numic expansion. North American Archaeologist, **10:** 39–53.

Arnold, D. E. 1971. Ethnominerology of Ticul, Yucatan potters: Etics and emics. American Antiquity, **36:** 20–40.

Bandelier, A. E. 1892. Final Report of Investigations among Indians of the Southwestern United States, carried on mainly in the years from 1880 to 1885. Part II. Papers of the Archaeological Institute of America, American Series IV. Cambridge University Press, Cambridge and New York, 511 pp.

Barth, F. 1969. Ethnic Groups and Boundaries: The Social Organization of Cultural Difference. Little, Brown and Co., Boston, 153 pp.

Beals, R. L., G. W. Brainerd, and Watson Smith. 1945. Archaeological Studies in Northeast Arizona. University of California Publications in American Archaeology and Ethnology, University of California Press, Berkeley and Los Angeles, 235 pp.

Bender, B. 1985. Emergent tribal formations in the American midcontinent. American Antiquity, **50:** 52–62.

Berry, D. R. 1983. Skeletal remains from RB568. Appendix I, pp. 64–69. *In* H. Crotty, Honoring the Dead: Anasazi Ceramics from the Rainbow Bridge–Monument Valley Expedition. Museum of Cultural History Monograph Series 22, University of California, Los Angeles.

Binford, L. R. 1972. An Archaeological Perspective. Seminar Press, New York, 464 pp.

Bradley, B. A. 1987. Annual Report of Excavations at Sand Canyon Pueblo (5MT765), Montezuma County, Colorado. 1986 Field Season. Report submitted by the Crow Canyon Archaeological Center to the Bureau of Land Management, Cortez, Col., 104 pp.

Braun, D. P. 1977. Middle Woodland–Early Late Woodland social change in the prehistoric Central Midwestern U.S. Ph.D. diss., Department of Anthropology, University of Michigan; University Microfilms, Ann Arbor, Mich., 300 pp.

———. 1983. Social evolution, prehistoric Central Midwestern U.S., 200 B.C.-A.D. 600. Grant proposal submitted to the National Science Foundation, Washington, D.C., 25 pp.

———. 1984. Midwestern Hopewellian exchange and supralocal interaction, pp. 117–126. *In* Renfrew, C., and J. Cherry, eds., Peer Polity Interaction and Sociopolitical Change. Cambridge University Press, Cambridge and New York.

———. 1991. Are there cross-cultural regularities in tribal social practices, pp. 423–444. *In* Gregg, S., ed., Between Bands and States. Center for Archaeological Investigations, Occasional Papers No. 9. Southern Illinois University, Carbondale, 450 pp.

Braun, D. P., and S. Plog. 1980. Evolution of 'tribal' social networks: Theory and prehistoric North American evidence. Paper presented at the 79th Annual Meeting of the American Anthropological Association, Washington, D.C., 10 pp.

———. 1982. Evolution of 'tribal' social networks: Theory and prehistoric North American evidence. American Antiquity, **47:** 504–525.

Breternitz, D. A. 1959. "Heltagito Rockshelter (NA6380)." Plateau, **30**(1): 1–16.

Burrough, P. A. 1986. Principles of Geographic Information Systems for Land Resource Assessment. Clarendon Press, Oxford, 150 pp.

Cann, J., and C. Renfrew. 1964. The characterization of Obsidian and its application to the Mediterranean region. Proceedings of the Prehistoric Society, **30:** 111–119.

Carneiro, R. L. 1970. A theory of the origin of the state. Science, **169:** 733–738.

———. 1978. Political expansion as an expression of the principle of competitive exclusion, pp. 205–224. *In* Cohen, R., and E. R. Service, eds., Origins of the State: The Anthropology of Political Evolution. Institute for the Study of Human Issues, Philadelphia.

Chagnon, N. 1968. Yanomamo: The Fierce People. Holt, Rinehart and Winston, New York, 130 pp.

———. 1983. Yanamamo: The Fierce People, 3rd ed. Holt, Rinehart and Winston, New York, 142 pp.

Christenson, A. L. 1983. The archaeological investigations of the Rainbow Bridge–Monument Valley Expedition, 1933–1938, pp. 9–23. *In* Crotty, H., Honoring the Dead: Anasazi Ceramics from the Rainbow Bridge–Monument Valley Expedition. Museum of Cultural History Monograph Series 22, University of California, Los Angeles.

Collins, M. B. 1975. Lithic technology as a means of processual inference, pp. 15–34. *In* Swanson, E., ed., Lithic Technology: Making and Using Stone Tools. Mouton Publishers, The Hague.

Cooley, M. E. 1962. Late Pleistocene and recent erosion and alluviation in parts of the Colorado River system, Arizona and Utah, pp. 48–50. *In* Geological Survey Research 1962: Short Papers in Geology, Hydrology, and Topography, Articles 1–59. United States Geological Survey Professional Paper 450-B, Washington, D.C.

Cordell, L. S. 1984. Prehistory of the Southwest. Academic Press, New York, 409 pp.

Courlander, H. C. 1982. The Fourth World of the Hopi. University of New Mexico Press, Albuquerque, 189 pp.

———. 1987. Hopi Voices. Recorded, transcribed, and annotated by Harold C. Courlander. University of New Mexico Press, Albuquerque, 255 pp.

Creamer, W., and J. Haas. 1985. Tribe versus Chiefdom in lower Central America. American Antiquity, **50:** 738–754.

Crotty, H. 1983. Honoring the Dead: Anasazi Ceramics from the Rainbow Bridge–Monument Valley Expedition. Museum of Cultural History Monograph Series 22, University of California, Los Angeles, 91 pp.

Cummings, B. 1953. First Inhabitants of Arizona and the Southwest. Cummings Publication Council, Tucson, 30 pp.

Danson, E. B. 1957. An archaeological

survey of west-central New Mexico and east-central Arizona. Papers of the Peabody Museum of Archaeology and Ethnology 44(1). Harvard University, Cambridge, 133 pp.

Dean, J. S. 1967. Chronological analysis of Tsegi Phase sites in northeastern Arizona. Ph.D. diss., Department of Anthropology, University of Arizona, Tucson, 300 pp.

———. 1969. Chronological analysis of Tsegi Phase sites in northeastern Arizona. Papers of the Laboratory of Tree-Ring Research, No. 3, University of Arizona, Tucson, 207 pp.

———. 1970. Aspects of Tsegi phase social organization: A trial reconstruction, pp. 140–174. *In* Longacre, W. A., ed., Reconstructing Prehistoric Pueblo Societies. University of New Mexico Press, Albuquerque.

———. 1986. Tse Yaa Kin: Houses Beneath the Rock, pp. 2–13. Exploration, School of American Research, Santa Fe, N. Mex.

Dean, J. S., A. J. Lindsay, Jr., and W. Robinson. 1978. Prehistoric settlement in Long House Valley, northeastern Arizona, pp. 25–44. *In* Euler R. C., and G. Gumerman, eds., Investigations of the Southwestern Anthropological Research Group: An Experiment in Archaeological Cooperation. The Proceedings of the 1976 Conference, Museum of Northern Arizona, Flagstaff.

Dean, J. S., R. C. Euler, G. J. Gumerman, F. Plog, R. H. Hevly, and T. N. V. Karlstrom. 1985. Human behavior, demography, and paleoenvironment on the Colorado plateaus. American Antiquity, **50:** 537–554.

Dean, J. S., and W. J. Robinson. 1977. Dendroclimatic Variability in the American Southwest: A.D. 680 to 1970. Laboratory of Tree Ring Research, University of Arizona, Tucson, 150 pp.

Dirks, R. 1980. Social responses during severe food shortages and famine. Current Anthropology, **21:** 21–44.

Dozier, E. P. 1970. The Pueblo Indians of North America. Holt, Rinehart and Winston, New York, 224 pp.

Dunnell, R. C. 1980. Evolutionary theory and archaeology, pp. 35–99. *In* Schiffer, M. B., ed., Advances in Archaeological Method and Theory. Academic Press, New York.

Effland, R. W. 1979. A study of prehistoric spatial behavior: Long House Valley, northeastern Arizona. Ph.D. diss., Department of Anthropology, Arizona State University, Tempe; University Microfilms, Ann Arbor, Mich., 286 pp.

Eggan, F. 1950. Social Organization of the Western Pueblos. University of Chicago Press, Chicago, 373 pp.

Ellis, F. Hawley. 1979. Isleta Pueblo, pp. 360–365. *In* Ortiz, A., ed., Handbook of North American Indians: Southwest, vol. 9. Smithsonian Institution, Washington, D.C.

Ember, M. 1982. Statistical evidence for an ecological explanation of warfare. American Anthropologist, **84:** 645–649.

Ember, M., and C. Ember. 1971. The conditions favoring matrilocal versus patrilocal residence. American Anthropologist, **73:** 571–594.

Englebrecht, W. E. 1974. The Iroquois: Archaeological patterning on the tribal level. World Archaeology, **6:** 52–65.

———. 1978. Ceramic patterning between New York Iroquois sites, pp. 141–152. *In* Hodder, I., ed., The Spatial Organisation of Culture. University of Pittsburgh Press, Pittsburgh.

Euler, R. C., G. J. Gumerman, T. N. V. Karlstrom, J. S. Dean, and R. H. Hevly. 1979. The Colorado plateaus: Cultural dynamics and paleoenvironment. Science, **205:** 1089–1101.

Farmer, M. 1957. A suggested typology for defensive systems in the Southwest. Southwestern Journal of Anthropology, **13**(3): 249–256.

Ferguson, R. B. 1984. Introduction: Studying war, pp. 1–82. *In* Ferguson, R. B., ed., Warfare, Culture and Environment. Academic Press, New York.

———. 1990. Explaining war, pp. 26–55. *In* Haas, J., ed., The Anthropology of War. Cambridge University Press, Cambridge and New York.

Ferguson, R. B., and N. L. Whitehead, eds. 1991. War in the Tribal Zone: Expanding Sites and Indigenous Warfare. School of American Research Press, Santa Fe, N. Mex, 303 pp.

Fewkes, J. Walter. 1911. Preliminary report on a visit to the Navaho National Monument, Arizona. Bureau of American Ethnology Bulletin 50, Washington, D.C., 35 pp.

Fried, M. H. 1975. The Notion of Tribe, Cummings, Menlo Park, Calif., 136 pp.

———. 1983. Tribe to State or State to Tribe in Ancient China?, pp. 467–493. *In* Keightley, D. K., ed., The Origins of Chinese Civilizaton. University of California Press, Berkeley, 453 pp.

Friedman, J., and M. Rowlands, eds. 1978. The Evolution of Social Systems. Duckworth, London, 180 pp.

Friedrich, M. H. 1970. Design structure and social interaction: Archaeological implications of an ethnographic analysis. American Antiquity, **35:** 332–343.

Garrett, E. M. 1986. A petrographic analysis of Black Mesa ceramics, pp. 114–142. *In* Plog, S., ed., Spatial Organization and Exchange: Archaeological Survey on Northern Black Mesa. Southern Illinois University Press, Carbondale.

Geib, P. R., and M. Callahan. 1985. Volcanic ash temper and ceramic exchange in the Kayenta Anasazi region. Paper presented at the 50th Annual Meeting of the Society for American Archaeology, Denver, Col., 15 pp.

Gibson, D. B., and M. N. Geselowitz, eds. 1988. Tribe and Polity in Late Prehistoric Europe. Plenum Press, New York, 234 pp.

Graves, M. W. 1981. Ethnoarchaeology of Kalinga ceramic design. Ph.D. diss., Department of Anthropology, University of Arizona, Tucson; University Microfilms, Ann Arbor, Mich. 300 pp.

Green, M. 1982. Chipped stone raw materials and the study of interaction. Unpublished Ph.D. diss., Arizona State University, Tempe, 300 pp.

———. 1983. The relationship of source distance to conservation of chipped stone raw materials, pp. 173–188. *In* Plog, S., and S. Powell, eds., Papers on the Archaeology of Black Mesa, Arizona, vol. II, Southern Illinois University Press, Carbondale.

———. 1985. Chipped stone raw materials and the study of interaction on Black Mesa, Arizona. Center for Archaeological Investigations, Occasional Paper No. 11, Southern Illinois University, Carbondale, 90 pp.

———. 1986. The distribution of chipped stone raw materials at functionally nonequivalent sites, pp. 143–168. *In* Plog, S., ed., Spatial Organization and Exchange: Archaeological Survey on Northern Black Mesa. Southern Illinois University Press, Carbondale.

Gregg, S. 1991. Between bands and states. Center for Archaeological Investigations, Occasional Paper No. 2, Southern Illinois University, Carbondale, 450 pp.

Gregory, H. E. 1917. Geology of the Navajo country: A reconnaissance of parts of Arizona, New Mexico and Utah. U.S. Geological Survey, Professional Paper 93, 161 pp.

Gumerman, G. J. 1969. The archaeology of the Hopi Buttes District, Arizona. Ph.D. diss., Department of Anthropology, University of Arizona, Tucson; University Microfilms, Ann Arbor, Mich., 234 pp.

———. 1984. A View from Black Mesa: The Changing Face of Archaeology. University of Arizona Press, Tucson, 184 pp.

———, ed. 1988. The Anasazi in a Changing Environment. Cambridge University Press, Cambridge and New York, 317 pp.

Gumerman, G., and R. Euler, eds. 1976. Papers on the Archaeology of Black Mesa, Arizona. Southern Illinois University Press, Carbondale, 186 pp.

Gumerman, G. J., D. Westfall, and C. S. Weed. 1972. Archaeological Investigations on Black Mesa: The 1969–1970 Seasons. Prescott College

Studies in Anthropology, No. 4, Prescott College Press, Prescott, Ariz., 250 pp.

Haas, J. 1980. Troubles with tribes: An Archaeological Approach to an Anthropological Problem. Paper presented at the 79th Annual Meeting of the American Anthropological Association, Washington, D.C., 10 pp.

———. 1989. The evolution of the Kayenta regional system, pp. 491–508. *In* Upham, S., and K. Lightfoot, eds., The Sociopolitical Structure of Prehistoric Southwestern Societies. Westview Press, Boulder, Col.

Hack, J. T. 1945. Recent geology of the Tsegi Canyon, Appendix I, pp. 151–158. *In* Beals, R. L., G. W. Brainerd, and W. Smith, Archaeological Studies in Northeast Arizona, vol. 44, no. 1. University of California Publications in American Archaeology and Ethnology, University of California Press, Berkeley.

Hargrave, L. L. 1935. Report on Archaeological Reconnaissance in the Rainbow Plateau Area of Northern Arizona and Southern Utah. University of California Press, Berkeley, 56 pp.

Harner, M. J. 1970. Population pressure and the social evolution of agriculturalists. Southwestern Journal of Anthropology, **26:** 67–86.

Harrill, B. G. 1982. Prehistoric agricultural adaptation and settlement in Long House Valley, northeastern Arizona. Ph.D. diss., Department of Anthropology, University of Arizona, Tempe; University Microfilms, Ann Arbor, Mich., 199 pp.

Hill, J. N. 1970. Broken K Pueblo: Prehistoric Social Organization in the American Southwest. University of Arizona Press, Tucson, 149 pp.

Hill, W. W. 1982. The Ethnography of Santa Clara Pueblo, New Mexico. University of New Mexico Press, Albuquerque, 400 pp.

Hobler, P. M. 1974. The late survival of pithouse architecture in the Kayenta Anasazi area. Southwestern Lore, **40**(2): 1–44.

Hodder, I. 1979. Economic and social stress and material culture patterning. American Antiquity, **44:** 446–454.

———. 1982. Toward a contextual approach to prehistoric exchange, pp. 213–235. *In* Ericson, J. E., and T. K. Earle, eds., Contexts for Prehistoric Exchange. Academic Press, New York.

Hoebel, E. 1978. The Cheyennes: Indians of the Great Plains. Holt, Rinehart and Winston, New York, 103 pp.

Johnson, A., and T. Earle. 1987. The Evolution of Human Societies: From Foraging Group to Agrarian State. Stanford University Press, Stanford, Calif., 360 pp.

Johnson, G. A. 1978. Information sources and the development of decision-making organizations, pp. 87–112. *In* Redman, C., et al., eds., Social Archaeology: Beyond Subsistence and Dating. Academic Press, New York.

———. 1982. Organizational structure and scalar stress, pp. 389–421. *In* Renfrew, C., M. J. Rowlands, and B. A. Segraves, eds., Theory and Explanation in Archaeology: The Southhampton Conference. Academic Press, New York.

Johnson, L. L. 1977. A technological analysis of an Aguas Verdes Quarry Workshop, pp. 205–229. *In* Hill, J. N., and J. Gunn, eds., The Individual in Prehistory. Academic Press, New York.

Kuklinski, T. T. 1985. A case for digitizer tablets. Computer Graphics World, **May:** 45–52.

Kvamme, K. L. 1983. Computer processing techniques for regional modeling of archaeological site locations. Advances in Computer Archaeology, **1:** 26–52.

———. 1989. Geographic information systems in regional archaeological research and data management, pp. 139–203. *In* Schiffer, M. B., ed., Archaeological Method and Theory, vol. 1. University of Arizona Press, Tucson.

Kvamme, K. L., and T. A. Kohler. 1988. Geographic information systems: Technical aids for data collection, analysis, and display, pp. 40–50. *In*

Judge, W. J., and L. Sebastian, eds., Quantifying the Present and Predicting the Past: Theory, Method, and Application of Archaeological Predictive Modeling. U.S. Government Printing Office, Washington, D.C., pp. 493–547.

Lam, N. S. N. 1983. Spatial interpolation methods: A review. The American Cartographer, **10:** 129–149.

Larson, B. M. 1983. Petrographic analysis of ceramics from the RB burial ground, Appendix II, pp. 70–75. *In* Crotty, H., Honoring the Dead: Anasazi Ceramics from the Rainbow Bridge-Monument Valley Expedition. Museum of Cultural History Monograph Series 22, University of California, Los Angeles, 91 pp.

Leonard, R. D., and G. T. Jones. 1987. Elements of an inclusive evolutionary model for archaeology. Journal of Anthropological Archaeology, **6**(3): 199–219.

Lewis, I. M. 1968. Tribal society, pp. 146–151. *In* Sills, D., ed., International Encyclopedia of the Social Sciences, vol. 16. Macmillan and Free Press, New York.

Lightfoot, K. G. 1984. Prehistoric Political Dynamics: A Case Study from the American Southwest. Northern Illinois University Press, DeKalb, Ill., 193 pp.

Lindsay, A. J., Jr. 1969. The Tsegi Phase of the Kayenta cultural tradition in northeastern Arizona. Ph.D. diss., Department of Anthropology, University of Arizona, Tucson; University Microfilms, Ann Arbor, Mich., 412 pp.

Lindsay, A. J., Jr., J. R. Ambler, M. A. Stein, and P. M. Hobler. 1968. Survey and excavations north and east of Navajo Mountain, Utah, 1959–1962. Museum of Northern Arizona Bulletin 45, Glen Canyon Series, 8, Flagstaff, 400 pp.

Lindsay, A. J., Jr., and J. S. Dean. 1971. Changing patterns of human settlement in the Long House Valley, northeastern Arizona, pp. 111–125. *In* Gumerman, G. J., ed., The Distribution of Prehistoric Population Aggregates. Prescott College Press, Prescott, Ariz.

Longacre, W. A. 1970. Archaeology as anthropology: A case study. Anthropological Papers of the University of Arizona, No. 17, Tucson, 56 pp.

Lucius, W. A. 1981. A resource approach for ceramic analysis. Paper presented at the 46th Annual Meeting of the Society for American Archaeology, San Diego, 10 pp.

Luedtke, B. 1976. Lithic material distributions and interaction patterns during the Late Woodland Period in Michigan. Ph.D. diss., University of Michigan, University Microfilms, Ann Arbor, 300 pp.

Mackey, J., and R. C. Green. 1979. Largo-Gallina Towers: An explanation. American Antiquity, **44:** 144–154.

Martin, P. S., and F. Plog. 1973. The Archaeology of Arizona. Natural History Press, Garden City, N.Y., 422 pp.

Mazer, R. 1980. Town and tribe in conflict. Ph.D. diss., Department of Anthropology, Columbia University, New York, 300 pp.

Monmonier, M. S. 1982. Computer Assisted Cartography: Principles and Prospects. Prentice-Hall, Englewood Cliffs, N.J., 250 pp.

National Cartographic Information Center. 1980. Digital Terrain Tapes: User Guide, 2nd ed. U.S. Department of the Interior, Geological Survey, Reston, Va., 100 pp.

———. 1988. Index to DLG from 1:24,000 Quadrangles and DEM. U.S. Department of the Interior, Geological Survey, Reston, Va., 100 pp.

Neely, J. A., and A. P. Olson. 1977. An archaeological survey of the Monument Valley region, northeastern Arizona. Unpublished manuscript, Museum of Northern Arizona, Flagstaff, 96 pp.

Nzimoro, I. 1979. Anthropologists and their terminologies: A critical review, pp. 69–83. *In* Huizer, G., and B. Mannheim, eds., The Politics of Anthropology: From Colonialism and

Sexism toward a View from Below. Mouton, The Hague.
Ortiz, A. 1969. The Tewa World. University of Chicago Press, Chicago, 197 pp.
Palkovich, A. M. 1980. The Arroyo Hondo Skeletal and Mortuary Remains. School of American Research Press, Santa Fe, N. Mex., 194 pp.
Plog, F. 1984. Exchange, tribes and alliances: The northern Southwest. American Archaeology, **4**(3): 217–223.
Plog, F., and S. Upham. 1983. The analysis of prehistoric political organization, pp. 199–213. *In* Tooker, E., ed., The Development of Political Organization in Native North America. American Ethnological Society, Washington, D.C.
Plog, S. 1980. Stylistic Variation in Prehistoric Ceramics. Cambridge University Press, Cambridge and New York, 160 pp.
———. 1983. Analysis of style in artifacts, pp. 125–142. *In* Siegel, B. J., A. R. Beals, and S. A. Tyler, eds., Annual Review of Anthropology 12. Annual Reviews, Palo Alto, Calif.
———, ed. 1986. Spatial Organization and Exchange: Archaeological Survey on Northern Black Mesa. Southern Illinois University Press, Carbondale, 377 pp.
Plog, S., and D. Braun. 1983. Some issues in the archaeology of 'tribal' social systems. American Antiquity, **48**: 619–625.
Plog, S., and S. Powell, eds. 1984. Papers on the Archaeology of Black Mesa, Arizona, vol. II. Southern Illinois University Press, Carbondale, 241 pp.
Powell, S. 1983. Mobiltiy and Adaptation: The Anasazi of Black Mesa, Arizona. Southern Illinois University Press, Carbondale, 160 pp.
Powell, S., and G. Gumerman. 1987. People of the Mesa: The Archaeology of Black Mesa, Arizona. Southern Illinois University Press, Carbondale, 175 pp.
Reed, Erik K. 1967. Human skeletal material from Navajo National Monument, Arizona. National Park Service, Santa Fe (unpublished).
Ryan, D. J. 1977. The paleopathology and paleoepidemiology of the Kayenta Anasazi Indians in northeastern Arizona. Ph.D. diss., Department of Anthropology, Arizona State University, Tucson; University Microfilms, Ann Arbor, Mich., 231 pp.
Sahlins, M. 1968. Tribesmen. Prentice-Hall, Englewood Cliffs, N.J., 118 pp.
———. 1972. Stone Age Economics. Aldine, Chicago, 348 pp.
Service, E. R. 1971. Primitive Social Organization: An Evolutionary Perspective, 2nd ed. Random House, New York, 160 pp.
Shepard, A. 1936. Technology of Pecos pottery. *In* Kidder, A. V., and A. O. Shepard, eds., The Pottery of Pecos, vol. 2. Papers of the Phillips Academy Southwestern Expedition, Andover, **7**: 389–587.
———. 1976. Ceramics for the Archaeologist. Carnegie Institution of Washington, Washington, D.C., 414 pp.
Smith, M. W. 1938. The War Complex of the Plains Indians. Proceedings of the American Philosophical Society, vol. 78, no. 3, 100 pp.
Squier, E. G., and E. H. Davis. 1848. Ancient Monuments of the Mississippi Valley. Smithsonian Contributions to Knowledge 1, Smithsonian Institution, Washington, D.C., 306 pp.
Steward, J. H. 1955. Theory of Cultural Change: The Methodology of Multilinear Evolution. University of Illinois Press, Urbana, 244 pp.
Stoltman, J. B., J. H. Burton, and J. Haas. 1992. Chemical and petrographic characterizations of ceramic pastes: Two perspectives on a single data set, pp. 85–92. *In* Neff, H., ed., Chemical Characterization of Ceramic Pastes in Archaeology. Prehistory Press, Madison, Wisc., 289 pp.
Stuart, G. 1988. America's Ancient Cities. National Geographic Society, Washington, D.C., 150 pp.
Swarthout, J., S. Stebbins, P. Stein, B. Harrill, and P. J. Pilles, Jr. 1986. The Kayenta Anasazi: Archaeological

Investigations along the Black Mesa Railroad Corridor. Museum of Northern Arizona Research Paper 30, vol. 2, Flagstaff, 686 pp.
Trigger, B. G. 1981. Prehistoric social and political organization: An Iroquoian case study, pp. 1–50. *In* Snow, D. R., ed., Foundations of Northeast Archaeology. Academic Press, New York.
Tuck, J. A. 1971a. Onondaga Iroquois Prehistory. Syracuse University Press, Syracuse, N.Y., 200 pp.
———. 1971b. The Iroquois Confederacy. Scientific American, **224**(2): 32–49.
Turner, C. 1962. A Summary of the Archaeological Explorations of Dr. Byron Cummings in the Anasazi Culture Area. Museum of Northern Arizona Technical Series 5, 15 pp.
Upham, S. 1982. Polities and Power: An Economic and Political History of the Western Pueblo. Academic Press, New York, 225 pp.
———. 1990. Analog or digital?: Toward a generic framework for explaining the development of emergent political systems, pp. 87–115. *In* Upham, S., ed., The Development of Political Systems in Prehistoric Sedentary Societies. Cambridge University Press, Cambridge and New York.
Vayda, A. 1976. War in Ecological Perspective: Persistence, Change and Adaptive Processes in Three Oceanian Societies. Plenum Press, New York, 129 pp.
Voss, J. A. 1980. Tribal emergence during the Neolithic of northwestern Europe. Ph.D. diss., Department of Anthropology, University of Michigan; University Microfilms, Ann Arbor, 300 pp.
———. 1987. Prehistoric tribalization in northwestern Europe, pp. 29–60. In Trinkhaus, K. M., ed., Polities and Partitions: Human Boundaries and the Growth of Complex Societies. Anthropological Research Papers No. 37, Arizona State University, Tempe.
Voth, H. 1905. Traditions of the Hopi. Field Museum of Natural History Publication 96, Anthropological Series No. 8, Chicago, 319 pp.
Ward, A. E. 1975. Inscription House: Two research reports. Technical Series No. 16, Museum of Northern Arizona, Flagstaff, 58 pp.
Washburn, D. K. 1978. A symmetry classification of pueblo ceramic design. Papers of the Peabody Museum of Archaeology and Ethnology 68. Peabody Museum Press, Cambridge, 180 pp.
Weigland, P. C., G. Harbottle, and E. V. Sayre. 1977. Turquoise sources and source analysis: Mesoamerica and the Southwestern U. S. A., pp. 15–34. *In* Earle, T. K., and J. E. Ericson, eds., Exchange Systems in Prehistory. Academic Press, New York.
Wendorf, F. 1953. Salvage Archaeology in the Chama Valley, New Mexico. Monograph No. 17, School of American Research, Santa Fe, N. Mex., 124 pp.
Whallon, R. E. 1968. Investigations of late prehistoric social organization in New York State, pp. 223–244. *In* Binford, S., and L. Binford, eds., New Perspectives in Archaeology. Aldine, Chicago.
Whitehead, N. L. 1989. Tribes make states and states make tribes: Warfare and the creation of colonial tribe and state in northeastern South America, 1492–1820. Paper presented at the School of American Research Advanced Seminar on Expanding States and Indigenous Warfare, Santa Fe, N. Mex., 40 pp.
Wilcox, D., and J. Haas. 1991. The scream of the butterfly: Competition and conflict in the prehistoric southwest. Paper presented at School of American Research, to be published by School of American Research Press.
Winterhalder, B. 1980. Environmental analysis in human evolution and adaptational research. Human Ecology, **8**: 135–170.
Wobst, H. M. 1977. Stylistic behavior and information exchange, pp. 317–342. *In* Cleland, C., ed., For the

Director: Research Essays in Honor of James B. Griffin. Museum of Anthropology Anthropological Papers No. 61, University of Michigan, Ann Arbor.

Woodbury, R. B. 1959. A reconsideration of pueblo warfare in the Southwestern United States, Actas del XXXIII Congreso Internacional de Americanistas, **II:** 124–133. Editorial Lehmann, San Jose, Costa Rica.

Zier, C. 1976. Excavations Near Zuni, New Mexico: 1973. Research Paper No. 2, Museum of Northern Arizona, Flagstaff, 50 pp.

APPENDIX A

EXCAVATIONS AT LHV72 AND LHV73

Jonathan Haas
Winifred Creamer

LHV72—The Brown Star Site

LHV72 (NA10,829) was a small, U-shaped, single-story pueblo consisting of four rooms and a kiva occupied during the early part of the Tsegi Phase. The site (figs. 3-2, 3-3) is located in a sand dune formation at the juncture of the valley floor and the sloping edge of the Shonto Plateau at an elevation of 6360 ft. The sloping bedrock of the Shonto Plateau delimits the northern side of the site area, and a large, 2-m sand dune separates the site from the valley floor to the south. Pinyon and juniper trees ring the site area, intermixed with big sagebrush, snakeweed, narrow leaf yucca, prickly pear, beeweed, and grasses. Surface material consisted of tan, sandy soil. Aeolian action has deposited 10–20 cm of sand over the northeast quadrant of the site, while at the same time erosional action has washed away trash and a probable plaza area in the southwest quadrant of the site.

LHV72 covers about 600 sq m (30 × 20 m) and consists of one block of four rooms and a separate rectangular structure (S. 1) identified as a kiva. The structures were built at the base of a bare sandstone outcrop in a pocket of sandy soil, and all were oriented roughly northeast–southwest. A sandy midden area was located 5–10 m south of the rooms. Three structures (S. 1, S. 2, and S. 3), a 2-×-2-m test unit adjacent to S. 3, and 1-×-1-m test units in the midden area were excavated. Two burials (Burial 1 and Burial 2) were excavated, one an adult female with substantial burial furniture and the second an adult male missing the skull and with only one vessel as burial furniture.

Structure 1

Structure 1 is a square, subterranean room, approximately 2.6 × 2.7 m in area and extending 1.3 m below ground surface with a maximum standing wall height of 1.6 m above the lowest floor. The upper courses of the walls were visible on the surface of the site. Excavation of the structure was carried out in June and July of 1983. The kiva was excavated in 10-cm levels. Three distinct layers of deposition, distinguished by color and texture changes in the soil, were observed, though there were no signs of either roof fall or deliberate filling. The structure was built of a single width of sandstone blocks and slabs, with a shaped, flat face on the interior. Courses averaged 19–32 cm wide. All the corners were of bonded construction. The overall appearance of the masonry was irregular, with only slight efforts at smoothing the interior face of rough blocks. Some chinking with small pieces of sandstone was observed. The walls were mortared together with a clay and sand mixture. There was 1–5 cm of mortar between stones.

The southeast wall consists of large flat sandstone slabs set upright and rising from the floor 40–60 cm. Above these slabs, the wall consists of more traditional coursed masonry. One of these slabs was removed during excavation, revealing that they had been set flush against the sandy external matrix. The structure walls were originally plastered with fine clay 0.5–2 cm thick. The interior of the kiva was heavily weathered, and most of the plaster had eroded away. Striations on slabs set in the southwest wall of the structure suggest that plaster may have been smoothed with an abrading stone or flat piece of wood. Some smoke-blackened plaster also remained on the southwest wall of the structure.

Two floor levels, both heavily disturbed, were found that were originally plastered with fine clay. Three large sherds, a scraper, and a large ground stone fragment were found in contact with the floor. Features in the floor include a slab, 31 × 53 cm, in the southwest corner and a hearth/deflector/ventilator complex in the center of the southeast wall. A clay-collared hearth is set into the floor 40 cm in front of a ventilator shaft opening in the center of the southeast wall. The hearth is 66 × 69 cm and 43 cm in interior diameter. It is lined with slabs and has a clay collar inlaid with undecorated Kayenta whitewear bowl fragments projecting 3–4 cm above the floor level. The base of the hearth is about 25 cm below floor level and is sandstone bedrock that slopes to the southeast.

The ventilator shaft opposite the hearth rises to the surface just outside the southeast wall. Between the ventilator opening and the hearth is a long thin slab set into the floor, with post holes at either end. As the slab did not rise more than 2–3 cm above the floor level, it is likely that posts supported some sort of wooden deflector between the ventilator and the hearth. Such an arrangement can be seen in one of the kivas in Kiet Siel (Dean, 1969). The floor of the structure has been resurfaced and raised slightly at least two times after the original construction, though none of the upper floor surfaces could be traced over the entire area of the structure. Overall, the subterranean context of the structure, the presence of the carefully constructed hearth filled with heavy ash, the deflector slab, and the ventilator shaft indicate that this was a kiva, fully analogous to the kiva-type structures found at numerous other Tsegi Phase Kayenta sites (Dean, 1969; Lindsay, 1969).

Structure 2

Structure 2 measures 2.7 m north–south by 2.5 m east–west. The northwest and southwest walls of the structure consist solely of a row of large upright slabs, which probably provided a foundation for an upper masonry wall at the time of construction. (Such a pattern of masonry on top of upright slabs is found at Inscription House, a large Tsegi Phase cliff dwelling to the west of Long House Valley, and at Nagashi Bikin in Tsegi Canyon.) The northeast wall, shared with S. 3, is masonry from the floor up, while the southeast wall is jacal (manifested by upright post impressions set in gray mortar and supported by small slabs of sandstone). As in S. 1, the sandstone blocks and slabs used in the walls are roughly cut and pecked into shape and made flat on the interior surface. The masonry averaged 41 cm thick, the slabs 16 cm, and the jacal 11 cm thick. Clay mortar 2–6 cm thick was used to cement the slabs and blocks of masonry. One section of wall made of chinking and mortar without blocks was also present.

There was one doorway in the center of the northeast wall of the room. The doorway was 53 cm high, 58 cm wide, and 29 cm deep. The sill was a shaped and slightly smooth slab of sandstone and was 53 cm above the floor of the room. There was what appeared to be a stepping stone on the floor directly below the sill. The stone extended 8 cm from the wall and was 40 cm wide and 21 cm high. It was a set on a pad of mortar 2–3 cm thick on the floor.

A slab-lined floor, associated with the base of the stone walls, was encountered at the bottom of the walls. A hearth constructed of roughly rectangular sandstone blocks was uncovered 10 cm above this floor, indicating a remodeling and change in room function. The hearth is square, unlined, and open to the east. The hearth was 49 × 53 cm and 32 cm deep. This feature was filled with ash charcoal, fire-cracked rock, and dirt. There were no signs of a second upper floor either in the horizontal exposures or in the room fill profile. The combination of a hearth and a jacal wall indicates that, at least for the second occupation, S. 2 probably served as a "living" room, as that is the common pattern at Betatakin and Kiet Siel (Dean, 1969). At the same time, the presence of a lower slab-lined floor and the absence of a hearth in the earlier occupation indicate that this room was used initially as a storeroom or granary, as this is a common pattern in the Kayenta region and elsewhere (Dean, 1969; Lindsay, 1969; Zier, 1976). If this was a storeroom initially, it is likely that in the remodeling the jacal wall replaced an original masonry wall on the south side of the room.

Subfloor testing showed that the outline of the room was pecked into the bedrock. This is a pattern common at sites in the Kayenta area, where rooms are constructed on exposed bedrock (cf. Beals et al., 1945).

Structure 3

Structures 2 and 3 were connected by the doorway described previously. Structure 3 is a rectangular masonry room, originally 2.2 × 2 m in area. The room was remodeled, and the original southeast wall was moved inward approximately 50 cm and the floor raised approximately 15 cm. The remodeled S. 3 measured 2.3 m northeast–southwest by 1.5 m northwest–southeast. All four remodeled walls in the room were coursed masonry, although it is likely that the original southeast wall was jacal, as post impressions set into mortar were found 50 cm outside the second masonry wall. The masonry was a single course of sandstone blocks set in mortar 2–5 cm thick. Some spaces between blocks were chinked as well. Blocks were 30–48 cm wide, some shaped. In addition to the doorway into S. 2, there was a doorway in the remodeled southeast wall as well. The door was along the southeast wall of the room and was 43 cm wide and over 35 cm high, and the sill was 27 cm high. There were two floors associated with S. 3. The earlier floor consisted of shaped bedrock, with an area in the bedrock shaped for the mealing complex, and the metate area pecked. The later floor was 15 cm above bedrock and was laid on loose fill. Two flat rocks in the fill between the two floors may represent an attempt to level the area. This upper floor was indistinct and could not be followed throughout the room.

Two features were found in S. 3. A bowl-shaped depression lined with gray mortar was associated with the later, upper floor. This mortar "mixing bowl" was probably associated with the physical remodeling rather than with the second occupation. Remains of a mealing bin complex were clearly associated with the first, lower floor, as the doorway in the remodeled southeast wall is directly in front of the complex. Although this mealing bin complex had been dismantled at the time of remodeling, there were some remains of side walls and imprints in floor clay of two metates. Interestingly, one metate was found face down on the slab floor of S. 2, along with several pieces of ground and shaped limestone, which were quite similar to the remaining pieces of side walls in the S. 3 mealing bin complex. It would thus appear that in dismantling the complex, the pieces were tossed into the next room and eventually incorporated into the floor.

In looking at the history of S. 3, it started out as a mealing room with a front (south) wall of jacal. As jacal walls occur most often with living rooms, but also in mealing rooms (Dean, 1969), it is possible that this room served as both a mealing room and living room. Later the room was remodeled, with a stone wall constructed inside the earlier jacal wall on the south side of the room and the mealing bin destroyed. At this point, the room was probably used for storage until the time of abandonment.

In addition to excavated rooms, there was at least one additional room at the site to the east of S. 2 and S. 3 that was not excavated. This room did not abut the east wall of S. 3 and would have been free-standing.

Burials

During the excavation of a test pit in the trash area to the south of the kiva, the end of a burial, Burial 1, was encountered. As portions of the burial were right at the surface and subject to immediate erosion, the decision was made to complete the excavation. The burial consisted of a single adult female between the ages of 25 and 35 placed in a shallow pit in an extended position (though the legs were crossed and slightly flexed) with the head to the southeast. The burial pit was 80–90 × 160 cm and 53 cm deep. The individual was accompanied by nine whole or partial ceramic bowls, including examples of Tusayan Polychrome, Kayenta Black-on-white, and Tusayan Polychrome B. The bowls were placed around the cranium and right shoulder, on the upper body, and beside the lower long bones. Other artifacts in the burial pit included a hammerstone, a polishing stone, several pieces of worked bone, pieces of ground stone, a large, heavily ground piece of hematite, and an unfired ball of red clay. The range of items interred with this individual, including the pottery, stone and bone tools, hematite, and the unfired ball of clay, suggest that this may be the burial of a female potter.

A second burial, Burial 2, immediately to the northwest of Burial 1, was excavated during the 1984 field season. This was an adult male, buried upside down in a flexed position. The skull of this individual was missing, but examination of the upper cervical vertebrae did not indicate whether or not the individual had been deliberately decapitated. One Tusayan Black-on-white effigy vessel accompanied the burial, and a projectile point was found in the vicinity of the pelvis. (This point had a distinctive basal stem and did not fit into any of the later Kayenta types [fig. 3-4].)

The differences between the two burials at LHV72 parallel to some extent the situation at the site of RB568, a focal site in Kayenta Valley. At RB568 there was an unexpectedly low number of adult males in the burial population (11.9% of the total [n = 42]), suggesting that males may have received different burial treatment than females. Also, grave goods found with adult female interments were more elaborate than with any other age segment, often including pottery, pottery-making items, and milling tools (Crotty, 1983:30).

Intrasite Dating

LHV72 appears to have been occupied for a short period of time, from around A.D. 1243 to 1280. Tree-ring samples were collected from most proveniences, and 75 samples were submitted for analysis. The bulk of the samples were pinyon pine, though others included juniper, ponderosa pine, poplar, and nonconiferous species. Dated samples and proveniences are provided in Table 3-1. With cutting dates in two different rooms of A.D. 1243, this seems a likely date for the initial occupation of the site. Although the exact length of

TABLE A-1. Ceramics at LHV72 (Fill/Floor*)

Ceramic Category	S. 1	S. 2	S. 3	Trash	Total
Grayware					
Kiet Siel Gray	117/12	30/3	34/1	1,036	
Moencopi Corrugated	16/0	24/2	5/0	126	
Tusayan Corrugated	2/0	1/0	2/0	42	
Unidentified grayware	0	0	0	4	
Total	147	60	42	1,208	
Whiteware					
Kayenta B/W	6/0	0	4/0	19†	
Tusayan B/W	11/1	0/2	3/1	31	
Betatakin B/W	1/0	0	0	4	
Flagstaff B/W	0	0	0	1	
Polacca B/W	0	0	2/0	0	
Sosi B/W	2/0	0	0	23	
Dogoszhi B/W	3/0	0	0	4	
Black Mesa B/W	0	0	0	1	
Kana'a B/W	0	0	0	5	
Shato B/W	0	0	0	2	
Unidentified B/W	10/0	0	1/0	33	
Undecorated whiteware	11/10	6/2	15/0	139	
Total	55	10	26	262	
Orangeware					
Kiet Siel Polychrome	8/0	5/0	5/0	21	
Kayenta Polychrome	1/0	1/0	0	1	
Tusayan Polychrome A	25/67‡	5/0	14/2	73	
Tusayan Polychrome B	4/1	2/0	1/0	19	
Unknown Polychrome	2/0	1/0	1/0	0	
Kiet Siel B/R	2/0	0/1	0	1	
Tusayan B/R	2/0	1/0	4/0	46	
Medicine B/R	0	0	0	5	
Unidentified B/R	1/1	1/0	3/0	4	
Tsegi B/O	2/0	0	0	3	
Unidentified B/O	3/0	0	2/0	10	
Tsegi Orange	30/0	7/0	7/2	130	
Orange with red slip	4/0	1/0	3/0	45	
Total	153	25	44	358	
Totals	355	95	112	1,828	2,390

* Fill indicates materials from a fill context, and floor indicates materials from a floor-contact context.

† Includes one worked sherd disk.

‡ The sherds on the floor were all small pieces from one vessel strewn across the room. The pieces are worn and represent a total of perhaps one-third of the vessel.

TABLE A-2. Frequency of Ceramic Wares at LHV72

Ceramic Category	S. 1		S. 2		S. 3		Trash		
	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Graywares	147	216	60	58	42	68	1,208	1,114	1,457
Whitewares	55	52	10	14	26	17	262	270	353
Orangewares	153	86	25	23	44	27	358	444	580
Totals	355		95		112		1,828		2,390

Chi-square = 126.02. df = 6. $P = <0.001$.

occupation cannot be determined, it can be inferred from the noncutting date of 1272 in the fill (20–60 cm below present ground surface) of S. 1, the kiva, that the site continued to be occupied at least into the 1270s.

Artifacts

The most common artifacts occurring at LHV72 are ceramics. The distribution of ceramics within the site is given in Table A-1. In general, the plainwares and whitewares are almost exclusively jars, while the orangewares are almost exclusively bowls. The "unknowns" listed in this table were all unusual variants of Kayenta types. There were no "trade" sherds coming from outside the Kayenta region found at the site. The "unidentifieds" were either too worn or did not have enough decoration to allow placement into one of the traditional types. Of the 2,390 ceramics recovered from the site, 2,211 were body sherds, 165 were rim sherds, and 14 were handle fragments. In looking at the frequency of different wares within the site (table A-2), Structures 1 and 3 have fewer than expected graywares and more than expected decorated wares. Such a pattern makes intuitive sense in having fewer storage-type ceramics in the kiva and living room; interestingly, however, as discussed below, a very different pattern was found at LHV73.

In addition to ceramics, bone, shell, and stone artifacts were recovered from LHV72 (table A-3). Very few of the artifacts were found in direct floor contact; therefore, it is difficult to make secure inferences about room functions. However, there are some broad patterns apparent in the distribution of the nonceramic artifacts. There is very little lithic debitage in S. 2, but quantities of whole and fragmentary ground stone. Most of the ground sandstone slabs appear to have been fragments of the demolished mealing bin complex. Although there was much less ground stone in S. 3, it is interesting to note that there were six hammerstones found in this room. (The one whole metate appears to have been taken out of the mealing bin complex in S. 2 and deposited in S. 3 just prior to the construction of the second, upper floor in the latter.)

The "limestone tools" listed in the table were recognized as tools only toward the end of the first season. At first glance, the limestone pieces

TABLE A-3. Nonceramic Artifacts at LHV72

Artifact	S. 1	S. 2	S. 3	Trash
Lithic debitage	30	2	16	145
Projectile point				
Whole				4
Fragment				2
Flake tools	2*		1†	1‡
Mano				
Whole	2	2	1	1
Fragment	2	3		5
Metate				
Whole		1	1§	
Fragment		6		3
Polishing stone	1	2	1	1
Hammerstone	2‖	1	6	19
Sandstone slab with grinding on one surface	2#	27	1	11
Shaped and ground sandstone slab		5	4	
Fragment				2
Limestone with ground edges	1			3
Hoe			1	
Fire dog			1	
Palette (fragment)		1		
Small polished quartzite cylinder				1
Small ground quartz cylinder				1
Bone awl	3	1		2
Bone bead	1			1
Cowrie shell (ventral half)				1
Unidentified shell fragments				2

* One chopping tool and one scraper, both floor contact.
† Biface.
‡ Flake tool of unknown function.
§ Floor contact.
‖ Floor contact.
One floor contact.

uncovered in the course of excavation seemed to be unmodified and unutilized. As limestone occurs in some abundance locally, it was thought that these pieces were simply part of the generic architectural rubble. However, upon closer examination it was discovered that virtually every piece of limestone less than about 20 cm in diameter showed signs of grinding and polishing on one or more of the natural edges. As these edges are not sharp enough to be an effective cutting tool for most substances, it is more likely that they were used for grinding grooves into either the soft Navajo sandstone used in construction or possibly into wood used for construction. Brief experiments indicated that fist-sized limestone pieces could be effectively used to shape sandstone blocks. If the block is first grooved using an edge of the limestone and then struck sharply with a blunt side of the limestone, the block can be shaped effectively and efficiently. It is thus a reasonable possibility that the abundant limestone tools were used in the shaping of the sandstone building blocks used in room construction. The relatively small number of such tools in LHV72 is also a reflection of the fact that this site was excavated in the first season, before these tools were recognized.

LHV73—The Potential Site

LHV73 (NA10,830) was a rectangular C-shaped roomblock of eight rooms, with two sequential oval kivas, and a separate mealing room in front of the roomblock to the south (figs. 3-5, 3-6). The site was located approximately 50 m from LHV72, and it was probably also occupied in the second half of the 13th century during the Tsegi Phase. This site, also a satellite of the Tower House cluster, was located in a small pocket of sandy soil in the bare sandstone bedrock that forms the northern and western margins of Long House Valley. The rooms are oriented northeast–southwest, with trash areas to the east and south of the site. Located in a less-sheltered spot on the bedrock, there was less sand obscuring this site than the neighboring LHV72. LHV73 is approximately 9.5 × 13 m or 450 sq m in area, with relatively shallow trash areas (15–50 cm in depth) around the perimeter. On the surface prior to excavation, the C-shaped pueblo appeared to be divisible into two halves, each near-mirror images of the other, with four rooms and a front kiva in each half. Thus, the decision was made in the 1983 season to excavate the east half of the roomblock and the adjacent oval kiva.

Since household clusters at Betatakin and Kiet Siel average around four rooms, it was expected that each half of the pueblo might represent a distinct household cluster. However, this did not turn out to be the case. The expected four rooms turned out to be only three, one of which, S. 9/10, was either twice as large as all the others in the roomblock or was internally divided by an ephemeral wood and/or brush wall. Furthermore, two of the rooms, S. 7 and S. 9/10, contained hearths, indicating that both were used as living rooms. Consequently, in 1984 the decision was made to excavate the remaining half of LHV73 since the surface indications did not represent an accurate reflection of the subsurface rooms. Subsequent work confirmed that the makeup of the site was indeed quite different from the initial prediction of two similar living/storage groups built together, and two kivas, one oval and one rectangular.

Structure 1

Structure 1 is a freestanding rectangular room 1.6 × 2.4 m, located approximately 3 m in front of the main roomblock in the northeast corner of the site area. The walls of the room were sandstone blocks mortared together with clay and chinked with small rocks. The corners of the structure were bonded, and the north, east, and west walls may have been shaped to have a flat face inside and out. However, the south wall was built without regard to the shape of stones, resulting in very irregular interior and exterior surfaces. Construction was of a single width of stones up to 24 cm wide. Maximum wall height was 56 cm with five courses. Structure 1 appears to have been a mealing room, based on the presence of a large, *in situ* sandstone metate resting several centimeters above the outlines of a mealing bin pecked into the bedrock below. Excavation in the room did not encounter a clear floor layer, but the occurrence of the metate and a number of other artifacts at 54–56 cm below datum would appear to indicate the probable location of the original floor. Insofar as the room was built on an earlier layer of trash (the basal course of wall rocks rests on bedrock at the north end and trash at the south end), it is not surprising that the floor was indistinct.

Structure 3

Structure 3 (S. 2 was originally used to designate the area between S. 1 and the main roomblock. Subsequently this turned out not to be a room) is a small storeroom on the end of the west arm of the "C," adjacent to S. 4. The room measures 1.8 m northwest–southeast by 1.6 m northeast–southwest with a maximum wall height of 32 cm. Though no specific features were found in this room, a large burned area containing charcoal, ash, and fragments of burned sandstone was noted in the center of the room. There was a sloping bedrock floor in this room. The absence of distinctive artifacts and a well-defined hearth would point to a storage function for this room. The burned area in the center of the room, however, might indicate that the room was used as a living room at least on a short-term basis.

Structure 4

Structure 4, another storeroom, measures 2.3 m northwest–southeast by 1.6 m northeast–southwest with a maximum wall height of 30 cm. This rectangular room was in the western arm of the pueblo, between S. 3 and S. 5. This room was built directly on bedrock with irregular sandstone blocks. Only the stones in the north wall (shared with S. 5) had been shaped to make a smooth interior wall surface. This may indicate that the north wall of S. 4 was once an exterior wall, with S. 4 and S. 3 added later. The basal course of wall rocks was missing from the northeast corner of the room, though a wall footing had been pecked out of the sandstone bedrock in this area. Stones were mortared together with clay and chinked with fragments of sandstone. The floor of this room was immediately above the bedrock. A wooden awl and a chopping tool were recovered on this floor level. There was a doorway from S. 4 into S. 5. Only the threshold of the doorway was found, and the door may have been plugged, possibly in connection with the construction of S. 4. A pecked depression in the northwest corner of the room may have been an attempt at leveling the bedrock floor. The absence of a hearth in this room indicates that it was not a living room and was probably used for some kind of storage.

Structure 5

Structure 5, also a storeroom, measures 1.4 m northwest–southeast by 1.6 m northeast–southwest and has a bedrock floor sloping downward from north to south. This room is located on the northern corner of the site adjacent to S. 4 and S. 8. The room was constructed of unshaped sandstone blocks mortared together with clay and chinked with sandstone fragments. The north and west walls appear to be of slightly different construction from the south and east walls of S. 5. There is one clear door leading into S. 8 to the west, and a gap in the masonry of the south wall indicates a probable door into S. 4. The floor of this room, in particular, is heavily worn from foot traffic, with the heaviest wear in front of doorways leading into S. 8 to the west and S. 4 to the south. In both of these latter rooms, worn stone steps were leaned up against the wall to assist in getting into S. 5. Aside from these steps and doorways, there were no other features found in S. 5. Apart from infrequent potsherds, no diagnostic artifacts were found in either fill or floor contact contexts in S. 5. The heavy chinking in the walls of this room indicates that it was built as a granary.

Structure 6

Structure 6 is another storeroom, measuring only 1.6 m southeast–northwest by 1.5 m northeast–southwest, with a maximum wall height of 52 cm. This room is located on the western corner of the pueblo, in between S. 7 and S. 9. The walls are of shaped sandstone blocks in the north and east walls and a mix of shaped and unshaped blocks in the west and south walls. Walls were bonded at the corners except for the south wall, where the corners were abutted. Wall blocks were laid up in the thick mortar, which minimized the importance of stone shape. Heavy chinking with small fragments of sandstone filled in the mortared areas and points to a probable function as a granary for this room.

The floor in this room is heavy gray clay, with bedrock emerging in the south corner of the room. A worn doorsill in the northwest wall indicates that there was probably a door in this wall leading to the outside. The fact that this room had an outside door and that there were no doors leading to the adjoining rooms to the northeast (S. 7) or southeast (S. 9/10) is somewhat anomalous for a Kayenta storeroom.

Structure 7

Structure 7 measures 2.5 m northeast-southwest and 1.9 m northwest-southeast, with standing walls reaching a maximum height of 70 cm above the floor. The walls were constructed of a single width of sandstone blocks set in clay mortar, except for the west wall between S. 7 and S. 6, which was a double wall. The walls were all chinked with fragments of sandstone. A doorway in the south wall led from S. 7 out into an open plaza area. There is no evidence of a doorway joining S. 7 with either S. 8 to the east or S. 6 to the west.

There were two distinct floor levels in the room, the second of which was 20 cm above the first. Both floors had slab-lined hearths in association. Both were rectangular, slab-sided hearths filled with ash and charcoal. The bottom of the lower hearth was bedrock. The lower floor may have had a deflector slab or entry box complex between the hearth and the door of the room. The hearth was opposite the doorway, and slabs were positioned between the hearth and the doorway. The presence of a hearth in both remodelings of this room suggests that this was a living room throughout its occupation.

Structure 8

Structure 8, located along the back of the roomblock, measures 2.2 m northwest-southeast by 2.4 m northeast-southwest, with a maximum standing wall height of 111 cm. The walls were constructed of sandstone blocks, slightly shaped, and set in clay mortar. Wall corners were bonded. Evidence for a door into S. 5 to the north included remains of a sill, a step up to the sill, and a gap in the masonry of the north wall. This room had been remodeled once, as evidenced by an upper clay floor superimposed on a lower bedrock floor. An area of blackened soil with burned corn kernels and seeds in it was found at the level of the upper floor, though there were no signs of a distinct hearth (as there were in S. 7, immediately to the southwest—see above). A worked stone slab was found in contact with the upper floor level, and several additional slab fragments were found in a semicircular group on the west side of the room. Although these were of the same size and shape as the slabs lining typical mealing bins, this feature was not in the configuration of a mealing bin, nor was there a metate in the room. Lumps of potter's clay were also found in the fill immediately above the floor. The bedrock floor of S. 8 lacked features that would identify the function of the room. However, there was no evidence of a hearth or other living area features. The upper clay floor of the room included a burned area, a slab-lined feature, and miscellaneous flat stones and slabs. Together these features suggest that the room may have been remodeled into a living room from a storage room.

Structure 9/10

Structure 9/10 was excavated during the first season of work at LHV73, in 1983. The structure has two number designations because the room was so long it was initially expected that excavation would reveal two rooms. However, in the course of excavation, no dividing walls were discovered in the center of this structure; furthermore, we encountered no eastern wall separating the structure from the open plaza. What the excavations revealed was a single room, 4.9 m northwest–southeast by approximately 1.9 m northeast–southwest. Although there were no indications of a stone or jacal wall along the east side of this structure, there was a clear soil color change between the room area and the plaza, and the line of this color change corresponded exactly with the line of the east wall separating S. 6 and S. 7. The northeast side of a slab-lined hearth found in the center of S. 9/10 also corresponded with this color change line. It would thus seem likely that there was some form of jacal wall along the east side of this structure separating the roofed interior from the open plaza area. (The presence of a roof was inferred from the discovery of a series of parallel roof beams in the lower fill of the structure.) Only one floor level was found in the structure, and the presence of a mortar mixing bowl below the floor level indicates that S. 9/10 may have been constructed sometime after the main northeast–southwest roomblock of the site. The presence of a hearth in this room along with the ephemeral east "wall" both point to a living room function for this structure.

Kivas

Initially it was estimated that there were two kivas, one oval and one rectangular, out in front of the roomblock. The rectangular "kiva," however, turned out to be the mealing complex. The oval feature, S. 2, did turn out to be a kiva, and excavations in the vicinity also revealed a second kiva, S. 11, immediately to the north, which was not visible from the surface.

Structure 2

The first kiva, S. 2, was located approximately 3 m to the east of S. 9/10. This kiva is in the shape of an elongated "D," with a 1.7-m-long flat wall along the northwest side of the structure. The total length of the structure is 2.4 m southeast–northwest and the maximum width is 2.0 m southwest–northeast, with the floor 1.6 m below the present ground surface. In the west half of the kiva, the bottom 10–40 cm of the floor had been cut directly out of bedrock, while the remaining walls were single-width, coursed masonry. All the interior wall faces had been ground flat to give an even surface. The walls of the kiva were not repaired or replastered, and there was no visible smoke-blackening on the walls. In the center of the north side of the

TABLE A-4. Ceramics at LHV73 (Fill/Floor, Except Plaza and Trash)

Ceramic Category	S. 1	S. 2	S. 3	S. 4	S. 5	S. 6
Plainware						
Kiet Siel Gray	220/0	267/0	75/0	73/0	13/0	17/0
Moencopi Corrugated	48/0	141/0	9/0	5/0	3/0	2/0
Tusayan Corrugated	5/0	6/0	1/0	1/0	0	0
Unknown corrugated	0	1/0	0	0	0	0
Total	273	415	85	79	16	19
Whiteware						
Kayenta B/W	8/0	0	1/0	1/0	0	5/0
Tusayan B/W	34/0	47/0	6/0	2/0	1/0	4/2
Betatakin B/W						
Flagstaff B/W	1/0	0	1/0	0	0	0
Sosi B/W	0	10/0	0	0	0	0
Dogoszhi B/W	0	7/0	0	0	0	0
Black Mesa B/W						
Kana'a B/W						
Shato B/W						
Unidentified B/W	8/0	22/0	7/0	10/0	4/0	0
Undecorated whiteware	32/0	61/0	12/0	22/0	6/0	2/0
Total	83	147	27	35	11	13
Orangeware						
Kiet Siel Polychrome	9/0	9/0	5/0	0	0	1/0
Kayenta Polychrome	1/0	1/0	0	0	0	0
Tusayan Polychrome A	17/0	22/0	4/0	3/0	0	0
Tusayan Polychrome B	10/0	6/0	1/0	3/0	0/1	1/0
Unknown polychrome	0	0	0	0	0	1/0
Kiet Siel B/R	0	0	0	0	0	1/0
Tusayan B/R	20/0	22/0	4/0	2/0	1/0	3/0
Unidentified B/R	0	4/0	0	3/0	0	0
Tsegi B/O	5/0	3/0	2/0	0	0	0
Tsegi Orange	68/0	42/0	18/0	15/0	7/0	1/0
Orange with red slip	22/0	12/0	9/0	7/0	5/0	2/0
Total	152	121	43	33	14	10
Totals	508	683	155	147	41	42

* One of these Kayenta B/W sherds is an oval-worked sherd disk.

† One of these unidentified B/W sherds is an oval-worked sherd disk.

‡ This single floor-contact sherd represented approximately half of a small bowl.

structure there was a niche in the wall, 121 cm above the floor. The niche measured 20 cm in height, 18 cm wide, and 27 cm deep. The primary floor feature was a clay-collared hearth slightly to the southeast of the center of the structure. The hearth collar rose 4–5 cm above the floor level, while the "bowl" was cut out 23 cm below the floor level. This bowl was filled with

TABLE A-4. *Extended*

S. 7	S. 8	S. 9	S. 10	S. 11	Plaza	Trash
90/3	101/0	57/17	50/0	303/0	252	2,884
36/1	17/0	19/7	21/0	154/0	112	863
0	1/0	0	1/0	8/0	3	146
0	0	1/0	0	1/0	8	11
130	119	101	72	466	375	3,904
0	0	8/0	6/0*	2/0	9	73*
8/1	7/0	6/0	2/0	47/0	52	343
					0	1
0	1/0	0	0	0	3	3
0	0	2/0	0	20	3	17
0	0	0	1/0	0	3	22
0	0	0	1/0	0		
2/0	1/0	0	0	1/0	4	7
					0	1
2/0	5/0	4/0†	5/0	16/0	18	33
13/1	17/0	11/4	7/0	26/0	99	586
27	31	35	22	94	191	1,086
5/1	17/0	5/4	2/0	4/0	12	106
2/0	2/0	0	0	0	0	26
4/3	8/1‡	6/2	3/0	27/0	36	305
3/0	5/0	2/1	1/0	13/0	17	90
2/0	2/0	1/0	1/0	2/0	5	13
					1	2
3/1	12/0	3/3	9/0	28/0	29	263
1/0	1/0	1/0	1/0	0	10	68
1/0	19/0	1/0	0	5/0	16	32
24/7	29/0	7/2	4/0	91/0	101	557
3/3	3/0	2/0	1/0	20/0	37	252
63	99	40	22	190	264	1,714
220	249	176	116	750	830	6,704

highly compressed white ash and charcoal. The southeast side of the hearth was actually composed of a masonry deflector, 45 cm high and 43 cm wide. This deflector separated the hearth from a ventilator shaft, which rose from floor level in the southeast end of the kiva and emerged just outside the wall. A possible sipapu, consisting of a circular hole in the floor, 5 cm in diameter, was located 10 cm in front of the hearth. Upon excavation, this hole was found to contain a stone biface. A possible loom anchor was found on the floor adjacent to the ventilator shaft. This artifact was a ground

TABLE A-5. Comparison of Ceramics in Rooms

	Plainware		Whiteware		Orangeware		
Room	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
S. 1	273	292	83	86	152	130	
S. 2	415	393	147	116	121	174	
S. 3	85	89	27	26	43	40	
S. 4	79	85	35	25	33	37	
S. 6	19	24	13	7	10	11	
S. 7	130	126	27	37	63	56	
S. 8	119	143	31	42	99	63	
S. 9	101	101	35	30	40	45	
S. 10	72	67	22	20	22	30	
S. 11	466	431	94	128	190	191	
Totals	1,775		525		787		3,087

Chi-square = 92.06. df = 20. P = <0.001.

sandstone block shaped into a "U," with the ends of the "U" resting on the floor.

Structure 11

In outlining the outside walls of S. 2, a second oval arrangement of rocks, designated S. 11, was found extending out to the west. Initially it was thought that this was a kiva annex, similar to those found in cliff dwellings in the Tsegi Canyon system (Dean, 1969). Upon excavation, however, S. 11 turned out to be a second, earlier oval kiva on which S. 2 had been partially superimposed. Specifically, the east wall of S. 11 had been replaced/destroyed in the construction of the west wall of S. 2. Structure 11 closely resembled S. 2 in its ovate form, size (2.2 m N–S by 2.0 m E–W), and layout. Judging by the fact that rubble from the destruction of the east wall of S. 11 was found on and immediately above the floor, it would appear that there was not a long hiatus between the occupation of S. 11 and the construction of S. 2. In contrast to S. 2, the hearth in S. 11 was rectangular and lined with

TABLE A-6. Comparison of Ceramics in Rooms versus Plaza

	Plainware		Whiteware		Orangeware		
Site	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Rooms	1,775	1,694	525	564	787	828	
Plaza	735	456	191	152	264	223	
Totals	2,150		716		1,051		3,917

Chi-square = 40.54. df = 2. P = <0.001.

TABLE A-7. Comparison of Ceramics in Rooms versus Trash

	Plainware		Whiteware		Orangeware		
Site	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Total
Rooms	1,775	1,791	525	508	787	789	
Trash	3,904	3,888	1,086	1,103	1,714	1,712	
Totals	5,679		1,611		2,501		9,791

Chi-square = 1.05. df = 2. P = 0.75–0.50.

sandstone slabs. This hearth, immediately adjacent to the east wall separating S. 2 and S. 11, was 43 cm long, 37 cm wide, and 30 cm deep. The upper edge of the hearth stuck up 6 cm above the floor. An earlier clay-lined hearth was found adjacent to (to the west) and below the slab-lined hearth. Two possible loom holes were found in the center of the floor. These holes, 7 cm in diameter and 5 cm deep, were manifested as plastered circular holes, 40 cm apart, and filled with soft brown soil. There was a slightly raised lip of clay around each hole. A third circular hole in the floor, 5 cm in diameter and 7 cm deep, was 12 cm northwest of the hearth and may have been a sipapu. The walls of the kiva were smoke-blackened. Also, the floor of S. 11 was plastered twice, indicating extended use over time.

Plaza Excavations

The northwest quadrant of the plaza at LHV73 was excavated. This area was adjacent to S. 7 and S. 9/10. Remains of mortar mixing bowls were uncovered in three locations, and the tops of these mixing bowls appeared to be at the same level as the use surface that was distinguished for the plaza. No other features were found in this area.

Bedrock Area A

North of S. 5, a 2-×-2-m area was cleared to investigate features in the bedrock. Seven bowl-shaped depressions were pecked into the bedrock adjacent to S. 5. No other features were associated with these pecked areas, and their function was not determined. It is possible that the pecked depressions were the foundations for support poles holding up some kind of ramada-like structure, though the depressions did not pattern in a way that would indicate a roof support.

Trash

Seventeen 1-×-1-m test units were placed in the trash midden area east of the site center. These units included lenses of ash and charcoal, fragments of ground and flaked stone, pottery, and animal bone. One burial was en-

TABLE A-8. Nonceramic Artifacts at LHV73

Artifact	S. 1	S. 2	S. 3	S. 4	S. 5	S. 6
Lithic debitage	36	74	6	13	2	7
Core	1					
Projectile point						
Whole		1	1			
Fragment		2				
Flake tools		2*		1†		
Mano						
Whole						
Fragment	1	1				1
Metate						
Whole	1					
Fragment			1	3		
Polishing stone				1		
Hammerstone	1			19		
Sandstone slab with grinding on one surface	1	6		1		3
Shaped and ground sandstone slab				1		
Floor polisher						
Slate pendant						
Whole	1					
Fragment						
Turquoise pendant				1		
Limestone with ground edges			1	3		
Chopper						
Whole	6	1		1		
Fragment	1					
Palette						
Whole						
Fragment						
Hoe		1				
Loomblock						
Abrader						
Axe		1				
Ground standstone cone fragment						
Ground sandstone in crescent shape						
Ground hematite fragment						
Sharpening stone ¶						
Grooved maul						

(*cont.*)

TABLE A-8. *Extended*

S. 7	S. 8	S. 9	S. 10	S. 11	Plaza	Trash
61	27	22	18	71	67	274
						2
1					1	
				2		3
1§				1‖	1‖	2‡‡
2					2	
1	1	2		3	2	4
1¶						
1	4	1	2	1	1	9
		1	1		1	4
1	5	1		2	2	12
10**	6¶	9††	1	3	9	21
4	4		1		13	15
1				1		
1		1			1	
					2#	1
1	5	1¶	1	4	42	16
				2	3	1
					1	1
						1
					1	
1¶		1				
					1	
1¶						1
				1¶		
				2		
				1		
						2§§
						1

(*cont.*)

TABLE A-8. Continued

Artifact	S. 1	S. 2	S. 3	S. 4	S. 5	S. 6
Small stone cylinder of unknown material						
Bone awl	2	1		1		2
Bone bead						
Bone needle						
Bone whistle						
Polished oval bone disk						
Olivella shell beads		2				

* One biface, one scraper.
† Worked flake.
§ Biface fragment.
‖ Flaked knife.
A matched pair found together, probably earrings.
¶ One in floor contact.
** Three pieces in floor contact.
†† Two pieces in floor contact.
‡‡ One worked flake, one biface.
§§ Sandstone with narrow grooves for sharpening bone awls and needles.

countered in these tests, in units N1E1 and N2E1. No other features were identified within the trash midden tests.

Burials

One interment was encountered in the trash midden test units to the southeast of the main site area. No burial pit was noted, and the individual appeared to have been placed directly in the trash. The burial was approximately 3 m southeast of the main living area of the site and 85 cm below the modern ground surface. The interment was a young female, as indicated by the prominence of skull sutures, flat brow ridges, and the shape of the pelvis. The body was supine with flexed legs and extended arms. A lump of clay was found near the right foot. Prior to the encounter with the actual burial, sherds from at least two vessels, one a Tusayan Black-on-red and one a Tsegi Red-on-orange, were located in the midden excavations above the body near the head. They were probably associated with the burial.

Artifacts

Ceramics were again the most common artifact at the site. The totals for the site appear in Table A-4. There are clear differences in terms of ceramic assemblages between the rooms. To compare the various assemblages, the ceramics were grouped into the larger "ware" categories of plainware, white-

TABLE A-8. *Extended*

S. 7	S. 8	S. 9	S. 10	S. 11	Plaza	Trash
						1
1	1		1			2
		1				1
						1
			10			
1		1				

ware, and orangeware. For a basic analysis, the room contents were compared with each other (table A-5), the rooms together were compared to the plaza (table A-6), and the rooms together were compared to the trash fill (table A-7). Three storerooms, S. 5, S. 6, and S. 8, and the probable mealing room, S. 1, all had substantially fewer than expected plainwares. Interestingly, the two kivas, S. 2 and S. 11, had significantly more than expected plainwares. A kiva, S. 2, and two storerooms, S. 4 and S. 6, had more than expected whitewares, while one living room, S. 7, and the second kiva, S. 11, had significantly less than expected whitewares. The mealing room, S. 1, and two storerooms, S. 5 and S. 8, had more than expected orangewares, and a kiva, S. 2, and a living room, S. 10, had fewer than expected orangewares. When reviewed broadly, the distribution of ceramics in the rooms at LHV73 does not lend itself to neat explanation. There is no consistent pattern for the ceramic assemblage in living rooms, storerooms, or kivas.

It is clear that there are significantly more plainwares in the rooms, and more whitewares and decorated wares in the plaza. This probably reflects greater storage activities in the rooms in general and a range of different work activities in the plaza. When the rooms are compared to the trash, however, there are no significant differences in any of the different wares. The contents of the trash, therefore, can be inferred to represent the range of activities carried out in the rooms.

The stone, bone, and shell artifacts recovered from LHV73 are listed in Table A-8. Again, there is a dearth of artifacts in floor contact, but broad patterns in the distribution of artifacts in general at the site. Structures 3, 5, and 6 stand out in a general lack of all types of artifacts, both ceramic and nonceramic. This pattern conforms to the lack of internal features in these rooms and confirms the probable storage function for all three rooms. The presence of loomblocks, grooved sandstone blocks used as anchors on weaving looms, in S. 2, S. 7, and S. 9, a kiva, and two living rooms indicates that there may have been weaving in all three rooms. There was also a whole metate at approximately floor level in S. 1, confirming the interpretation of this as a grinding room. There was also a whole slab metate on the floor of S. 7, though no signs of a mealing bin complex were encountered in this room. This structure also has a higher frequency of lithic debitage (in relation to the total number of artifacts in the room) than do the other rooms. Overall, there was a higher frequency and greater range of different kinds of artifacts in the living rooms, S. 7 and S. 9/10, and the kivas, S. 2 and S. 11, than in the storage and specialized-use rooms, S. 1, S. 3, S. 4, S. 5, S. 6, and S. 8.

Intrasite Chronology

Like LHV72, LHV73 appears to have been occupied for a relatively short period of time in the 13th century. Tree-ring samples were taken from all proveniences except S. 4, S. 5, and S. 8. A total of 495 samples were collected. Tree species included pinyon, juniper, ponderosa pine, oak, aspen, and non-coniferous species. Twelve of these yielded dates, though none of them were cutting dates. The results are given in Table 3-2. Though none is a cutting date, the cluster of three dates from S. 9 (1245, 1248, and 1257) suggests that there was use of the site during the 1240s and 1250s, though the initial and final dates of occupation cannot be determined. Although there are two early dates from the plaza area, these are in association with a later, 13th century date. This is probably a case of reusing wood from an earlier site, rather than an earlier occupation at this site.

APPENDIX B

COMPUTER METHODS: GEOGRAPHIC INFORMATION SYSTEMS

Kenneth L. Kvamme
Arizona State Museum
Tucson, Arizona

Geographic information systems (GISs) are special computer database management systems that have a spatial component. In other words, GISs are designed for the retrieval, storage, manipulation, analysis, and display of data that can be referenced to geographic locations. It is this spatial reference that makes GISs distinct from, and gives them added capabilities over, traditional database management systems. Any type of geographically distributed information can be encoded within a GIS, from such diverse sources as conventional maps, site files, aerial photographs, and satellite imagery. GISs incorporate these data in a common coordinate base system (e.g., the Universal Transverse Mercator, or UTM grid), thus providing a unifying framework for data storage, manipulation, retrieval, and interpretation. GISs allow concurrent access to multiple data themes for a single locus or over wide regions, and overlays of multiple data themes easily can be created because of the common coordinate system. Mapping capabilities can yield maps on a video monitor or on paper in a variety of formats. Additionally, GISs can provide thousands of measurements of environmental or other characteristics, and complex calculations, data models, or landform indices can be obtained in vast numbers (Kvamme, 1989; Burrough, 1986). In short, GISs provide ideal tools to archaeologists faced with a large spatial analysis problem.

A variety of GIS methods were used in this project to investigate defensive localities in the Klethla and Long House valleys. Broadly speaking, the goals of this work were (1) to create a computer representation or model of the landform of the region, (2) to use the landform model to allow the computer to identify potential defensive localities, and (3) using the landform model, to compute the presence or absence of intervisibility between each possible pair of potential defensive localities. The following sections overview and document some of the details behind these tasks.

Landform Model

The creation of a computer representation of landform for a region of study is not a simple undertaking. Such a computer model normally is represented by a matrix of elevation values. The elevations in this matrix form a gridded structure where a value occurs at regular intervals—for example, every 100 m in north-south and east-west directions across the region of interest. In computer parlance, this elevation matrix is termed a digital elevation model (DEM). A ready source of DEM data is the U.S. Defense Mapping agency, which provides them on computer tape for the entire country (National Cartographic Information Center, 1980). These data, however, were created from 1:250,000-scale maps and therefore offered much too crude a representation to be of use to this project (they lacked the detail necessary to identify defensive positions). Although the U.S. Geological Survey (USGS) is in the process of producing digital DEM data for their series of 1:24,000-scale maps, few of these data sets are currently available (National Cartographic Information Center, 1988). It therefore was necessary to create a DEM of the study region from scratch.

The building of a DEM was accomplished using somewhat standard techniques described by Kvamme and Kohler (1988), Burroughs (1986), and Monmonier (1982). The process entailed (1) manual tracing of map contour lines on a digitizing tablet, (2) converting the vector contour line data to a gridded or raster format, and (3) interpolation of elevation values at noncontour locations. The following describes these steps in more detail.

A digitizing tablet is a computer device, shaped much like a tabletop, for the inputting of graphic data. The tablet contains on the order of 1 million addressable (x, y) coordinates per square inch. A cursor, or puck, which is electronically connected to the tablet, is moved over the tablet's surface. The exact position of the puck is translated to a particular coordinate that is sent to the computer. With a graphic attached to the tablet, and using cross-hairs that exist on the puck for precise locational control, it is possible to trace graphic features (points and lines) on maps and translate them to numerous coordinates that a computer can process (Kuklinski, 1985).

A digitizing tablet was used to manually digitize the contour lines in the five USGS 1:24,000-scale quadrangle maps that make up the Klethla and Long House Valley study area. The data set that resulted, besides requiring more than 100 person-hours to generate, constituted several hundred thousand coordinate points representing the contour line data.

A special computer program was written to convert these vector data to the raster (gridded) structure needed for a DEM. This vector-to-raster conversion program takes the digitized coordinate data for the contour line and assigns appropriate grid cells in the data base of the elevation value of that contour. In other words, a gridded representation of the contour line is made (fig. B-1). This process is repeated for each digitized contour line to ultimately yield a rasterized version of the entire contour map (for more details, see Kvamme & Kohler, 1988; Burrough, 1986).

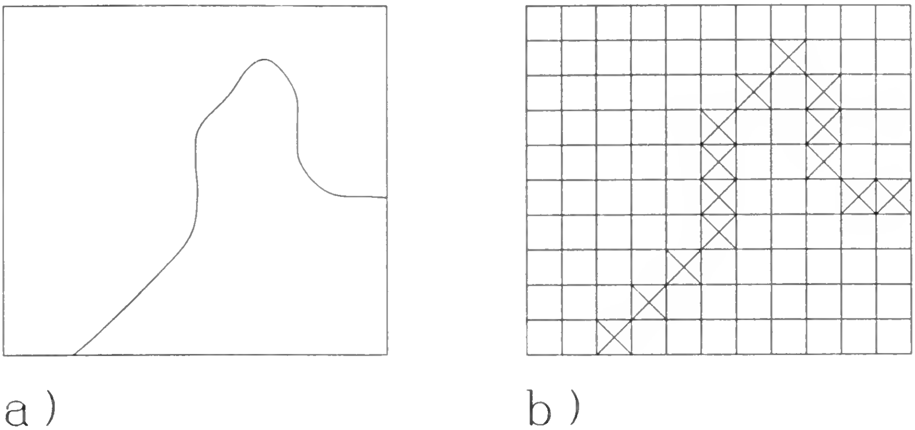


Figure B-1. Rasterization of contour data: a) original contour line; b) contour line in raster format.

In the present data base, a 50-×-50 cell size was employed in a matrix encompassing the study region of 420 rows and 460 columns. Although 420 × 460 = 193,200 cells are represented in this rectangle, only the approximately 110,000 cells within the actual study boundary were utilized (this study area is illustrated in fig. B-3).

The above process yielded grid cells that contained a contour line, and therefore an elevation value, and those that did not. Two-dimensional interpolation routines next were employed to estimate elevation values for

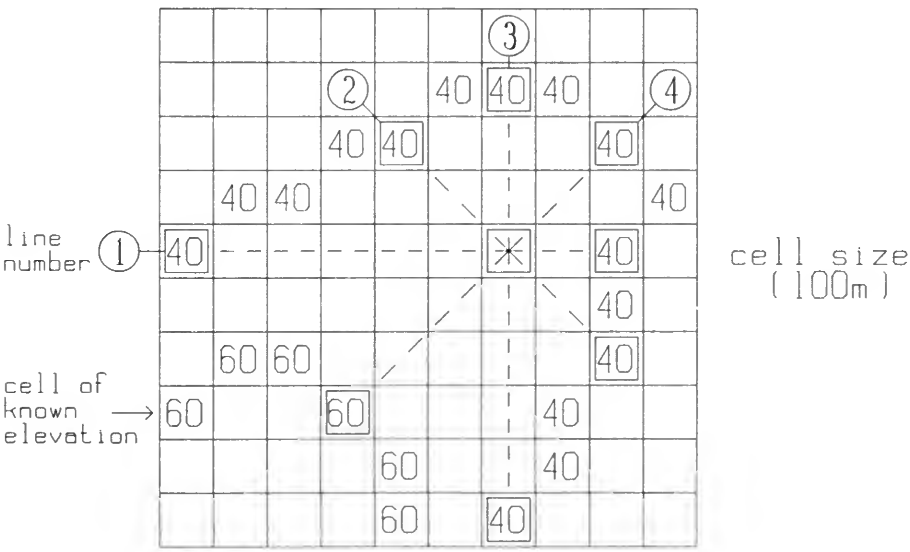


Figure B-2. A search along four lines crossing a cell of unknown elevation. Line 4 offers the steepest ascent across the locus and therefore is used as the basis for a linear interpolation (see table B-1).

TABLE B-1. Interpolation Calculations for the Steepest Ascent Algorithm Using Data in Figure B-2

Step 1. Determine line of steepest ascent:

Line No.	Length of Line	Elevation Change	Slope of Line
1	800 m	0 m	0
2	500 m	0 m	0
3	800 m	0 m	0
4	707 m	20 m	0.0283* (*line of steepest ascent)

Step 2. Interpolate elevation at locus using steepest line:

The equation of a line is

$$y = mx + b$$

where m is the slope, b is a known starting elevation, x is the distance between the starting elevation and the locus of interest, and y is the estimate of the unknown elevation at the locus.

Let the upper-right end point of Line 4 (fig. B-2) be the starting point. Then $b = 40$, $x = 283$, and $m = 0.0283$. Therefore,

$$y = 0.0283(283) + 40 = 48 \text{ m}.$$

each cell lacking one. While literally hundreds of interpolation algorithms exist (Lam, 1983), the one used here, which gives very good results, searches along four lines (left–right, up–down, and the two diagonals) that cross any cell of unknown elevation until cells of known elevation are encountered at both ends of each search line (fig. B-2). An elevation then is linearly interpolated at the locus based on the line that yields the steepest elevation increase. The mechanics of the calculations are shown in Table B-1. This procedure was repeated for each cell of unknown elevation until every cell in the entire database matrix contained an elevation. It should be noted that this method closely mimics techniques one would use to manually estimate an elevation at a point on a contour map.

As a final step in the creation of the DEM, the full matrix of elevations was postprocessed by a weighted average filter (Monmonier, 1982). This step was necessary because each interpolation was made independent of the others, causing a somewhat rough or variable surface. By taking a weighted average of the elevations in the eight cells adjacent to each interpolated cell (with most weight being given to the latter), not only was a better estimate obtained (because adjacent elevations also are good estimates), but a less variable, more realistic surface resulted. A portrayal of the Klethla and Long House valleys created by shading each of the 110,000 cells of the final DEM data base according to ground steepness is given in Figure B-3.

Defining Potential Defensive Localities

With a 50-m-resolution DEM for the entire region established, the next step was to use this landform representation in an attempt to allow the computer to identify potential hilltop localities with defensive characteristics. This task had, to our knowledge, no precedent in the literature of archaeology or computer science. The most difficult part of this undertaking, of course, was to first define as objectively as possible exactly what constitutes a hilltop defensive position in terms of landform characteristics. This process was aided by a thorough examination of already known defensive sites. With this accomplished, the second step was the implementation of the definition as a set of computer instructions.

As it turned out, the actual procedure used to achieve the end result became an interactive one. A definition would be made, implemented in computer terms, and the locations of potential defensive hilltops by the definition would be mapped by GIS cartographic software. Close inspection and comparison of the computer maps with USGS topographic maps, together with a great deal of previous experience in the region, allowed alterations and improvements in the definitions and ultimately the corresponding computer instructions. This interactive process of definition, computer implementation, mapping, and evaluation was repeated several times until a satisfactory result was achieved.

The defensive hilltop definitions rested on the local elevation characteristics of any potential candidate cell as well as associated slope (ground steepness) data. The need for slope information required a separate slope data base or layer to be created. This was accomplished using the DEM data and common GIS data generation techniques. To each cell and its surrounding eight neighbors (i.e., a 3-×-3 matrix centered around the cell) in the DEM matrix, a least-squares plane was fit by the computer; the maximum gradient on this plane then was determined as a percent-grade slope value (see Kvamme & Kohler, 1988; Burrough, 1986). The end result was a slope layer, containing 110,000 slope values for the study region, spatially co-registered to the cells of the DEM layer (it is the slope data base that actually is portrayed in fig. B-3).

Using the combination of elevation and slope data, all of the defensive hilltop definitions that were explored required (1) a level location (cell), (2) possibly associated with a radius of several level locations (recognizing that a hilltop can encompass more than one 50-m cell), (3) with a limited amount of elevation increase within the radius, and (4) with a significant increase in slope in at least three directions (north, south, east, or west) combined with an elevation decrease in each case. Variations in the definitions imple-

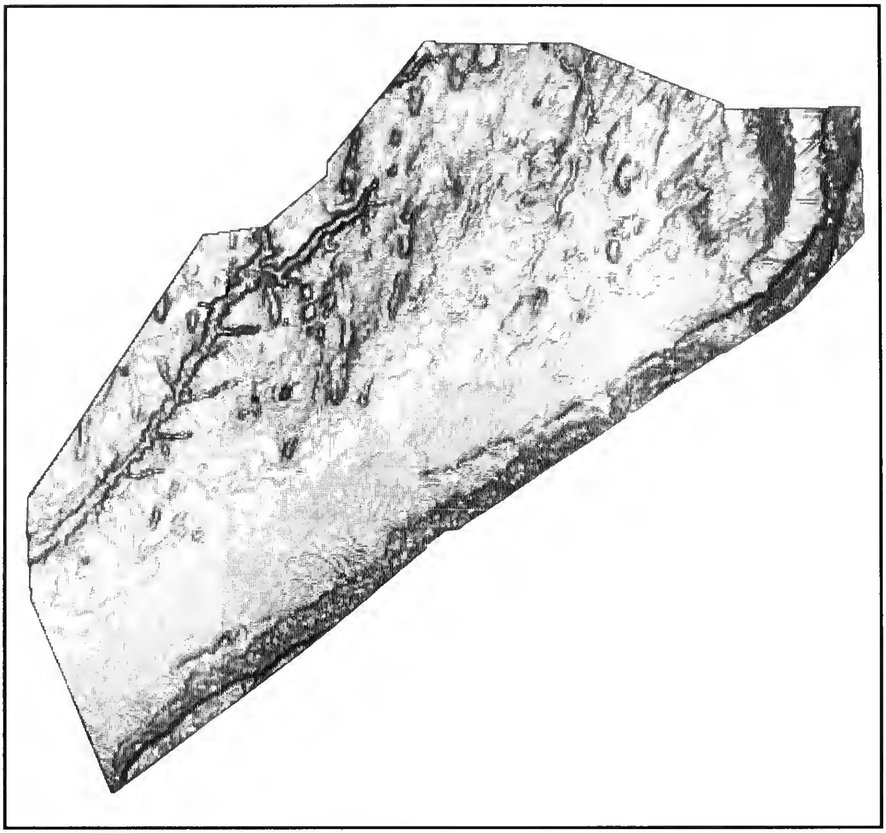


Figure B-3. Computer-generated shaded slope map of Klethla and Long House valleys. Dark shading represents steep ground. A number of small and large mesas and canyons are clearly visible.

mented on the computer revolved around alteration of values of (1) how level a defensive hilltop could be, (2) how large (number of cells) a defensive hilltop could be, (3) how much of an elevation increase was allowed on a defensive hilltop, and (4) what constituted a significant slope increase in the three orthogonal directions. The definition that ultimately was used to denote known defensive sites and other locations with similar features possessed the following specific characteristics. For any cell to be classified as a member in the defensive hilltop set it had to:

1. possess a slope value less than or equal to a 22% grade; and
2. in at least three directions (out of left, right, up, or down choices in the raster structure that corresponded with the primary directions) there had to be, within 600 m (12 cells) of the current cell: (a) either (1) an increase in slope of 6% combined with an elevation drop, or (2) a slope greater than the current slope and greater than 15% combined with an elevation drop; and (b) no more than a 12-m increase in elevation.

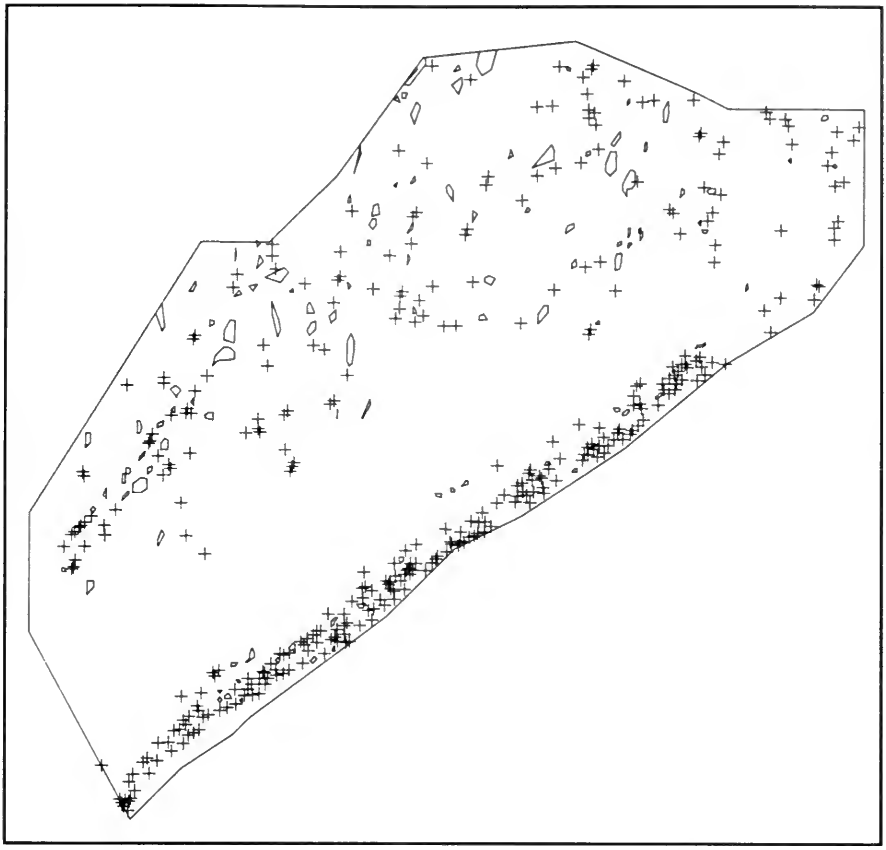


Figure B-4. The 452 potential defensive hilltop locations identified by the computer program.

Any cell that did not meet these criteria was classified as a nondefensive position.

This definition was applied to each of the 110,000 cells of the study region using the combined DEM and slope data base. The end result was the definition of 452 potential defensive hilltop localities, mapped in Figure B-4.

Computing Intervisibility Between Defensive Localities

With the DEM representation of landform and 452 defined defensive localities, the task of computing locus-to-locus visibility between each possible pair of candidates could be undertaken. As will be shown, the computation of the presence or absence of visibility between any two points (cells) in a DEM involves not a trivial amount of computation; the present problem called for visibility to be determined between each pair of loci out of a set of 452, or a minimum of (452)(451)/2 = 101,926 determinations (the number compared actually was much greater because many defensive hilltops in-

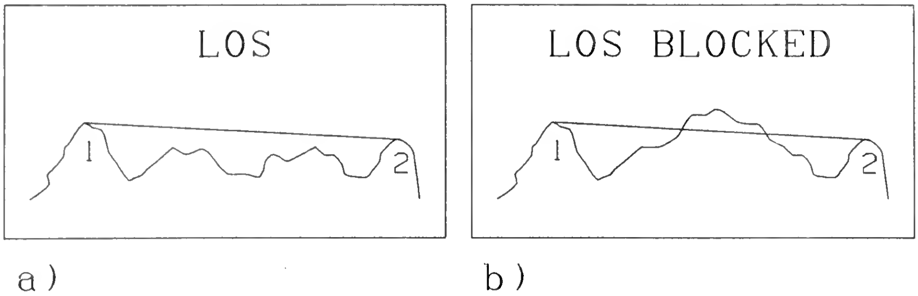


Figure B-5. a) illustration of a line of sight (LOS) between Positions 1 and 2, viewed in cross-section. b) The intervening mountain blocks the LOS.

volved more than one cell, requiring each member cell to be checked for possible visibility with the others as well).

The algorithm used for computing the presence or absence of visibility between two points in a DEM is straightforward. The equation of the line-of-sight (LOS) line is computed between the points and the elevation of this

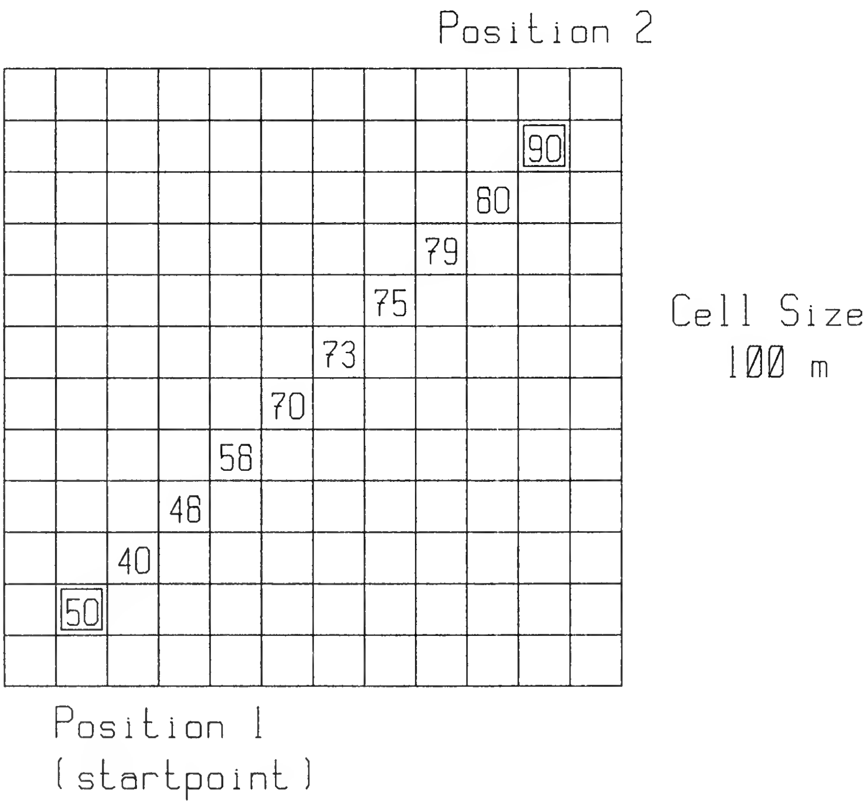


Figure B-6. A digital elevation model segment showing elevations at and between two hypothetical defensive hilltops (Positions 1 and 2).

TABLE B-2. Line-of-Sight (LOS) Status for the Data in Figure B-6, Assuming Position 1 is the Startpoint

LOS equation (see text): $y = 0.03143x + 50$

Cell	Distance from Position 1 (x)	LOS Elevation (y)	Digital Elevation Model* Elevation	LOS Status
A	141.4 m	54.44 m	40 m	Unblocked
B	282.8 m	58.89 m	48 m	Unblocked
C	424.3 m	63.33 m	58 m	Unblocked
D	565.7 m	67.78 m	70 m	Blocked

* See Figure B-6.

line is compared along its length to the actual ground elevation held in the DEM. If, for any point on the LOS, the elevation of the DEM is greater, then the LOS is blocked; otherwise it is not (fig. B-5).

The procedure actually used for this determination involved three steps that allowed simplification of the process. Knowing the two elevations of the LOS end points:

1. if any one of the intervening elevations in the DEM was higher than the highest of these end points, then an immediate determination was made of no visibility;
2. if all of the intervening elevations in the DEM were lower than the lowest of the end points, then an immediate determination was made of visibility;
3. otherwise, the equation of the LOS was computed and its elevation was compared cell-by-cell with the DEM to ascertain whether or not visibility was present. This latter step requires elaboration.

Show in Figure B-6 is a hypothetical portion of a DEM between two defensive hilltop positions labeled 1 and 2. Elevations are shown within each cell. Using position 1 as the "startpoint," the equation of the LOS (using the same methods given in table B-1 for the equation of a line) between the position can be found from the data in Figure B-6 to be

$$y = 0.03143x + 50,$$

where x is the distance from the startpoint's cell center in the direction of the LOS and y is the elevation of the LOS at the distance, x. The LOS elevation (y) obtained by this equation is compared against the DEM elevations that follow this line for the determination of presence or absence of visibility.

Table B-2 presents the data for the case in Figure B-6 where visibility is blocked.

This LOS determination procedure, as noted earlier, was performed between each possible pair of the 452 computer-defined defensive hilltops (fig. B-4), for more than 100,000 comparisons. For each hilltop the computer reported in tabular form (1) a unique identification number for the hilltop, (2) the number of other hilltops that were visible, and (3) a listing of the identification numbers of the other hilltops that were visible. This tabular listing was the end product used for subsequent investigations involving archaeological survey and testing of notions about the role of defensibility in Klethla and Long House valleys.

APPENDIX C

CHIPPED STONE RAW MATERIALS FROM LONG HOUSE, KLETHLA, AND KAYENTA VALLEYS

Margerie Green
Archaeological Consulting Services, Ltd.
Tempe, Arizona

Study of chipped stone raw materials from Kayenta, Long House, and Klethla valleys was oriented toward testing the model of prehistoric warfare and alliance discussed in Chapter 1. In the model, alliance and warfare are viewed as two sides of the same coin; alliance, in this context, is considered a response to intergroup conflict and warfare. Previous seasons of work have demonstrated that changes in organization of sites in the three valleys conform to a pattern of increased tribalization in the 13th century with increased interaction reflected in the development of site clusters, each with a focal site, and line-of-sight connections between the focal sites within a valley. A 15-km gap was found to exist during the Tsegi Phase between sites in the Klethla and Long House valleys that did not exist during earlier time periods. During the same period, sites in the Long House and Kayenta valleys were visible to one another. Therefore, it is suggested that warfare existed during this late portion of the cultural sequence and that, although inhabitants of Kayenta and Long House valleys were allies, there was conflict between populations in Klethla and Long House valleys. Based on the alliance mentioned above, this conflict may have existed between populations in the Kayenta and Klethla valleys as well.

When tied to source locales, chipped stone raw materials found on sites have been demonstrated to be useful referents in studies of interaction (Green, 1985). Chipped stone has certain qualities that ceramics, the usual focus of interaction studies, do not possess, including the fact that chipped stone artifacts usually occur in large numbers on sites and they are durable. Chipped stone differs from ceramics in that lithic manufacture is a subtractive, rather than additive, process. That is, rather than adding clay and smoothing over errors, as is possible in the initial construction of a pot, lithic manufacture involves the continual breaking down of the core into the desired form.

During this procedure, wastes produced are usually left in the place where manufacture occurred (Collins, 1975; Johnson, 1977).

Another factor that simplifies analyses of interaction based on chipped stone raw materials is that chipped stone artifacts typically are composed of only a single element, stone raw material, whereas elements of ceramic construction typically include clay, temper, and perhaps paint, all of which may have different points of origin. The matter of determining whether or not a chipped stone artifact was manufactured from a material obtained locally is further simplified when an area is geologically distinct from surrounding areas. For example, there is no source of igneous rock on Black Mesa in northeastern Arizona; therefore, if obsidian or basalt artifacts are found on Black Mesa sites, it is certain that either the raw material for its manufacture or the artifact itself was imported. Combining this evidence with on-site debitage produced during the subtractive act of lithic manufacture will help demonstrate whether it was the raw material that was imported or the finished artifact.

During the 13th century, a significant decrease in chipped stone raw materials with sources limited to Klethla Valley should be observed at Long House Valley and Kayenta Valley sites if a boundary existed between those two areas. One material that would fit this description is the chert that outcrops in limestone lenses in the Navajo Sandstone. Conversely, in order to demonstrate continued ties between Long House Valley sites and those in Kayenta Valley, materials from the latter area should continue to occur at Long House Valley sites. Materials from Kayenta Valley sources should decrease in frequency at Klethla Valley sites during the later phases of occupation. Distributions of chert that outcrops in the Owl Rock Member of the Chinle Formation were investigated to illustrate the link, or lack of one, between these areas. Finally, distributions of materials that occur outside the study area were investigated to determine whether or not those with sources to the north occur only at Kayenta and Long House Valley sites during the Tsegi Phase and whether or not those with sources to the south have distributions limited to Klethla Valley sites during that period.

Research on chipped stone raw materials in the Kayenta area and adjacent Black Mesa was conducted between 1980 and 1987. The complete collection assembled at that time was used for the present analysis and includes materials available on Black Mesa including some unusual materials such as baked siltstone that are related to coal deposits, raw material samples from the Shonto Plateau, and sources as distant as Cameron in Arizona, Montezuma Canyon in Utah and Colorado, Mesa Verde in Colorado, and Washington Pass in New Mexico. Obsidian sources from the Four Corners region to Flagstaff, Arizona, were reviewed, as well.

Fifty-four raw material categories were employed in this analysis and represent an undefined number of sources as color distinctions were made among materials from the same source. Detailed descriptions of the various raw materials and their source locales have been presented in detail previously (Green, 1982, 1985) and will not be repeated here. In order to maintain materials from the critical source locales in separate groups, material groupings have been combined into nine groups based on general source areas: (1) probably local, (2) Black Mesa, (3) Kayenta vicinity, (4) Klethla vicinity, (5) nonlocal southern sources, (6) nonlocal northern sources, (7) nonlocal direction unknown, (8) possibly Black Mesa, possibly Mesa Verde, and (9) material unknown. The raw material groups and their associated materials are provided in Table C-1.

Group 1 includes a variety of materials that occur either as part of the bedrock geology of the area (i.e., sandstone and limestone) or have recently been stream deposited, or materials that occur as deposits of lag gravels (i.e., chert, jasper, and quartzite). They are found in many places throughout the study area and are not unique to any one or two of the valleys under consideration.

The materials of Black Mesa origin in Group 2 are either those specific to the bedrock geology of Black Mesa but not the surrounding valleys (i.e., purple conglomerate from the Toreva formation), or materials that are directly related to the coal seams located on Black Mesa but not elsewhere in the immediate vicinity (i.e., baked siltstone, baked sandstone, and fused material).

An understanding of the distribution of materials available in the Kayenta Valley vicinity (Group 3), along with those in Group 4, materials from the Klethla Valley vicinity, is central to a test of the warfare hypothesis. Material types in Group 3 include those from the Chinle Formation (i.e., Owl Rock chert and petrified wood), minette from volcanic dikes such as Church Rock, and several distinctive cherts found in lag gravels in the Kayenta area. The petrified wood that occurs in the Petrified Forest Member of the Chinle Formation at the base of Skeleton Mesa is very different in quality and appearance from the more fine-grained, colorful, and vitreous petrified wood found in the same formation at the Petrified Forest National Monument. Therefore, the material from the latter source can be found in Group 5. Petrified wood also occurs in the Wepo Formation on Black Mesa, but it is assumed that the low-quality petrified wood found on sites in the three valleys is from the more local, Kayenta Valley source. Materials found in Klethla Valley, Group 4, include a wide variety of chert, some with limestone adhering to it, from the Navajo Sandstone.

The nonlocal south and nonlocal north groups (Groups 5 and 6, respectively) also will figure importantly in this analysis. The first group includes materials, such as obsidian and basalt, from volcanic sources, the higher-quality petrified wood, and a distinctive chert, referred to as Chinle chert from the formation of the same name. Although the obsidian artifacts included in this analysis have not been chemically tied to sources, source analysis of 40 artifacts from nearby Black Mesa showed the vast majority to be from the San Francisco Volcanic Field near Flagstaff, specifically from the Government Mountain and Crater Lake sources (Green, 1985). Therefore,

TABLE C-1. Raw Material Source Groups

Code	Raw Material Category
Group 1: Locally available, specific sources unknown	
1	Chalcedony
3	Jasper
5	Vein quartz
9	Quartzite
12	Limestone
13	Fine-grained sandstone
14	Medium-grained sandstone
15	Coarse-grained sandstone
50	Gray chert, rolled percussion cortex
55	Brown chert, rolled percussion cortex
59	Quartzitic chert
60	Oolitic and fossiliferous chert
90	Quartz pebble
Group 2: Black Mesa origin	
10	Slate/shale
11	Baked siltstone
16	Gypsum
17	Calcite
18	Siderite
19	Fine-grained sandstone/siltstone
22	Fused glass
23	Baked sandstone
24	Purple conglomerate
26	Fused material
29	Iron concretion
71	White baked siltstone
72	Gray baked siltstone
73	Pink baked siltstone
74	Yellow baked siltstone
84	Hematite
Group 3: Kayenta vicinity	
4	Coarse-grained petrified wood
25	Minette
27	Green chert
28	Pink chert
40	Owl Rock chert
41	Owl Rock chert with limestone
45	Purple-white chalcedony/chert
Group 4: Klethla vicinity	
30	Brown Navajo chert
35	Red, white, and blue Navajo chert
37	White Navajo chert
38	Navajo chert with limestone
Group 5: Nonlocal south	
6	Obsidian
7	Basalt
8	Red volcanic
21	Andesite
53	Fine-grained petrified wood
63	Chinle chert
Group 6: Nonlocal north	
57	Fracture-line chert
58	Creamy opaque silicified claystone
Group 7: Nonlocal unknown	
80	Chrysocolla
81	Turquoise
83	Malachite
Group 8: Nonlocal Black Mesa/Mesa Verde	
82	Mancos (green) shale
Group 9: Unknown materials	
2	Unknown chert
20	Unknown material

the assumption that volcanic materials found in the area presently under consideration originated at a source or sources to the south should be fairly secure. The nonlocal north group of sources includes only two materials, fracture-line chert and creamy opaque silicified claystone, which are found in the Mesa Verde and Four Corners areas, respectively.

It is likely, but not at all certain, that the three materials that form Group 7, turquoise, chrysocolla, and malachite, also are from northern sources. However, the sources are unknown, and source assignment should await chemical characterization of these materials. The single material forming Group 8 is a green shale or siltstone from the Mancos Shale. The point of origin for this material is unknown. Although the Mancos Shale is represented in Black Mesa, this material is not found on sites there, nor has it been seen in outcrop. It does form an important component of Mesa Verde chipped stone assemblages, another area where the Mancos Shale is represented.

The final category, material unknown, includes all materials unidentifiable by the author as well as all cherts that could not be readily assigned to a more specific source group.

Artifacts labeled with drainage, site number, and provenience were sorted into specific chipped stone raw material types. The comparative collection was referenced in ambiguous cases, and a 10× hand lens was employed when necessary. On the first sort, the unknown material and unknown chert categories were used whenever the source assignment was not immediately apparent with the expectation that the sorted artifacts might provide ranges of variation for the materials that were not represented in the source collection. After all the artifacts had been inspected once, materials in these two categories were reinspected to determine whether or not they could be assigned to a particular material type. Once the sort was complete, the raw material information was coded directly into a portable computer using a spreadsheet program. This was used to determine frequencies of materials at sites and within each of the valleys and to determine the frequencies for each of the material groups.

Establishing points of origin for raw materials used in chipped stone artifact manufacture has been an archaeological concern since at least the mid-1800s, when Squier and Davis (1848) speculated on the source of Hopewellian obsidian. Linking artifacts with their sources remained in the realm of conjecture until techniques that could match artifact and source on the basis of shared unique chemical composition were developed, including optical spectroscopy, x-ray fluorescence, and neutron activation analysis. The material most commonly the focus of such studies has traditionally been obsidian because it was widely traded prehistorically. Much variation in appearance exists within a single source of obsidian; therefore, chemical identification is necessary to determine the specific obsidian flow of origin (Cann & Renfrew, 1964).

TABLE C-2. Frequencies of Raw Material Groups Across the Three Valleys

Raw Material Source Group	Kayenta Valley	Long House Valley	Klethla Valley	Totals
Local unknown	436	224	211	871
Black Mesa	172	42	52	266
Kayenta	975	318	72	1,365
Klethla	194	140	495	829
Nonlocal south	62	6	31	99
Nonlocal north	1	0	1	2
Nonlocal unknown	5	0	1	6
Black Mesa/Mesa Verde	10	40	1	51
Material unknown	150	48	71	269
Totals	2,005	818	935	3,758

However, geologic source characterization (not bedrock outcrop) can be accomplished fairly accurately through visual means for many materials other than obsidian. Luedtke's (1976) analysis of Michigan cherts both through visual means and then verification through neutron activation analysis resulted in only an 8.7% discrepancy between the two methods. This error rate indicates that visual sorting of cherts is reliable within an acceptable error range. In assemblages with a wide variety of different raw material classes (e.g., petrified wood, sandstone, chert, baked siltstone, obsidian), the error rate Luedtke experienced during her study of cherts should be reduced. The assemblages involved in this study can be characterized as diverse and, therefore, the visual sort with the aid of a comparative source collection should be sufficient to characterize them.

For this study, 3,758 artifacts from 217 sites were analyzed. Kayenta Valley had 152 sites and 2,005 artifacts, Long House Valley had 7 sites and 818 artifacts, and Klethla Valley sites numbered 58 with a total of 935 artifacts. The average number of artifacts per site for the study was 17, but this figure differed considerably from valley to valley, largely because all sites in Long House Valley had been at least partially excavated, as had some of the sites in Klethla Valley. Sites in Kayenta Valley were known from the 1985 survey only. The average number of lithics per site in Kayenta Valley was 13; this figure at the Long House sites was 117, with an average of 16 artifacts per site in Klethla Valley.

All nine raw material groups were represented at sites in each of the three valleys, with two exceptions: Long House Valley sites had no materials from nonlocal north sources or from nonlocal unknown sources. As only two artifacts from nonlocal north sources and six from nonlocal unknown sources were found in the entire assemblage, the lack of materials from these sources

TABLE C-3. Percentages of Raw Material Groups Across the Three Valleys

Raw Material Source Group	Kayenta Valley	Long House Valley	Klethla Valley	Totals
Local unknown	0.22	0.27	0.23	0.23
Black Mesa	0.09	0.05	0.06	0.07
Kayenta	0.49	0.39	0.08	0.36
Klethla	0.10	0.17	0.53	0.22
Nonlocal south	0.03	0.01	0.03	0.03
Nonlocal north	0.00	0.00	0.00	0.00
Nonlocal unknown	0.00	0.00	0.00	0.00
Black Mesa/Mesa Verde	0.00	0.05	0.00	0.01
Material unknown	0.07	0.06	0.08	0.07
Totals	1.00	1.00	1.01	0.99

could be the result of sampling error and should not be regarded as significant. Tables C-2 and C-3 show the distributions, by frequency and percent, of the nine material groups across the three valleys.

Table C-3 illustrates the samples by percentage. Raw materials in two of the groups, local unknown and Black Mesa, were expected to be equally available to populations in all three valleys, and the table shows that the percentages of these raw material groups appear to reflect just such a situation. The material unknown group also is roughly equally distributed across the three drainages and probably reflects the fact that many of the cherts placed in this category actually belong in the local unknown group along with the other stream-deposited gravels.

It was expected that materials in the nonlocal south group would have been more readily available to populations in Klethla Valley, but according to the percentages in Table C-3, these materials appear to have been equally accessible to the three valleys. It may be that access to these materials was equal during the earlier time periods but changed with the onset of warfare in Pueblo III times. If the distribution shows the majority of nonlocal south materials to occur at pre-Pueblo III sites, then the model will still hold. Changes in distributions over time will be discussed below.

Two groups, nonlocal north and nonlocal unknown, are represented by so few artifacts that they are not apparent on the percentage table, and the frequencies table (table C-2) must be consulted. These sample sizes really are too low for meaningful analysis, but it will be interesting to see if their distributions support the hypothesized trends. Only two artifacts fell into the nonlocal north group, one from a Kayenta Valley site and one from a Klethla Valley site. As observed in Table C-2, this distribution does not appear to support the model, but might still support it if the single Klethla Valley site dates prior to the onset of the postulated Pueblo III hostilities. The nonlocal unknown materials, which include turquoise, chrysocolla, and malachite, are distributed unevenly, with five specimens at Kayenta Valley sites and only one at a Klethla Valley site. Again, sample sizes are small, but the postulated northern origin for these items would appear to be in accord with their distribution in the valley with the best access to northern sources.

The material from the Black Mesa/Mesa Verde group would appear to have been most readily available to Long House Valley sites (tables C-2, C-3). However, sample sizes are still relatively low, and in fact all 40 pieces of this material found in Long House Valley were found at one site, LHV73. Although a technological analysis was not completed at the same time as the raw material analysis, it was the impression of this author that most, if not all, of these 40 artifacts were flakes, possibly from a single core. Given the model of alliance, the distribution as it stands could be consistent with either a Mesa Verde or Black Mesa source for this material, and because the source is not known, this material cannot be used to help test the model of alliance and warfare.

Table C-3 indicates clear differences in the distributions of the Kayenta and Klethla material groups across the valleys in the directions expected (i.e., 49% Kayenta materials at Kayenta Valley sites and 53% Klethla materials at Klethla Valley sites). However, it should be realized that the high values of Kayenta materials at Kayenta Valley sites and the high values of Klethla materials at Klethla Valley sites could just as easily be supporting a mini–max model in which people maximized use of materials available in their own "backyards." The distributions of the two material groups at the Long House Valley sites (i.e., intermediate between the two other valleys in both cases, but considerably closer to Kayenta Valley patterns in both cases) would suggest that more than simple mini–max factors were in operation. The analysis of change over time in the distributions of these materials across the three valleys is looked to for more conclusive support of the model.

The chi-square statistic was chosen to test the model of restricted access to specific materials by populations in specific valleys during the Pueblo III period. Six sets of chi-square tests were performed to test the hypothesis on the Kayenta and Klethla Valley materials. Each was a two-way test with site data classes on one axis and a contrast between either Kayenta and Klethla materials and all other materials on the other axis. The significance level for the tests was 0.05.

Site dates were determined based on associated ceramics or the lack of ceramics and presence of diagnostic Archaic lithics. Sites were assigned period or phase dates such as Basketmaker III, Pueblo II, and Pueblo III–Tsegi Phase. The phases were combined into site date classes in two ways for purposes of analysis. The first breakdown recognizes two periods of occupation, pre-Tsegi Phase and Tsegi Phase, in order to compare raw material distributions dating to the phase most critical to the warfare model with patterns prior to that phase. As there is no reason in this analysis to keep sites that date

TABLE C-4. Number of Sites by Drainage and Date Class Used in Chi-square Analyses

Date Class	Kayenta Valley	Long House Valley	Klethla Valley	Totals
Undated	18	0	0	18
Pre-Tsegi	95	1	45	141
Span	6	3	5	14
Tsegi	33	3	8	44
Pre-Pueblo III	50	0	29	79
Span	12	2	8	22
Pueblo III	72	5	21	98
Total sites	152	7	58	217

to individual earlier phases separate, all phases prior to the Tsegi Phase were collapsed into the pre-Tsegi class. Once this division had been made, two groups of sites remained that were not included in the analysis. Eighteen sites that were mainly lithic scatters and could not be dated composed the first group. The second group includes 14 sites that span the two date class groups (i.e., were occupied both prior to and during the Tsegi Phase). As it would be very difficult to separate lithics from these multicomponent sites into pre-Tsegi and Tsegi assemblages, they have been deleted from this portion of the study. Table C-4 provides numbers of sites from each valley that fall into the different classes.

The second breakdown juxtaposes all Pueblo III sites with all earlier sites in an effort to ascertain whether or not the clear pattern of warfare visible at the Tsegi Phase sites had its roots earlier in the Pueblo III period. Again, sites that span the two periods under consideration and those that could not be assigned dates have been deleted from this portion of the analysis (Table C-4). Pairs of tests run on the same materials in the same valleys using the different temporal breakdowns will be discussed as a unit.

The first two tests were run on the Kayenta materials in Kayenta Valley. The null hypothesis, H0, for all the tests is that there is no significant association between site date and raw material distribution. In the Kayenta materials–Kayenta Valley case, as these materials were available within the valley, there is no reason to believe that a breakdown in relations with populations outside the valley would have affected access to locally available materials. However, a decrease in access to materials outside the valley may well have served to significantly increase the reliance on locally available materials. Therefore, the alternative hypothesis, H1, is that there is a significant relationship between site date and raw material use, specifically, that the use of locally available Kayenta materials increased during the Pueblo III period. This and all following tests are one-tailed tests because a specific

TABLE C-5. Chi-square Analysis for Kayenta Materials at Kayenta Sites during Pre-Tsegi and Tsegi Times

Era	Kayenta	Others	Totals
Pre-Tsegi	505	620	1,125
Tsegi	350	226	576
Totals	855	846	1,701

Pc1 = 0.502646 Pc1r1 = 565.4761
Pc2 = 0.497354 Pc2r1 = 559.5238
Pr1 = 0.661375 Pc1r2 = 289.5238
Pr2 = 0.338624 Pc2r2 = 286.4761

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	505	565.48	−60.48	3,657.37	6.47
b	620	559.52	60.48	3,657.37	6.54
c	350	289.52	60.48	3,657.37	12.63
d	226	286.47	−60.47	3,657.37	12.77
Totals	1,701	1,701	0		38.4

Chi-square = 38.4. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant. Oi = observed incidence, Ei = expected incidence.

direction for the association between variables is expected. At the 0.05 level, with 1 degree of freedom, the critical chi-square value for a one-tailed test is equivalent to that of the 0.025 value in a two-tailed test, or 5.02389. As can be seen in Table C-5, the chi-square value for this test was 38.4, which exceeds the critical value and calls for rejection of H0. In comparing the expected and observed values in the table, it is clear that this nonrandom association takes the direction suggested in H1, that of significantly increased use of Kayenta materials in the Kayenta Valley during the Tsegi Phase.

Table C-6 depicts the outcome of the paired test on the use of Kayenta Valley materials at Kayenta Valley sites both at pre-Pueblo III and Pueblo III sites. The results are again significant, with a chi-square value of 52.22, suggesting that relationships outside the valley may have begun to break down prior to the Tsegi Phase.

The next pair of tests was to have been on the distribution of Kayenta materials at Long House Valley sites. However, only the test using the pre-Tsegi and Tsegi date classes could be run because none of the seven sites analyzed from Long House Valley were occupied exclusively prior to Pueblo III. The results for the test that could be run were not significant (table C-7), thereby suggesting, counter to the model proposed, that in Long House Valley there was no association between raw material use and period of site occupation. The numbers provided in Table C-4 are instructive in the evaluation

TABLE C-6. Chi-square Analysis for Kayenta Materials at Kayenta Sites during Pre-Pueblo III and Pueblo III Times

Era	Kayenta	Others	Totals
Pre-Pueblo III	207	339	546
Pueblo III	631	480	1,111
Totals	838	819	1,657

Pc1 = 0.505733 Pc1r1 = 276.1303
Pc2 = 0.494267 Pc2r1 = 269.8696
Pr1 = 0.329511 Pc1r2 = 561.8696
Pr2 = 0.670488 Pc2r2 = 549.1303

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	207	276.13	−69.13	4,779.01	17.31
b	339	269.87	69.13	4,779.01	17.71
c	631	561.87	69.13	4,779.01	8.51
d	480	549.13	−69.13	4,779.01	8.70
Totals	1,657	1,657	0		52.22

Chi-square = 52.22. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

TABLE C-7. Chi-square Analysis for Kayenta Materials at Long House Sites during Pre-Tsegi and Tsegi Times

Era	Kayenta	Others	Totals
Pre-Tsegi	13	31	44
Tsegi	169	297	466
Totals	182	328	510

Pc1 = 0.356862 Pc1r1 = 15.70196
Pc2 = 0.643137 Pc2r1 = 28.29803
Pr1 = 0.086274 Pc1r2 = 166.2980
Pr2 = 0.913725 Pc2r2 = 299.7019

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	13	15.70	−2.70	7.30	0.46
b	31	28.30	2.70	7.30	0.26
c	169	166.30	2.70	7.30	0.04
d	297	299.70	−2.70	7.30	0.02
Totals	510	510	0		0.791

Chi-square = 0.791. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results not significant.

TABLE C-8. Chi-square Analysis for Kayenta Materials at Klethla Sites during Pre-Tsegi and Tsegi Times

Era	Kayenta	Others	Totals
Pre-Tsegi	43	335	378
Tsegi	23	450	473
Totals	66	785	851

Pc1 = 0.077555 Pc1r1 = 29.31609
Pc2 = 0.922444 Pc2r1 = 348.6839
Pr1 = 0.444183 Pc1r2 = 36.68390
Pr2 = 0.555816 Pc2r2 = 436.3160

Outcome	Oi	Ei	Oi − Ei	$(Oi - Ei)^2$	$(Oi - Ei)^2 \div Ei$
a	43	29.32	13.68	187.25	6.39
b	335	348.68	−13.68	187.25	0.54
c	23	36.68	−13.68	187.25	5.10
d	450	436.32	13.68	187.25	0.43
Totals	851	851	0		

Chi-square = 12.458. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

TABLE C-9. Chi-square Analysis for Kayenta Materials at Klethla Sites during Pre-Pueblo III and Pueblo III Times

Era	Kayenta	Others	Totals
Pre-Pueblo III	29	213	242
Pueblo III	39	602	641
Totals	68	815	883

Pc1 = 0.077010 Pc1r1 = 18.63646
Pc2 = 0.922989 Pc2r1 = 223.3635
Pr1 = 0.274065 Pc1r2 = 49.36353
Pr2 = 0.725934 Pc2r2 = 591.6364

Outcome	Oi	Ei	Oi − Ei	$(Oi - Ei)^2$	$(Oi - Ei)^2 \div Ei$
a	29	18.64	10.36	107.40	5.76
b	213	223.36	−10.36	107.40	0.48
c	39	49.36	−10.36	107.40	2.18
d	602	591.64	10.36	107.40	0.18
Totals	883	883	0		8.60

Chi-square = 8.601. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

TABLE C-10. Chi-square Analysis for Klethla Materials at Kayenta Sites during Pre-Tsegi and Tsegi Times

Era	Klethla	Others	Totals
Pre-Tsegi	129	996	1,125
Tsegi	35	541	576
Totals	164	1,537	1,701

Pc1 = 0.096413 Pc1r1 = 108.4656
Pc2 = 0.903586 Pc2r1 = 1,016.534
Pr1 = 0.661375 Pc1r2 = 55.53439
Pr2 = 0.338624 Pc2r2 = 520.4656

Outcome	Oi	Ei	Oi − Ei	$(Oi - Ei)^2$	$(Oi - Ei)^2 \div Ei$
a	129	108.47	20.53	421.66	3.89
b	996	1,016.53	−20.53	421.66	0.41
c	35	55.53	−20.53	421.66	7.59
d	541	520.47	20.53	421.66	0.81
Totals	1,701	1,701	0		12.71

Chi-square = 12.705. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

TABLE C-11. Chi-square Analysis for Klethla Materials at Kayenta Sites during Pre-Pueblo III and Pueblo III Times

Era	Klethla	Others	Totals
Pre-Pueblo III	67	479	546
Pueblo III	91	1,020	1,111
Totals	158	1,499	1,657

Pc1 = 0.095353 Pc1r1 = 52.06276
Pc2 = 0.904646 Pc2r1 = 493.9372
Pr1 = 0.329511 Pc1r2 = 105.9372
Pr2 = 0.670488 Pc2r2 = 1,005.062

Outcome	Oi	Ei	Oi − Ei	$(Oi - Ei)^2$	$(Oi - Ei)^2 \div Ei$
a	67	52.06	14.94	223.12	4.29
b	479	493.94	−14.94	223.12	0.45
c	91	105.94	−14.94	223.12	2.11
d	1,020	1,005.06	14.94	223.12	0.22
Totals	1,657	1,657	0		7.065

Chi-square = 7.065. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

of these results. It should be noted that as compared to 95 sites in Kayenta Valley and 45 sites in Klethla Valley occupied prior to the Tsegi Phase, only one in Long House Valley was occupied at this time. Therefore, although the artifact numbers were high enough to make the test valid, all of the artifacts were from a single site. It is questionable whether a single site can be truly representative of the situation in this entire valley and strongly recommended that data from more sites in Long House Valley be added before reaching the conclusion that Long House Valley was not affected by the postulated alliance and hostility situation.

The final set of tests on the Kayenta materials was performed on the Klethla Valley sites. In this case the alternative hypothesis is that, owing to more restricted access to the materials and/or their sources because of hostilities with populations near those sources, the proportions of Kayenta Valley materials found at Klethla Valley sites should be significantly lower than would be expected by chance alone. The chi-square result (12.458) was above the critical value, thereby supporting the alternative hypothesis of restricted access (table C-8). Table C-9 shows that the same pattern held true throughout the Pueblo III period.

The next set of tests was run for the materials available in Klethla Valley, beginning with Kayenta Valley sites. Here, the alternative hypothesis is the same as in the test above: a significant decrease in use of these materials is expected to have occurred with the onset of hostilities. Table C-10 reveals that the results were significant, thereby supporting the alternative hypothesis of restricted access during the Tsegi Phase as opposed to all earlier phases combined. Again, the pattern held true throughout the Pueblo III period, as seen by the significant results in Table C-11.

The test was run for the Klethla materials at Long House sites, but the same data restrictions apply here as before. The nonsignificant result depicted in Table C-12 should be questioned as to whether it is truly representative of the situation in Long House Valley.

The final set of tests for the Kayenta and Klethla materials was run for Klethla materials at Klethla sites. The alternative hypothesis here is that the use of these locally available materials should have increased significantly as access to materials in Kayenta Valley became more restricted. Tables C-13 and C-14 show that this was the case both for the Tsegi Phase and for Pueblo III as a whole.

Another group of tests was run for materials from nonlocal sources to the south at the Kayenta and Klethla sites. The tests could not be run for Long House Valley sites because only six artifacts from this source group occurred at those sites. These six artifacts were found at two Tsegi Phase sites, which is counter to the model, but again sample sizes were too low to be really meaningful.

The first pair of tests was run on nonlocal south materials at Kayenta sites. Neither of the tests (tables C-15, C-16) was significant. In other words, there was not a significant association between site date and access to materials

TABLE C-12. Chi-square Analysis for Klethla Materials at Long House Sites during Pre-Tsegi and Tsegi Times

Era	Klethla	Others	Totals
Pre-Tsegi	6	38	44
Tsegi	65	401	466
Totals	71	439	510

Pc1 = 0.139215 Pc1r1 = 6.125490
Pc2 = 0.860784 Pc2r1 = 37.87450
Pr1 = 0.086274 Pc1r2 = 64.87450
Pr2 = 0.913725 Pc2r2 = 401.1254

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	6	6.13	−0.13	0.02	0.003
b	38	37.87	0.13	0.02	0.0004
c	65	64.87	0.13	0.02	0.0002
d	401	401.13	−0.13	0.02	0.00004
Totals	510	510	0		0.003

Chi-square = 0.003. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results not significant.

TABLE C-13. Chi-square Analysis for Klethla Materials at Klethla Sites during Pre-Tsegi and Tsegi Times

Era	Klethla	Others	Totals
Pre-Tsegi	162	216	378
Tsegi	276	197	473
Totals	438	413	851

Pc1 = 0.514688 Pc1r1 = 194.5522
Pc2 = 0.485311 Pc2r1 = 183.4477
Pr1 = 0.444183 Pc1r2 = 243.4477
Pr2 = 0.555816 Pc2r2 = 229.5522

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	162	194.55	−32.55	1,059.65	5.45
b	216	183.45	32.55	1,059.65	5.78
c	276	243.45	32.55	1,059.65	4.35
d	197	229.55	−32.55	1,059.65	4.62
Totals	851	851	0		20.192

Chi-square = 20.192. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

available nonlocally with sources to the south. Table C-16 shows a slightly lower frequency than would be expected by chance alone, but this difference is too small to be statistically significant.

The second pair of tests was run on nonlocal south materials at Klethla sites. Both of these tests had significant results. However, the patterns evidenced in comparing the expected and observed values in Tables C-17 and C-18 are opposite to those expected under the model. That is, rather than evidencing an increase in materials available to the south once ties had broken down to the north, the supply of these materials decreased significantly.

Chi-square tests could not be run on the nonlocal north materials, but the frequency distribution was examined to determine if it trended in accord with the model. Expectations would be that if nonlocal materials with sources to the north were found at sites, they would be at all sites during the early period, but only at Kayenta and/or Long House sites during the period of hostility. Only one artifact from a nonlocal source to the north was found at a Kayenta site, and this site dated to the Pueblo III phases prior to the Tsegi Phase. No artifacts from nonlocal sources to the north were found at Long House Valley sites. A single artifact from one of these sources was found at the Klethla Valley site, but the site dated to the Tsegi Phase. Thus, the single artifact from a nonlocal source to the north found at a Klethla Valley site conflicts with the proposed model, but sample size again was too low to be meaningful.

The statistical analyses performed on the three groups of material, Kayenta sources, Klethla sources, and nonlocal sources to the south, had some conflicting results. The distributions of the Kayenta and Klethla materials within those two valleys conformed extremely well to the model of restricted access over time. From these analyses it appears that there was a breakdown in relations beginning at least in early Pueblo III times and certainly continuing into the Tsegi Phase. This analysis cannot ascertain whether the decrease in raw materials represents a denial of access to sources or a breakdown in trade relations, but regardless of the mechanism of acquisition, the people in these opposing valleys were acquiring these materials in significantly lower numbers than they had prior to the onset of the Pueblo III period.

No significant change was apparent among the Long House Valley sites, contrary to the model proposed in which populations in Long House Valley were allied with those in Kayenta Valley but estranged from Klethla Valley populations. However, as pointed out in the testing section, although sample numbers were adequate for testing, the number of sites ($n = 1$) in the pre-Tsegi occupation class really is too small to assume that it accurately characterizes the situation in that valley. More sites dating to the earlier periods will have to be added to the analysis before the test results can be used to evaluate the model.

The nonlocal south materials evidenced significant patterning in Klethla Valley that was contrary to the model. That is, rather than an increase in materials from nonlocal southern sources, there was a significant decrease

TABLE C-14. Chi-square Analysis for Klethla Materials at Klethla Sites during Pre-Pueblo III and Pueblo III Times

Era	Klethla	Others	Totals
Pre-Pueblo III	110	132	242
Pueblo III	359	282	641
Totals	469	414	883

Pc1 = 0.531143 Pc1r1 = 128.5368
Pc2 = 0.468856 Pc2r1 = 113.4631
Pr1 = 0.274065 Pc1r2 = 340.4631
Pr2 = 0.725934 Pc2r2 = 300.5368

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	110	128.54	−18.54	343.61	2.67
b	132	113.46	18.54	343.61	3.03
c	359	340.46	18.54	343.61	1.01
d	282	300.54	−18.54	343.61	1.14
Totals	883	883	0		7.854

Chi-square = 7.854. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

TABLE C-15. Chi-square Analysis for Nonlocal (NL) South Materials at Kayenta Sites during Pre-Tsegi and Tsegi Times

Era	NL South	Others	Totals
Pre-Tsegi	29	1,096	1,125
Tsegi	15	561	576
Totals	44	1,657	1,701

Pc1 = 0.025867 Pc1r1 = 29.10052
Pc2 = 0.974132 Pc2r1 = 1,095.899
Pr1 = 0.661375 Pc1r2 = 14.89947
Pr2 = 0.338624 Pc2r2 = 561.1005

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)²	(Oi − Ei)² ÷ Ei
a	29	29.10	−0.10	0.01	0.0003
b	1,096	1,095.90	0.10	0.01	0.000009
c	15	14.90	0.10	0.01	0.0006
d	561	561.10	−0.10	0.01	0.00001
Totals	1,701	1,701	0		0.001

Chi-square = 0.001. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results not significant.

TABLE C-16. Chi-square Analysis for Nonlocal (NL) South Materials at Kayenta Sites during Pre-Pueblo III and Pueblo III Times

Era	NL South	Others	Totals
Pre-Pueblo III	16	530	546
Pueblo III	25	1,086	1,111
Totals	41	1,616	1,657

Pc1 = 0.024744 Pc1r1 = 13.50995
Pc2 = 0.975256 Pc2r1 = 532.4900
Pr1 = 0.329511 Pc1r2 = 27.49004
Pr2 = 0.670488 Pc2r2 = 1,083.509

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)^2	(Oi − Ei)^2 ÷ Ei
a	16	13.51	2.49	6.20	0.46
b	530	532.49	−2.49	6.20	0.01
c	25	27.49	−2.49	6.20	0.23
d	1,086	1,083.51	2.49	6.20	0.01
Totals	1,657	1,657	0		0.702

Chi-square = 0.702. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results not significant.

TABLE C-17. Chi-square Analysis for Nonlocal (NL) South Materials at Klethla Sites during Pre-Tsegi and Tsegi Times

Era	NL South	Others	Totals
Pre-Tsegi	19	359	378
Tsegi	10	463	473
Totals	29	822	851

Pc1 = 0.034077 Pc1r1 = 12.88131
Pc2 = 0.965922 Pc2r1 = 365.1186
Pr1 = 0.444183 Pc1r2 = 16.11868
Pr2 = 0.555816 Pc2r2 = 456.8813

Outcome	Oi	Ei	Oi − Ei	(Oi − Ei)^2	(Oi − Ei)^2 ÷ Ei
a	19	12.88	6.12	37.44	2.91
b	359	365.12	−6.12	37.44	0.10
c	10	16.12	−6.12	37.44	2.32
d	463	456.88	6.12	37.44	0.08
Totals	851	851	0		5.414

Chi-square = 5.414. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

TABLE C-18. Chi-square Analysis for Nonlocal (NL) South Materials at Klethla Sites during Pre-Pueblo III and Pueblo III Times

Era	NL South	Others	Totals
Pre-Pueblo III	19	223	242
Pueblo III	10	631	641
Totals	29	854	883

Pc1 = 0.032842 Pc1r1 = 7.947904
Pc2 = 0.967157 Pc2r1 = 234.0520
Pr1 = 0.274065 Pc1r2 = 21.05209
Pr2 = 0.725934 Pc2r2 = 619.9479

Outcome	Oi	Ei	Oi − Ei	$(Oi - Ei)^2$	$(Oi - Ei)^2 \div Ei$
a	19	7.95	11.05	122.15	15.37
b	223	234.05	−11.05	122.15	0.52
c	10	21.05	−11.05	122.15	5.80
d	631	619.95	11.05	122.15	0.20
Totals	883	883	0		21.89

Chi-square = 21.89. df = 1. Critical value for one-tailed test at 0.05 level = 5.02389. Results significant.

in those materials in the Pueblo III period and the Tsegi Phase. Several explanations are possible. First, the assumption that obsidian was obtained from sources to the south, based on the patterns evidenced by the Black Mesa chipped stone assemblage, might be in error. If it is found that obsidian actually originated to the north, this pattern might actually be supporting the model. It would be worth having a sample of the obsidian artifacts from the study area traced to their sources to be certain. Second, it is possible that at the same time ties were breaking down with neighboring valleys to the north, ties with traders or source areas to the south also were dissolving. The nonlocal materials with sources to the north were few in numbers, with a single artifact conflicting with the model.

In summary, it would appear that the chipped stone raw material analysis largely supported the model of decreased interaction between the Kayenta and Klethla valleys during the Pueblo III period, and the Tsegi Phase in particular.

The discussion earlier regarding the utility of chipped stone raw materials in studies of interaction was not meant to imply that tracing chipped stone raw materials to their sources is an effortless task, merely that the effort expended in conducting such a study has tremendous benefits. The performance of a chipped stone raw material analysis for this study would not have been possible without the years of support provided by the Black Mesa

Archaeological Project in the development of a comparative source collection. In addition to those in charge of the project, Drs. George Gumerman, Stephen Plog, and Shirley Powell, I am indebted to U.S.G.S. geologist J. Philip Schafer, whose knowledge of the target area aided the original source survey immensely.

APPENDIX D

TEMPER ANALYSIS OF CERAMICS

William A. Lucius
Cortez, Colorado

Analysis of sherds from the Kayenta, Long House, and Klethla valleys was undertaken to examine possible exchange of ceramics among valleys as a measure of their levels of interaction during the Tsegi Phase. A total of 950 Tusayan and Kayenta Black-on-white sherds were analyzed, from nine sites in Kayenta Valley, six sites in Long House Valley, and five sites in Klethla Valley. Sherds were identified by site number and typological group. Valley and site location data were not provided until after completion of the analysis.

Determination of intraregional ceramic movements initially requires identification of temper and paste combinations that can be correlated with specific locales of manufacture. This approach is based in part on the provenience postulate (Weigand et al., 1977:24), that variability between individual temper and clay sources is greater than variability within any particular source. Ceramics found in areas other than their locale of manufacture indicate exchange or other interaction (Lucius, 1981). Kayenta whiteware ceramics were selected for analysis because they exhibit a wide range of temper and clay types that suggest numerous production locales.

Geib and Callahan (1985) have documented the use of volcanic ash as a tempering agent in ceramics in Klethla Valley. Ceramic analysis undertaken by this author has shown that a fine-textured, crushed sandstone was consistently selected for ceramic production in the Hard Rocks area in southern Utah. These apparent production locales defined by temper are called tracts (Lucius, 1981), and indicate there was consistent selection of a specific tempering agent for ceramic production that varied from place to place (Arnold, 1971:39; Shepard, 1936:389). The Klethla tract represents an area of ceramic production in Klethla Valley that is identified by pottery with volcanic ash temper. Fine sandstone temper suggests the Hard Rocks tract as the production location. The geographic location of the remaining tracts is presently unknown, and they will be referred to by their associated temper types (e.g., coarse sand).

Temper-type identification was carried out with a 20× binocular microscope. Each sherd was nipped with pliers to create a fresh surface and viewed under magnification to identify temper constituents. Tempering agents recorded are described in Table D-1. This characterization was used to assign each sherd to a production tract.

Each tract was subdivided into smaller production locales or zones by analysis of refiring color (Bishop, 1980:47). Refiring analysis entails heating the sherd nips created by temper analysis in an oxidizing atmosphere to 950° C. An electric kiln with a standardized time–temperature curve is used to bring all samples to a comparable state and to allow oxidation of the iron fraction of the clay. Since iron is the primary element used to characterize separate clay sources (Shepard, 1936:494), refiring identifies different clay types within each tract.

Each tract and included zones are shown in Table D-2. Zones are labeled by refiring color until their geographic location within the tract can be determined. Empty cells in the chart indicate that those particular combinations of temper type and refired clay colors are possible but did not occur within this data set. The "00" color designation includes white burning clays with low iron content. The "VIT" designation refers to sherds that could not be assigned a specific color category because they were fired or refired prehistorically at temperatures that vitrified the clay body (Shepard, 1936:23).

Data produced by the analysis included provenience, typological category, and tract and zone assignments. Summary and comparisons are not based on sherd counts, however, but on weight of sherds from each provenience. Sample sizes are extremely variable, and percentages based on weight in grams were believed to provide the best interpretation of the data.

Data Collected

Ceramic collections from sites in the research area were examined by tract and zone affiliation. If specific valleys within the research area were allied during this period, they might reveal similar ceramic assemblages owing to interaction and exchange of goods (Chagnon, 1968:100). In contrast, the marked gap in settlement between Long House and Klethla valleys might represent an alliance boundary that would be reflected archaeologically in the absence of ceramic exchange from known production locales in Klethla Valley into the adjacent valleys.

Ceramic profiles, that is, the Tsegi whiteware sample from each site, presented by tract, were used to summarize and compare data from each valley. This approach was used because standard statistical measures, which are based on item counts, cannot be used to summarize the weight-derived percentages presented here.

The ceramic profile for Kayenta Valley (table D-3A) indicates that the individual sites within the valley are generally similar. Klethla tract ceramics constitute the majority of associated ceramics in all sites except LCD-174,

TABLE D-1. Temper-Type Descriptions

Temper type	Description
Ash	
Ash and sand	Composed of thin, curvilinear plates of volcanic ash with equal or greater amounts of a medium-sized, clear rounded quartz sand.
Volcanic ash	Composed of thin, curvilinear plates of volcanic glass that give the appearance of broken light bulb glass. Quartz sand is present as a minor accessory.
Sand	
Fine	Composed of copious amounts of small, rounded clear quartz grains that give the sherd break the appearance of fine-grained sandstone. Sand grains reveal iron staining upon refiring.
Coarse	Composed primarily of large subangular frosted quartz grains with occasional nonquartz accessories.
Sandstone	
Fine	Composed primarily of small, subangular quartz grains often in isolation but usually within a white cementing matrix indicative of a crushed sandstone origin.
Medium	Composed primarily of medium-sized, subangular quartz grains often in isolation but usually within a white cementing matrix indicative of a crushed sandstone origin.
Coarse	Composed primarily of large, subangular quartz grains most often in isolation but with occasional occurrences of a white cementing matrix indicative of a crushed sandstone matrix.
Sherd	
Fine	Composed of small fragments of crushed sherd that often can be seen to contain small to medium fragments of sand or sandstone as the original tempering agent.
Coarse	Composed of large fragments of crushed sherd usually accompanied by large quartz sand fragments that have been broken away from the sherd matrix by crushing.

TABLE D-2. Ceramic Profile, Tract by Zone, Tsegi Phase Whiteware Ceramics, All Valleys

	Color*							
Tract	00	5YR 6/8	5YR 7/6	7.5YR 7/6	7.5YR 8/4	10YR 8/4	VIT	All
Klethla	29.9		0.1	0.4	14.2	33.8	21.7	100
Hard Rocks	9.5	0.7	0.7	3.8	37.5	36.0	11.8	100
Ash and sand	42.5			4.0	6.0	31.2	16.3	100
Fine sand	3.0		2.4		67.1	24.8	2.7	100
Coarse sand				73.7	17.0	9.4		100
Fine sherd	3.7			10.1	53.5	19.8	12.9	100
Coarse sherd	18.0		3.1	20.3	51.3	6.8	0.5	100
Medium sandstone	57.4			3.3	5.1	31.6	2.6	100
All	24.6	0.1	0.5	3.8	23.0	31.3	16.7	100

* Munsell soil colors.

with ceramics from the Hard Rocks tract slightly more common than those exhibiting coarse sherd temper. The high percentage of ceramics from the Hard Rocks tract at LCD-174 and the lack of Klethla tract items probably results from sampling error, as the collection from LCD-174 includes only five sherds. The high percentage of medium sandstone tempered ceramics at LCD-177 is also likely to result from the low number of sherds in the sample from that site. By the same token, the high percentage of Klethla tract ceramics at LCD-50 appears to accurately represent the collection and is not a result of small sample size.

TABLE D-3A. Ceramic Profile, Site No. by Tract, Tsegi Phase Whiteware Ceramics, Kayenta Valley

	Tract*								
Site	KL	HR	AS	FS	CS	FH	CH	MS	All
LCD-9	76.9	4.5				8.7	7.9	2.0	100
LCD-20	41.4	22.1				3.3	33.2		100
LCD-50	94.8	5.2							100
LCD-52	35.9	9.1	14.2	5.9	5.9		29.0		100
LCD-93	58.7	19.6					21.7		100
LCD-166	62.2	11.2			9.5	5.4	11.6		100
LCD-169	50.1	16.5	2.1	11.5		5.3	14.6		100
LCD-174		46.3			14.6		39.0		100
LCD-177	44.4	16.6			5.8			33.2	100
All	51.9	12.6	5.2	2.9	2.8	2.2	20.7	1.8	100

* For abbreviations, see "Tract" column in Table D-2: e.g., KL = Klethla, HR = Hard Rocks, and so on.

TABLE D-3B. Ceramic Profile, Site No. by Tract, Tsegi Phase Whiteware Ceramics, Long House Valley

	Tract*								
Site	KL	HR	AS	FS	CS	FH	CH	MS	All
LH	79.6	12.2	6.6					1.6	100
TH	52.2		11.9	14.9			20.9		100
LHV6	38.2	25.4				9.6		26.8	100
LHV31	37.5	31.3						31.3	100
LHV72	86.8	7.1	3.3	1.3			1.5		100
LHV73	85.8	4.8					9.3		100
All	78.6	9.7	3.1	0.5		0.9	4.0	3.2	100

LH = Long House, TH = Tower House.
* For abbreviations, see "Tract" column in Table D-2.

Comparison of the Long House (table D-3B) and Kayenta Valley ceramic profiles shows similarity between the two valleys. Klethla tract ceramics predominate in Long House Valley sites. Hard Rocks tract ceramics occur in quantities similar to those seen in Kayenta Valley sites (4.5–46.3%) and in Long House Valley (4.8–31.3%), with the exception of Tower House, where none were identified. Once again, the sample size from Tower House is small and probably accounts for the absence of Hard Rocks tract ceramics. The quantity of coarse sherd tempered ceramics decreases from Kayenta to Long House Valley, and coarse sand tempered ceramics are not present in the Long House Valley samples, while they were present at half the sites sampled in Kayenta Valley.

The decline in coarse sherd tempered ceramics may indicate that these were produced in Kayenta Valley and exchanged to Long House Valley sites, with fall-off in quantity over distance. The absence of whiteware with coarse

TABLE D-3C. Ceramic Profile, Site No. by Tract, Tsegi Phase Whiteware Ceramics, Klethla Valley

	Tract*								
Site	KL	HR	AS	FS	CS	FH	CH	MS	All
UKV-77	56.3	37.8	5.6					0.4	100
UKV-75	52.6	31.8	2.4	6.0		2.6	4.7		100
UKV-80	49.9	31.0	6.4	6.0		1.7	5.0		100
UKV-92	75.5	17.1	3.4	2.2		1.8			100
UKV-115	63.0	29.1	6.3					1.6	100
All	60.1	30.6	5.3	1.5		0.7	1.0	0.7	100

* For abbreviations, see "Tract" column in Table D-2.

TABLE D-4A. Ceramic Profile, Tract by Zone, Tsegi Phase Whiteware Ceramics, Klethla Valley

	Color†							
Tract*	00	5YR 6/8	5YR 7/6	7.5YR 7/6	7.5YR 8/4	10YR 8/4	VIT	All
KL	23.3		0.2	0.4	11.4	35.2	29.5	100
HR	4.1	0.9	1.0	1.8	41.4	36.2	14.5	100
AS	10.4			7.5	3.1	50.5	28.5	100
FS			5.8		34.8	59.4		100
CS								
FH					27.1	72.9		100
CH	52.2		39.1				8.7	100
MS	24.6					75.4		100
All	16.5	0.3	0.9	1.2	20.4	36.9	23.8	100

* For abbreviations, see "Tract" column in Table D-2.
† Munsell soil colors.

sand temper in Long House Valley may also reflect distance fall-off from a production locale in Kayenta Valley or further distant. The relatively high percentages of medium sandstone tempered ceramics in LHV6 and LHV31 and the rarity of items with that temper type in Kayenta Valley might indicate the proximity of those sites to a center of production.

Comparing the Kayenta and Long House valleys by tracts and zones (table D-5) illustrates some differences between valleys. Klethla tract ceramics are similar in both valleys, with one more zone present in the Long House Valley

TABLE D-4B. Ceramic Profile, Tract by Zone, Tsegi Phase Whiteware Ceramics, Kayenta Valley

	Color†							
Tract*	00	5YR 6/8	5YR 7/6	7.5YR 7/6	7.5YR 8/4	10YR 8/4	VIT	All
KL	36.9				19.9	32.5	10.7	100
HR	21.3			12.5	34.3	30.6	1.3	100
AS	97.1					2.9		100
FS					100.0			100
CS				73.7	17.0	9.4		
FH	6.1			16.8	55.7		21.4	100
CH	9.3			23.8	60.2	6.8		100
MS	86.8				13.2			100
All	30.5			8.9	31.9	22.5	6.2	100

* For abbreviations, see "Tract" column in Table D-2.
† Munsell soil colors.

TABLE D-4C. Ceramic Profile, Tract by Zone, Tsegi Phase Whiteware Ceramics, Long House Valley

	Color†							
Tract*	00	5YR 6/8	5YR 7/6	7.5YR 7/6	7.5YR 8/4	10YR 8/4	VIT	All
KL	35.4			1.1	12.9	32.3	18.4	100
HR	29.6				9.6	47.2	13.6	100
AS	25.3				40.0	26.3	8.4	100
FS								
CS								
F					100.0			100
CH	80.6		8.1			11.3		100
MS	47.5			8.9		36.6	6.9	100
All	36.5		0.3	1.2	13.1	32.4	16.5	100

* For abbreviations, see "Tract" column in Table D-2.
† Munsell soil colors.

collections than in the Kayenta Valley collections. Hard Rocks tract ceramics show greater variation, with one less zone present in Long House Valley samples than in Kayenta samples, but also different percentages of ceramics from each zone in each valley. This could reflect the greater number of vitrified items in Long House Valley than in Kayenta Valley, or it may indicate variation in the source of Hard Rocks tract ceramics for each valley.

In the Klethla Valley ceramic profile, sites appear to be largely consistent in the presence of ceramics from the Klethla and Hard Rocks tracts (table D-5). Sampling error would be greatest in the collection from UKV-80, which is less than half the size of the next largest collection. The percentages of temper types, however, correspond to the other sites in Klethla Valley. The Klethla Valley profile is similar to that of Long House Valley, especially in the absence of coarse sand tempered items (table D-5). This further supports the likelihood of a coarse sand tempered whiteware source in Kayenta Valley (table D-5). This is also true for coarse sherd tempered whiteware, as the quantity of this temper type decreases from Kayenta Valley to Long House Valley to Klethla Valley. Fine sherd temper is usually present in smaller quantities than coarse sherd temper in each valley, and the two temper types may be related by proximity of source locations. Medium sandstone temper is present in Klethla Valley in extremely small amounts and may come from Long House Valley, or from a location entirely outside the research area.

Temper types that appear to come from Klethla Valley are the Klethla tract, or volcanic ash, ash and sand, present at all sampled Klethla Valley sites. Hard Rocks tract ceramics are also present at all sampled sites in Klethla Valley and appear to have been extensively exchanged into the research area. Only the fine sand tempered items do not show distinct patterning based on the samples tested.

TABLE D-5. Site No. by Tract, Tsegi Phase Whiteware Ceramics, All Valleys

Site	KL	HR	AS	FS	CS	FH	CH	MS	All
Kayenta Valley									
LCD-9	8	2				1	1	1	13
LCD-20	16	6				2	8		32
LCD-50	19	1							20
LCD-52	21	3	3	1	1		7		36
LCD-93	16	4					7		27
LCD-166	6	3			1	1	1		12
LCD-169	15	5	1	1		1	3		26
LCD-174		2			1		2		5
LCD-177	4	1			1			1	7
Total	105	27	4	2	4	5	29	2	178
Long House Valley									
LH	53	8	6					2	69
TH	6		1	1			2		10
LHV6	7	4				1		5	17
LHV31	1	2						1	4
LHV72	26	3	1	1			1		32
LHV73	26	3					3		32
Total	119	20	8	2		1	6	8	164
Klethla Valley									
UKV-77	57	27	5					1	90
UKV-75	28	19	2	2		2	2		55
UKV-80	14	6	1	1		1	1		24
UKV-92	47	15	2	1		1			66
UKV-115	62	35	7					2	106
Total	208	102	17	4		4	3	3	341
All valleys	432	149	29	8	4	10	38	13	683

For abbreviations, see "Tract" column in Table D-2.

Discussion

Petrographic examination of 950 sherds from 20 sites in Kayenta, Long House, and Klethla valleys revealed that different temper sources were used in making whitewares found in the three valleys. Volcanic ash (Klethla tract), fine sandstone (Hard Rocks tract), coarse sherd, and coarse sand are the temper types most often employed in whitewares of Kayenta Valley. Volcanic ash, fine sandstone, and medium sandstone are tempers of most frequent use in Long House Valley, while volcanic ash, fine sandstone, and ash and sand temper are the most frequently used temper in whiteware of Klethla Valley.

Volcanic ash (Klethla tract) temper was the most widely used in whitewares

TABLE D-6. Site No. by Tract, Pre-Tsegi Phase Whiteware Ceramics, All Valleys

Site	KL	HR	AS	FS	CS	FH	CH	MS	CS	All
Kayenta Valley										
LCD-9							2	2	2	6
LCD-20		1							1	2
LCD-50										
LCD-52			1			1	2	2	1	7
LCD-93		2						1	2	5
LCD-166						1				1
LCD-169						3	1			4
LCD-174		1					7	2		10
LCD-177										
Total		4	1			2	14	8	6	35
Long House Valley										
LH	1	9	1				1	9	1	22
TH		5		1			4	10	2	22
LHV6	1	6				2		14		23
LHV31		11				2		13	11	37
LHV72		2					2	3	5	12
LHV73	1	3	1		6		3	4		18
Total	3	36	2	1	6	4	10	53	19	134
Klethla Valley										
UKV-77	7	3	1						1	12
UKV-75		2								2
UKV-80	4	7	1		1	1		3	1	18
UKV-92	5	4								9
UKV-115	1							1		2
Total	17	16	2		1	1		4	2	43
All valleys	20	56	5	1	7	7	24	65	27	212

For abbreviations, see "Tract" column in Table D-2.

across the entire research area. The known source for volcanic ash is located in Klethla Valley (Geib & Callahan, 1985). Either the bulk of whitewares used in the research area were produced in Klethla Valley and distributed widely, or sources of volcanic ash other than the ones that have been identified to date also exist. Since the identified sources occur in the escarpment of Black Mesa, it is possible that outcrops of volcanic ash occur all across the base of the formation, which forms the southern boundary of the research area. In this case, volcanic ash could have come from several sources, all approximately the same distance from target sites as the Klethla source is from sampled sites in Klethla Valley.

Fine sandstone (Hard Rocks tract) temper was also widely used in whitewares throughout the study area. This temper appears to have a source north of the valleys sampled, and whitewares would have been distributed widely from that zone. However, sandstone forms the majority of rock outcrops all across the research area and could well have been ground for temper in numerous localities. In the material examined it seems most likely that fine sandstone represents a specific group of whitewares produced in one area. Medium sandstone temper, which is more variable in occurrence, in the whitewares examined is likely to have been produced in numerous localities as needed for locally made whitewares.

Coarse sherd and coarse sand tempers appear to be used in ceramics predominantly from Kayenta Valley. Coarse sand tempered whitewares were not recorded from Long House or Klethla Valley, implying a production locality or ceramic type produced in Kayenta Valley that was not exchanged outward. Coarse sherd temper was found in whitewares from most of the Kayenta Valley sites sampled, though much less coarse sherd temper was used in Long House Valley, and even less in ceramics from Klethla Valley. It appears that coarse sherd tempered whitewares were produced in Kayenta Valley and distributed to the west from there. This may also be true for fine sherd tempered pottery, as fine sherd temper is found in samples from all three valleys, largely paralleling the distribution of coarse sherd temper.

Medium sandstone temper was most frequently used in Long House Valley, suggesting that local production of whiteware with sandstone temper took place there. The distribution of whiteware temper suggests that Long House Valley received pottery from neighboring areas, producing less in the valley than came in from elsewhere.

Besides being the apparent production area for volcanic ash tempered whiteware, Klethla Valley may have been a zone where whitewares tempered with a mixture of volcanic ash and sand were made. Ash and sand temper was found in whitewares from all sites sampled in Klethla Valley, though it was found at half the sites sampled in Long House Valley and at only a third of sites in Kayenta Valley. This suggests fall-off from the production locality with distance, from the production locality in Klethla Valley on the west to Kayenta Valley on the east, over 80 km distant.

The distribution of ceramics by temper type over the research area indicates that the largest production localities, or localities from which whitewares were distributed the farthest, seem to have been located at the two ends of the research area. Klethla Valley appears to have included production localities for volcanic ash, and ash and sand tempered whitewares, while in Kayenta Valley whitewares with sand and coarse sherd temper were made. Whitewares from Long House Valley include sherds from both of the adjacent valleys. This is in part due to the fact that Long House Valley provides the only easy access between the other valleys, and Long House Valley itself is quite small.

Survey data from the research area showed a gap in settlement between Long House and Klethla valleys during the Tsegi Phase, suggesting a subregional boundary among the valleys. This analysis of whitewares does not show an abrupt change in ceramic source localities from one valley to another but, rather, a gradual fall-off in some whiteware temper types from one side of the research area to the other. At the same time, two temper types, volcanic ash (Klethla tract) and fine sandstone (Hard Rocks tract), seem to be common to the entire research area. If Klethla Valley and the Hard Rocks area of Utah were the only sources of volcanic ash and fine sandstone temper, respectively, then there are no apparent boundaries among the valleys of the research area. Differences in the temper types used in whitewares in this case would be due to the distance of each site from ceramic production localities.

If, however, volcanic ash can be found all along the base of Black Mesa, ash tempered whitewares could have been made in a number of localities. This is also possible for fine sandstone temper, since sandstone is widespread in the research area. In this case, with ash and fine sandstone tempered whitewares made in numerous localities, the different frequencies of ash and sand temper in Klethla Valley, and coarse sherd and coarse sand temper in Kayenta Valley, could indicate a boundary between the two places. The ceramics and their temper identified from Long House Valley sites do not group strongly with either valley. The boundary between valleys could not be precisely located with respect to Long House Valley. We would have to rely on the gap in Tsegi Phase sites to suggest that the boundary was between Klethla Valley and Long House Valley, rather than through Long House Valley as a whole.

It is also possible that whiteware ceramics do not reflect boundary divisions within the research area. If boundaries were primarily political, marking separate tribal divisions, perhaps a few specific classes of objects, or specific practices, were used to connote separate groups. This could include stone tools, redwares, graywares, wooden objects, or perishables, such as basketry. Body painting, hair style, and type of dress could also be indicators of tribal differences without yielding clear archaeological indications of those boundary markers.

Field Museum of Natural History
Roosevelt Road at Lake Shore Drive
Chicago, Illinois 60605-2496
Telephone: (312) 922-9410