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ANASAZI CULTURE AND ITS RELATIONSHIP TO THE ENVIRONMENT
IN THE RED ROCK PLATEAU REGION, SOUTHEASTERN UTAH

A Dissertation Presented to the Faculty of the Graduate School
of Yale University in Candidacy for the Degree of Doctor of
Philosophy

by

William David Lipe

1967
ABSTRACT

The problem addressed by this study is specification of the principal cultural and environmental variables that enabled the Anasazi, during five phases of culture, to occupy and adapt to the environment of the Red Rock Plateau, a part of the Glen Canyon area of southeastern Utah.

Although the Red Rock Plateau lies well below the altitude normally favored by the Anasazi, it had good enough soil and water in a few places to attract fairly heavy occupations at several times. The most favored locations were canyons cut into the Glen Canyon group of sandstones. These canyons have numerous springs and, at the time of Anasazi occupation, had sandy alluvial floors that were flooded after showers; they thus could support crops even though rainfall alone is inadequate for dry-farming. The canyons also had a wild flora much richer than that of the barren divides between streams, and an important game animal—bighorn sheep—was apparently not uncommon.

The region's first occupation, probably in or near the third century A.D., was by Basket Makers of the White Dog phase. White Dog sites cluster in the only habitable canyons that give easy access to the highlands north and east of the Red Rock Plateau. It was postulated that the White Dog people depended both on farming in the canyons and on food collecting in the adjacent highlands. Pinyon nuts, grass seeds, deer, and rabbits are important wild foods that are more abundant in the highlands than in the Red Rock Plateau.

The reason's for the region's long abandonment between ca. 300 or 400 and 1100 A.D. are not entirely clear. There are some indications that during this period the Anasazi, who initially favored sheltered canyon farming locations, were turning increasingly to open highland fields, because of improved crops, houses, dry-farming techniques, and/or climate. The early Klethla phase occupation of the Red Rock Plateau (ca. 1100-1150) probably is an overflow of the peak population that was inhabiting the adjacent highlands at this time. This occupation also correlates with a long period of above-average rainfall. The many small Klethla sites were clustered in the Red Rock Plateau canyons most suited to farming and were not confined to the highland margins as had been the White Dog sites. The region's abandonment about 1150 correlates with the de-population of most of the Glen Canyon area and probably with the onset of a severe drought.

The reoccupation of the Red Rock Plateau in the early 1200's may correlate with displacement of population from adjacent regions due to cooling climate, which affected high-altitude sites, and to arroyo-cutting, which affected canyon settlements. The Red Rock Plateau was affected by neither factor. The Horsefly Hollow phase (ca. 1210-1260), formed by immigrants from both the Mesa Verde and Kayenta branch areas, was the time of the region's heaviest occupation; all the potentially habitable canyons were settled during this phase. Despite a general trend to large pueblos current in the Four Corners area at this time, the Red Rock Plateau sites remained small and dispersed even where soil and water appear to have been sufficient to support larger residential groups. Abandonment of the region at the end of this phase correlates roughly with the onset of the "great drought." The emigrants probably settled in one or more of the large pueblos built in the Navajo Mountain region about this time.

During the Pueblo IV period (ca. 1300-1600), small groups of Hopi travelled into or through the Red Rock Plateau. These parties may have been engaged in hunting, trade, or pilgrimages to shrines, but clearly did no farming.
ACKNOWLEDGMENTS

The archeological data utilized in this study were gathered largely during fieldwork carried on from 1958 through 1962 by the University of Utah Department of Anthropology as part of the Upper Colorado River Basin Archeological Salvage Project (hereafter called the Glen Canyon Project), which was sponsored by the U.S. National Park Service. I am grateful to Jesse D. Jennings, director of the University of Utah section of the Glen Canyon Project, for the opportunity to work as a paid staff member of this project from June, 1958 through September, 1960, and again in the summer of 1961. Dr. Jennings also made the facilities and collections of the University of Utah Glen Canyon Project available to me for further study during the academic year 1962-63, at which time I was supported by a National Science Foundation Graduate Fellowship.

All of the archeologists of the University of Utah Glen Canyon Project staff went out of their way at various times to discuss the parts of the research they were involved in, to provide me with unpublished manuscripts upon which they were working, and to comment on my work. Especially helpful in this respect were Jesse D. Jennings, Floyd W. Sharrock, Kent Day, and David Dibble. Sharrock was also of great assistance to me in 1965 and 1966 in tracking down the answers to specific questions and in providing me with various maps, manuscripts, and sets of notes that I requested from the Glen Canyon Project files.
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Chapter 1

INTRODUCTION

THE PROBLEM

The problem with which this thesis is concerned is the relationship between Anasazi culture and the environment it encountered in the Red Rock Plateau of southeastern Utah. The inquiry may be summarized under two broad related questions: 1) How did Anasazi culture in this region adapt to its environment during each of its five sequent phases? In other words, what resources did the people find there, and in what way were they used; also, what were the limitations of the region, in the sense that it prohibited development of characteristics common to Anasazi culture elsewhere? 2) What role, if any, did environmental factors play in the culture history of the region, particularly in the population movements implied in several periods of occupation and abandonment, and in the shifting of cultural boundaries?

The Red Rock Plateau (see Figs. 1-4) is a good region in which to study the relationship between culture and environment. Most important is the fact that it has a marginal and rather impoverished environment, relative to the areas which supported the bulk of Anasazi population. These latter areas, being higher, receive considerably more rainfall, and cultivable soils are generally more abundant and fertile. The inhabitants of the Red Rock Plateau must have entered it from the higher and more favorable areas. They must have found that the choices available to them in such things as field and house locations, methods of farming, even raw materials for some manufactures, were more
restricted. Thus it may be possible to identify the culturally-limiting environmental variables of this region more easily than those of areas which provided a greater number of options. Furthermore, existence in the Red Rock Plateau in prehistoric times must have been rather precarious. Relatively small changes in environmental factors such as stream and floodplain regimens, or in the ability of the people to exploit the environmental resources, would have had more profound effects than in a more favored or ecologically varied area.

A second argument for the appropriateness of the Red Rock Plateau to this kind of study is that there has been a good deal of research on its environment as well as on its archeology. This is largely the result of the broad regional orientation of the Glen Canyon project; at the same time that the salvage archeologists were at work, geologists, botanists, zoologists, and historians were salvaging information relevant to their fields of inquiry (see Bibliography).

Studies of the relationships of culture and environment are also available for other parts of the northern Southwest; information on this topic, while still woefully incomplete, is probably at a higher level in this area than in any other section of the Southwest (and perhaps of North America). To mention some of the more important examples of this sort of research, we have several excellent studies of the relation of alluvial geology to archeology and to climate (e.g., Bryan 1941, 1954; Cooley 1962; Hack 1942; Schoenwetter and Eddy 1964), the dated record of prehistoric climatic fluctuations contained in the Central Pueblo tree-ring chronology (e.g., Douglass 1935; Schulman 1956 — see also Fig. 5 in Chapter 3), initial attempts to reconstruct plant
communities and climate through palynology (Schoenwetter and Eddy 1964; Schoenwetter 1962; Hevly 1964), the recent series of specialized ecological studies in Mesa Verde National Park (Osborne 1965), and the numerous attempts to round up environmental data relevant to the problem of the abandonment of the northern Southwest during the twelfth and thirteenth centuries (e.g., Jett 1964). All these contribute relevant support to the study of culture and environment relationships in the Red Rock Plateau proper.

GEOGRAPHICAL PERSPECTIVE

In the following paragraphs, I will call attention to the several major geographic and cultural areas of which the Red Rock Plateau forms a part. Additional geographic features, place names, site locations, etc. will be introduced in succeeding chapters. Because of the complexity of Southwestern geography, and because the various cultural, physiographic, and biotic areas referred to overlap but do not often coincide, the reader is advised to consult the accompanying maps frequently.

The distinctive features of the Anasazi cultural tradition seem first to have appeared in the higher parts of the area drained by the San Juan River (Reed 1946). The canyons and mesas of this "Four Corners" area (Fig. 1) are, then, the original Anasazi homeland. As this culture's geographic range expanded, it came to occupy the whole southern two-thirds of the Colorado Plateau physiographic province. In addition, there were brief expansions west and south into the Basin and
Range physiographic province, as well as a more lasting occupation of the Rio Grande Valley and the fringes of the Southern Rockies to the southeast (Jennings 1956: 64-5).

The Anasazi of course occupied only a relatively small part of the Southwestern culture area, both in prehistoric and especially in ethno-graphic times. In this thesis, the culture area designation "northern Southwest" will be used occasionally. This term appears fairly often in the literature, and generally seems to refer to the part of the Colorado Plateau occupied by the Anasazi during their period of maximum expansion, plus the adjacent small parts of the Basin and Range prov-ince and Southern Rockies also occupied during this time. This is the area that was almost entirely abandoned by the Anasazi during the twelfth and thirteenth centuries A.D.

The "Four Corners area," another culture area label, refers to the part of the northern Southwest that was the original Anasazi homeland, as noted above. Geographically, it consists of the San Juan drainage basin and the region drained by the headwaters of the Dolores (Fig. 1). For the purposes of this paper, all of the Red Rock Plateau may be con-sidered to be a part of the Four Corners area, even though some of its streams empty into the Colorado rather than into the San Juan or Dolores.

In modern political terms, the location of the Four Corners area is indicated by its name—it centers on the point where the four states of Utah, Colorado, New Mexico and Arizona meet. In terms of prehis- toric culture, it is the area in which three important Anasazi branches or minor regional traditions—Kayenta, Mesa Verde, and Chaco—are found.
The boundaries of these three branches shifted through time, with some branches extending beyond the geographic limits of the Four Corners area at various times. The culture centers or climaxs of all three branches lie within the Four Corners area, however. These centers are small, ecologically favored areas in which sites are extremely abundant and where a few unusually large pueblos were built in the period just preceding abandonment. The Kayenta center, of which the best-known ruins are the Betatakin and Kiet Siel cliff-dwellings, lies in the Tsegi Canyon-Marsh Pass region near the present town of Kayenta, in northeastern Arizona. The climax of the Chaco branch was in northwestern New Mexico, in the canyon of Chaco Wash. Here are found a number of large, superbly-constructed pueblos built in the open, such as Pueblo Bonito, Pueblo del Arroyo, and Chetro Ketl. The Mesa Verde branch of course takes its name from the Mesa Verde, a small plateau in extreme southwestern Colorado. Now a national park, this highland has a number of large well-preserved cliff-dwellings, of which the best known are probably Cliff Palace and Spruce Tree House. A multitude of smaller ruins is also to be found on the mesa.

The Red Rock Plateau, the geographic focus of this study, is a physiographically-defined unit, bounded by the Colorado and San Juan Rivers, the Red House Cliffs, and Red Canyon (Figs. 2-4). It lies at the heart of the Canyon Lands section of the Colorado Plateau, and consists in large part of a maze of deep canyons separated by generally barren stretches of eroded rock desert. Culturally, it seems to have been part of the territory of the Kayenta branch, except for one phase of occupation (the Horsefly Hollow Phase) during which there was
substantial Mesa Verde branch encroachment.

ORGANIZATION OF THE DISSERTATION

Chapter two consists of a brief historical survey of the amount and kind of archeological research that has been done in the Red Rock Plateau, and in the remainder of the Four Corners area as well. Chapter three describes the natural environment under the rubrics of physiography, climate, and biota. The emphasis is on the potential resources and limitations that the Red Rock Plateau environment presented to its Anasazi inhabitants.

Chapters four, five, and six are devoted to analyzing the adaptation of the Anasazi to the Red Rock Plateau environment during five phases of culture. These phases, with chapter reference, estimated absolute date, and position in the Pecos classification, are as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Chapter</th>
<th>Estimated Date in Red Rock Plateau</th>
<th>Stage/Period in Pecos Classification</th>
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</thead>
<tbody>
<tr>
<td>White Dog</td>
<td>4</td>
<td>200-300 A.D.</td>
<td>Basket Maker II (1-450 A.D.)</td>
</tr>
<tr>
<td>Kleethla</td>
<td>5</td>
<td>1100-1150 A.D.</td>
<td>Pueblo III (1100-1300 A.D.)</td>
</tr>
<tr>
<td>Horsefly Hollow</td>
<td>5</td>
<td>1210-1260 A.D.</td>
<td>Pueblo III (1100-1300 A.D.)</td>
</tr>
<tr>
<td>Jeddito and Sikyatki</td>
<td>6</td>
<td>1300-1600 A.D.</td>
<td>Pueblo IV (1300-1700 A.D.)</td>
</tr>
</tbody>
</table>

Because the Red Rock Plateau was marginal to the innovating Anasazi culture centers, its phases are essentially extensions of those found in adjacent parts of the Four Corners area. Thus in the Red Rock Plateau I am concerned largely with identifying phases that have been
defined elsewhere. An exception to this statement is the Horsefly Hollow phase, which probably is confined to this area. It appears to be the result of contact and mixture, in the Red Rock Plateau, between the Tsegi phase of the Kayenta branch, and an unnamed and poorly known variant of the Mesa Verde branch, which has some characteristics of the Mesa Verde phase but is not identical to it. It is a moot question whether the "Horsefly Hollow" occupation should be treated as one phase or two; this topic is considered in more detail in Chapter five.

In each of chapters four through six, there is a discussion of the time and space distributions of the phases (or their nearest relatives) both within and outside of the Red Rock Plateau. On the basis of these discussions, inferences are made as to the movements of Anasazi groups into and out of the Red Rock Plateau through time. Wherever possible, the effects of environmental variables on these movements are assessed. Additionally, an attempt is made to reconstruct, for each phase, its settlement pattern and subsistence base, under the assumption that these are aspects of culture in which the interplay of environmental and cultural variables are most likely to be relatively direct and accessible to investigation.

Chapter seven summarizes the major points made in the previous chapters and presents conclusions about the degree to which environmental variables have shaped the particular features of Anasazi culture in the Red Rock Plateau, or have affected the movements of peoples into and out of the region.
Chapter 2

ARCHEOLOGICAL BACKGROUND

ARCHEOLOGICAL RESEARCH IN THE FOUR CORNERS AREA

The Red Rock Plateau is in the western part of the Four Corners area (Fig. 1). Because the first Southwestern ruins to attract wide public attention were in the Four Corners area, and because a number of the founders of modern American archeology "cut their teeth" on the problems of the area, it has played a major role in the emergence of Southwestern, and indeed, of American archeology as distinct and recognized disciplines. Although intensive archeological research in the Red Rock Plateau is of relatively recent date, an understanding of this limited region's prehistory must depend to some extent on the interpretive frame of reference developed during the many years of archeological research elsewhere in the Four Corners area. The brief outline of archeological history that follows leans heavily for its periodization and content on Brew's (1946: 15-31) detailed account of the history of archeological research in the northeastern or Mesa Verde part of the Four Corners area, as well as on his discussion of systems of cultural classification in the Southwest (ibid.: 32-43). Much use has also been made of papers dealing with the history of Southwestern archeology in general by Taylor (1955) and Roberts (1935).

Early Explorations: Up to 1885

In 1776, Fray Escalante described in his journal several ruins near the Mesa Verde in what is now southwestern Colorado. This seems
to be the first literary reference to archeological sites in the Mesa Verde region (Brew 1946: 16) and probably the first for the Four Corners in general. In the succeeding 75 to 100 years, various explorers, trappers, traders, prospectors, and cattlemen visited the area, but only a few left written records of any kind.

Detailed published descriptions of the Four Corners area, some of which included accounts of the archeological sites, first began to appear as a result of 1) official government exploration under the War Department and the United States Geological and Geographic Survey of the Territories, and 2) railroad surveys seeking feasible routes to the West Coast (ibid.: 17). These brought into the Four Corners area men trained in scientific observation and equipped to make accurate maps, sketches and photographs. The reports of Simpson (1850), Leow (1875), Powell (1875), Macomb (1876), Jackson (1876, 1878), Barber (1876, 1877), and Holmes (1878), for example, stem from these surveys. These observers did little or no excavation, but they made fairly detailed records of the larger ruins, and sometimes of the kinds of artifacts associated with them. Although lacking a concept of a temporal sequence of sites, they did recognize the relationship between the archeological peoples of the area and the living Puebloans. By the end of this period, archeological data from the Four Corners area was beginning to be used in comparative studies of American archeology and ethnology (i.e., Holmes 1886, Morgan 1881).

**Extensive Survey and Uncontrolled Excavation: 1885-1914**

During this period, the discovery of all the larger ruins in the
major clusters at Chaco Canyon, Mesa Verde and the Tsegi Canyon area was completed, and many other areas were combed for sites by the Wetherill brothers, McIntyre and Graham Prudden (1903, 1914, 1918), Cummings (1910, 1915), and others. Large-scale excavations also were conducted for the first time. They were concentrated in the large, late masonry pueblos, particularly the cliff dwellings, and in the earlier dry burial caves of what came to be known as the Basket Maker period. This choice of sites reflected the dominant archeological objective of the period—to obtain large collections of attractive or unusual specimens. Private collectors or museums, both usually eastern, financed the work, but the actual excavations were usually run by local men who knew how to find choice artifacts in a minimum of time.

Of these local professional collectors, the most active were the Wetherill brothers, especially Richard and John, of Mancos, Colorado. They independently excavated and sold large collections from Mesa Verde, Grand Gulch in Utah, Chaco Canyon, and elsewhere. They also participated in the major expeditions that worked in the area during this period: Gustav Nordenskiold's Mesa Verde expedition of 1891; the Hyde expedition to Chaco Canyon of 1897-1900, under the field direction of George Pepper; and Byron Cummings' many visits to Tsegi Canyon and adjacent areas between 1907 and 1930.

The Wetherills seem to have been keen observers, and were deeply interested in the region's prehistory; the professional archeologists and museum men with whom they worked respected their advice and opinions (Brew 1946: 20-21). The few important theoretical advances of this period, in fact, are generally credited to the Wetherills,
although they did not themselves explicate these ideas in print. Richard Wetherill made the major advance when he foreshadowed later methodology by noting stratigraphic differences in the kinds of artifacts he found in Southeastern Utah cave sites (ibid.: 20; McNitt 1957: 59-72). From these observations, he evolved the concept of an early people, the Basket Makers, who preceded the "Cliff Dwellers." Although the term Basket Maker first appeared in print in Wetherill's letter to The Antiquarian in 1897 (Brew 1946: 20), Pepper (1902a) was the first to publish a detailed account of this culture, which he based on studies of the Wetherill and McLoyd and Graham collections at the American Museum of Natural History in New York.

Richard Wetherill credited his friend Talbot Hyde with suggesting to him the term Basket Maker, but claimed to have himself originated the "Cliff Dweller" label (McNitt 1957: 65-6). Although Colton (1939: 9) credits Kidder (1936: 59) with introducing the Navajo term "Anasazi" for reference to the Basket Maker and Pueblo cultures taken together, Richard Wetherill seems to have been using the word in that sense as early as 1893 (McNitt 1957: 57). Another contribution of the Wetherills was to oppose the theory, strong in the late nineteenth century, that the Cliff Dwellers were a different people from those who lived in the large open sites (Brew 1946: 21).

Other workers in the Southwest during this time, which Taylor (1955: 561-2) calls the "Cushing-Fewkes period," showed a general lack of concern with temporal distinctions. This disinterest in chronology was characteristic of American anthropology in general at that time, probably because earlier attempts to apply the stages of Old World
prehistoric and of unilinear evolution had been unsuccessful, and because it was generally thought that the American Indians had arrived too recently to have left a stratified record of culture change (Rouse 1955: 572). Other than the desire to make collections, the basic interest of the period was in relating the archeological materials to the culture of living Pueblo peoples. Often the methods chosen, however, depended not so much on direct comparison of archeological and ethnological materials as on native traditions or proximity to contemporary Pueblo settlements. Observed distributional differences in the archeological remains were attributed largely to environmentally-based modifications in the single, unitary Pueblo culture (Taylor 1955: 561-2).

All told, this period was an unfortunate one in Southwestern archeology. The large collections that were gathered remain mostly unreported, and the excavations were made with little or no attempt to try to extract information from the archeological context. A majority of the potentially very informative dry sites was destroyed. Even worse is the fact that work of this character was continued by some archeologists into the next period. Fewkes, for example, ignored stratigraphy and systematic reporting of artifact inventories well into the 1920's. Cummings worked year after year in northeastern Arizona without publishing, and perhaps without making, any written record of his findings, while Kerr, his successor at the University of Utah after 1912, did nothing but amass collections (Brew 1946: 23). Bernheimer's (1923, 1929) expeditions of the 1920's were in the old style, contributing collections to museums, but little to the published record.
Period of Stratigraphic Excavation and Initial Synthesis: 1915-27

In 1912, Nels C. Nelson, working in the Galisteo Basin southeast of the Four Corners area (Fig. 1), pioneered the method of metrical stratigraphy, one that was new to archeology. By working down, in measured levels, from the top to the bottom of refuse heaps, he detected changes with depth in ceramic styles. By matching variations in the kinds and frequencies of pottery types from levels in several refuse heaps, he was able to build up a ceramic chronology that proved useful for the Rio Grande region (Roberts 1935: 2-3).

Only a few years later, in 1914-17, Samuel Guernsey, and for the first season and a half, A. V. Kidder, successfully applied stratigraphic methods to sites in the Tsegi Canyon-Marsh Pass (or Kayenta) region of northeastern Arizona. The first two seasons' work resulted in the formation of a sequence from Basket Maker, to Slab-house, to Cliff-house culture (Kidder and Guernsey 1919). Within the Cliff-house period, temporal differences were inferred from the presence of more highly specialized, intensively decorated, localized, and hence presumably later pottery types at the cliff ruins, as opposed to less elaborate and more widely distributed materials at several smaller open sites (ibid.: 200-1). By 1921, a new period, Post-Basket Maker, had been added, and the name of its immediate successor changed from Slab-house to Pre-Pueblo (Guernsey and Kidder 1921).

In a brief but important synthetic paper (Kidder 1917) based on the 1914-15 findings and in the final report of that work (Kidder and Guernsey 1919), Kidder drew some broader generalizations about the San Juan area as a whole. He characterized the prehistoric culture of this
region, as opposed to that elsewhere in the Southwest, as the "great northern Kiva-culture," after its most distinctive architectural feature. He recognized that, in Cliff Dweller times, at least, this culture had several regional variants, distinguished by differing pottery and kiva styles. The Kayenta sites represented one such variant, the Chaco Canyon and Mesa Verde-McElmo-Montezuma River materials two others. The Aztec-Bloomfield sites he thought to be allied architecturally with Chaco and ceramically with Mesa Verde.

Anticipating later problem-oriented studies, Guernsey in 1916 and 1917 concentrated only on the Basket Maker sites in the Kayenta area, because this culture had previously been reported from only one small area in southeastern Utah, and its temporal priority had been questioned because the original stratigraphic observations had not been made by professional archeologists (Guernsey and Kidder 1921: iii). The work verified Wetherill's original conclusions about the distinctness and temporal position of the Basket Makers, and resulted in the recovery of a wealth of data that Guernsey and Kidder wove into a masterful reconstruction of Basket Maker life.

Elsewhere in the Four Corners area, Earl Morris was undertaking the first stratigraphic excavations in the Mesa Verde region; in 1921, he published the first chronology of this area, correlating his findings with the 1919 Kidder and Guernsey three-period sequence, but dividing the Cliff-house culture into Early and Late parts on the basis of black-on-white pottery variations (Brew 1946: 25, 53-4). In 1920 through 1927, Neil Judd was carrying out the monumental task of excavating Pueblo Bonito and Pueblo del Arroyo in Chaco Canyon. The
results of this work have been published only recently, however (Judd 1954, 1959, 1964).

Much of the information rapidly being accumulated by these and other workers, as well as data gleaned from older sources, was brought together by Kidder in 1924 in his classic *Introduction to the Study of Southwestern Archaeology*. This still-useful work, in addition to reporting Kidder's excavations at Pecos, New Mexico, was the first detailed synthesis of the prehistory of any part of the New World (Rouse 1962: 1).

Kidder devoted much more space to the San Juan, the best-known region, than to any of the other Southwestern areas. His San Juan temporal sequence followed the 1921 Guernsey and Kidder four-period scheme, but used only pottery as the diagnostic criteria (Kidder 1924: 166). As in earlier works, areal differences in culture were described only for the latest period, but treatment was much more detailed, especially of architecture and pottery. No accurate absolute chronology had yet been developed, although Kidder correctly estimated a date of A.D. 800-1100 for the principal buildings at Chaco, based on assignment of Spinden's dates to "Toltecans" pottery found there.

The interest aroused by Kidder's book, plus the growing amount of new information resulting from field work, as well as the increasing difficulties in correlating the new information, led to an informal conference of Southwestern archeologists at Kidder's Pecos field camp in 1927. The principal result was the Pecos classification, a sequence of cultural stages similar to but more detailed than Kidder's earlier San Juan sequence, and hopefully of broader application. The agreed-
upon stages and their diagnostic criteria are as follows (Kidder 1927: 490):

**Basket Maker I, or Early Basket Maker**—a postulated ... stage, preagricultural, yet adumbrating later developments.

**Basket Maker II, or Basket Maker**—the agricultural, atlatl-using, non-pottery-making stage...

**Late Basket Maker, Basket Maker III, or Post-Basket Maker**—the pit- or slab-house building, pottery-making stage [the three Basket Maker stages were characterized by a long-headed population, which did not practice skull-deformation.]

**Pueblo I, or Proto-Pueblo**—the first stage during which cranial deformation was practiced, vessel neck corrugation was introduced, and villages composed of true masonry were developed [it was generally agreed that the term pre-Pueblo, hitherto sometimes applied to this period, should be discontinued.]

**Pueblo II**—the stage marked by widespread geographical extension of life in small villages; corrugation, often of elaborate technique, extended over the whole surface of cooking vessels.

**Pueblo III, or Great Period**—the stage of large communities, great development of the arts, and growth of intensive local specialization.
Pueblo IV, or Proto-Historic—the stage characterized by contraction of the area occupied; by the gradual disappearance of corrugated wares; and, in general, by decline from the preceding cultural peak.

Pueblo V, or Historic—the period from 1600 A.D. to the present.

The Pecos classification thus stressed 1) developmental trends in the evolution of Southwestern peoples from semi-nomads to settled villagers fully dependent on agriculture and 2) stylistic features of wide distribution and presumably of limited chronological extent. It was, as Reed (1940) has pointed out, a "horizontal" classification, "concerned with similarities over a wide area during a given time."

Period of Taxonomic, Analytical, and Problem-oriented Studies: 1927-50

Archeologists working in the southern and western or Desert, section of the Southwest soon found that the Pecos classification was difficult to apply to their area. Consequently, at a meeting in Globe, Arizona, in 1931, they proposed the Hohokam culture as a tradition coordinate to and separate from the Basket Maker-Pueblo culture, and set up a different sequence of named temporal stages for this major new unit (Brew 1946: 40-1). The chief promulgator of the new concept was Harold Gladwin, who a few years later, with Winifred Gladwin, went on to introduce another taxonomic scheme, which embraced the entire Southwest (Gladwin and Gladwin 1934).

This latter development resulted from Gladwin's difficulties in
analyzing the sherd collections gathered by his far-flung Gila Pueblo surveys of the late 1920's and early 1930's. Neither the Pecos nor Hohokam classifications seemed adequate to express the numerous sub-traditions and temporal variations within these that Gladwin had detected.

The result was a hierarchical, phylogenetic classification, in which the smallest units or "phases" were grouped into "branches" comparable to the distinctive Pueblo culture areas, such as Kayenta and Chaco, that had been designated by Kidder. Related branches were grouped into "stems" named after major geographical regions, and these in turn were assigned to a small number of "roots from which the later peoples are believed to have sprung" ([ibid.]: 9). Although Kidder in 1919 and 1924 had anticipated some of Gladwin's branches, he recognized these regional variants of the San Juan Pueblo culture only during their most distinctive stage—Pueblo III—and did not trace them back in time to earlier periods. Gladwin's new system did just this, and extended the approach to the entire Southwest, postulating a large number of long-lasting traditions or branches, which in turn were combined on the basis of presumed genetic relationship into stems and roots.

The smallest classificatory unit in Gladwin's system—the phase—was designed to cover minor variations in both time and space. In effect, a branch consisted of one or more temporal sequences of phases; most branches had only a single sequence, but Gladwin recognized a few that contained parallel phase sequences occupying different parts of the branch's territory.

The entire system depended heavily on ceramic similarities,
especially at the phase level, where the diagnostic criteria were distinctive pottery types. The arrangement of phases into sequences was made possible by the temporal control generally available because of the success of the methods of ceramic stratigraphy and seriation in the Southwest. Furthermore, a powerful new absolute dating method—dendrochronology—had been perfected and was achieving its first major successes in the northern Southwest at the time the Gladwins wrote (Douglass 1929, 1935).

In a parallel development that ultimately had some ramifications in the Southwest, archeologists of the Midwestern United States during the 1930's were also experimenting with ways of classifying the numerous data they had assembled. These efforts crystalized as the "Midwestern taxonomic method," best described by McKern (1934, 1939, 1940), who had played a large part in its formulation.

Unlike their Southwestern colleagues, the Midwestern archeologists had been notably unsuccessful in determining the chronology of their materials, as well as in attempting to apply culture area approaches to them. Consequently, their classificatory system was based "on the cultural factor alone;" it was felt that "temporal and distributional treatments will follow as accumulating data shall warrant" (McKern 1939: 303).

The lowest level category and basic working unit of the system was the focus, defined as
that class of culture exhibiting characteristic peculiarities in the finest analysis of cultural detail, [which] may in instances correspond closely to the local tribe in ethnology. It is dangerous, however, to define it as such (ibid.: 308).

The focus was to be established, in each case, by comparisons of complexes of traits found associated in sites. If a complex of trait units found at one site

is found to recur in characteristic purity and practical completeness at other sites, to an extent suggestive of cultural identity, this recurring complex establishes...the focus (ibid.)

The manifestation of a focus at a specific site was termed a component, and foci were grouped, on the basis of increasingly generalized similarities, into a hierarchy of aspects, phases, and patterns. Traits that served to demarcate a particular unit, at whatever level, were called determinants; a unit's determinants of course varied with the particular comparison being made. The grouping of units at each stage depended only on an evaluation of total similarity and difference in cultural content; temporal and spatial similarity and assumptions of genetic relationship were specifically excluded. Although it was recognized that pottery was useful in trait comparisons, it was not given the excessive weight that it had in Gladwin's system; the implication was, rather, that any and all variable and recurrent traits
should be used in setting up the units. The Midwestern system thus
only superficially resembled Gladwin's phylogenetic family tree, lack-
ing the latter's assumptions about the genetic relationship of the
grouped units, and its dependence on distributional and temporal infor-
mation. McKern was apparently unaware of Gladwin's work, not only when
he presented a preliminary version of the Midwestern system at the 1934
American Anthropological Association meetings (McKern 1934), but even
in 1939 when his major publication on the system appeared. Otherwise,
he surely would not have used Gladwin's term "phase" in an entirely
different way.

The Midwestern taxonomic system was first felt in the Southwest in
1939, when Colton grafted some elements of it onto Gladwin's system,
while applying the latter to the archeology of Northern Arizona.
Colton substituted "focus" for Gladwin's "phase" and also adopted the
notion of "component." The listing below compares the three systems of
terminology.

<table>
<thead>
<tr>
<th>Gladwin (1934)</th>
<th>Colton (1939)</th>
<th>McKern (1939)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>Root</td>
<td>Pattern</td>
</tr>
<tr>
<td>Stem</td>
<td>Stem</td>
<td>Phase</td>
</tr>
<tr>
<td>Branch</td>
<td>Branch</td>
<td>Aspect</td>
</tr>
<tr>
<td>Phase</td>
<td>Focus</td>
<td>Focus</td>
</tr>
<tr>
<td></td>
<td>Component</td>
<td>Component</td>
</tr>
</tbody>
</table>

Colton set up his units in terms of "determinants" following
McKern, and attempted to use a greater variety of traits than did Glad-
win. He admitted, however (Colton 1939: 10-11), that his primary
emphasis was on pottery. He felt that variations in the pottery "ware"--by which he meant the general characteristics of manufacture, paste, color, etc.--were the best criteria to use in distinguishing branches. Furthermore, the wares of the unpainted "utility" or cooking and storage vessels were particularly good branch determinants. For distinguishing between foci of the same branch, and particularly when these distinctions were temporal ones, he preferred to use pottery types based on stylistic variations. The utility pottery was not so useful here, because it generally did not show rapid change through time, but the painted or "table" pottery did. Hence types based on this latter kind of pottery were most likely to be useful as focus determinants.

In general, Colton's system was much closer to Gladwin's than to McKern's, and this he acknowledges. He specifically considered chronological significance as of value in choosing focus diagnostics; "since archaeology is history and history involves the idea of chronology, the most satisfactory system of classifying phases or foci is one that involves time" (ibid.: 8). He also assumed the validity of genetic relationship among the foci that comprised a branch, and among the branches that made up the higher units. It was, like Gladwin's system, a "vertical" classification, concerned with tracing cultural lineages over long periods of time in delimited regions (Reed 1940).

Despite stinging criticism of Gladwin's and Colton's taxonomies (Steward 1941b; Brew 1946), they have been useful in regional syntheses, and in spotting geographical and temporal gaps in the record. In recent years, the systems' higher levels have been little used, but
application of phase and branch labels is standard practice. Colton and his co-workers at the Museum of Northern Arizona have now abandoned the term focus in favor of phase. The phase concept itself has attained the status of a basic archeological unit in much of the New World (Willey and Phillips 1958; 22). Southwesternists still conceive of a phase largely as a temporally limited segment of a tradition, to be defined in terms of pottery types (Olson 1962).

While arguments raged about the merits and demerits of these classificatory systems, progress in analytical studies continued, often motivated by the need for more precise artifactual classifications upon which to base phases and other taxonomic units. Most of this work was devoted to pottery, and, in the Four Corners area, resulted in such detailed and sophisticated ceramic studies as those of Shepard (1939), Hawley (1936), and Colton and Hargrave (1937).

Great strides also were made in methods of determining chronology. As already noted, dendrochronology matured during the early part of this period. Most effective in the Four Corners area, it made possible the dating of many ruins and the development of the most detailed chronology of any area of the New World. For this reason, the new method of radiocarbon dating, developed at the very end of the period, had less effect in the Four Corners area than elsewhere in the Southwest. Geochronological techniques also came into use; particularly important was the development and application of the Southwestern alluvial chronology.

The Pecos classification was not superseded by the Gladwin-Colton approach, but continued in parallel use both as a set of time periods
and a set of developmental stages. These two usages are not always wholly consistent, as shown by the contemporaneity in Chaco Canyon of large sites of the Pueblo III sort and small "unit pueblos" thought characteristic of Pueblo II. Furthermore, all these sites apparently date largely to the 900–1100 A.D. time period generally labelled Pueblo II (Kluckhohn 1939).

In 1935, the Pecos classification was given a face-lift by Roberts, who brought it up to date by adding new archeological information, and by suggesting a more streamlined terminology that expressed the developmental assumptions of the classification, as follows:

<table>
<thead>
<tr>
<th>Kidder (1927)</th>
<th>Roberts (1935)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basket Maker I</td>
<td>Omitted</td>
</tr>
<tr>
<td>Basket Maker II</td>
<td>Basket Maker</td>
</tr>
<tr>
<td>Basket Maker III</td>
<td>Modified Basket Maker</td>
</tr>
<tr>
<td>Pueblo I</td>
<td>Combined as Developmental Pueblo</td>
</tr>
<tr>
<td>Pueblo II</td>
<td></td>
</tr>
<tr>
<td>Pueblo III</td>
<td>Great Pueblo</td>
</tr>
<tr>
<td>Pueblo IV</td>
<td>Regressive Pueblo</td>
</tr>
<tr>
<td>Pueblo V</td>
<td>Historic Pueblo</td>
</tr>
</tbody>
</table>

In the Four Corners area, where the Regressive and Historic Pueblo stages are missing, this represented a return to a four-fold periodization directly correlative with that used by Kidder in 1921 and 1924.

Survey and excavation programs directed at specific archeological problems played a greater role in the Four Corners area during the 1927–50 period than either before or since. Most of these projects
were spawned to fill the gaps in knowledge revealed during the development of the Pecos classification or of the Gladwin-Colton syntheses. Brew undertook extensive excavations at Alkali Ridge, Utah, because the Pueblo II stage of the Pecos classification seemed poorly grounded in data, and because with the exception of the work of Morris and a few others, little scientific archeology had ever been done in the Mesa Verde region, despite the great amount of digging. Similar objectives guided the Rainbow Bridge-Monument Valley expedition in the Kayenta area (Beals et al. 1945: 4; Lockett and Hargrave 1953). At Chaco Canyon, the University of New Mexico field schools focused on the small sites that had been neglected during the earlier concentration on the large pueblos.

**Period of Salvage Archeology: 1950–present**

As elsewhere in the United States, a great number of new dams, highways, pipelines, subdivisions, and other construction projects were initiated in the Southwest after the end of World War II. Realizing that these would destroy many archeological sites, various universities, museums, government agencies, and utility companies made efforts to save some of the remains. In the Four Corners area, this period begins in 1950, when the first large-scale salvage project in the area was initiated, to salvage sites in the right-of-way of a major El Paso Gas Company pipeline (Wendorf et al. 1956). Since that time, the bulk of the archeological work done in the area has been salvage. All four states now employ a "highway archeologist," several field crews have investigated pipeline or powerline (Sciscenti and Greminger 1962)
rights-of-way through the region, and there have been two major salvage projects associated with dam construction. One of these, the Navajo Dam project on the upper San Juan, was administered by the Museum of New Mexico (Dittert 1958; Dittert et al. 1961; Dittert and Eddy 1963; Eddy 1961, 1963; Hester and Shiner 1963). The other was the Glen Canyon Project, which is described in a later section of this chapter.

Although by its nature salvage archeology arbitrarily defines the area and kinds of sites that will be investigated, this limitation has not generally resulted in a scientific step backwards. In fact, the necessity of investigating all parts of a threatened area has forced in some cases the abandonment of old stereotypes. A good example is Bliss' (1960) discovery, while on a pipeline survey, of extensive Pueblo III pithouse communities buried beneath drifting sand in some of the Kayenta area valleys. The Rainbow Bridge--Monument Valley expedition had investigated these valleys in the 1930's, but its archeologists concentrated on the cliffs and on obvious surface masonry pueblos, missing the pithouses. Bliss believes that between 900 and 1200 A.D., 80 to 90 percent of the region's population lived in these sub-surface structures.

Another possible contribution of salvage archeology has been the introduction of an effective regional approach, with a number of cultural and environmental variables being investigated concurrently by teams of both archeologists and natural scientists. The Rainbow Bridge --Monument Valley expedition attempted this sort of study, but most lines of research were not carried to completion, and only two significant reports (Beals et al., 1945; Lockett and Hargrave 1953), both dealing largely with archeology, have appeared.
Salvage archeology in the Four Corners area in this period has also attempted to maintain or improve standards of controlled stratigraphic excavation, systematic reporting, precise chronological placement of sites, and taxonomic classification set in previous years. Except where time limitations have been too extreme, it usually has also been possible to allocate archeological efforts within the project area in terms of a set of problems (Danson 1958; Lister 1961: 44). Jennings (n.d.) gives a fuller discussion of the contributions of salvage archeology to archeological methodology in general.

The one large-scale study undertaken in the Four Corners area during this period that was not a salvage operation was the National Park Service's Wetherill Mesa project at Mesa Verde. Designed to prepare additional sites for visitation and to gather new information about the area, this work may at last give us a good understanding of the prehistory of the Mesa Verde proper. Although the basic excavation reports and the overall synthesis have not yet appeared, a surface survey report (Hayes 1964) and a volume of specialized studies of particular aspects of the prehistoric culture and environment have recently been published (Osborne 1965). The fresh insights and new data contained in some of these papers show how fruitful the interdisciplinary team approach referred to above can be.

Included in the 1965 Wetherill Mesa volume is a paper by Rohn (1965) on the inference of socio-economic groupings from the architectural layout at one of the smaller cliff dwellings. Elsewhere in the Southwest (Longacre 1964 a and b; Brown and Freeman 1964; Dozier 1965) and in American archeology in general (Sears 1961; Binford 1962, 1963),
there has been a growing interest in attempting to study prehistoric social groups, structures, and processes, using archeological data. This is in a sense a return to the objectives of Taylor's maligned "Cushing-Fewkes period," but the modern pursuants of these goals attempt to implement them through a rigorous methodology and modern anthropological concepts. Rohn's paper seems to be the first evidence of this new trend in the Four Corners area.

In conclusion, it is apparent that a great deal of scientific archeology has been done in the Four Corners area during this last 15 years, perhaps more than in all the preceding periods combined. Descriptive reports of much of this work have already been published, but syntheses have generally not yet been forthcoming. Hopefully this study of the prehistoric cultural units of one small part of the Four Corners area will contribute to the development of such syntheses.

**ARCHEOLOGICAL RESEARCH IN THE RED ROCK PLATEAU**

**Work Before 1957**

The Red Rock Plateau (Figs. 2-3) has been known to contain archeological sites since Powell's (1875: 68; 1947: 127) first trip through the Glen Canyon in 1869. Between that time and the start of the Glen Canyon project in 1957, no less than 21 additional trips penetrating or touching on the region were made by various investigators in search of archeological sites. Adams (1960) lists and briefly describes these expeditions in his excellent summary of the history of archeology in the Glen Canyon region as a whole.

All but three of this total of 22 expeditions travelled by boat on
either the San Juan or Colorado Rivers. Their work thus was confined
to the main canyons and to the lower ends of the tributaries, on the
south and west margins of the Red Rock Plateau. All the boat parties
and two of the three overland expeditions conducted only reconnaissance
or at most, very limited testing. The 1929 Bernheimer expedition, how-
ever, partially excavated several sites in Wilson, Lake, and Moqui
Canyons. Two sites in the latter canyon yielded a number of well-
preserved Basket Maker burials and artifacts (Bernheimer n.d.; Morris
n.d.).

Although Bernheimer and his principal advisor on the trip, Earl
Morris, kept journals in which they described the excavations, these
accounts were never published. The numerous reconnaissances also
resulted in very little in the way of substantial publications. The
most useful published report is Julian Steward's (1941a) description of
his 1932 Glen Canyon survey, to which he devotes only 27 pages. His
conclusions, however, are essentially accurate, though very generalized.
He postulated that the canyon had always been sparsely occupied, that
settlement consisted primarily of "outposts from both Mesa Verde and
Kayenta," that the Kayenta sites were more common to the south, and
that although the Glen Canyon settlements had been in contact with
"Northern Peripheral" cultures such as the Fremont, there had been
little influence in either direction (ibid.: 354)

The pre-1957 work did result in a superficial knowledge of the
region's archeological resources, and the amassing of artifact collec-
tions, some of which are accessible to scientific study. By and large,
however, it did not lead to cumulative increases in knowledge. Adams
(1960: 19) commentary on the Glen Canyon region as a whole is appropriate:

Season after season has seen expeditions return to the same canyons, visit the same sites, collect from the ever-diminishing stock of potsherds and implements—and contribute nothing to the general body of prehistoric knowledge. The enormous expenditure of time and energy that has gone into archeological expeditions in the region has already included a large amount of costly duplication, yet today there is not a single canyon or mesa explored before 1957 that will not have to be re-surveyed in the course of the Upper Colorado River Basin Salvage Program.

The Glen Canyon Project: 1957-63

In 1956, Congress authorized dam construction at several points in the Upper Colorado River drainage basin. The largest of these, Glen Canyon Dam, was begun in 1957 near the present town of Page, Arizona, just south of the Utah border and about 15 river miles upstream from the lower end of Glen Canyon (Fig. 2). In January of 1963, the dam was sufficiently complete to allow the filling of Lake Powell to begin. At full pool, this lake will flood the entire Glen Canyon above the dam, a distance, measured along the twisting river channel, of about 170 miles. The lower parts of the Colorado tributary canyons are of course also affected.
Shortly after the Glen Canyon Dam was authorized, National Park Service officials, realizing that it would inundate numerous archeological sites, requested and received Federal funds to salvage as much information about them as possible. In 1957, the Park Service established the Upper Colorado River Basin Archeological Salvage Project (hereafter called the Glen Canyon Project) and awarded contracts for salvage investigations to the Museum of Northern Arizona and the University of Utah. The bulk of the money was to go for archeology, but provisions were also made for study of geological, ecological, and historical materials. Overall director of the University of Utah part of the project was Jesse D. Jennings; his counterpart at the Museum of Northern Arizona was Edward B. Danson.

The territory within the Glen Canyon area (Fig. 2) assigned to the Museum of Northern Arizona included the left or west bank of the Colorado below the confluence with the San Juan, the left or south bank of the San Juan, and all the territory west and south of the two rivers, respectively. The University of Utah was responsible for the remainder of the area, including the Red Rock Plateau. Except for the south bank of the San Juan Canyon, then, all the salvage archeology in the Red Rock Plateau was done by the University of Utah Glen Canyon Project crews.

The field work was not rigidly confined to the area that actually would be flooded. It was recognized that the new lake would attract numerous visitors who would explore, and perhaps damage, archeological sites at some distance from the shore. More importantly, the Park Service administrators realized that a good understanding of the archeological and other resources of the region might depend on investigation
of related materials at some distance from the flooded area (Jennings 1959: 5). Because of this orientation, tributaries were usually surveyed fully, even when only their lower ends would be flooded, and considerable attention was given to the highlands closest to Glen Canyon, including for example, the Clay Hills Pass area around the upper part of Castle Wash, which is well above and back from the new lake.

The primary stated objective of the University of Utah Glen Canyon Project was to preserve an "adequate sample of raw data, without reference to its relevance to any previous campaign of problem-oriented study" (Jennings 1959: 9). What might constitute an adequate sample was never explicitly spelled out, but in practice it was interpreted to mean as full a sample as possible. An attempt was made to locate every possibly discernable site, particularly within the canyons that would be flooded or would become avenues for hikers and picnickers after the region was opened up. Sites were chosen for excavation largely on the basis of the number of artifacts or architectural features that might be lost were they to be destroyed, secondarily on their contribution to a sampling of the variety of cultural materials within the region.

Even though many buried sites in the canyons and small campsites on the interstream divides undoubtedly were missed, and samples of artifacts collected at some of the surveyed sites were too small, a relatively high percentage of the existent archeological materials in the region probably was recorded or collected. This dragnet approach was successful in the Red Rock Plateau because 1) the extreme localization of water and soil resources concentrated the sites into a
fraction of the region's total area; 2) aridity and erosion made most sites visible; 3) even the largest sites were small enough so that a major portion could be dug in a few weeks; and 4) enough funds were available to do this kind of extensive study intensively. Although the site sample that was obtained probably includes a high proportion of the area's existent sites, it does not, of course, include sites destroyed by erosion or other natural processes. Since arroyos have been very active in part of the region, it is a moot question how many sites they have destroyed. This point will be further discussed in Chapter Five.

The archeological survey and excavations of the Glen Canyon Project in the Red Rock Plateau and bordering portions of the Glen and San Juan Canyons were carried out by no less than 11 investigators in 20 separate campaigns over a period of six years, with the results being published in a number of separate papers. Table 1 gives a chronological summary of this work. I estimate that the survey crews, which ranged in size from two to four men, were engaged in the region for a total of about 15 and a half months. The excavation parties, ranging in size from five to a dozen men, spent a total of 12 months in the field.

Altogether, 512 sites were located by the survey in the Red Rock Plateau and the bordering portions of the main canyons. Almost any spot that showed traces of prehistoric cultures was given a site designation. Thus the category "site" includes everything from substantial pueblos to small chipping stations, and from isolated petroglyph panels to hand-and-toe-hold trails pecked in the rock. Most of the sites date
Table 1. Glen Canyon Project Salvage Operations in the Red Rock Plateau Region.

<table>
<thead>
<tr>
<th>No.</th>
<th>Institution</th>
<th>Date</th>
<th>Principal Investigator</th>
<th>Area</th>
<th>Kind of Work</th>
<th>Published References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>M.N.A.</td>
<td>*Summer '57</td>
<td>G. Foster</td>
<td>Glen Canyon and lower tributaries</td>
<td>Survey</td>
<td>Sites incl. in Fowler 1959a and b</td>
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<td>2.</td>
<td>M.N.A.</td>
<td>*Fall '57</td>
<td>W. Y. Adams</td>
<td>San Juan Canyon</td>
<td>Survey</td>
<td>Adams and Adams 1959</td>
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<tr>
<td>4.</td>
<td>Utah</td>
<td>*April '58</td>
<td>J. D. Jennings</td>
<td>Glen Canyon and lower tributaries</td>
<td>Survey</td>
<td>Sites incl. in Fowler 1959a and b</td>
</tr>
<tr>
<td>5.</td>
<td>Utah</td>
<td>*May-Sept. '58</td>
<td>T. W. Matthews</td>
<td>&quot;Triangle&quot; region</td>
<td>Survey</td>
<td>Weller 1959</td>
</tr>
<tr>
<td>7.</td>
<td>Utah</td>
<td>Sept. '58</td>
<td>D. D. Fowler</td>
<td>Glen Canyon and lower tributaries</td>
<td>Survey</td>
<td>Fowler 1959a and b</td>
</tr>
<tr>
<td>8.</td>
<td>Utah</td>
<td>Sept. '58</td>
<td>W. D. Lipe</td>
<td>Red Canyon</td>
<td>Excavation</td>
<td>Lipe 1960</td>
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<tr>
<td>10.</td>
<td>Utah</td>
<td>June-Aug. '59</td>
<td>W. D. Lipe</td>
<td>Glen Canyon and lower tributaries</td>
<td>Excavation</td>
<td>Lipe et al. 1960</td>
</tr>
<tr>
<td>11.</td>
<td>Utah</td>
<td>Sept. '59</td>
<td>D. A. Suhm</td>
<td>Little Rincon</td>
<td>Excavation</td>
<td>Sharrock et al. 1961b</td>
</tr>
</tbody>
</table>

* All work not confined to the Red Rock Plateau.
<table>
<thead>
<tr>
<th>No.</th>
<th>Institution</th>
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<th>Principal Investigator</th>
<th>Area</th>
<th>Kind of Work</th>
<th>Published References</th>
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</thead>
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<tr>
<td>12.</td>
<td>M.N.A.</td>
<td>May '60 ?</td>
<td>A. J. Lindsay</td>
<td>San Juan Canyon at Beaver Creek</td>
<td>Excavation</td>
<td>Lindsay 1961</td>
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<td>13.</td>
<td>Utah</td>
<td>June-Aug. '60</td>
<td>D. D. Fowler</td>
<td>Lake and Moqui Canyons</td>
<td>Survey and testing</td>
<td>Fowler 1961</td>
</tr>
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<td>14.</td>
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<td>June-Aug. '60</td>
<td>W. D. Lipe</td>
<td>Lake Canyon</td>
<td>Excavation</td>
<td>Sharrock et al. 1961a</td>
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<tr>
<td>15.</td>
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<td>July '60</td>
<td>R. H. Lister</td>
<td>Upper Castle Wash</td>
<td>Testing</td>
<td>Lister 1960</td>
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<td>16.</td>
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<td>Aug. '60</td>
<td>F. W. Sharrock</td>
<td>Little Rincon</td>
<td>Excavation</td>
<td>Sharrock et al. 1961b</td>
</tr>
<tr>
<td>17.</td>
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<td>June-Aug. '61</td>
<td>K. Day</td>
<td>Moqui Canyon and Upper Castle Wash</td>
<td>Survey and testing</td>
<td>Day 1963</td>
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<tr>
<td>20.</td>
<td>Utah</td>
<td>*June-Aug. '62</td>
<td>F. W. Sharrock</td>
<td>Glen &amp; Slickrock Canyons, Excavation Upper Castle Wash</td>
<td>Survey and testing</td>
<td>Sharrock 1964</td>
</tr>
</tbody>
</table>

* All work not confined to the Red Rock Plateau
from the Pueblo period, or at least include Pueblo components; a few, however, are probably wholly Basket Maker. In addition, a small number of historic sites resulting from Navajo or Ute occupation of the area were given site numbers.

The site numbers assigned by the University of Utah Glen Canyon Project follow the format used by the continuing University of Utah statewide archeological survey. A typical site number is 42Sa364. The 42 stands for the state in which the site is found, in this case Utah. (At the time the system was devised, Utah was the 42nd state in alphabetical order.) The "Sa" is a county abbreviation, and here indicates San Juan county. Since all the sites dealt with in this study are in Utah, the state designator "42" will not be used.

The Museum of Northern Arizona Glen Canyon Project also used the labelling system of its parent institution. A typical number, such as NA2320, means simply that the site is the 2,230th ever recorded by the Museum of Northern Arizona survey. There is no attempt to introduce locational indicators. In this paper, when a site has been assigned both Museum of Northern Arizona and University of Utah survey numbers, only the latter will be used.

Of the 512 known Red Rock Plateau sites, 417 were investigated only by surficial observations and collections. Thirty-six others were tested—that is, were trenched or pitted and found to be unproductive or essentially lacking in depth and features. Several sites that were completely excavated but that yielded little in the way of artifacts, structures, or stratigraphy were grouped in this category for ease in reporting. In the remaining 59 sites, excavations ranging from fairly
extensive to complete were carried out, and the results reported in considerable detail.

An attempt was made to report the findings of each summer's field work before returning to the field the following summer. A special Glen Canyon series of the University of Utah Anthropological Papers was set up as a publication outlet for these reports. At the outset, Jennings ([ibid.]) specified that

reports should be descriptive in nature; preoccupation with extensive comparisons, synthesis, or interpretation must be deferred or held as incidental until the gathering of data is curtailed by filling of the reservoir...or other circumstances outside staff control.

This approach to reporting was followed fairly closely, and the schedule of publication was met—all the descriptive accounts of the University of Utah fieldwork in the Red Rock Plateau have been in print since 1964 or earlier (see references in Table 1). The Glen Canyon Project archeologists of the Museum of Northern Arizona also promptly published their reports of work in the San Juan Canyon on the south margin of the Red Rock Plateau. As yet no synthesis of the prehistory of the Red Rock Plateau or any other substantial part of the Glen Canyon region has appeared. Jennings (n.d.), however, has in draft form a general synthesis for the Glen Canyon region as a whole. This paper emphasizes the contributions to archeological knowledge and methodology made by the Glen Canyon Project; it draws a number of examples from the Red Rock Plateau.
Chapter 3

THE RED ROCK PLATEAU ENVIRONMENT

GEOGRAPHICAL SETTING: THE COLORADO PLATEAU

The Red Rock Plateau lies at the heart of an immense dissected highland—the Colorado Plateau (Fig. 1). Some of the environmental characteristics of the Red Rock Plateau are unique, but most are shared with other parts of the Colorado Plateau. Furthermore, most of Anasazi history has taken place in this great highland. Its peculiar resources and limitations cannot fail to have been reflected in the general development of Anasazi culture.

The Colorado Plateau (or Plateaus, to be strictly accurate—Fenneman 1928: 338; 1931: 274) is a physiographic province covering about 150,000 square miles (Hunt 1956: 2) in Utah, Colorado, Arizona, and New Mexico. It differs from the Rocky Mountains to the north and east and from the Basin and Range province to the west and south in several major respects.

Structurally, the Plateau is composed of approximately horizontal geologic strata. Although there are numerous minor local basins and upwarps, the rock layers are vastly less deformed than in the Rockies, and considerably less so than in the Basin and Range province. Geologically, the Plateau is made up primarily of sedimentary formations, many of great extent. The Mesaverde and Navajo sandstones, for example, are widely exposed. This gives the canyons and mesas of many parts of the province a certain homogeneity of appearance, because these two formations form cliffs at nearly every outcrop. There are a few
volcanic areas, such as the San Francisco Peaks and the Datil section in Arizona, and scattered laccolithic domes such as the Henry Mountains and Navajo Mountain in Utah, but generally, much less igneous rock is exposed on the Plateau than in either the Rockies or the Basin and Range. The Plateau's better drainage and more active erosion result also in the relative scarcity there of the thick deposits of unconsolidated colluvium and alluvium so common in the Basin and Range.

The Plateau, as its name suggests, is a highland. Although the deep canyons of the Colorado and its tributaries are incised in some places below 4000, and in the Grand Canyon, below 2000, feet, most of the land surface is between 5000 and 7000 feet in elevation, with the highest plateaus and igneous peaks locally reaching above 10,000 or even 11,000 feet. The Plateau thus rivals the Rockies in regional elevation, and is considerably higher than the Sonoran Desert section of the Basin and Range province to the south or even the Great Basin section to the west.

The region shares clear skies, high temperatures, and rainfall shortage with the other areas between the Sierras and Rockies, and is described as generally arid to semiarid (Thornthwaite 1941: Fig. 2). The great variations in altitude, however, from canyon bottoms to high plateaus and peaks, give it a remarkable variety of local microclimates. For example, Lees Ferry, at about 3140 feet in lower Glen Canyon, has a mean July temperature of 87 degrees, and gets only about six inches of rain a year. Bright Angel Ranger Station, on the Kaibab Plateau at the same latitude but 5260 feet higher, averages 62 degrees in July and 27 inches of precipitation annually (U.S. Dept. of Agricul-
ture 1941: 761). Thornthwaite (1941: Plate 3), using an index of precipitation effectiveness based on the temperature at which moisture falls, classes the lowest areas as arid, but parts of the higher plateaus as subhumid or even humid.

Because of the variations in altitude and hence in climate, the biota of the Plateau also vary. Dice (1943: 39-44) places the Plateau in his Navahonian biotic province, and describes a series of differing "life belts" related to elevation. He also notes that these belts are not entirely uniform over the whole Plateau, probably because of the diversity of physiographic conditions and the province's great latitudinal and longitudinal extent.

The Colorado River system drains about 90 percent of the Plateau (Hunt 1956: 2). The Colorado, which cuts from northeast to southwest through the heart of the province, has its headwaters in the Rockies, as do its main upstream tributaries, the Green, Gunnison, Dolores and San Juan. These streams, fed by melting snows in the spring and summer, contribute the major part of the water carried by the river in the Plateau. Relatively less comes from tributaries originating within the province, such as the Little Colorado, Dirty Devil (Fremont), Escalante, Paria and Kanab.

The Colorado crosses the Plateau in a series of deep canyons named by John Wesley Powell on his pioneering voyage down the Green and Colorado in 1869 (Powell 1875). Cataract Canyon, extending from the mouth of the Green to the mouth of the Dirty Devil, is very deep and has a steep gradient with many rapids. Glen Canyon, meandering 186 miles from the Dirty Devil to the mouth of the Paria, is less deep, and has
the gentlest gradient—only about two feet per mile—and the fewest rapids of any of the Colorado Canyons. This is because it skirts major structural features and hence is cut into relatively flat-lying, homogeneous rocks—mostly sandstones of the Glen Canyon group. Powell named the canyon for its shady tributaries, where springs and small groves of oak and cottonwood are found (ibid.: 71–2). Below the mouth of the Paria, the river's gradient again steepens as it runs through ever-deepening Marble Canyon and into the Grand. The Glen Canyon region (Fig. 2), as used here, consists of all the area drained by the tributaries that join the Colorado in the Glen Canyon, except for the watersheds of the Dirty Devil, the Paria, and the San Juan above the Red House Cliffs.

The Colorado River enters the Plateau near Rifle, Colorado at an elevation of about 5300 feet, and emerges from it at the lower end of the Grand Canyon at about 900 feet (or did, before Lake Mead formed), having dropped 4400 feet in little more than 400 airline miles. If its sinuous actual course were followed, this distance would be half to two-thirds again as great, but the average gradient would still be very high. Many of the river's tributaries, of course, originate in or enter the Plateau at even higher elevations. As a result of the steep stream gradients, a tremendous amount of energy per unit of distance is available to erode and transport materials.

By geologic standards, the Plateau itself has been uplifted rather recently; the streams have not had time greatly to reduce its relief, although they have intricately dissected it. The canyon depth and degree of regional dissection is probably about as great as it ever
will be, barring further uplift (Fenneman 1931: 284-5). The prevailing horizontal rock beda include resistant formations that sustain steep, even vertical slopes, as well as softer beds that erode rapidly. The dry climate, strong winds, and marked daily and annual temperature fluctuations promote mechanical weathering. A general scarcity of vegetation and soil, plus violent windstorms and showers leads to predominantly eolian and hydraulic transport of materials. These kinds of weathering and transport result in topographic features with concave-upward slopes. Only in the isolated high humid regions do chemical weathering, soil creep, and rounded forms with convex-upward slopes predominate.

This combination of factors—youthful streams, widespread dissec-
tion of the uplands, horizontal strata with alternate hard and soft beds, and predominantly arid-zone weathering and transport—yields the set of physiographic features so characteristic of the region. The horizon often appears flat, but on closer inspection one sees that canyons are everywhere; many are deep, narrow, and steep-walled. They cut the uplands into separate plateaus and mesas, the escarpments of which are serrated by the headward erosion of many ephemeral streams. Talus slopes and cones fringe but seldom smother the cliffs. Plateau remnants, cut off by erosion, form the prominent buttes, monuments, and spires beloved by photographers. Active or stabilized sand dunes cover parts of the lower plateaus and sometimes choke the canyons. Water-
deposited alluvium forms a flat floor in many canyons. At present, most of these fills are trenched by arroyos; the process of deposition and arroyo-cutting is apparently cyclical (Hack 1942: 45-69).
Fig. 1 Map of the Four Corners Area and the Northern Southwest
Fig. 2. Map of the Glen Canyon Area
Fig. 3. Drainages and Geographical Features of the Red Rock Plateau
Fig. 4. Topography of the Red Rock Plateau
PHYSIOGRAPHY OF THE RED ROCK PLATEAU

General Characteristics of the Region

The Red Rock Plateau (Fig. 3-4), a region first delineated by Gregory (1938: 13-4), comprises about one-tenth of the Glen Canyon area (Fig. 2). Most of the archeological work of the University of Utah Glen Canyon Project east of the Colorado and north of the San Juan was confined to this region. The culture of its prehistoric Anasazi inhabitants is the subject of this dissertation.

The Glen Canyon Project archeologists initially set out to study a much larger area, which they named the "San Juan Triangle." Its archeological survey was begun in 1958 by Thomas W. Matthews, who defined it (Weller 1959: 549) as including several of Gregory's (1938: 6-15 and Plate 1) subdivisions of the San Juan country—not only the Red Rock, but the Grand Gulch and Dark Canyon Plateaus, and Beef Basin. Most of this larger area was never surveyed; the need to salvage the archeological remains most threatened by the formation of Lake Powell forced concentration on the area near the confluence of the Colorado and San Juan. Although the term "Triangle" continued to be used in publications by the Glen Canyon Project archeologists, in fact nearly all the sites studied in that area were in the part corresponding to the Red Rock Plateau. This latter region has definite unity in the general factors controlling physiography, climate, water supply, and biota. It is a convenient unit of study and as such provides the areal focus of this paper. The Red Rock Plateau should not be confused with the Red Rock Valley, also of some archeological interest (E. H. Morris 1936; E. A. Morris 1959; Jett 1965c), located about 70 miles to the
southeast in Arizona.

As defined by Gregory, the Red Rock Plateau (Fig. 3-4) is bounded on the northeast by White Canyon, on the southeast by the Red House Cliffs (sometimes called the Clay Hills), on the south by the San Juan Canyon, and on the northwest by the Glen Canyon of the Colorado. Here, I will use Red, rather than White Canyon, as the northeast boundary, except in the Glen Canyon proper. This shifts the boundary only a few miles southwest. Lower White Canyon and the highland between White and Red Canyons were not thoroughly surveyed archeologically; while I doubt that there are many sites in this area, I cannot be sure and will exclude it. As thus defined, the region is about 20 miles wide, 50 miles long on the northwest side, and 25 miles long on the southeast side. Its area of roughly 750 square miles is about two-thirds that of the state of Rhode Island.

Because of the westward slope of the land, most of the drainage of the region is toward the Colorado. The major Colorado tributaries, moving from the San Juan upstream, are Wilson, Slickrock, Lake, Moqui, Beaver, Forgotten, Knowles, Cedar and Red Creeks. Red and Moqui, the longest, head in the Clay Hills, the highland in the northeast part of the plateau, as does the only long San Juan tributary, Castle Wash (with its upstream extension, Steer Pasture Canyon). This drainage starts out flowing in a general southwesterly direction, but is diverted to the south and the San Juan by the Nokai Dome, a northeast-trending structural and topographic ridge that crosses the San Juan about 15 miles east of its confluence with the Colorado.

The Clay Hills terminate on the southeast in the Red House Cliffs,
which continue southwest down to the San Juan River. Clay Hills Pass, the major means of access to the Red Rock Plateau from the east, is a break in the cliffs at their highest point. Other highlands include Mancos Mesa, a long, narrow, much-dissected ridge that runs northwest from the Clay Hills along the south rim of Red Canyon. Cedar Creek and the northern tributaries of Moqui head in this feature. Wilson Mesa (Grey Mesa to the 1880 Mormon pioneers and to the U.S. Geological Survey) is a narrow tableland covered with sparse grass and low brush that rises to about 4900 feet near the confluence of the Colorado and San Juan. From its top, it is possible to look down 1500 feet into the Great Bend of the San Juan.

Two other features of note are the Rincon, an abandoned meander of the Colorado just downstream from Wilson Canyon, and the Little Rincon, located in the Glen Canyon just below Red Canyon. The latter is not an old meander, but an open place in the canyon where several small streams have cut back the cliffs.

Because of its inaccessibility and its hot, dry climate due to low elevation, there are today few, perhaps no, permanent residents of the Red Rock Plateau. At the time of my fieldwork, several families lived at Hite, but they probably have been flooded out by Lake Powell. Blanding, Utah stockmen make use of the region lightly as a winter pasture, and it has seen dozens of short-lived gold and uranium mining projects. Tourist river trips became popular after World War II, and Lake Powell is already drawing thousands of boaters annually. Until this last development, however, the biggest population boom in the region had been during the Pueblo period.
Physiographically, the Red Rock Plateau is well marked off from the Dark Canyon and Grand Gulch Plateaus which border it on the north-east and east respectively (Fig. 2). Were it not for the deep San Juan and Colorado Canyons, however, it would be difficult to separate from parts of the Rainbow Plateau and Tsegi Mesas to the south (Gregory 1916: 44–8) or the Escalante Plateau (Gregory and Moore 1931: 81, 120) to the west.

If extensive dissection is typical of the Colorado Plateau as a whole, then the Red Rock Plateau is hyper-typical. Gregory (1938: 14), speaking of the area near the confluence of the San Juan and Colorado, reports that

in a day's walk, covering two miles, 25 canyons were crossed. It is a region of bare rock towers, alcoves, arches, and deep vertical walled grooves

—the roughest country seen in the Plateau province.

In 1880, it took over a month for wagons carrying Mormon pioneers to the San Juan country to travel the 30 miles between the "Hole-in-the-Rock" crossing of the Colorado and the Clay Hills Pass through the Red House Cliffs (Miller 1959). Today only one road usable by ordinary passenger cars crosses the area, and it has been improved to this state only recently to provide access to Lake Powell. There are few other roads passable to any kind of vehicle. Even foot travel is sometimes difficult, as attested by Gregory's account, though it is doubtful that it seemed as troublesome to prehistoric inhabitants not culturally oriented toward flat land, horses, and vehicles.
By Colorado Plateau standards, the Red Rock Plateau is low in elevation (Fig. 4). The floor of the Glen Canyon is of course the lowest—about 3455 feet at Hite and 3255 feet at the confluence with the San Juan. Although the tributaries have steeper gradients, their floors usually are below 4000 feet. Canyons are incised up to 1500 feet below the plateau surface, which averages about 4500 feet elevation near the Colorado and San Juan but gradually rises away from them to about 6000 feet in the northeast corner of the area. Here is found the highest point in the region—6850 feet—an isolated knob of Navajo sandstone standing above the Red House Cliffs near Clay Hills Pass. By contrast, in the Tsegi Canyon region near Kayenta, Arizona, where numerous Anasazi sites occur, the canyon floors are between six and seven thousand feet in elevation, while the surrounding highlands range up to 8000 feet. At other population centers, such as the Mesa Verde and Chaco Canyon, the major concentrations of sites also occur above 6000 feet.

To understand why the prehistoric Anasazi came to the marginal and rather forbidding Red Rock Plateau region, and how they were able to live there, one needs to know something of its resources as well as its limitations. In the following more detailed description of the physiography, elements that constituted resources for these people will be noted.

**Structural Relationships**

Structurally, the region lies on the west flank of the Monument Upwarp; its rock strata dip gently west toward the Kaiparowits and
Henry Mountains Basins. The Red Rock Plateau is composed primarily of Upper Triassic through Jurassic rocks that have not yet been stripped from the upwarp, as they have been farther east. The Red House Cliffs are the westward-retreating escarpment of these formations.

All the rock strata in the region are sedimentary and essentially undeformed. There are, however, several relatively minor structures that affect to some extent stream locations and the kinds of formations exposed. Most pronounced is the Waterpocket Fold (Fig. 2), a structural ridge that crosses the Colorado and plunges below the surface at the Rincon. The river originally detoured around this, but has since cut a straighter course, leaving a high butte isolated in its abandoned meander. The structural high here has exposed the Chinle and several older formations, which sink below the surface both north and south from the Rincon. Lower Castle Creek seems to follow the Nokai Syncline, a minor trough between the Castle Creek or No Man's Mesa anticline (Mullens 1960: 302-3; Cooley 1959: 53) and the Nokai Dome. This syncline, which extends north of the Nokai Dome, is also crossed by Lake Canyon. This probably aids spring flow in the upper and middle parts of the canyon, because its walls intersect ground water moving down-dip in the Navajo sandstone.

**Bedrock Formations**

The principal rock formations exposed in the Red Rock Plateau are, from early to late, the Cutler, Moenkopi, Chinle, Wingate, Kayenta, Navajo, Carmel, and Entrada. By far the bulk of the exposures fall within the Chinle to Navajo part of the sequence.
Below, the formations are briefly described, their age, distribution and general physiographic expression indicated, and their importance to the region's prehistoric inhabitants speculated upon. Most descriptions, dates, and statements about physiographic expression are roughly adapted from Cooley (1958: 24-6). I have treated his Moenave formation as part of the Wingate, and have added a question mark to his Jurassic date for the Navajo sandstone because it has not been shown definitely to be of that date (Mullens 1960: 295).

San Rafael group

Entreda sandstone

Age: Jurassic

Description: Color red or buff to white; bedding thick, cross-bedded, partly flat-bedded.

Physiographic expression: Forms rounded and smooth vertical cliffs and irregular ledges.

Distribution in the Red Rock Plateau: A few buttes and knobs near the mouths of Lake and Moqui Canyons.

Importance to region's prehistoric inhabitants: Probably little or no direct importance as a resource.

Carmel formation

Age: Jurassic

Description: Siltstone or sandstone; deep red; flat-bedded, with individual beds ranging from thick to thin.

Physiographic expression: Chiefly forms broad and irregular slopes; locally may outcrop in resistant
ledges; caps low mesas of Navajo sandstone.

**Distribution:** Gentle slopes and flat areas on the divides between lower Lake and Moqui Canyons; also caps Wilson Mesa.

**Importance to region's prehistoric inhabitants:** Probably none, unless in wet years the residual soils on Wilson Mesa were used for farming; this seems unlikely, since most of the sites found there were chipping stations, probably used by hunters (Weller 1959: 559).

**Glen Canyon group**

**Navajo sandstone**

**Age:** Jurassic (?)  

**Description:** Massive, uniform-textured sandstone; grayish-red to light gray in fresh fractures, weathers red-orange; cliffs sometimes are dark with water-stains and "desert varnish"; very thick beds, very large-scale cross-bedding, no flat-bedding except in rare limestone lenses (probably pond deposits) near the top of the formation; ranges from 500 to 1500 feet in total thickness.

**Physiographic expression:** Between canyons, forms knobs and hummocky "baldrock" or "slickrock"; in walls of canyons, mesas or buttes, forms vertical, rounded or irregular cliffs up to several hundreds of feet high; cliffs commonly possess bell-shaped alcoves.
or shelters formed where rock has weathered out along large convex-upward bedding planes; potholes, spires and fantastic forms created by erosion are common; vertical jointing sometimes gives cliffs a columned appearance.

**Distribution:** Throughout the region, either as the major exposed formation or in upland buttes and mesas.

**Importance to prehistoric inhabitants:** Typically it is too soft and fine-grained to be good for food-grinding implements, but some beds may be adequate since a few Navajo sandstone metates and manos have been identified (Lindsay *et al.* n.d.) It weathers into soft lumps that make poor building material, but was often used when nothing else was available. The limestone lenses are an exception, for their tabular fragments make excellent masonry; presence of these deposits may have determined some site locations. The region's largest and dryest natural shelters occur in cliffs of Navajo sandstone; it also is a talus-producer, furnishing narrow elevated floors at the bases of cliffs and alcoves. It is the region's best aquifer, and canyons cut into it generally contain springs, usually at the contact with the less-permeable Kayenta formation. The frequent eroded potholes form small reservoirs
that hold rainwater for several weeks. The Navajo also provides much of the sand for dunes and alluvial fills. Its vertical weathered surfaces made an ideal medium for petroglyphs because they contrast with the unweathered surfaces exposed by pecking or incision. In summary, this sandstone provided a number of resources; archeological sites usually are abundant in canyons cut into or through it.

Kayenta formation

Age: Jurassic (?)

Description: A sandstone; grayish-red to grayish-purple in fresh fractures, weathers to only slightly darker colors; thick-bedded, flat or lenticular bedding; total thickness never as much as either the Wingate or Navajo.

Distribution: Over nearly all the region, except in parts of the west, where only younger rocks are exposed.

Importance to prehistoric inhabitants: It fractures into tabular slabs useful in masonry, lining fire-boxes, making doors for granaries, etc. Its harder, coarser lenses may have been used for food-grinding implements. It often floors shelters in cliffs of Navajo sandstone, and sometimes has ledges that served as low shelters.
Wingate sandstone

Age: Upper Triassic

Description: A relatively fine-grained, uniform-textured sandstone, often harder than the Navajo; orange-red, weathering to a dark red-brown or red-purple, with "desert varnish" common; very large-scale cross-bedding except in the uppermost part, where bedding tends to be flat or lenticular (Cooley's Moenave Formation); jointing is closely-spaced, giving exposures a blocky or columnar look.

Physiographic expression: Usually stands in large jointed vertical cliffs; alcoves and overhangs are common, but usually not so large or dry as those in the Navajo; taluses are common at the formation's base, where they sometimes provide floors in shelters; huge blocks of the Wingate cliffs have in some places slid down slippery Chinle slopes.

Distribution: Forms buttes and canyon walls in the northern and eastern part of the region, and also in the Rincon area.

Importance to prehistoric inhabitants: It was used in masonry, and provides natural shelters. Houses were sometimes built against large Wingate slump-boulders. Typical pieces do not make good food-grinding tools, but some beds may. Although not as good an aquifer as the Navajo, it has occasional
springs at the Chinle contact; some springs appear to depend on water collected in the extensive rubble-filled joints and cracks of the cliff-margins. (Flow of the large springs at the Creeping Dune site [Sharrock et al. 1961a] may be augmented by water collected in such cracks, as well as in falling dunes.) Weathered surfaces of the Wingate were a prime petroglyph medium, giving even better contrast than the Navajo.

**Chinle formation, upper part** (This and succeeding strata do not belong to the Glen Canyon group.)

**Age:** Upper Triassic

**Description:** A variety of soft limestones, sandstones, siltstones and mudstones, some bentonitic; colors range from pastel to dark red, gray, green and blue; bedding flat or lenticular, varying from thick to thin.

**Physiographic expression:** Upper members form irregular slopes and ledges, often talus-covered; lower members form regular, irregular, or rolling slopes, and badlands; erodes rapidly; slumpage common.

**Distribution:** Extensive exposures in the Red House Cliffs and elsewhere in the deeper canyons—Glen Canyon from the upper end to just below the Little Rincon, in the Rincon proper, nearly throughout San Juan Canyon, and in Red, Cedar, and upper Moqui.

**Importance to prehistoric inhabitants:** The shaly members
probably were a source of clay for pottery, although this has not been demonstrated. Exposures are almost barren of vegetation and lack springs, except around the contact with outcrops of the overlying Wingate sandstone. In general, in the Red Rock Plateau, valleys cut into the Chinle formation were avoided as site locations. Exceptions are places where 1) surficial deposits such as alluvium, colluvium, or dune sand cover the Chinle, and 2) there are cliffs of Wingate sandstone to provide springs, rock shelters, and slump boulders against which houses could be built. Adams and Adams (1959: 9, 11) show that in the San Juan Canyon, sites are relatively numerous in the large Chinle-floored basins and box canyons, because the two conditions listed above also are present.

**Chinle formation, Shinarump member**

**Age:** Upper Triassic

**Description:** Light gray conglomeratic sandstone with thick beds and cross or lenticular bedding.

**Physiographic expression:** Forms irregular and vertical cliffs, with frequent overhangs, and often underlies stripped slopes and benches.

**Distribution:** In Glen Canyon upstream from the Little Rincon, in Red Canyon, the Rincon, the Red House Cliffs, and the San Juan Canyon upstream from the Great Bend.

**Importance to prehistoric inhabitants:** A few overhangs were used for shelter and some of the rubble was used for
masonry. Some beds were in demand in making food-grinding tools (Turner and Cooley 1960: 50). Deposits of malachite (Mullens 1960: 306) were probably used for pigments.

Moenkopi formation

**Age:** Lower and Middle (?) Triassic

**Description:** A reddish-brown siltstone or silty sandstone with thin, flat beds and some included gypsum deposits.

**Physiographic expression:** Generally forms irregular slopes, with sandy units forming irregular ledges; slumpage common.

**Distribution:** Same as the Shinarump.

**Importance to prehistoric inhabitants:** Its tabular slabs make excellent masonry, as for example at Loper Ruin, Red Canyon area. Selenite occurring in the gypsum lenses was also used for ornaments (Lipe 1960: 166-7).

Cutler formation

**Age:** Permian

**Description:** Includes several distinct members, all sandstones.

**Topographic expression:** Generally forms ledges and cliffs.

**Distribution:** In Glen Canyon above Red Canyon, at the Rincon, in San Juan Canyon at the mouth of Nokai Creek, and at the Red House Cliffs.

**Importance to prehistoric inhabitants:** Ledge shelters may have been used.
Surficial Deposits

Floodplain Alluvium

Patches of sandy or gravelly alluvium occur widely in the canyons of the main streams and in some of their tributaries. Along their edges, these deposits intergrade with alluvial fan material, falling dunes, taluses, and colluvium.

The alluvium can roughly be divided into 1) older and 2) recent deposits. The latter are largely transient, and are removed and re-deposited annually by floods; in the main canyons they form low terraces and sandbars, while in the tributaries they usually occur in patches over bedrock on the floors of narrow arroyos. In both kinds of canyon, remnants of the older alluvium (Lance's "banded alluvium" 1963: 354) remain as a fragmentary terrace next to the canyon walls. The tops of these terrace remnants range from about 20 feet higher than the present stream level, in the Glen Canyon, to 100 feet higher, in some of the tributaries. The older alluvium, as compared with the younger, apparently was deposited in a more uniform manner by less violent floods on streams running at a higher level. After aggradation stopped, downcutting by these streams dissected the older deposits.

Archeological sites occur on the older alluvium, and in a few spots, in its top few feet, but not on or in the younger material. It seems clear that during the Pueblo occupation of the region, streams were running at levels near those of the present terrace surface, and downcutting had not begun. In some places, floodplain aggradation may have continued through the period of occupation.

These floodplain deposits must have been very important to the
prehistoric peoples, because rainfall alone in this region is insufficient to sustain crops. The alluvium not only was easily worked, but it received an increment of moisture from flooding. Floodwater farming has been and continues to be a very important technique for some Pueblo peoples (see for example Hack 1942: 26–31; Bryan 1941, 1954: 39–47; Stewart 1940, and Forde 1931). Located in canyons, the alluvium is also watered in some spots by springs and seeps. By contrast, the rare residual soils, and most exposures of eolian material and colluvium, get only rainfall.

The distribution of floodplain alluvium seems to correlate with exposures of Glen Canyon group sandstones, especially in the tributaries. This relationship probably exists because 1) dune sand, an important source of alluvial material, is most abundant on or near exposures of these sandstones; 2) canyons cut in these rocks are usually narrow, with confined floodplains; 3) springs are much more common in these canyons than in others, promoting plant growth, which in turn stabilizes the floodplain and catches wind and water-deposited sand to speed aggradation; and 4) when aggrading, streams in this region seem not to have moved sediments far from their sources, but merely to have reworked materials supplied locally by wind, slope wash, and small gullies.

In the tributaries, canyons cut into the older formations, especially the Chinle, are notably dry and lacking in floodplain alluvium. In the Glen Canyon, the best-developed alluvial deposits occur where the walls are of Glen Canyon sandstones, but there also are terrace remains above Red Canyon, where older formations are exposed. These
latter deposits seem to be made up in part, however, of coalescent alluvial fans derived from the small steep gullies that are dissecting the cliffs.

The greatest concentrations of archeological sites in the Red Rock Plateau are associated with thick bodies of sandy alluvium in the middle and upper parts of Lake and Moqui Canyons and upper Castle Wash. Relatively large terrace remnants also occur at the insides of bends in the Glen Canyon proper and at a few places on the San Juan; they seem to have been less important to prehistoric peoples, judging by the number and size of associated sites. This probably is because the alluvium along the main streams was less often flooded, due to wide variation in the amount of spring runoff from the snowpack in the Rockies, and because floods, when they came, were likely to be violent and relatively prolonged. The tributaries, on the other hand, were probably flooded several times each year. Floods resulting from local midsummer thunderstorms would have been especially important to prehistoric farmers, because they would come at the time crops were beginning to mature.

The Southwestern alluvial chronology. Because floodplain alluvium was so important to the prehistoric occupants of the region, a knowledge of the history of alluviation in the area is important for interpreting the archeological record. As background for discussing this history, I will briefly review the alluvial chronology developed by Bryan (1925, 1940, 1941, 1954), Hack (1942) and others, as it applies to some nearby parts of the southern Colorado Plateau.

In some of the valleys of the Hopi Country, at Chaco and Tsegi
Canyons, and in a few other loci on the southern Colorado Plateau (Fig. 1), geologists have distinguished several roughly correlative alluvial periods, each generally followed by a phase of arroyo-cutting. Although they have not found the full sequence in all areas, they have recognized a total of three major alluviations. In the area he studied, Hack (ibid.: 45-69) named the formations resulting from these cycles of sedimentation the Jeddito, Tsegi, and Naha. This sequence of formations has come to be used as a kind of reference standard, and various other alluvial sequences both in the Colorado Plateau and in more distant parts of the arid West have with some success been correlated with it.

The oldest of the three formations, the Jeddito, contains proboscidian fossils and probably dates to late Pleistocene times. The major erosion following its deposition seems to have been during a period of drought, as shown by large falling dunes extending into the arroyos. Following Antevs, Hack dated this erosion as "Middle Post-pluvial" between about 5500 and 2000 B.C. (ibid.: 68). Antevs has subsequently called this period the Altithermal (1948: 176) and the Long Drought (1955: 328).

The next formation, the Tsegi, in some places consists of two members, separated by a minor erosion (Hack 1942: 51, 64). In the Jeddito Valley and Tsegi Canyon, late Pueblo II and III sites are common on top of the formation, showing deposition had stopped by about 1100 A.D. (ibid.). At Chaco Canyon, Bryan's second sedimentation (1954: 49) probably correlates with the Tsegi formation. Remains of the "Pit House Period" (probably Pueblo I-II) were found buried six to
21 feet below the fill's surface, while Pueblo III artifacts were found only in the top six feet. The canyon seems to have been abandoned by the middle of the twelfth century (Wormington 1956: 90), so the Pueblo III artifacts must be of that age or earlier.

Bryan thinks the "Post-Bonita Arroyo" which gullied the Tsegi formation-equivalent at Chaco was probably cut about the time the canyon was abandoned. He reasoned that the Chacoans were very dependent on floodwater farming, and left because arroyo-cutting made it impossible (Bryan 1954: 47). Although this correlation is probable on theoretical grounds, the only direct archeological evidence of it is several hearths and sherds from an alluvial fan built into the Post-Bonitan arroyo (ibid.: 36), showing that at least some Puebloans still occupied the canyon when the arroyo was open.

In Tsegi Canyon, because Pueblo III sites dating between 1100 and 1300 A.D. were cut by the post-Tsegi arroyo, Hack (1942: 62) concludes it must postdate them. He does not say how the sites were dated, but one assumes it was through pottery types correlated with tree-ring dates from the nearby cliff ruins. Hack suggests a date of about A.D. 1300 for the arroyo-cutting, which seems an acceptable maximum age. Tree-ring dates show that Tsegi Canyon was occupied until late in the thirteenth century (Wormington 1956: 99), and it probably could not have been if the floodplain were trenched by a major arroyo before the late 1200's. If both Bryan's and Hack's dates are right, it must indicate that cycles of erosion may take effect in some areas much earlier than in others.

The post-Tsegi arroyo was filled in a number of locations by the Naha formation or its equivalent. In Jeddito Wash, Hack found Pueblo IV
sherds in the Naha, and got tree-ring dates of about 1700 A.D. for wood from a firepit at its top (Hack 1942: 53). Today in many parts of the Southwest, the Naha is trenched by arroyos which seem to have begun at various times between 1880 and 1910 (ibid.: 64)

Application of the Southwestern alluvial chronology to the Red Rock Plateau. No late Pleistocene deposits correlative with the Jeddito formation seem to occur in the tributary canyons of the Red Rock Plateau, but Cooley (1962: Fig. 18. 2A,D) speculates that they are present beneath the riverbed in Glen Canyon, and indicates that they are exposed in the canyon of the Escalante River, a Colorado tributary located west of the Red Rock Plateau. In Lake and Moqui Canyons, falling dunes, perhaps from Altithermal times, occur beneath the older or banded alluvium (Lance, 1963: 355-6, 359).

Lance's banded alluvium must correlate with the Tsegi formation, because Pueblo III sites occur on top of it, and in a few places, several feet beneath its surface. The best-studied exposures of this alluvium are in Lake and Moqui Canyons. In Lake, Lance (ibid.: 362-5) found predominantly medium to fine sand fill with numerous dark humic bands and lenses. These dark deposits were probably formed in vegetated areas kept very moist by springs. The banded sands continued to the top of the fill, covering the Dead Tree Flats site (Sa627) to a depth of about two feet. This site probably dates to the early twelfth century. In Moqui Canyon (ibid.: 367), the profile was similar, although there were fewer dark humic bands, probably because springs are scarcer in this canyon. The top 20 feet or so of fill showed a shift toward less regularly bedded sands containing more fine gravel, as well as evidence of the cutting and probable rapid filling of
shallow arroyos. At the Red Ant Kiva site (Sa675), a kiva dating probably to the twelfth century was buried by 12 to 14 feet of this deposit; slightly later structures occurred stratigraphically two to four feet higher.

Before the Dead Tree Flats site in Lake Canyon was excavated, Cooley (1962: Fig. 18.2F) studied the arroyo cut at this location and concluded that the upper third of the deposit probably correlated with the Naha Formation. This could not be correct because of the twelfth century date of the site, which lies at the top of the fill.

In fact, the principal difference between the Red Rock Plateau alluvial sequence and the general Southwestern one is the absence of any clear evidence of the Tsegi-Naha erosion and the subsequent Naha deposition. Cooley (1962: Fig. 18.2A) tentatively correlates some of the alluvium in the Glen Canyon proper with the Naha, but indicates he cannot clearly distinguish it from deposits being made on the present floodplain.

The present arroyo-cutting cycle in the Red Rock Plateau probably started early in the twentieth century, or at least did in Moqui and Lake Canyons, where we have informants' accounts. By Southwestern standards, this is relatively late in the present erosional phase, which may indicate that streams of the area resisted entrenchment in modern times as they seem to have done earlier. It may also be due to the relatively late introduction of livestock into the area—not until after 1890.

For archeological purposes, the major conclusion we may draw from this survey is that at least in the tributaries, the streams of the
region probably did not cut arroyos during the twelfth and thirteenth centuries at a time when many other streams in the northern Southwest seem to have done so. This in turn may help explain why such an environmentally marginal area continued to be occupied at a time when other seemingly more favorable areas were being abandoned.

Alluvial Fans

Several of the larger Colorado and San Juan tributaries have built gravel and boulder fans at their mouths. Some of these partially dam the main streams, which lack the power to remove them; most "rapids" in the Glen and lower San Juan Canyons are at these locations. The large fan of Beaver Creek, just across the San Juan from the Red Rock Plateau, was intensively farmed in prehistoric times. In addition to boulders and gravel, it contains considerable sand and silt deposited by Beaver Creek and by slopewash and wind. Lindsay (1961) found small habitation sites here, as well as traces of "terraces, linear and grid borders, ditches, windscreens, and possible cisterns or walled-in springs" used to control and conserve the Beaver Creek flood water.

No similar features were found in the Glen Canyon. Here, canyon mouth fans seem to contain more boulders, and often are swept by the Colorado's high floods. Some of these, however, must have made convenient fords at low water during midsummer through winter. The Buried Olla site (Ga367), located near such a ford made by the fans of Forgotten and Smith Fork Creeks, was probably a camping spot along an old trail (Lipe et al. 1960: 70-1).

Smaller drains or gullies in the cliffs may form small alluvial
fans where they empty out onto the floodplain or terrace of the larger streams. Some of these may have been used as fields in prehistoric times, although no direct evidence of it was found. In the Hopi Country, "akchin" (gully-mouth) fields on these small fans are numerous and very important (Hack 1942: 26-8). In the Red Rock Plateau, however, most of the valleys are so narrow that the fan material would simply have been reworked by the main stream and merged with the floodplain deposit.

Terrace Gravels

Along Glen and San Juan Canyons, large gravel deposits occur on benches cut into the bedrock during Pleistocene times, when the rivers ran at much higher levels. These terraces stand from a few feet to as much as 500 feet above the Colorado (Hunt et al. 1953: 175) and up to 700 feet above the San Juan (Mullens 1960: 297), and occur at even higher levels on the bordering uplands.

These gravels often contain fine gold particles, which have been the object of many unsuccessful placer-mining operations over the last 75 years (Crampton 1962, 1964; Stanton 1961). It was not gold that made these gravels important in prehistoric times, however. Included in the gravels are several kinds of hard, silicious, conchoidally-fracturing stones--cherts, jaspers, and fine-grained quartzites and felsites (Cooley, 1960). Chipped stone tools in use throughout the region were made from these materials. That they also were important to the Tsegi Canyon Pueblos, 30-40 miles south of the San Juan (Fig. 1), has been indicated by Turner and Cooley (1960: 46-53) in a
comparative study of rock and tool types. Large pieces of the hard Dakota sandstone, useful for food-grinding tools, were also sought in the gravels. The terrace gravels, an important prehistoric resource, are most abundant along the main canyons of the Red Rock Plateau area (Hunt et al. 1953: 174-5; Baker 1936: 79; Miser 1925: 126).

Sand Dunes

The various sandstones of the region provide an abundant supply of sand and the extremely dry climate allows much of it to be moved by the wind. Active or stabilized dunes lie on most of the platform areas between streams, especially in the section between the Rincon, Moqui Canyon, and Castle Wash (Fig. 3). The prevailing south and southwest winds blow much sand into the east-west trending tributaries of the Colorado; several falling dunes more than 500 feet high spill over Moqui Canyon's south rim, providing the easiest access to its floor. Castle Wash receives enough dune sand to almost bury parts of its shallow upper canyon.

Hack (1942: 12-5, 32-4) has pointed out the importance of dune sand to the water supply in the Hopi Country and to Hopi agriculture. Some of the factors operative there may also apply to the Red Rock Plateau. Because there is so little soil and vegetation in arid regions, most of the scant rainfall either drains off or evaporates. Dune sand, however, provides an absolutely absorbent surface, and the water rapidly sinks deep enough to escape evaporation. Active dunes are especially good reservoirs because they have no vegetation to sap the moisture. Springs often occur at the base of large dunes; this is
certainly true of some of the falling dunes in Moqui Canyon. Another
good spring location is at the base of a permeable rock bed capped by
dune sand. Probably one reason for the large number of springs in Lake
and Moqui Canyons and upper Castle Wash is that dune sand often lies
near the windward rim on the Wingate or Navajo formations. Primitive
horticulturalists can also use dune moisture by farming directly on
them or at their bases; this probably was also done in the canyons of
the Red Rock Plateau. Dune sand trapped in canyons is also a major
source of material for alluvial fills; in the absence of perennial
stream flow to redistribute sand, falling dunes may even form dams that
hasten the filling process (Lance 1963: 365).

Landslide Deposits and Taluses

Landslide deposits are most abundant where both the Wingate and
Chinle formations are exposed. The easily-eroded shales and mudstones
in the upper Chinle are slick when wet, forming good planes of slippage.
Large blocks of Wingate and Chinle, up to several hundred yards long,
have slid away from the cliff face at a number of locales. Weathering
and further slippage gradually reduce these blocks to rubble, until
they become indistinguishable from the taluses formed directly from the
cliffs. As noted in discussion of the Wingate, the rubble accumulation
may contribute to spring formation, and houses sometimes were built
against isolated landslide boulders. Mullens (1960: 299) suggests that
alluvium in Mikes Canyon, a short San Juan tributary, may have been
deposited in a landslide-dammed lake. An extant pond in the upper part
of Wilson Canyon lies behind a rubble dam created by a huge landslide
or rockfall from the Navajo sandstone cliff. The importance of taluses in flooring shelters and as sources of building stone has already been notes.

Colluvium and Residual Soils

Residual soils are rare, and where found, are generally outside the canyons, and are shallow and poorly watered. They probably were not important to prehistoric peoples. Colluvium occurs in most canyons, and intergrades with alluvium at the edge of the floodplain. Most colluvium-covered slopes are well drained and too dry for farming, but where watered by springs and seeps, would be adequate. In a few canyons, perhaps especially in Slickrock Canyon (Fig. 3), deposits of this latter sort may have been important to farmers.

CLIMATE OF THE RED ROCK PLATEAU

Present Conditions

The Colorado Plateau in general has high summer temperatures and scant precipitation; because of its relatively low elevation, the Red Rock Plateau stands at the extremes in both these categories, as a glance at Table 2 will confirm. Data from Bluff, Hite and Lees Ferry, located respectively east of, at the north margin of, and southwest of the region (Fig. 2), show the general relationships of climatic variables to altitude and latitude. The greatest differences, amounting to 6.6 degrees in mean annual temperature and over an inch and a half in annual precipitation, are between Bluff, at 4320 feet, and Lees Ferry, almost 1200 feet lower. Hite, about 300 feet higher than Lees Ferry, is close to this station in temperature, but its rainfall
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<td>46.9</td>
<td>73.9</td>
</tr>
<tr>
<td>(19 yr. record)</td>
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</tr>
<tr>
<td>Mean Min. Temp.</td>
<td>24.8</td>
<td>29.8</td>
<td>31.1</td>
<td>44.9</td>
<td>53.5</td>
<td>61.1</td>
<td>69.1</td>
<td>67.7</td>
<td>57.5</td>
<td>44.8</td>
<td>34.1</td>
<td>25.5</td>
<td>45.8</td>
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<tr>
<td>(19 yr. record)</td>
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<tr>
<td><strong>Lees Ferry (3141 ft. elev.)</strong></td>
<td></td>
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</tr>
<tr>
<td>Aver. Precipitation</td>
<td>.39</td>
<td>.55</td>
<td>.45</td>
<td>.40</td>
<td>.28</td>
<td>.18</td>
<td>.61</td>
<td>1.21</td>
<td>.50</td>
<td>.51</td>
<td>.39</td>
<td>.50</td>
<td>5.97</td>
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<td>(28-31 yr. record)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean Temperature</td>
<td>35.7</td>
<td>43.9</td>
<td>52.7</td>
<td>62.9</td>
<td>71.3</td>
<td>80.8</td>
<td>88.0</td>
<td>85.4</td>
<td>78.1</td>
<td>64.4</td>
<td>47.8</td>
<td>38.8</td>
<td>62.5</td>
</tr>
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<td>(16 yr. record)</td>
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</tr>
<tr>
<td>Mean Max. Temp.</td>
<td>47.0</td>
<td>56.5</td>
<td>66.8</td>
<td>77.5</td>
<td>86.5</td>
<td>97.2</td>
<td>103.5</td>
<td>100.6</td>
<td>94.5</td>
<td>79.6</td>
<td>61.1</td>
<td>49.7</td>
<td>76.7</td>
</tr>
<tr>
<td>(16 yr. record)</td>
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</tr>
<tr>
<td>Mean Min. Temp.</td>
<td>24.4</td>
<td>31.3</td>
<td>38.7</td>
<td>48.2</td>
<td>56.1</td>
<td>64.3</td>
<td>72.6</td>
<td>70.1</td>
<td>61.7</td>
<td>49.3</td>
<td>34.6</td>
<td>27.9</td>
<td>48.3</td>
</tr>
<tr>
<td>(16 yr. record)</td>
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</tbody>
</table>

* Precipitation figures are in inches, temperatures in degrees Fahrenheit

Source: U. S. Dept. of Commerce, 1953, parts 1 and 5.
approximates that of Bluff. This is perhaps because Hite lies near the moisture-catching Henry Mountains, and because it is nearly a degree of latitude north of Lees Ferry.

Hite and Bluff have similar seasonal distributions of rainfall and contrast in this respect with Lees Ferry. At the former station, precipitation is more common in midsummer through early spring, while late spring and early summer are very dry. At Lees Ferry, these latter seasons also are the driest, but fall and winter are not far behind. Here, a markedly greater proportion of total annual moisture comes in midsummer; 30.4 percent of average year's precipitation falls in July and August, whereas only about 19 and 17 percent, respectively, occurs at Bluff and Hite in these months.

These data indicate that Lees Ferry has a rainfall regime typical of the southeastern part of the arid West, while Bluff and Hite border on the northern zone. The boundary is roughly along the Utah-Arizona line (McGehee 1963: 118). North of this, rainfall comes largely from polar Pacific air masses, which sweep in from the northwest and most often penetrate the intermountain region in the winter and early spring. Areas to the south and southeast of this border are watered predominantly by moist Gulf of Mexico air masses, which reach the interior only in middle and late summer. South Pacific air sometimes brings storms to interior Southern California and western Arizona, but seldom reaches the Colorado Plateau (Thomas 1962: 9-11). The boundary zone, into which Hite and Bluff evidently fall, is likely to receive some winter moisture from the northern storm system and some midsummer precipitation from the southeastern one. As briefly discussed later in this
section, location of these weather zone boundaries may have been some-
what different in the past.

Whatever the ultimate source of precipitation in the Red Rock Pla-
teau, however, it clearly provides inadequate moisture for dry farming. 
Even at higher, cooler elevations, where evaporation is less, dry farm-
ing with Anasazi crops probably requires about 15 inches of rainfall a
year.

Hack (1942: 19-25) shows that in the Hopi Country, the altitude
zone best for agriculture centers at about 6000 feet. Here, the 130-
day growing season is adequate for most Hopi crops, and the 10–12 inch
rainfall is apparently optimum for flood-water farming under the pre-
vailing summer-rainfall regime. Above this altitude, chance of frost
during the growing season rapidly increases, and below it, the water
supply is usually insufficient. In this lower zone, farms are concen-
trated along very large streams or where springs are abundant (ibid.: 
22). Both these conditions are of course present in the Red Rock
Plateau, and the latter was probably especially important in the occu-
pation of some of the tributary canyons. Frost would certainly not
have been a problem in the region; there are no data for Hite, but the
growing season averages 188 days at Bluff and 227 days at Lees Ferry
(U.S. Dept. of Agriculture 1941: 761, 1148).

Past Fluctuations

Past fluctuations in the climate of the Four Corners area have
been postulated on the basis of a number of different lines of evidence.
Among these are tree-ring records, cycles of arroyo-cutting and
alluviation, palynology, correlations with macro-climatic episodes
demonstrated elsewhere, soil zones, caliche horizons and other geomor-
phological features, and displacements of human and animal populations.
In the following paragraphs, I will discuss what seem to me the three
principal and most fruitful lines of evidence--tree-ring records,
arroyo-cutting cycles, and macroclimatic episodes. Evidence from
palynology and other sources enters into these discussions to some
extent. Discussion of human population movements will be reserved for
the chapters dealing with the prehistoric cultures.

Inferences from Tree-ring Records

Because the subsistence technologies of Southwestern Indians were
so closely adjusted to the environment, changes in climate could have
had major effects on these populations. For this reason, Southwestern
archeologists have long been interested in evidence of past fluctuations.
One potentially valuable (though perhaps often misused) source of such
data are tree-ring chronologies, because they are based on fluctuations
in tree-ring width, which in turn are related to fluctuations in
climate. Since these chronologies give absolute dates, they provide a
way of dating, as well as of identifying, climatic changes. An inter-
est in cyclic climatic variations was in fact what originally led
A. E. Douglass to the investigations of tree-rings that eventually
culminated in his development of dendrochronology.

Although the varying widths of tree rings reflect climatic varia-
tions, this relationship is extremely complex (see the "model for tree-
ring growth and climate" presented in Fritts et al. 1965: 115) and
climatic interpretation of the tree-ring record presents many pitfalls for the unwary. The best recent study of the paleoclimatic interpretation of tree-rings is that of Fritts et al., noted above. The authors of this paper conclude 1) that precipitation is the principal variable affecting ring width, with temperature exerting a lesser influence, 2) that these two main variables have different effects at different seasons of the year, and 3) that these seasonal effects vary with the species of tree involved. Because I make some climatic inferences from the ring growth record for Douglas fir at Mesa Verde, as presented by Fritts et al., I will discuss relevant findings of these authors in the following paragraphs.

The three coniferous species studied by Fritts et al. were Utah juniper, pinyon, and Douglas fir. The ring records of living trees of these species were studied, and variations in ring widths since 1922 were correlated with climatic records kept starting in that year at the Mesa Verde weather station. The findings are summarized in Table 3.

As Table 3 shows, ring width in Utah juniper and pinyon pine are primarily correlated with the precipitation and temperatures of the October through May preceding the early summer growing season. Ring growth in Douglas fir, on the other hand, was affected not only by the October-May climate, but by the climate of the current June, and of the previous June-September period as well. Fritts et al. (1965: 117) rank the importance of various climatic intervals in the growth of Douglas fir as follows, in order of decreasing weight: 1) March-May, 2) October-November, 3) August-September, 4) current June, 5) December-February, and 6) previous June.
Table 3. Effects of Seasonal Climates in Producing Narrow Rings in Three Species at Mesa Verde National Park\(^1\) (after Fritts et al. 1965: Table 8).

<table>
<thead>
<tr>
<th>Seasonal Period</th>
<th>Location of Sample</th>
<th>Wetherill Mesa</th>
<th>Navajo Canyon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Species and Age of Trees</td>
<td>400-year-old Utah Juniper</td>
<td>250-year-old Pinyon Pine</td>
</tr>
<tr>
<td></td>
<td>Size of Sample</td>
<td>5 trees</td>
<td>5 trees</td>
</tr>
<tr>
<td>Previous June, July</td>
<td>no effect</td>
<td>no effect</td>
<td>6-warm, dry(^2)</td>
</tr>
<tr>
<td>Previous August, Sept.</td>
<td>no effect</td>
<td>no effect</td>
<td>3-dry(^3)</td>
</tr>
<tr>
<td>Previous Oct., Nov.</td>
<td>3-dry, warm(^3)</td>
<td>1-dry(^3)</td>
<td>1-dry(^3)</td>
</tr>
<tr>
<td>Previous Dec.–Feb.</td>
<td>1-dry, cool(^3)</td>
<td>2-dry(^3)</td>
<td>2-dry(^3)</td>
</tr>
<tr>
<td>Current March–May</td>
<td>2-dry, warm(^3)</td>
<td>4-dry, cool(^2)</td>
<td>4-dry, cool(^3)</td>
</tr>
<tr>
<td>Current June</td>
<td>no effect</td>
<td>no effect</td>
<td>5-dry(^2)</td>
</tr>
<tr>
<td>Current July</td>
<td>no effect</td>
<td>3-warm(^3)</td>
<td>no effect</td>
</tr>
</tbody>
</table>

\(^1\)Numbers from 1 to 6 indicate the rank of importance, from high to low, of the climatic interval in the production of narrow rings.

\(^2\)Relationship significant \(P < .05\)

\(^3\)Relationship significant \(P < .01\)
These seasonal differences among species are useful in evaluating climatic inferences from tree-rings, because we are most interested in the climate of the seasons most important to the growth of Anasazi crops. The mid- and late-summer rains were probably crucial in ensuring the success of an Anasazi corn crop, but the length of the growing season and the amount of soil moisture accumulated during the winter was also important, especially in the higher dry-farming areas. Douglas fir reflects these seasonal climatic variations better than do either pinyon or juniper. It is the only species in which summer moisture has a significant effect on ring growth, so that summer droughts would be likely to be recorded; furthermore, its growth is strongly inhibited by dry and cool springs. Spring weather of this sort would also be bad for Anasazi farmers, because it would 1) delay the time of planting or destroy seedlings through late frosts, and 2) dissipate the soil moisture that had accumulated during the winter. Jett (1964: 282), Hack (1942: 20, 26, 32) and others (cited in Jett) have emphasized the important role of residual soil moisture during the critical period following planting and preceding the summer showers. Therefore, even though the climatic requirements of Douglas fir and Anasazi crops are somewhat different, we may conclude that a long series of narrow rings in Douglas fir probably reflects a period which also was bad for Anasazi agriculture. Although far from ideal, this tree-ting record seems clearly to be the most precise and sensitive single source of inferences about past climatic fluctuations that we have.

The principal conclusions of Fritts et al. about past climates on the Mesa Verde are derived from a chart of ring width variations in
Douglas fir; this is based on a combination of sequences from living trees and from archeological wood specimens. This chart is reproduced as my Fig. 5. The ring width indices represent proportions of the growth trend of the tree, and the points plotted are actually running means for the five years preceding the year at which the point is located. For further explanation of technical considerations in constructing this chart, the reader should turn to the original source (Fritts et al. 1965: 118-9, Fig. 10); it is sufficient here to say that the peaks and valleys of the chart show upward and downward deviations from the mean trend of ring growth, and hence reflect probable variations in the favorability of the climate.

In summarizing the climatic changes recorded by this chart, Fritts et al. point out that since A.D. 445, there have been at least ten "droughts more severe in both magnitude and length than the drought of 1276-89," which is generally referred to as the "Great Drought." These ten other droughts showed their lowest five-year means in A.D. 517, 565, 614, 844, 1170, 1402, 1525, and 1670. Perhaps instead of "drought," a label such as "unfavorable climatic period" should have been used in recognition of the fact that temperature may act in combination with precipitation to affect ring widths.

Because of the greater sensitivity of Douglas fir to the kinds of climatic fluctuations important to this study, and because of the care and sophistication with which Fritts et al. have compiled the chronology shown in Fig. 5, I will use this chart as the principal basis for my inferences from tree-rings about climatic changes in the Red Rock Plateau and Four Corners area in general during the Pueblo period.
Fig. 5. Five-year Running Means of Corrected Douglas Fir Tree-Ring Indices from Mesa Verde, Plotted on Every Even Year (after Fritts et al. 1965: Fig. 10)
Although the Fritts chart is based on a single small area, and may thus reflect local peculiarities, it nevertheless is at about the same latitude as the Red Rock Plateau, and should thus be in about the same position with respect to the competing rainfall regimes described in the discussion of the modern Red Rock Plateau climate. I will in any case check my inferences against Schulman's (1956: Table 49) summary of ring width variations for all species in the Colorado River Basin as a whole, and will point out any significant differences between the two sources. Schulman's data will also be used for discussions of climate during the Basket Maker occupation of the Red Rock Plateau, because Fritts' Mesa Verde chronology extends back to only 445 A.D.

Apart from the complexities of the climate-ring width relationship noted above, a further major problem in the climatic interpretation of tree-rings is that the record gives a better record of short-term relative variations in climate than of long-term general trends. This is because the ring width indices have to be plotted as departures from a curve reflecting the average radial growth trend of the tree through time, which in turn is calculated from the ring widths themselves. Thus, as Schulman (1956: 56) points out,

a slow secular trend in climate will result merely in a somewhat different slope in the age trend in radial growth of the trees, an effect superposed on but not separable from the age trend the tree would have had under generally unchanged climate.
Inferences from Alluviation and Arroyo-cutting

The sedimentation and erosion cycles on which the Southwestern alluvial chronology is based have also been interpreted as evidence of climatic change. The "Bryan-Anteves model" (Martin 1963b: 61) of post-pluvial climate correlates arroyo-cutting with drought, under the assumption that during such times, runoff after rainstorms would increase in proportion and rate, and hence in erosive power. Within the last century, overgrazing has had the same effect (Anteves 1962: 195), perhaps aided by drought. Periods of alluviation, on the other hand, are thought to be times of greater moisture. The reconstruction of Southwestern climatic history by Anteves and others depends not only on the evidence of erosion and sedimentation, but on climatic interpretations of the nature of the sediments, of fossils, soils, caliches, lake levels, terraces, wind erosion and dunes, tree-rings, glacial fluctuations, and on correlations with dated climatic events elsewhere (Anteves 1955: 317; Martin 1963b: 61).

Martin (1963a, 1963b; Martin et al. 1961) recently proposed a markedly different correlation of seasonal climates with arroyo-cutting and alluviation. In a study of pollen profiles from sites in southern Arizona, he found no evidence of dryer climates during the Altithermal (ca. 5500-2000 B.C.) or the late thirteenth century, a time when the so-called "great drought" was recorded by tree-rings in the southern Colorado Plateau to the north. On the contrary, the minor vegetational variations observed by Martin during Altithermal times indicated a climate if anything slightly wetter than that of today (Martin 1963b; 61, 67-8). He suggests the Altithermal arroyo-cutting was accomplished
by increased summer rainfall. He reasons that during this time, a
temperature rise in the Midwest and Great Lakes intensified the rain-
fall regime characteristic of the eastern southwest by bringing in more
moist air masses from the Caribbean and Gulf, thereby increasing summer
precipitation (ibid.: 4, 67). He found no evidence of any change in
the southern Arizona vegetation during the late thirteenth century
period of the "great drought" (ibid.: 66). The correlation between
narrow tree-rings, the Tsegi-Naha erosion, and Pueblo abandonment of
the southern Colorado Plateau seemingly contradicts his argument, but
in defense, he cites Gladwin's (1947) statement that ring growth re-
flects primarily winter, rather than annual, rainfall. Hence, a shift
to a higher proportion of summer rainfall, if accompanied by a drop in
winter precipitation, would result in narrow tree-rings, but not in a
drought that would "shrink upland vegetation zones" enough to be re-
corded in the pollen sequence.

Schoenwetter (1962), a student of Martin, has presented similar
climatic reconstructions in attempting to interpret pollen sequences
from east-central Arizona, on the southern margin of the Colorado Pla-
teau. Schoenwetter finds a marked increase in chenopod-amaranth pollen
at about 1000 A.D., plus or minus 100 years. He interprets this as
indicating the onset of arroyo cutting, because these plants thrive on
eroded and disturbed sediments. Arroyo-cutting he in turn attributes
to increased summer rainfall, but adduces no independent evidence,
citing instead the propositions of Martin et al. (1961) to support his
interpretation.

Martin's climatic interpretations have brought a shower of
responses, most of them negative. Antevs (1962) challenges Martin's hypothesis on the grounds that it rests only on pollen data, and other lines of evidence contradict it. He suggests that the pollen variations most crucial to Martin's argument are from sediments deposited in a very short time, and thus probably reflect only differences in preservation, sampling, and local edaphic factors. He also doubts that the meteorological shifts Martin postulates would increase summer rainfall in the Southwest, since this kind of situation would be accompanied by higher temperatures, leading to an inflow of warm dry Pacific air that would cancel out the greater summer quantities of moist Gulf air.

Sayles (1965) has convincingly shown that Martin misinterpreted the stratigraphy at some of the sites he sampled, and that his most important sequences are therefore invalid. He adds that conclusions based on one small area of southeastern Arizona cannot be considered applicable to the whole Southwest.

With respect to the "great drought" and the tree-ring record, Ellis (1964: 214) makes the relevant observation that the "great drought" of the thirteenth century was a phenomenon of the Plateau, and should not be expected to show up in climatic records of southern Arizona, since it does not even seem to be recorded in the Rio Grande tree-ring chronology. As previously noted, Fritts et al. (1965) have showed that ring growth in Douglas fir is significantly affected by summer precipitation, so that Martin's statement that tree-ring records only reflect winter moisture is not entirely true. Fritts et al. (ibid: 119) also tested Martin's hypothesis that the "great drought" was a period of low winter and high summer precipitation. They compared
pinyon and juniper records, which primarily show winter precipitation, with the Douglas fir record, which reflects summer rainfall as well. They reasoned that if Martin were right, pinyon and juniper should show significantly narrower rings during the "great drought" than would Douglas fir. Their findings did not support Martin's position.

No significant differences are apparent between the chronologies of different species, but some differences were observed in the direction of lower growth in the Douglas fir chronologies. We conclude that there is no tree-ring evidence to support a hypothesis that summers were moist, but there is evidence that winter and summer precipitation were both low and summer and autumn temperatures were probably high (ibid.).

Correlations with Macro-climatic Episodes

The previous approaches to the reconstruction of past climatic fluctuations have depended primarily on Southwestern data, and have concentrated on short-term climatic events, such as the "great drought." Another approach to climatic reconstruction is to view past fluctuations in the Southwest as part of major worldwide or multi-regional climatic episodes. These episodes appear to be the result of changes in major atmospheric circulation patterns, and are based on a number of lines of evidence from several areas, sometimes including, but not limited to, the Southwest. The effects of these macroclimatic
episodes in the Southwest may be 1) deduced through the application of meteorological theory and 2) inferred from the available Southwestern evidence.

The most recent attempt to summarize the major post-Hypsithermal (the Southwestern version of this interval is called the Altithermal) climatic episodes of the United States is that of Baerreis and Bryson (1965). Their principal objective is to correlate these episodes with expansions and contractions of the Mississippian cultures, but they also summarize the climatic evidence for much of western North America. For the Southwestern evidence, they rely primarily on a paper by R. Woodbury (1961), who in turn was relying on an unpublished paper dealing with climatic episodes by R. W. Fairbridge, as well as on his own knowledge of the Southwestern climatic data. The climatic episodes identified by Baerreis and Bryson, with their principal geologic-climatic expression, are as follows: (The absolute dates are of course approximate and may vary from one area to the next)
<table>
<thead>
<tr>
<th>Date</th>
<th>Episode</th>
<th>Geologic-climatic Expression in the Southwest</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 500 B.C. to 400 A.D.</td>
<td>Sub-Atlantic</td>
<td>Warmer&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>ca. 400 -800 A.D.</td>
<td>Scandic</td>
<td>Accelerated erosion in Southwestern mountains.</td>
</tr>
<tr>
<td>800 or 900 A.D. to ca. 1250</td>
<td>Neo-Atlantic</td>
<td>Warmer, gullying begins in valleys of Colorado Plateau and the Rio Grande area.</td>
</tr>
<tr>
<td>ca. 1250 A.D. to ca. 1450</td>
<td>Pacific</td>
<td>Summer rains diminish, winter rains increase (probably cooler).</td>
</tr>
<tr>
<td>ca. 1450 A.D. to 1550</td>
<td>Return to Neo-Atlantic conditions</td>
<td>Warmer</td>
</tr>
<tr>
<td>ca. 1550 A.D. to ca. 1880</td>
<td>Neo-Boreal</td>
<td>Cooler, glaciers reappear in Rockies as far south as New Mexico.</td>
</tr>
</tbody>
</table>

Baerreis and Bryson's Neo-Atlantic and Pacific periods are of greatest interest to us, because the Pueblo occupations of the Red Rock Plateau overlap both periods. For this reason, it is useful here to

<sup>1</sup>R. Woodbury (1961) is cited for this conclusion. Actually, he qualified this interpretation somewhat, as follows.

The Altithermal was followed...by a long period of cooler conditions, interrupted by a somewhat warmer period of roughly 1700 to 1500 B.C. By 300 B.C., warmer conditions had again returned. A cooling trend occupied the next three or four centuries, but from about 100 to 1100 A.D. there was increasing warmth...
quote at greater length Baerreis and Bryson's principal conclusions about these two periods, and to comment on these conclusions.

The Neo-Atlantic period, according to Baerreis and Bryson (1965: 215-6), began about A.D. 800-900...

Just as the Sub-Atlantic might be called, alternately, the Graeco-Roman, Han, Hopewell or Dorset period, so the Neo-Atlantic...might be called the Viking, Western Thule, Anasazi, or Middle Mississippian. We have chosen to call it the Neo-Atlantic because of its similarity to the Atlantic (Lamb, 1963). Drift ice was greatly reduced in the Arctic and the Canadian Arctic Archipelago was apparently free of permanent sea ice. Inland Canada was warmer and the boreal forest advanced northward... European summers were remarkably warm and dry, but the circulation pattern of well developed subtropical anticyclones associated with such conditions brings an influx of moist tropical air into the Great Plains of North America to provide abundant summer rain—in turn supporting the extension of corn farming by the Upper Republican people. The Southwest was warmer, glaciers disappeared from the United States portion of the Rocky Mountains, and extensive gullying began in the valleys of the Colorado Plateau and the Rio Grande area, apparently in response to increased summer rainfall (Woodbury 1961; Bryson and Julian
1963). During this time the Anasazi corn farmers, using the summer rains, expanded to their maximum extent, and more Mexican faunal elements entered the southwestern United States.

Regarding the Pacific period, Baerreis and Bryson write: A rather sharp change in the atmospheric circulation appears to have taken place around A.D. 1250. Written records from Europe indicate that the pattern of dry summers and mild winters that had characterized Western Europe during the Neo-Atlantic gave way in a few decades to a pattern of wet, cool summers in coastal Europe and dry summers and cold winters in eastern Europe (Lamb 1963). This is a pattern recognized today as 'Westwetter' or predominantly zonal flow. Farms on heavy clay soil areas of England and Denmark were abandoned, and ice conditions worsened in the sub-Arctic. The closing of the waterways in the Canadian Arctic Archipelago terminated whaling by the Western Thule people.

Zonal flow produces damp, cool summers in coastal Europe, but has a quite different effect in interior North America. Pacific air streams across the western Cordillera, descending across the Plains. Summer rains diminish in the Southwest and the northern Plains, while Oklahoma and Texas receive more summer rain, and winter precipitation increases in the Rockies and the Colorado
Plateau. During this interval...the Upper Republi-
can corn farming ceased on the Plains...and a cata-
trophic reduction of the area occupied by the Anasazi
occurred (Woodbury 1961).

As Baerreis and Bryson note, their Neo-Atlantic period has been
called the "little climatic optimum" because of its similarity to the
postglacial climatic optimum (or Hypsithermal period--see Deevey and
Flint 1957) which occurred before 1500 or 2000 B.C. In the Southwest,
the Altithermal period (Antevs 1948), which lasted from about 5500 to
about 2000 B.C., seems to be the local expression of the Hypsithermal.
As noted in the discussion of the Southwestern alluvial chronology,
Martin's thesis that the Altithermal was a time of increased summer
rains is far from proved, and in fact the weight of evidence seems to
be against it. I therefore am somewhat skeptical of Baerreis and
Bryson's statement that gullying in the Southwest during the "little
climatic optimum" was initiated by increased summer rain. As pointed
out above, Fritts et al. (1965) give evidence that the late thirteenth
century "great drought" was a time of dry winters and summers--yet
arroyo-cutting seems to have been very active during or perhaps just
after this period.

R. Woodbury (1961) places the end of the "little climatic optimum"
in the twelfth century, somewhat earlier than Baerreis and Bryson's
date of 1250. Since the Tsegi-Naha arroyos probably were cut at dif-
ferent times between about A.D. 1150 and 1300 or 1350, Woodbury's date
would place all or most of the arroyo-cutting just after the shift to a
new climatic regime. Baerreis and Bryson's date of A.D. 1250 for the
transition (which both they and Woodbury believe was rather abrupt) would have some of the arroyos cut well before the end of the Neo-Atlantic, others after the beginning of the Pacific period. If arroyo-cutting is in fact related to the rainfall regime of the Neo-Atlantic, as Baerreis and Bryson assert, it is difficult to see why arroyos should appear only in the last 100 years or so of this several-hundred-year period. On the other hand, if the Neo-Atlantic was a kind of minor Altithermal, one would expect it to be accompanied by arroyo-cutting, as was the earlier episode. Historical evidence shows that the modern Southwestern arroyo system was initiated in the 1870's and 80's, about the time the Neo-Boreal was giving way to the warmer modern climate. Perhaps the most supportable conclusion, given the current inadequate state of our information, is that the Tsegi-Naha arroyos appeared during the transition from one climatic regime to the next, and that this transition was perhaps not as abrupt as Baerreis, Bryson, and R. Woodbury have postulated.

An expansion into lower elevations by the Southwestern coniferous forests clearly seems to have taken place in the 1300's through mid-1500's (Smiley 1961: 703), that is, during the Pacific period. A small amount of evidence indicates this expansion may have begun somewhat earlier. Schoenwetter and Eddy (1964) found an increase of arboreal pollen after about 1100 in the Navajo Reservoir district of northwestern New Mexico, while Leopold et al. (1963, cited in Martin and Byers 1965) recorded an increase in pine pollen during the 1200-1400 period in north-central New Mexico. Schoenwetter (1962) and Martin and Byers (1965), on the other hand, did not encounter a marked increase in
arboreal pollen until after abandonment of their areas, probably in the mid-1300's and late 1200's respectively. Martin and Byers point out, however, that this apparent increase in arboreal pollen may simply reflect the relative decrease, as a result of abandonment, of plants living on disturbed soil, such as the Chenopod-amaranth group. It would seem that this qualification applies to Schoenwetter's data too, because his samples are from ruins. In general, the expansion of forests during the Pacific period must be the result of increased precipitation, but lower temperatures may also have been a factor.

Baerreis and Bryson do not explicitly say what kind of temperatures they believe prevailed during the Pacific period in the Southwest, but I infer from their other statements that the climate was probably somewhat cooler than in the Neo-Atlantic. R. Woodbury (1961: 707) specifically postulates a shift, during the 1100's, from a warm to a somewhat cooler climate.

In conclusion, it appears that a climatic episode characterized by warm conditions existed in the Southwest for several hundred years after A.D. 800 or 900. The rainfall regime characteristic of this period is still not entirely clear, at least to me. Sometime between A.D. 1100 and 1300, there was a shift to a new climatic episode, one that almost certainly was cooler, and which may have had increased winter rainfall. The relationship of arroyo-cutting to these periods is not yet certain. The current state of the evidence does not seem to permit a precise resolution of this question, but it at least does not preclude the hypothesis that the Tsegii-Naha arroyos were the product of unusually dry intervals that happened to fall during the transition.
from one climatic episode to another.

BIOTA OF THE RED ROCK PLATEAU

Several ecological surveys were made as part of the Glen Canyon Project (A. Woodbury et al. 1958, 1959a and b) with the result that the inventory of plants and animals present in the Glen Canyon proper and the lower parts of its tributaries is rather well known. Plant and animal remains from archeological sites are virtually all of species and subspecies still to be found in the region. This suggests that approximately the same inventory of wild plants and animals is present today as during the period of Anasazi occupation.

There is good reason to believe, however, that the distributions and relative frequencies of species may have been somewhat different in the past. For one thing, man's role in the ecosystem has clearly changed. The Anasazi must have farmed numerous small patches of land, replacing native plants with their domestic ones, and encouraging, either purposely or inadvertently, the growth of "disturbed soil" plants such as beeweed, chenopods, and amaranths (which often thrive in contemporary Hopi cornfields.) The prehistoric inhabitants must also have done a good deal of hunting, although admittedly with rather inefficient weapons. After a period in which man was largely absent from the area, Europeans and probably a few Navajos and Paiutes entered the picture, bringing an entirely different kind of land use. Most were transient--miners, cowboys, even outlaws--so they did little farming. They also probably spent little time in hunting, but because their weapons were very efficient, they may have decimated the larger game as
much or more than had the Anasazi. Most importantly, they introduced
cattle and horses, whose grazing clearly seems to have reduced total
ground cover, probably by reducing the proportions of grasses and com-
posites to shrubby plants. These introduced grazing animals must have
partially displaced the native deer and bighorn sheep, particularly the
latter. Smaller mammals, dependent on the plants used by livestock,
were probably also affected. Also with the Europeans came a number of
foreign plants, the most successful of which has been tamarix; this
shrub or tree has partially displaced the native streamside willows.
Several of the few varieties of fish found in the Colorado also seem to
have been introduced in historic times.

Present and past biotic communities also differ to some extent
because of recent arroyo-cutting, which may or may not be related to
overgrazing. Floodplains that once must have been rather heavily vege-
tated are now dry terraces supporting only desert plants, while the
streams, whose flow has been increased by entrenchment, are bordered by
narrow strips of phreatophytic plants such as tamarix, sedges, and wil-
lows.

For the reasons given above, it is somewhat difficult to draw a
precise picture of the wild plant and animal communities encountered by
the first Anasazi inhabitants of the region, or of the wild sector of
the new ecosystem that developed as Anasazi hunting, gathering, and
farming became adjusted to the region. The literature on the present
plant and animal species of the region, plus archeological findings and
pollen analysis, enable us, however, to construct an approximate picture
of the biotic resources available to the Anasazi.
Mammals

The mice, ground squirrels, and other very small mammals of the Red Rock Plateau generally resemble those of northeastern Arizona more than those of south central and southwest Utah. These small animals apparently find the Colorado River an impassible barrier; as a result, species differences have developed on opposite sides (Durrant 1952: 487). There also are noticeable altitudinal differences in the distribution of small mammal species. The larger mammals, on the other hand, apparently did not find the Colorado a barrier, and are not closely confined to particular altitudinal zones. The larger mammals of the Red Rock Plateau are in general those that appear all over the northern Southwest.

Because the emphasis in this chapter is on the resources the Red Rock Plateau furnished the Anasazi, there is no need to list all the mammal species ever identified in the region. The animal remains found in the archeological sites probably record in an approximate way the animals that were important prehistorically, so I will orient my discussion around these findings. Of course, the relative frequency with which a species occurs archeologically does not necessarily reflect the actual resource importance of the animal, because imperishable parts may not have been brought back to the site (Davis 1960). On the other hand, if animal remains do regularly occur archeologically, this can be taken as positive evidence that the species in question were utilized at least to some extent by the prehistoric peoples.

By far the most abundant mammalian remains in the archeological collections are those of the bighorn sheep, which must have been the
major prey of the Anasazi hunters. Although a few of these animals have been killed or sighted in the Glen Canyon area in recent years (Durrant and Dean 1959: 99), they are at present virtually absent from the area. Mule deer, on the other hand, are quite often seen today, but seem to have been a distant second to the bighorn as a food animal in prehistoric times. This would seem to reflect differences in the population sizes of these two species; it is unlikely that the Anasazi would choose to ignore any large game animal in this area where all game must have been scarce, or that they would bring home the bones of one kind of large ungulate but not another. A. Woodbury (1965: 46) believes that the rugged low canyon lands of the Glen Canyon area were probably more nearly an optimum environment for the bighorn sheep than for the mule deer. The shift in the relative abundance of bighorn vs. deer since prehistoric times probably does not reflect climatic change, but only the greater vulnerability of the bighorn to hunters with rifles and to competition with livestock.

Next to bighorn and deer, the animal that most commonly occurs in the archeological collections is the rabbit, generally the cottontail. Rabbit bones are rare at sites in the Glen Canyon proper, except in the relatively open Red Canyon area. They occur with considerable frequency in the middle and upper parts of the larger tributary canyons.

Other animals appear so infrequently as to suggest they were not regularly sought after, or if they were, that the carcasses were not brought back to the site. Some of the smaller rodents may have been intruded into sites after they were abandoned. The inventory of these occasionally-hunted forms and chance occurrences includes badger,
beaver, black-footed ferret (?), bobcat, chipmunk, coyote, gopher, gray wolf (?), ground squirrel, kangaroo rat, marmot, muskrat, porcupine, ringtail cat, and various woodrats and mice.

Visitors to the Glen Canyon are often surprised to see beaver, because they usually occur in cooler climates. Nevertheless, this animal today is probably the most common mammal larger than a rabbit. Most live in the banks of the Colorado River and spend no time in futile dam-building attempts. Several small colonies that have intruded up the tributaries occasionally succeed in damming these smaller canyons may have been important in the past in helping speed the accumulation of sediments on the canyon floor, and in stabilizing the floodplain.

Of the animals listed, only the gray wolf and muskrat have not been recently reported from the Glen Canyon or nearby areas (Durrant 1952, Durrant and Dean 1959; Smith 1959). The wolf identification is questionable, but the occurrence of this animal is not impossible, because it once had a nearly Utah-wide distribution (Durrant 1952: 398). The status of muskrats in Utah is not clearly understood because of recent introductions, but this animal has previously been reported from the San Juan drainage in the state (ibid.: 359).

**Other Animals**

Ninety-seven species of birds have been identified in the Glen Canyon area (A. Woodbury 1965), including 11 species of ducks and geese, and several large shore and wading birds that could have been a source
of meat. Out of the 69 Pueblo III and Basket Maker sites that form the basis for this study, only 26 yielded bird remains, mostly bone, but with a few occurrences of feathers or feather-wrapped cordage. Feather-wrapped cordage was the only kind of bird remains at five of these sites. This cordage is probably not a very good indicator of how the local arifauna was used, because either the feathers or the finished fabric could have been brought in from elsewhere by trade (Hargrave 1960). By contrast, the occurrence of bird bone in the refuse deposits is probably a fairly good indication that the specimens were hunted locally (although surface finds are suspect, since they may have been brought to the site by scavenging animals).

Unfortunately, the bones and feathers, with one exception, were not identified as to species, although Lipe et al. (1960: 218) remark that most of the avian remains recovered during the 1959 season were from small birds, with a few occurrences of large waterfowl. The one identification made by an expert was of turkey feathers in a sample of cordage from Loper Ruin (Hargrave 1960). As noted above, this material could have been acquired by trade. It would be useful to have the unidentified bird bones examined by a specialist to determine if domestic turkey were present. The problem of distinguishing domestic from wild turkey remains should be less in the low-lying canyons of the Glen Canyon area than elsewhere, because the Glen Canyon is well outside the habitat of the wild species. Any turkey bones that occurred would probably be from domesticated birds.

The fact that bird remains were found in only about a third of the sites examined and that they were quantitatively unimportant even in
these sites leads to the conclusion that the Red Rock Plateau avifauna was not an especially important resource for the prehistoric peoples. Birds may have been sought after as much for feathers as for meat, judging by the fairly common occurrence of the smaller species (Lipe et al. 1960: 218; personal observation); some of the larger species of course also yielded attractive feathers. Indirect evidence for the importance of bird-hunting was also lacking; no specialized equipment, such as nets, snares, decoys, or harpoons, was recovered.

Seventeen different species of fish have been collected in the Colorado River and its tributaries in the Glen Canyon area, but only six of these are native to the region, the rest having been introduced in historic times. The six native species include three suckers and three minnows, none of them choice food fish, although several become fairly large (A. Woodbury 1965). In general, the Colorado is so silty and its level varies so greatly that it is not a very favorable habitat for fish. This situation is reflected in the general absence of fish remains at the archeological sites, even those at which preservation was very good. Two sites, both located close to Colorado, yielded a few bones of the Colorado Squawfish, a large minnow.

The reptilian fauna of the Glen Canyon region includes 1 turtle, 14 species of lizard, and seven kinds of snake (ibid.). Small reptiles, particularly lizards, are among the most abundant and noticeable of the wildlife of the area, but reptiles seldom appear in the archeological deposits. Of the three occurrences of lizard remains in the sample of sites I am concerned with, all are questionable—-they may have been introduced after the period of occupation. It is quite possible, of
course, that small reptiles could have been eaten whole, in which case their remains would not show up in the refuse deposits.

Amphibia of the Glen Canyon region include five species of toad, frog, and salamander (ibid.). None of these were found in the sites, and it is not likely that they were of any importance as a resource, although the small burrowing desert toads are common wherever the subsoil is at all moist. A great many species of insects also are found in the area, but there is no evidence they were used by the aboriginal inhabitants, although they may have been. A few insects were found preserved in dry deposits, but it was impossible to determine whether they were natural intrusions, or had been collected by the prehistoric occupants of the site. A. Woodbury (ibid.) discusses a variety of parasitic and insect-borne diseases that might have affected the prehistoric occupants of the area, but there is no direct evidence that they were thus affected.

Plants

Dice (1943:39-42) placed the entire Colorado Plateau in his Navahonian biotic province, which has several differing "life belts," broadly dependent on elevation. From lowest to highest, these are the arid grassland, sabinal or pinyon-juniper, montane, and alpine. The pinyon-juniper belt is the most extensive. The actual elevations at which these belts occur vary somewhat with physiography and latitude. Except for its northeast corner, the Red Rock Plateau falls into the lowest, or arid grassland zone, which is characterized by the general absence of trees except along streams and by a very sparse and open
ground cover furnished by drought-resistant grasses and shrubs.

Gregory (1915: 572-3), in his geographical study of the Navajo Country, located just south of the San Juan, distinguished five altitudinal zones characterized by different floral assemblages. These roughly parallel Dice's life belts, except that the arid grassland belt is subdivided by Gregory into a lower and higher zone. Since Gregory's lowest three vegetational zones seem generally applicable to the Red Rock Plateau—at least to the platform areas between the canyons—it is useful to present his summary description of them (ibid.).

1. Zone of cottonwood [along streams], cactus, and yucca, altitude 3500-5000 feet... Within this zone, vegetation is scanty and over large areas very inconspicuous. 'Flat-leaved' and 'globular' cacti are abundant, yucca is common; grass is absent or scanty and commonly in detached tufts; sage and greasewood are of small size; scrub cedar [juniper] and pinyon are rare. During the rainy season there is a profusion of annuals, among which Mariposa lily, yellow sun-flowers, and related compositae are abundantly represented.

2. Zone of sage brush (Artemisia) and greasewood (Sarcobatus); altitude 5000-6000 feet... Sage within this zone attains heights of four to five feet and, in places so closely spaced as to render travel difficult, may occupy the surface to the exclusion of trees. Besides the ever-present sage and greasewood,
grass is fairly abundant in this zone. Patches of pinyon and cedar are irregularly distributed, usually along rocky ridges, but are in general of 'scrub' size.

3. Zone of pinyon (*Pinus edulis*) and cedar (*Juniperus monosperma*); altitude 6000-7000 feet, the cedar [juniper] generally occurring at lower altitudes than the pinyon... Much of the pinyon and cedar is of scrub character, but trees 12-20 inches in diameter are not uncommon... Sage brush, and to a less extent greasewood, usually of strong growth, occupy open spaces. Groves of pinyon surrounding parks of sage is the ordinary arrangement. Pine and a second variety of juniper ... and aspen... are found in a few well-watered canyons. Grass in tufts and scattered mats grows everywhere except in the densest shade.

Gregory's first and lowest zone occurs in the southern and western parts of the Red Rock Plateau. His second zone--sagebrush and greasewood, with scattered pinyons and junipers--is generally characteristic of the areas above 5000 feet in the eastern and northern parts of the area. This zone grades into the third, or pinyon-juniper zone, in the highest parts of the region--along the Clay Hills and eastern Mancos Mesa. The pinyon-juniper floral assemblage is generally characteristic of the tablelands north, east, and south of the Red Rock Plateau.

These zonal schemes characterize fairly well the vegetational
complexes of the open platform areas between canyons, where the only source of moisture is rainfall. The canyons themselves, because of their sheltering physiography and above all, because they contain sources of water other than direct rainfall, have a somewhat different and richer flora. Although the Glen Canyon and its tributary canyons probably comprise little more than about 100 square miles (Jennings n.d.) out of the roughly 7500 square miles in the Glen Canyon region, they add greatly to the botanical diversity of the area because they shelter a number of plant species that cannot grow on the relatively open and dry platform areas between canyons. Clark (n.d., cited in Jennings n.d.) lists approximately 920 different plant species that have been recorded for the Glen Canyon region, most of them from the Glen Canyon proper or from the lower parts of its tributaries. An intensive botanical survey of a single short tributary—Slickrock Canyon, located in the Red Rock Plateau—resulted in the identification there of 172 different species of plants, exclusive of algae, lichens, and mosses (Sharrock 1964: 28-31).

Because of the canyons' physiographic complexity, soils, exposures, water supplies, and air and ground temperatures may vary greatly even within a few hundred square feet. Thus the canyons contain a great many microenvironments, each supporting a somewhat different assemblage of plants. Any simple typology of canyon plant communities therefore must ignore numerous minor variations, and focus only on the most widespread kinds of environment and their principal associated plants. A relatively simple typology of this sort was worked out by Flowers (1959; also summarized in A. Woodbury et al. 1959a and A. Woodbury 1965).
Working primarily with data from the Glen Canyon proper, Flowers recognized different groups of plants associated with streamside, terrace, hillside, and spring or seep environments. He also noted that the tributary canyons differ somewhat from each other and from the Glen Canyon in vegetation. Nevertheless, the four-fold typology of plant communities he developed for the Glen Canyon proper seems to apply in a general way and with certain qualifications to the Red Rock Plateau tributaries in which we are interested, as well as to the main canyon itself.

The streamside type of vegetation is most distinctive and best developed along the banks of the Colorado, at or just above the flood level, where the plants can immerse their roots in the percolating soil water supplied by the river. The result is a very dense growth of phreatophytic shrubs and small trees in a narrow strip—usually not much more than 10 to 60 feet wide—along the edge of the river. The ground cover is about 90 percent, and there is considerable vegetative litter on the soil surface. The dominant plants in this community are usually sandbar willow, tamarix, baccharis, and arrowweed. Locally the larger Goodding willow and the cottonwood may occur. Present in some localities are three-lobed squawbush, poison sumac, and datura. In swampy spots are rushes, sedges, and reed cane. This community extends up the tributaries wherever there is flowing water, but the dense growth thins out away from the Colorado. In the tributaries, baccharis, tamarix, and arrowweed are much less common, sandbar willows are scattered, and a variety of other plants, particularly the sedges and rushes, and the larger trees, such as cottonwood and Gooding willow, are more
common. With the exception of tamarix, an introduced plant, this
streamside community probably was present along the Colorado in abori-
ginal times. It is doubtful, however, that it occurred as a definable
streamside community in the alluvium-filled tributaries in prehistoric
days; most of these streams must have had only poorly defined channels
and little if any permanent flow before the recent dissection of their
floodplains by arroyos. It seems likely, however, that most of the
"streamside" plants were present to some degree in the moister portions
of the old unchanneled floodplains.

Flowers' terrace community occurs, in the Glen Canyon, atop the
older alluvium, between the narrow fringe of dense streamside vegeta-
tion and the canyon wall. Many of the plants in this zone use capill-
ary water drawn from the relatively high water table of the terrace,
which in turn is charged both by the river and by springs and seeps in
the canyon wall. A. Woodbury (1965: 6) notes that the terrace plants
usually cover approximately one-half the soil area and that generally
there are fairly heavy crops of annuals between the perennial shrubs.
The dominant plants in this community are rabbit brush, four-winged
saltbush, seepweed, hackberry, and Gambel oak. Also fairly common are
arrowweed, sand sagebrush, prickly pear and hedgehog cactus, three-
lobed squawbush, greasewood, cottonwood, drop-seed and salt grass, and
ephedra or joint-fir. It seems probable that this basic plant commun-
ity also populated the flood-plains of the alluvium-filled tributary
canyons before they were cut by the arroyos. Since these floodplains
would probably have had an even higher water table than the Glen Canyon
terraces, the species dependent on capillary water probably were
present in higher frequencies, and there was probably less sharp separation into "streamside" and "terrace" communities. Judging from the parts of Lake, Wilson and Slickrock canyons that were unaffected or relatively unaffected by the recent arroyo-cutting, groves of oak, hackberry, and cottonwood trees were more common than at present. Prior to arroyo cutting, the tributary canyons also probably had a somewhat richer botanical endowment in number of species. Slickrock Canyon, which has little alluvium, and hence was not affected by arroyo-cutting, yielded the greatest number of plant species of any of the Glen Canyon tributaries that were investigated (Sharrock 1964: 28). It is probable that overgrazing by domestic livestock has also to some extent reduced the variety of species present.

The third community recognized by Flowers was the hillside grouping. This consists of the plants found on the taluses, dry colluvium, dunes, and ledges of the canyon walls. These plants are almost entirely dependent on direct precipitation, and cover only about a fifth of the ground surface (A. Woodbury 1965: 5). Perennials are heavily dominant except in wet years. Because of their dependence on rainfall only, the plants of this community are quite similar to those of the platform areas between streams. In the Glen Canyon proper, the dominant hillside plants are shadscale, ephedra or joint-fir, various grasses (especially Indian rice-grass—Oryzopsis hymenoides), indigo bush, black brush, and wolf-berry (Lycium andersoni). Less common are sagebrush, rabbit brush, buckthorn, peppergrass, saltbush, cacti, and yucca. In the higher tributaries, such as the upper part of Moqui Canyon and upper Castle Wash, juniper and pinyon appear in the hillside
community, the grasses become more abundant, and the most drought-adapted plants, such as black-brush, tend to drop out. In general, in the higher tributaries, there is less difference between the platform, hillside, and terrace communities than in the low-lying tributary canyons or in Glen Canyon proper.

The communities supported by flowing springs and surface seeps often are dominated by maidenhair fern, panic grass, and columbines. Mosses and liverworts also are well-developed in these environments. If a seep is covered by colluvium or talus, it may support a dense growth of oak, hackberry, and shrubs instead of the plants listed above.

The degree to which the prehistoric Anasazi utilized and even depended on wild plant foods has probably been underestimated. The canyons of the Red Rock Plateau are deficient in what probably were the most substantial and nutritious wild plant foods of the Colorado Plateau—pinyon nuts and grass seeds—but they shelter a number of other useful food plants, including some that are rare in the juniper-pinyon zone. Among the wild plant foods more common in the Red Rock Plateau canyons than in the highlands, the most important probably was *Opuntia* or prickly pear cactus. The fruits and joints of this plant were eaten by the Hopi when crops failed (Whiting 1939: 20, 85-6) and by the Southern Paiute in the spring when other foods were not available (Kelly 1964). Cactus remains are fairly common in dry cave sites in the Red Rock Plateau, and Martin and Sharrock (1964) found that cactus pollen fairly consistently occurred in human feces from this area. Since cactus pollen is not present in the natural airborne pollen rain of the area, they infer that cactus was a dietary item.
Occurrence of cactus seeds in human feces from the lower Glen Canyon (Lipe 1960: 215) and finds of roasted cactus joints at Benchmark Cave (Sharrock 1964: 14-15) support this conclusion.

Martin and Sharrock (1964) also concluded on the basis of their study of the pollen contained in human feces from the Red Rock Plateau sites that the prehistoric inhabitants of the area probably chewed cottonwood buds and catkins, and that beeweed (*Cleome*) was an important food. Whiting (1939) reports ethnographically that the Hopi chew cottonwood "berries" much as we would chewing gum (*ibid.*: 20, 72), and that beeweed was not only eaten, but was a source of wood for prayer-sticks, and of black pigment for pottery decoration (*ibid.*: 77-8). The Hopi often let beeweed mature and go to seed in their cornfields to ensure a supply of this plant the following year; it is thus semi-domesticated. The ethnographically-reported species of beeweed (*Cleome serrata*) is usually found at fairly high altitudes, but a similar species (*Cleome lutea*) is common in the Glen Canyon and tributaries. Martin and Sharrock were unable to identify the species that produced the beeweed pollen they found.

Judging by the ethnographic record of plant use by the Pueblo Indians, many of the plant species found in the Red Rock Plateau would have been useful to the prehistoric inhabitants, either as food, or as seasonings, medicine, or raw materials for manufacture of ceremonial and utilitarian material items. Clark (n.d., cited in Jennings n.d.) reports that of the over 920 plant species known to occur in the Glen Canyon, its tributaries, and adjacent platform area, approximately 390, not including mosses and lichens, are known to have been used by modern
Pueblo groups. Furthermore, 110 of these 390 species have actually been recovered from archeological sites in the Glen Canyon area (ibid.; see also A. Woodbury 1965).

It is probable that the contemporary plant communities of the Red Rock Plateau reflect to some extent changes in the native biota resulting from the Anasazi occupation. Yarnell (1965) has recently shown that on the Pajarito Plateau in New Mexico, certain plants tended to be most common or to be found only around Pueblo ruins. He infers that some of these were probably semi-domesticated, while others became established because soil disturbance by the Puebloans opened up new environmental niches. Systematic surveys of this sort were not done in the Red Rock Plateau, but Sharrock (1964: 23–31) has noted that the most favorable field location (an area of about $2\frac{1}{2}$ acres, watered by subsurface seeps) in Slickrock Canyon is marked by quite distinctive vegetation—a heavy stand of old man or sand sagebrush (Artemisia filifolia) with scattered clumps of prickly pear and Indian rice-grass. There were only a few other occurrences of this kind of sagebrush in the canyon. Sharrock (ibid.: 24) also observed that other parts of the canyon floor suitable for gardening "were marked by heavy growths of prickly pear and rice grass to the exclusion of other plants."

Certainly it is reasonable to expect that the clearing of brush and the introduction of various domesticated and semi-domesticated plants into the canyons by the Anasazi would have had marked effects on the pre-existing plant communities. Jennings (n.d.) thinks that some of the bands of ash and charcoal occasionally seen in exposures of alluvium may result from the fire-drive technique of hunting which
should have been very effective in the narrow canyons. This seems a plausible inference, although, as Jennings points out, non-human agencies such as lightning may have caused some or all these fires; also, some of the charcoal bands are so deeply buried that they probably pre-date the Anasazi occupation of the area. Fire must also have been used in clearing areas of heavy oak brush or other tough dense vegetation for gardening. The near-absence of stone axes or other efficient heavy cutting tools in the site collections supports this inference. The use of fire would of course have had profound effects on the plant communities affected.

In conclusion, it appears that the variety of plants to be found in the canyon environments of the Red Rock Plateau constituted an important resource for the prehistoric Anasazi inhabitants. Although some of the most important plants of the highland zone—such as pinyon and juniper—were largely absent, the canyons provided a number of other useful plants that were not present in the highlands. Modifications of the biota by the Anasazi may to some extent be reflected in the contemporary composition and distribution of plants in the area. This inference seems quite likely on theoretical grounds, and is supported by evidence from Slickrock Canyon.
Chapter 4

THE WHITE DOG PHASE

DEFINITION

This phase was first defined by Colton (1939: 52-3). He named it after an exceptionally rich Basket Maker site near Marsh Pass in northeastern Arizona, dug by Guernsey in 1916 (Guernsey and Kidder 1921: 10-27). His description of the phase was based on the findings at this and other sites in northeastern Arizona excavated by Guernsey and Kidder (Kidder and Guernsey 1919; Guernsey and Kidder 1921; Guernsey 1931) and by Lockett (probably the cave site reported in Lockett and Hargrave 1953). Colton lists the following "determinants" for this phase. I have inserted a few comments.

Pottery: No pottery.

Architecture: Slab cists lined with grass or leaves in caves, covered with cross beams. [Colton fails to note that unlined jar-shaped storage cists dug into the clay hardpan floors of caves are equally if not more common than slab-lined structures.] Temporary brush shelters in the open [In the sources Colton relied upon, these are only postulated, not reported as observations. Recent excavations at the Lone Tree Dune site (Sharrock et al. 1963: 151-9), which I assign to the White Dog phase, have revealed a fairly substantial shallow pit-house. Haury (1945: 17-18) has also found, at Painted

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Cave in northeastern Arizona, a shallow pithouse that may belong to this phase.]

**Stone:** No turquoise; pipe: squat, conical; knife: notch at acute angle; dart points; metate: for rotary grinding [what is generally in the Glen Canyon literature called a grinding or milling slab, following R. Woodbury 1954]; cylindrical stone beads; seed beads.

**Bone:** Dice; other bone work not distinctive.

**Shell:** Olivella.

**Wood:** Atlatl: spear flush, thin, stone weight; ball, fending stick, combs.

**Hide:** Dressed skin robes, fur cord blankets, skin moccasins, skin pouches. Clothes: bifurcated baby blanket [usually woven of fur cord or strips]; loose string apron [Colton probably meant to include this in the next category, because these normally are of fiber]; umbilical pad [for infants.]

**Fiber:** Sandal: square toe, twined woven of fine cord with toe fringe [often with colored geometric decoration]; coarse leaved crushed yucca leaf; coarse weave fiber; twilled yucca leaf. Basket [coiled]: 2 rod and bundle, non-interlocking stitch [most common, although other techniques were known; commonest basketry forms were large conical carrying baskets and large shallow circular trays]; twined bags [often elaborately decorated in geometric patterns]; twined conical water bottles;
juniper bark matting.

**Food:** Yellow flint corn [probably not a true flint],
squash, no beans [also abundant evidence of use of wild
foods, probably more than in Pueblo times.]

**Disposal of dead:** Flexed and bundled in slab [or hardpan]
cists [or in crevices]; often covered with baskets [and
twined bags.]

**Physical type:** Undeformed, long, scaphoid skull; heavy frame.

**Petroglyph:** Square shoulder, painted. [Colton appears here
to be referring to anthropomorphic pictographs. Turner
(1963) recognizes a style of petroglyph (Style 5) that
includes zoomorphs and geometric elements, and that may
be Basket Maker in origin. It is found in a number of
locations in the Glen Canyon area.]

**Domestic animals:** Dog, no turkey. [The latter assertion is
open to doubt, because turkey feathers have been identi-
fied at Woodchuck Cave, a White Dog phase site in Tsegi
Canyon (Lockett and Hargrave 1953: 20). Furthermore, a
fabric made of cord wrapped in turkey feathers seems to
have come into use during late Basket Maker II times in
the Canyon de Chelly area and probably in Grand Gulch
(Morris 1939: 18). It is of course possible that wild
turkeys were the source of these feathers.]
Assignment of Components to the White Dog Phase

The identification of the Basket Maker remains from the Red Rock Plateau as belonging to the White Dog phase requires no special pleading. With the exception of pipes, all the determinants listed by Colton are found in one or the other of the region's Basket Maker sites. The absence of pipes, which normally are rare, may simply be due to sampling error.

Within the Red Rock Plateau, the identification of specific sites as being of the White Dog phase is sometimes more difficult. A number of non-ceramic sites and a few non-ceramic layers were found in otherwise pottery-bearing sites, but not all of these could be surely assigned to Basket Maker origins. Some probably reflect aspects of Pueblo activity that did not involve pottery or leave other diagnostic traces. Also, the chances of finding "pure" Basket Maker components are small. Most of the favorable habitation or storage sites, especially those in caves, were utilized by Puebloans. Traces of White Dog phase occupations are likely to have been destroyed or masked by these later occupations, particularly where site deposits are shallow or where Pueblo constructional activity churned the fill. The Puebloans are also known to have engaged in a certain amount of "relic-collecting" (Morris 1925: 291; 1939: 15), so even the finding of a distinctive Basket Maker artifact in an otherwise Puebloan collection is no assurance that a White Dog component is actually present at the site. Furthermore, because of their greater age, White Dog components are more likely to have been buried or removed by geomorphic processes than are the later Pueblo components. Turner (1963), for example, shows a number of pictures of early Style 5 petroglyphs that are located well over
six feet above the ground surface; erosion has removed the talus and other deposits that once lay at the foot of the cliff.

In the following discussion, 17 sites which have yielded substantial typological indications of White Dog occupation are relied upon (Table 4). In most of these, the typological assignment is also supported by stratigraphic position, by radiocarbon dating, or by the absence of a significant amount of distinctively Puebloan material. Most of the 17 components were excavated or tested; survey collections were in general too small and observations too superficial to permit reliable assessment. It is therefore likely that the sample of White Dog phase components I am dealing with is somewhat less than the actual number of such components represented in the sites recorded from the region. It is unlikely, however, that any major habitation or storage sites of this phase were recorded but remain unrecognized.

Some comment on Table 4 is necessary. The assignment to the White Dog phase of components that yielded typical Basket Maker burials, perishable artifacts, and structures raises few problems; this phase and the Basket Maker II stage in general were defined entirely on the basis of similar material taken from dry caves, most of it associated with burials. I have, however, also identified 8 open sites (Nos. 1-2, 6, 8, 13-16 in Table 4) as belonging to the phase. Although most workers have postulated that the cave sites represented only one aspect of Basket Maker II culture, there have been few attempts to identify non-cave sites. Morris (1939: 17) as late as 1939 could remark, "up to the present there is, as far as I know, not even a tentative record of Basket Maker II remains of any sort outside of caves." He (Morris and
Table 4. Components of the White Dog Phase in the Red Rock Plateau

<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Component Designation</th>
<th>Published Reference</th>
<th>Relationship to Other Components in Site</th>
<th>Principal Criteria for Inclusion in Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Glen Canyon at Rincon</td>
<td>Grimm site (Sa637), Area 1, Layers 2-5</td>
<td>Lipe et al. 1960: 15-19</td>
<td>Stratified below pottery-bearing deposit</td>
<td>Abundant lithic debris, large notched point</td>
</tr>
<tr>
<td>2?</td>
<td>Mouth of Moqui Canyon in Glen Canyon</td>
<td>Bar Point site</td>
<td>Sharrock 1964: 5-8</td>
<td>Probably single component</td>
<td>Non-ceramic, large notched dart points, one-hand manos</td>
</tr>
<tr>
<td>3?</td>
<td>Moqui Canyon</td>
<td>Echo Cave (Sa583)</td>
<td>Lipe et al. 1960: 60-9</td>
<td>Mixed with Pueblo component</td>
<td>Numerous jar-shaped hardpan cists</td>
</tr>
<tr>
<td>4</td>
<td>Moqui Canyon</td>
<td>Rehab Center (Sa681), Lower trash, Burials 1-3</td>
<td>Sharrock et al. 1963: 69-91</td>
<td>Stratified below Pueblo occupation in some places</td>
<td>Non-ceramic layer, typical Basket Maker burials and perishable artifacts</td>
</tr>
<tr>
<td>5-8</td>
<td>Camp Canyon (a Moqui tributary)</td>
<td>Sa735, 748, 749, 776</td>
<td>Day 1963: 243-5, 251, 287</td>
<td>Single component, except for five Pueblo sherds</td>
<td>Many large notched dart points, grinding slabs, and one-hand manos</td>
</tr>
<tr>
<td>9</td>
<td>Moqui Canyon</td>
<td>Sa772</td>
<td>Day 1963: 296</td>
<td>Single component save for a few surface sherds</td>
<td>Typical Basket Maker burials, perishable artifacts, and pictographs found by 1929 Bernheimer Expedition</td>
</tr>
</tbody>
</table>

* Question marks indicate identifications based on less than conclusive evidence.
<table>
<thead>
<tr>
<th>No.</th>
<th>Location</th>
<th>Component Designation</th>
<th>Published Reference</th>
<th>Relationship to Other Components in Site</th>
<th>Principal Criteria for Inclusion in Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Moqui Canyon</td>
<td>Bernheimer Alcove (Sa736), Lower trash layer, burials</td>
<td>Sharrock et al. 1963: 34-59</td>
<td>In most places, stratified below Pueblo occupation</td>
<td>Typical Basket Maker burials, perishable artifacts, pictographs</td>
</tr>
<tr>
<td>11</td>
<td>Blocked Draw (a Moqui tributary)</td>
<td>Honeycomb Alcove (Sa754)</td>
<td>Sharrock et al. 1963: 26-34</td>
<td>Single component</td>
<td>Numerous hardpan cists, large conical coiled carrying basket, no pottery</td>
</tr>
<tr>
<td>13?</td>
<td>Castle Wash</td>
<td>Green Water Spring (Sa444), Strata 1 and 2</td>
<td>Sharrock et al. 1963: 137-51</td>
<td>Stratified below Pueblo materials</td>
<td>Non-ceramic layer containing one notched point.</td>
</tr>
<tr>
<td>14</td>
<td>Castle Wash</td>
<td>Lone Tree Dune (Sa363)</td>
<td>Sharrock et al. 1963: 151-61</td>
<td>Single component</td>
<td>Distinctive house and cist, notched points, grinding slabs, no pottery</td>
</tr>
<tr>
<td>15-</td>
<td>Castle Wash</td>
<td>Sa355 and 360</td>
<td>Weller 1959: 623, 625</td>
<td>Single component</td>
<td>Non-ceramic, close to Lone Tree Dune and in similar physiographic locations</td>
</tr>
<tr>
<td>16?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Castle Wash</td>
<td>Sa356</td>
<td>Day 1964: 141-2</td>
<td>Single component</td>
<td>Non-ceramic, slab cists</td>
</tr>
</tbody>
</table>
Burgh 1954) later went on to locate and excavate Talus Village, an open settlement near Durango in southwestern Colorado. More recently, de Harport (1951) has identified open Basket Maker sites in Canyon de Chelly, and the archeologists of the Navajo Dam Project have excavated unsheltered Basket Maker II villages of the Los Pinos phase in northwestern New Mexico (Eddy 1961).

In assigning the 10 Red Rock Plateau components mentioned above to the White Dog phase, I have relied primarily on the absence of pottery and arrow points, and the presence of characteristic Basket Maker dart points. An examination of the literature shows that the points found with the Basket Maker II cave materials from Grand Gulch (Pepper 1902b: Pl. 2), northeastern Arizona (Kidder and Guernsey 1919: Fig. 90; Guernsey and Kidder 1921: Pl. 35; Guernsey 1931: Pl. 48; Lockett and Hargrave 1953: Fig. 13), and Cave du Pont (Nusbaum et al. 1922: Pl. 46) are virtually all large, fairly well-made, side or corner-notched dart points. These contrast markedly with the small arrow points of the later Pueblos, particularly in the Red Rock Plateau. Here, the characteristic Pueblo projectile point was a small, light, unstemmed, unnotched triangle (see for example Lipe et al. 1960: Fig. 43: j-q). Most of the 8 open sites in question yielded at least one or two of the Basket Maker style notched dart points, and none of the later triangular arrow points. The dart points were particularly abundant and characteristic at the group of sites in Camp Canyon. Lone Tree Dune, in Castle Wash, yielded only two dart points, but the shallow pithouse and large storage cist found there were markedly different from the structures found at the Pueblo sites in the area. Furthermore, charcoal
from this site was dated at A.D. 250 ± 80, in the center of the estimated time range of the Basket Maker II stage. The two adjacent sites --Sa355 and Sa360--on similar isolated sandy ridges, were not excavated, but displayed surface indications similar to Lone Tree Dune. No points were found at these two sites, however, so the identification is tentative.

DATING

In northeastern Arizona, where the White Dog phase was first defined, its relative age has been determined stratigraphically. The earliest culture known in the region, it occurs below remains of the Lino phase (Basket Maker III), which in turn is antecedent to the Marsh Pass, Black Mesa, Klethla, and Tsegi phases (correlative with the Pueblo I-III stages of the Pecos classification--Colton 1939: 52-9). In the Red Rock Plateau, the White Dog phase is also earliest, and occurs stratigraphically below the Klethla phase at the Rehab Center site (Sa681). In this region, the Lino, Marsh Pass, and Black Mesa phases or equivalent units are absent; apparently the Red Rock Plateau was unoccupied at this time. The detailed typological similarity of the Red Rock Plateau components of the White Dog phase to their analogs in the Kayenta region implies a fairly close contemporaneity of the two groups of sites.

There are no absolute dates for any of the White Dog components in northeastern Arizona, but two radio-carbon dates have been run on Red Rock Plateau specimens thought to belong to this phase. As previously noted, charcoal from a firepit at the Lone Tree Dune house yielded a
date of about 250 A.D. The second date, A.D. 1700 ± 60 (M. Stuiver, personal communication), was from a large piece of juniper bark found in a shallow pit at Sa735. As pointed out in the previous discussion and in Table 4, this site was one of four in Camp Canyon assigned to the White Dog phase because they contained distinctive notched dart points and numerous grinding slabs and one-hand manos differing from the typical Pueblo food-grinding tools.

Obviously both dates cannot apply to the White Dog phase. Since the Lone Tree Dune date fits well the phase's relative time position and with absolute dates determined for similar materials elsewhere, I am inclined to accept it. The contradiction may then be resolved by assuming that the Sa735 date is in error. Since the bark specimen that was dated came from beneath only a small amount of loose blow sand, and may have been uncovered at times in the past, it is possible that some contaminant affecting the dating may have entered it. Possible contaminants include fallout from the Nevada atomic bomb tests, or modern carbon introduced by insects or rodents. On the other hand, the bark specimen did not appear to be insect infested, and was thick enough so that a protected inner piece could be used in dating; the C-14 laboratory was advised to take this precaution and presumably did. Furthermore, if modern carbon were the contaminant, it would have to make up about four-fifths of the sample to produce a date of A.D. 1700 instead of 500 (ibid.).

The alternative is to accept the date as valid, which raises archeological problems. If the specimen is correctly dated, there are two feasible interpretations. 1) All the materials at Sa735 represent
occupation not by Basket Makers, but by some other people with a generally similar way of life; perhaps southern Paiute or Navajo, both of whom could have been in the area this early. The difficulties with this interpretation are that the Southern Paiute seem generally to have used small triangular arrow-points with small side-notches, and to have made a distinctive kind of pottery as far back as the twelfth century A.D. (Euler 1964). Occupation by these people cannot be entirely ruled out, however, because they sometimes used large notched points (perhaps collected from earlier Anasazi sites) in addition to their usual variety, and rarely made pottery as far east as the Glen Canyon region (ibid.). The Navajo apparently also used the bow and arrow and made pottery at this time. Another possible candidate is the Hopi; occasional hunting parties of these people may have been in the Glen Canyon region about this time. The Sa735 materials clearly are not Hopi in typology, however. 2) The shallow pit from which the bark specimen comes (perhaps a sleeping place), was constructed about 1700 by Paiute, Navajo, or Hopi transients; most of the remaining site material belongs to the much earlier White Dog phase. This is certainly possible, although shallow bark-lined sleeping or storage pits are not unusual in Basket Maker sites (McGregor 1965: 174; Wormington 1956: 36), and there is no positive typological or stratigraphic evidence to back up this hypothesis.

Since the artifactual evidence for assigning Sa735 to the White Dog phase seems to me fairly good, I will assume that the radiocarbon date does not apply, either because it is the result of contamination or because it dates only a small amount of much later intrusive material.
Correlation with dated sites in adjacent regions lends additional support to a third century A.D. dating for the White Dog phase components in the Red Rock Plateau. At Cave du Pont in south central Utah (Fig. 1), a pinyon log produced a bark date of A.D. 217 (Stallings 1941). Although this site is about 120 miles west of the region around Kayenta where most of the northeastern Arizona White Dog phase materials come from, the Basket Maker materials from both areas are very similar. Kidder and Guernsey (Nusbaum et al. 1922: 65) remark about the Cave du Pont artifacts:

The writers have been particularly impressed by the remarkable similarity, even in apparently unimportant details, between many of these specimens and corresponding Basket-maker objects which they have recovered in northeastern Arizona.... The inference is strong that the Cave du Pont people were approximately if not exactly contemporaneous with the Basket-makers of Marsh Pass and Grand Gulch.

By a similar argument, the burials and perishables from Moqui Canyon, which closely resemble their counterparts at Cave du Pont and in northeastern Arizona, are thus probably of about the same age. The absolute date from Lone Tree Dune places this rather different site in the same age horizon.

Further correlational data comes from the tree-ring dates of A.D. 46 to 324 (Morris 1952) for somewhat different but related Basket Maker
materials excavated near Durango in southwestern Colorado (Morris and Burgh 1954). Also, the Los Pinos phase of northwestern New Mexico (Fig. 1), which has many affinities to the Durango materials, has recently yielded four radiocarbon dates in the second through fourth centuries A.D. and one from the sixth century (Eddy 1961: 103, 106).

The White Dog phase occupation of the Red Rock Plateau was probably rather brief, although this statement cannot be supported unequivocally without absolute dates from more sites. None of the individual components, however, shows a thick accumulation of trash such as would accompany lengthy or oft-repeated occupation. In areas such as Grand Gulch, Canyon del Muerto, and the Kayenta region, where occupation continued on into the Basket Maker III stage, many sites do, however, show thick accumulations of Basket Maker II refuse.

It seems clear that the Red Rock Plateau region was abandoned by the Basket Makers before pottery and other features of the Basket Maker III stage (or locally, the Lino phase) evolved. Pottery seems first to have made its appearance in nearby northeastern Arizona in the latter half of the fifth century A.D., judging by the tree-ring dates of A.D. 477 to 486 from pottery-bearing deposits at Obelisk Cave in the Red Rock Valley (Douglass 1936: 33). Also, feather-string blankets, which Morris (1939: 18) postulates appeared only at the end of the Basket Maker II stage, are absent from the Moqui Canyon burials, suggesting that they may pre-date the appearance of this trait.

Although admittedly incomplete, the evidence seems fairly strong that the Red Rock Plateau was occupied by people of the White Dog phase during all or part of the third century A.D., and that they had
abandoned it before the end of the fifth century, perhaps well before; the shallow nature of the site deposits indicates that the total period of occupation was rather brief.

**DISTRIBUTION**

Within the Red Rock Plateau (Fig. 3,6), components of the White Dog phase are concentrated in Moqui Canyon and in Castle Wash, with a questionable occurrence in the Glen Canyon proper. Since Castle Wash and Moqui Canyon were also population centers in the later Pueblo phases, it is surprising that no traces of White Dog occupation have been found in Lake Canyon, perhaps the most densely settled part of the region in Pueblo times. Any statements about the distribution of White Dog phase sites are of course qualified by the aforementioned difficulties in identifying such sites.

Although the best examples of White Dog phase components occur in the Red Rock Plateau, there may be others elsewhere in the Glen Canyon region (Fig. 2). At the Catfish Canyon site in lower Glen Canyon, excavations revealed two infant cradle burials closely resembling those from Bernheimer Alcove in Moqui Canyon and some of the ones found by Kidder and Guernsey in the Kayenta area (Lipe 1960: 36-40; 220-7). The non-ceramic Wright site (ibid.: 105-9), and the lower levels of Lizard Alcove (ibid.: 77-89), and of Benchmark Cave (ibid.: 91-104; Sharrock 1964: 9-19) are perhaps also White Dog components. Some of the sites in Harris Wash (Fowler 1963), a tributary of the Escalante River, also yielded a number of artifacts that are typologically Basket Maker, but the situation is complicated by 1) vandalism that churned the deposits
at the most productive site, Pantry Alcove, and 2) the presence of Fremont pottery at these sites. The Fremont culture retained many Basket Maker-like traits long after they were given up by the Puebloans farther east and south.

In his original formulation of the White Dog phase, Colton gave its distribution as only the Rainbow Plateau and Tsegi Canyon of Northern Arizona (Fig. 1). I have here proposed extending the boundaries of the phase to include the Red Rock Plateau and perhaps the rest of the Glen Canyon region. It also seems impossible to assign the Grand Bulch Basket Maker collections or Cave du Pont to any other phase, in light of their close resemblance to the Kayenta materials. Morris' Basket Maker findings at Canyon del Muerto are still largely unreported, but he has indicated their detailed similarity to the Grand Gulch and Kayenta area collections (Morris 1925, 1939; Morris and Burgh 1941), so the Canyon de Chelly area should perhaps also be included within the phase boundary. A finer subdivision of the phase may someday be possible, but will depend on future studies of detailed stylistic variations in the more abundant kinds of artifacts. Consistent application of the kind of criteria listed by Colton demands the extension of the phase boundaries to the areas noted.

To the east, the contemporaneous Los Pinos phase, and the closely related Durango Basket Maker II, resemble the White Dog phase, but probably not enough to be merged with it. The distinctive cribbed log houses, greater apparent sedentism, possibly earlier appearance of pottery (in the Los Pinos river valley, at least), and the absence of fine twined sandals and colored decoration on coiled basketry are characteristics of the Durango-Los Pinos manifestation that support its
separation from the White Dog phase.

In summary, the White Dog phase seems to occur in the middle and lower San Juan drainage, and to extend well to the west in the northern tributaries of the Colorado. The San Juan headwaters, on the other hand, were occupied by a somewhat different variety of Basket Maker culture.

HISTORICAL INFERENCES

Throughout its area of distribution, the White Dog phase seems to appear full-blown without definite local antecedents. Neither have extra-local sources for this phase been clearly identified, although the late Cochise-like culture of the area between the Rio Grande and the upper San Juan is a good candidate (McGregor 1965: 131-6), as is the Great Basin Desert culture to the west. In any case, current evidence indicates that the territory occupied by the White Dog phase was previously vacant. It seems likely that this phase became established in other parts of the Four Corners area before the Red Rock Plateau was occupied; judging by the evidence of sparse and brief occupation, the White Dog people did not find this region optimal for settlement. The first occupants of the Red Rock Plateau probably originated in the larger populations centered in Grand Gulch. Since this major focus of Basket Maker activity is only about 10 miles east of the Red House Cliffs, it is even possible that some of the Castle Wash and Moqui Canyon sites represent seasonal forays by parties from the Grand Gulch area.

The settlement pattern, discussed in more detail later, indicates
the first settlers of the Red Rock Plateau probably were attracted primarily by the farming potential of the flood and spring-watered alluvial soils of Moqui Canyon and Castle Wash. These areas also provided easy access to the higher juniper-pinyon zone with its richer resources of wild plant and animal foods. Lake Canyon, despite its good soil and water supply, seems not to have been settled during this phase, probably because it is much more isolated from the highlands than either Moqui or Castle Wash.

As previously concluded, the White Dog phase occupation of the Red Rock Plateau seems to have been during a rather brief period probably centered in the third century A.D. The region then was abandoned for perhaps 750 to 800 years. Why did the White Dog phase occupation occur when it did, and why was the region then abandoned?

In attempting to account for the White Dog expansion into the Red Rock Plateau, the first hypothesis that comes to mind—and I fear this is perhaps more the result of this paper's bias than of any compelling indicative evidence from the data at hand—is climatic fluctuation. If R. Woodbury (1961: 707) is correct, a long warming trend started in the Southwest about A.D. 100. By lengthening the growing season, this would probably have favored population growth in the northern part of the Southwest through decreasing the number of crop failures. The Basket Maker maize, a variety of the Mexican race Chapalote, which had been introduced to the northern Southwest by way of the Mogollon area, does not appear to have been as well adapted to cool climates or short growing seasons as maize varieties that were introduced somewhat later (Galinat and Gunnerson 1963); hence, Basket Maker farming was even more
susceptible to crop failure than was Pueblo.

Furthermore, examining Schulman's (1956: Table 49) composite record of tree-ring growth in the upper Colorado River Basin between 1-500 A.D., I note several periods of stable and above-average growth (and presumably of precipitation). The longest (though not the wettest) is a 69-year period, bracketed by the three-year means centered on A.D. 161 and 227. During this time, ring growth averaged about 5.5 percent above normal. More importantly, growth was remarkably stable; only three isolated three-year intervals show growth below 90 percent of normal, the lowest of these being 72 percent, in the three years centered on A.D. 173. Such a period of stable and higher than normal precipitation would be optimal for a buildup of population among the White Dog people. The apparent lack of any profound or prolonged droughts during this time is especially important, because it is the poorest years that determine the size of population a marginal environment can maintain. With their apparent ability to exploit a variety of both wild and domesticated foods, and fairly good techniques of food storage and preservation, the White Dog people could probably have survived the three short moderately dry intervals during this period without much curtailment of population growth. Prolonged droughts, or especially severe short periods of rainfall deficit, would probably have been more than their technology could cope with, and would have had negative effects on population.

In light of this climatic evidence, it is tempting to postulate an expansion of White Dog phase population during the latter part of the second and early third centuries which led them to settle in previously
uninhabited areas such as the Red Rock Plateau. Admittedly the Cave du Pont date of A.D. 217 agrees better with this correlation than the one of 250 from Castle Wash, but the standard deviations of the latter overlap the climatic period I am discussing. In connection with Cave du Pont (Fig. 1), which was probably also first utilized during this period, it is interesting to note that the dated pinyon specimen (Stal- lings 1941) shows that the rainfall pattern in that locality reflected fairly well the overall pattern for the northern Southwest, as shown by Schulman's combined data. The deviations that did occur in the Cave du Pont record are in the direction of locally more abundant rainfall, especially after A.D. 170. In the dated pinyon log from this site, growth began at A.D. 91. A number of dry years occur before A.D. 170, but between this time and the end of the record at 217, the rings are exceptionally wide, with narrow (but not extremely narrow) rings only at 178 and 201.

Ranged against this climatic interpretation of the White Dog phase occupation of the Red Rock Plateau is the fact that similar periods of stable above-average rainfall in later years do not seem to have resulted in reoccupation, at least not until the Klethla phase. Pertinent here is a period of 57 years, from the A.D. 395 to 449 three-year means, during which ring growth was 9.9 percent above normal and there was only one three-year period in which growth was less than 90 percent of normal (78 percent in the interval centered on 428), and a period of 36 years, bracketed by the A.D. 476 and 509 means, in which growth averaged 12.3 percent over normal and there were no intervals of sub-normal growth at all.
The latter of these two periods is in the time of the Basket Maker III stage (or Lino phase in northeastern Arizona and southeastern Utah) but there is no evidence of any occupation of the Red Rock Plateau during this time. Basket Maker III sites do, however, appear in some of the nearby highlands (Fig. 2)—on Cummings Mesa (Ambler et al. 1964: 95), Cedar Mesa (Sharrock 1964: 76) and at Natural Bridges National Monument (Schroeder 1965). Why do the Basket Maker III sites not occur in the Red Rock Plateau as well?

If we examine the entire geographic range of the White Dog phase, its known sites appear almost exclusively in entrenched sandstone canyons where springs and fairly large floods water patches of soil. Later Anasazi manifestations in the same areas are found in these canyon locations but are also widely scattered over the more open intercanyon highlands where rainfall may be greater but where water-concentrating agencies such as floods and springs are less well-developed. If this distribution is not just the result of faulty sampling, it may indicate that by Basket Maker III times in northeastern Arizona and southeastern Utah, continued warming of the climate, increased adaptedness of the maize to a short growing season, improvement in dry-farming methods, better housing, or some other factor had made the more extensive but less well-watered highland soils more attractive, putting less pressure on utilization of the entrenched canyons. This hypothesis is little more than a guess, of course, in the absence of good evidence of the kinds of changes referred to. It does suggest a direction for further inquiry.

Partial support for this hypothesis comes from an ethnographic
analogy to the Southern Paiute, the principal occupants of the western sector of the northern Southwest, including part of the Glen Canyon area, in historic times (Kelly 1964). The San Juan and Kaibab branches of the Southern Paiute adopted agriculture from the Hopi and St. George Paiute, respectively, probably sometime during the nineteenth century. They maintained, however, considerable dependence on wild food resources as well. In this respect, as well as in their relative lack of experience with agriculture, they probably resembled the White Dog people. It is also interesting to note that, like the Basket Makers, the Southern Paiute did not grow beans; the Hopi or St. George Paiutes could have supplied the seeds but the Southern Paiute apparently chose not to borrow this crop.

Both the San Juan and Kaibab Paiute confined their farming to small spring-watered plots at the lower elevations of their range. The group geographically closest to the Red Rock Plateau was the San Juan Paiute, who occupied the area between the Little Colorado and the San Juan Rivers, extending from the Colorado on the west to Monument Valley on the east. Although informants remembered gardens near the towns of Kayenta and Tuba City in northeastern Arizona, the best area for farming seems to have been near springs in Navajo Canyon, one of the east-bank tributaries of the Colorado in the southern part of the Glen Canyon area. This canyon appears to be rather similar in physiography, soil, and water supply to both Moqui Canyon and Grand Gulch. The inference is that the Basket Makers of the White Dog phase, like the Southern Paiute, confined their first attempts at farming to small but abundantly-watered locations at lower elevations, usually in the
entrenched canyons. (If this hypothesis has any validity, it may be
confined just to the area of the White Dog phase. The settlements of
the Durango-Los Pines phase farther east occur in somewhat different
physiographic, biotic, climatic, and perhaps cultural, contexts.)

SETTLEMENT AND SUBSISTENCE PATTERNS

Inferences from Site Clusters

As previously noted, there are two clusters of White Dog phase
sites (Fig. 6) in the Red Rock Plateau—one in Moqui Canyon, and
another in upper Castle Wash. The only other site is a questionable
one, located in Glen Canyon at the Rincon, that is some distance from
either of the two clusters. The principal areas of occupation—
Castle Wash and Moqui Canyon—are well supplied with 1) easily culti-
vated, flood-watered, sandy alluvium, 2) springs for domestic water
supply and irrigation, and 3) large dry natural shelters for habita-
tion and/or storage. It seems likely that these three kinds of physio-
graphic resource were basic desiderata for the White Dog people in
their choice of areas for settlement.

They were apparently not the only desiderata, however, for these
physiographic resources also are found in areas where White Dog phase
sites are not. Good water, soil, and shelter occur in Lake, Forgotten,
Slickrock, and Wilson Canyons, and at a number of spots in Glen Canyon
proper. The later Puebloan inhabitants (Fig. 9, 10) made much fuller
use of these resources, settling all the locations just listed as well
as Moqui Canyon and upper Castle Wash; why then did the White Dog
people not do the same? It seems to me probable that the restricted
distribution of White Dog site clusters results from these people's need for easy access to the juniper-pinyon covered highlands that occur above about 5500-6000 feet in elevation in the north and east parts of the region (Fig. 4), a need that was not so important for the Puebloans.

The Castle Wash and Moqui Canyon site clusters occupy two of the three Red Rock Plateau drainages which head in the juniper and pinyon covered highlands. The third, Red Canyon, is deficient in water, sandy alluvium, and large natural shelters. In Castle Wash, the sites of the White Dog phase are in the upper part of the canyon, which is actually in the juniper-pinyon highlands; in Moqui Canyon, the sites are lower down, but the inhabitants had easy access to the highlands because the canyon and some of its tributaries extend into them a few miles from where the sites are located.

Lake Canyon, on the other hand, is located in the low western part of the Red Rock Plateau, and is relatively short, not extending back into the highlands. Its best deposits of alluvial soil are separated from the nearest juniper-pinyon highlands by 15 to 20 miles of almost waterless slickrock and sand. Today, cattlemen driving stock from winter pasture in Lake to summer highland pastures by way of Clay Hills Pass often try to traverse this barren stretch at night to avoid over-taxing the animals. Uppermost Glen Canyon, Forgotten, Slickrock, and Wilson Canyons are equally or more isolated from the highlands.

There seem to me to be two possible explanations for this seeming importance of an access to the highlands. The first is historical and sociological: the earliest inhabitants of the region settled in the parts most accessible from the east because they came from the east;
because only a few small groups ever lived in the Red Rock Plateau, they had no need to expand into new areas, and the locations of the original settlements enabled them to maintain close contact with related groups centered in the Grand Gulch area.

A second, and to me more appealing, explanation is that the settlement pattern fairly closely reflects the demands of the White Dog subsistence pattern. Although farming was probably the single most important means of livelihood during this phase, hunting and gathering seem clearly to have been more important than they were to the later Puebloans. An analysis of site types (see succeeding sub-section) indicated that some of the White Dog camp sites in the Red Rock Plateau were the result of hunting and gathering activities, and pinyon nuts which must have come from the highlands were found at some of the storage sites. If we look at all the sites of this phase, throughout its geographic range, we see that numerous caches of wild seeds have been found (Morris 1939: 15) and that animal bone and hunting-and-gathering equipment is relatively abundant, indicating that wild foods made up an important part of the subsistence base. The canyons of the Red Rock Plateau contained some resources for part-time food collectors, including a few, such as agave, cacti, and bighorn sheep, that may have been less abundant at higher elevations. On the other hand, the pinyon-juniper highland zone clearly had much better supplies of deer, rabbits, and perhaps antelope, contained greater quantities and varieties of grasses and other seed-bearing flowering plants, and was the only source for the nutritious pinyon nuts, an abundant harvest of which could be expected every few years. Thus, if the White Dog people
relied to any important extent on the resources of the highlands, and it is probable they did, the parts of the Red Rock Plateau that they settled were the only parts they could have occupied. Only these locations gave them access to the resources necessary for both the farming and food-collecting elements of their subsistence pattern. The later Puebloans, on the other hand, were much more dependent on farming, and hence did not need frequent access to the highlands.

As compared with the settlements of the White Dog phase in the rest of the Four Corners area, the White Dog settlement of the Red Rock Plateau is atypical only in that it was very sparse and occurred at a somewhat lower-than-usual elevation, at least in Moqui Canyon. Although our sampling is undoubtedly biased, it appears that the White Dog people utilized canyon environments to a great extent throughout their geographic range. The largest sites recorded for this phase occur in entrenched, steep-sided, relatively narrow sandstone canyons with abundant springs and flood-watered alluvial floors but with no permanent through-flowing streams. The Tsegi canyons, Grand Gulch, Canon de Chelly, Canon del Muerto, and Three Lakes Canyon (location of Cave du Pont) (Fig. 1) are all of this type, as are Castle Wash and Moqui Canyon. The conjunction of easily cultivated soils, dependable water supply, and natural shelters for habitation and storage were probably the most important reasons for the concentration of these sites in entrenched canyons. With the exception of Moqui Canyon and perhaps of lower Grand Gulch, all the sites are high enough to be in the juniper-pinyon woodland zone. By contrast, the later Anasazi occupants of the Four Corners area, from Basket Maker III through Pueblo III times, seem
to have settled a broader range of physiographic environments; their sites are found in the shallower broad canyons and on the interstream divides in addition to being in the entrenched canyons. As previously noted, the dry White Dog sites in canyon shelters have been the object of much more reconnaissance and excavation than have the less easily recognized and less productive open sites. It is quite possible that open sites exist outside the canyons, but have been overlooked. The distributional argument presented above must, then, bear this qualification.

Inferences from Site Types

In the preceding paragraphs, an examination of the distribution of the two White Dog site clusters with respect to physiography and biotic zones yielded several inferences about the interrelationships of settlement pattern, subsistence economy, and the Red Rock Plateau environment. These interrelationships may be pursued in greater detail by analyzing in functional terms the kinds of sites present in each cluster, and their distribution with respect to each other and to their specific environmental settings.

The White Dog components within each cluster can be classified into several functional types on the basis of their physiographic setting and cultural contents. In the absence of precise dating of each site, it is not possible to assert unequivocally that all were in use at the same time. I have, however, presented some evidence that the White Dog occupation of this region was fairly brief, so I will assume that the sites within each cluster are roughly contemporaneous and that
the site types reflect differing functions rather than temporal change.

Moqui Canyon Cluster

The Moqui Canyon site cluster includes three natural shelters, located in an area about two and a half miles in diameter. The shelters seem to have been favored habitation sites, judging by the amount and kind of refuse. In addition, a number of burials was made there. The cluster also contains four shallow camp sites in Camp Canyon, a small tributary to Moqui Canyon located near the center of the group of three habitation sites. The four camp sites probably are the result of specialized food-collecting activities. A fifth food-collecting camp-site, somewhat different in appearance and contents from the others, was found at the mouth of Moqui Canyon about 12 miles from the habitation sites. Two storage sites, characterized by numerous jar-shaped cists, are also peripheral to the group of habitations; one is located several miles down the canyon from this central part of the cluster, the other several miles upstream from it. These site types and their geographical relationships are mapped in Fig. 6 and are discussed in more detail below.

1. Habitation and burial places. Three sites, all natural shelters, contained White Dog habitational residue and burials: Bernheimer Alcove (Sa736); Rehab Center (Sa681); and Sa772. These sites are located in a stretch of about two and one-half miles near the upper end of the canyon's body of floodplain alluvium and amidst the major concentration of springs occurring above the mouth of North Gulch. Painted pictographs adorned the walls of all three shelters, and at all
three, there were trash deposits containing food remains and abundant evidence of fire; slab-lined hearths were, however, found only at Sa681. No evidence of storage was found except at Sa736, where a cache of whole ears of corn wrapped in juniper bark was recovered. The typical slab-lined storage cists seem to be absent at all sites, although these might have originally been present but have been destroyed by later Puebloans or, at Sa736 and Sa772, by the extensive diggings of the 1929 Bernheimer Expedition. Grinding slabs were uncommon at all three sites, but numerous food-grinding and tool-shaping depressions were found on boulders at Sa736. Some or all of these may be Puebloan, however.

Of the 18 burials found at these three sites, 12 were at Sa736, which probably was the most heavily occupied (although Sa681 yielded much more food bone and more elaborate hearth structures). Five of the burials at Sa736 were of infants under two years old; they lay overlapping one another at the bottom of a crevice, and none seemed to have been disturbed. This suggests they were buried at about the same time, which in turn indicates that at least three nuclear families were using the shelter at the same time. This inference must be qualified, however. The burials were tied onto cradle boards and the location was dry enough so they had not entirely decomposed after 1500-2000 years. Conceivably the grave could have been opened repeatedly over a number of years and new interments made without noticeable derangement of the earlier burials taking place (a relevant ethnographic example of repeated infant burials in the same grave by the same family is given in Simmons 1942: 261, 270, 284, 290). On the other hand, the sand around the burials was fairly clean even though overlain by a trash
deposit; this suggests that the grave was not opened repeatedly.

In any case, the fact that habitation residue is concentrated in a relatively small area at each site indicates the population using the site was small, probably only a few related families. At present, there seems to be no way to determine whether or not the same families used all three sites.

2. Food-collecting camps. The four sites in Camp Canyon and the Bar Point site on the Colorado at the mouth of Moqui probably reflect short term stays by small hunting and/or gathering parties. Two of the Camp Canyon sites are in large alcoves, and one is associated with a shallow shelter; the fourth is in the open next to what appears to be an inactive dune-base spring. Essentially the same artifact complex was found at all four—projectile points and flaking debris, and numerous thin sandstone grinding slabs and one-hand manos. None of the sites shows much habitation residue, and even traces of fire are scant. Sa735 did have three fragmentary burials and a small number of storage or sleeping pits that may or may not be associated with the White Dog occupation (see discussion of dating earlier in this chapter). Cultural deposits at all four sites are very shallow, and two were enough wind-eroded so that trash deposits might have been removed if ever present. In general, however, the site characteristics suggest brief, though perhaps repeated occupation.

These sites probably were not connected with farming; Camp Canyon, although well watered, is choked with huge falling sand dunes, has little alluvium, and was almost entirely neglected by the later Puebloans, who made much more extensive use of the region's cultivable
soils than did the Basket Makers. It seems to me more likely that the four camps reflect food-collecting activities, probably centered on the harvesting of wild seeds. Morris (1939: 15) reports that caches of wild seeds are frequently found in Basket Maker sites and that the identified varieties include *Ephedra* sp., *Chenopodium* sp., *Coreocarpus* sp., and *Oryzopsis hymenoides*. The last, commonly known as Indian rice-grass, now is fairly common on the Camp Canyon dunes and must have been more abundant before the introduction of cattle. Seeds of this plant were a staple for most Paiute groups (Steward 1938), including all the Southern Paiute bands (Kelly 1964: 41–2, 153, 170, 179), and were collected by the Hopi in times of famine (Whiting 1939: 65). Most of the Paiute groups collected the seeds with a beater woven of sticks and a basketry tray. The Owens Valley Paiute also robbed the underground seed caches of kangaroo rats (Steward 1933: 244), and this may have been a more widespread technique, since this grass and the kangaroo rat are usually found in similar environments. The techniques used by the Kaibab Paiute (Kelly 1964: 41–2) to prepare these seeds are probably typical for both Southern and Great Basin Paiute. A pile of seeds was ignited to burn off the stems and some of the hull; light rubbing with a mano on a grinding slab then removed the rest of the hull. After being winnowed in a basketry tray, the seeds were parched by tossing them with live coals in a tray. Finally, they were ground into flour on the grinding slab. The flour was either eaten dry or mixed with water to form a mush. Since the White Dog people undoubtedly also used grinding slabs and manos in a similar way when preparing these seeds, the relative abundance of such artifacts at the Camp
Canyon sites supports the inference that the sites reflect seed-collecting activities.

As previously noted, the Camp Canyon sites also contained a number of projectile points and considerable flaking debris; the latter included chips, cores, and hammerstones. Perhaps the men manufactured dart points at these sites while the women processed the seeds that had been collected. Sweeney and Euler (1964) report that sites identified by their (male) Southern Paiute informants as "hunting camps" had thin sandstone grinding slabs as well as points and flaking debris on the surface. The Camp Canyon sites probably were not often used for overnight stays, because none of the three major habitation shelters was more than a mile and a half away. This, plus the fact that a grass-seed harvest would have been in mid-summer, explains the general scarcity of traces of fire at these sites. Use of fire for hulling and parching, if the Paiute process was followed, would not have produced much ash or charcoal.

The Bar Point site, in Glen Canyon at the mouth of Moqui, yielded only a small collection of artifacts, including a few grinding tools and points. Evidence of fire is abundant here; there are stone-lined hearths and the fill is stained with ash and charcoal. If this site relates to the White Dog phase, it probably represents an overnight camping place used repeatedly by hunting and gathering parties from the community centered some 12 miles away in the middle reaches of Moqui Canyon.

3. Storage sites. Two sites, Echo Cave (Sa583) and Honeycomb Alcove (Sa754), fall into this class. The former is located well
downstream from the cluster of habitation sites, the latter upstream from them. Both sites consist largely of pits and cists dug into a natural clay-like hardpan on the floors of dry shelters. Echo Cave, which was re-occupied by Puebloans, contained 16 jar-shaped cists and deep pits ranging from a few inches up to five and one-half feet in diameter. All appear to have been cleaned out by the Basket Makers, the Puebloans, or by rodents, except one shallow pit that contained caked organic material that probably was poured into place when in a mush-like consistency. Remains of prickly-pear cactus, corn, and squash were abundant in the fill, and perhaps represent the original contents of the cists, but could equally well have been brought in by the Puebloans or by rodents.

Honeycomb Alcove (Sa754), which apparently was not re-used by Puebloans, contained 58 pits and jar-shaped cists in an area only 65 by 12 feet. The storage structures ranged in diameter from a few inches up to about three feet in diameter. Most had been thoroughly cleaned out before the site was abandoned. The few remains left included pinyon nuts, corn kernels, squash fragments, a flint core, a digging stick, a bundle of unworked sheep metatarsals, fragments of a large conical carrying basket, and pieces of juniper bark and yucca matting probably once used to wrap cached goods. There was no habitation trash, and only a few small flecks of charcoal were found.

The location of these sites may perhaps reflect only the presence there of deposits of fine-grained hardpan, which does not occur in all the caves of the region. The fact that the sites bracket the cluster of habitation sites, however, suggests they may have been established
to store the results of wide-ranging hunting and gathering expeditions, as well as the harvests from outlying farm plots. Blocked Draw, the tributary canyon in which Honeycomb Alcove is located, heads in a small portion of Mancos Mesa that tops 6000 feet (Fig. 4). Perhaps pinyon nuts were gathered in this highland in the fall and brought down to the canyon for storage, to be consumed in the winter and following spring. The fact that both the nuts themselves and parts of a carrying basket were found at the site support this conclusion. Echo Cave, located only a few miles from Glen Canyon proper, may have been a location where cactus fruits and pads, more common on the low terraces bordering the Colorado than in the highlands, were stored, along with corn. This interpretation is but a guess, however, because of the already-noted difficulties in determining what was originally stored at the site.

Castle Wash Cluster

This cluster contains fewer sites and is confined to a much smaller area than the Moqui Canyon cluster. The most definite habitation site found was a small shallow pithouse built in the open; surface indications suggested there might be two similar houses near it. This kind of habitation contrasts with that of the Moqui Canyon community, where people seem to have lived in natural shelters and not to have built houses at all. The other Castle Wash sites include a cave that seems to have been used both for storage and as an occasional camping place, and tentatively, an open campsite near a spring.

1. Habitation sites. The best example is the Lone Tree Dune site (Sa363), a single shallow circular pithouse about 20 feet in diameter
with a nearby deep jar-shaped cist about 5 feet in diameter. The housepit was only a foot to 18 inches deep, so did not require a great amount of labor to build; the superstructure, probably of poles leaned against an interior frame, was not nearly as massive as the cribbed log structures reported from the upper San Juan in the Durango-Los Pinos area, but neither was it a flimsy brush hut such as the Paiutes used and as was formerly postulated for the Basket Maker stage. The entrance-way to the Lone Tree Dune house was lined with stone slabs; a vertical slab deflector was also set just inside the doorway. Only one small firepit, slightly off center, was found. Filled with charcoal rather than ash, it may not have been a true indoor fireplace. A large outdoor slab-lined hearth was found, however, about 70 feet from the house. According to Naroll's (1962) formula relating house-floor area to household size, an occupancy by only three or four adults, or perhaps a married couple with several children, is indicated.

As previously noted, two non-ceramic sites on adjacent sand ridges show surface evidences similar to Sa363, although they are more eroded. If they represent similar structures (and it is little more than a guess that they do), a settlement of several nuclear families, perhaps related by marriage or descent, is implied.

2. Storage and campsite. Only one site of this sort, Sa356, was found. Located in a dry alcove, it contained three slab-lined cists, one unlined storage pit, and two slab-lined firepits. The thin layer of trash yielded corncobs, squash fragments, pinyon nuts, and a few perishable artifacts, but little animal bone and almost no stone artifacts.
3. Camp site. The thin aceramic lower strata at the Greenwater Spring site may relate to the White Dog phase. Little was found here except three slab-lined hearths, and a few chipped flint artifacts. As the name indicates, the site is close to a spring, probably the best one in this canyon.

Glen Canyon Site

The non-ceramic lower levels of the Grimm site (Sa637) may tentatively be assigned to the White Dog phase. This site, located on the banks of the Colorado River in the Rincon area, is of course a number of miles from either the Castle Wash or Moqui Canyon site clusters, and may perhaps relate to some other White Dog community, if in fact it dates from the Basket Maker period at all.

Functionally, the component appears to be a camp site, perhaps one at which special food-collecting activities were carried out. The fill contains abundant ash and charcoal, both inside and outside four definite hearths. The collections include very large quantities of flaking debris, numerous crude cutting and scraping tools, only a few well-made flint artifacts, and no ground stone tools at all. The stone artifact assemblage and the abundance of charcoal in the fill resemble the findings at Benchmark Cave (Lipe 1960: 91-104; Sharrock 1964: 9-19), which seems to have been used largely for the roasting of the edible parts of narrow-leaved yucca, agave, and cactus plants. The roasting pits and charred and dried fragments of the plants themselves were preserved at this site. An ethnographic analogy, again with the Southern Paiute, suggests an explanation for the Benchmark Cave site. During their
"starvation time," in the late winter and early spring, the Paiute often descended to the Colorado canyons to live off the fleshy parts of yucca, agave, and cacti (Kelly 1964: 44-5).

The similarities between Benchmark Cave and the Grimm site component under discussion do not necessarily imply the assignment of a Basket Maker date to the former or a food-processing function to the latter, however. Benchmark Cave, though non-ceramic and probably Basket Maker in its lower levels, had Klethla phase pottery in its upper strata. Also, no actual plant remains were preserved at the Grimm site, and it may perhaps have been a flint workshop rather than a food-processing station. There were, however, no obvious deposits of gravel containing chert nodules in the immediate vicinity of the site.

Summary and Conclusions on Subsistence and Settlement

The picture that has emerged from the foregoing discussion is, in the broadest perspective, one of two site clusters, a larger one in Moqui Canyon and a smaller one in upper Castle Wash. The location of these clusters probably reflects the dependence of the White Dog people both on food collecting and on food producing. The canyon environments where the sites occur were probably best for their small-scale farming, but the people also needed access to the highlands east and north of the Red Rock Plateau in order to obtain the wild plants and animals to be found there. The two site clusters appear in the only two locations in the region where both these requirements are met. Thus, in the largest sense, the settlement pattern of the White Dog phase in this region seems determined by the interaction of the subsistence pattern
with the environmental resources available.

A closer look at the site clusters themselves reveals that the individual sites are functionally differentiated into several types: 1) habitation sites, probably located near the better farming areas, 2) food-collecting camps, some apparently located near particularly abundant sources of wild plant food, others perhaps just overnight stopping places for foraging parties far from home, and 3) storage sites, usually located at some distance from the habitations, where both wild foods and the products of outlying fields could be stored. Thus the differences between the sites in each cluster, and to some extent their geographic relationships with one another, seem also to reflect primarily the demands of the mixed food-gathering and food-producing subsistence pattern.

A similar conclusion can be drawn from examining the site and settlement data from still another perspective—that of scale. Habitation sites are small, lack elaborate structures, and are widely spaced. Site clusters are also more widely spaced and are fewer in number than in the succeeding Pueblo periods. These characteristics can in turn be related to the region's low population density, a product of the limiting environment and the apparently rather inefficient subsistence technology. Subsistence techniques may not have been much removed from "the simple levels of generalized hunting and collecting economies (at which) population densities may be primarily determined by environmental factors" (Birdsell 1958: 191).

The differences between the Moqui Canyon and Castle Wash site clusters are primarily in 1) the presence of houses in Castle Wash and
their absence in Moqui and 2) the apparently more intensive occupation of Moqui Canyon. The relationship between the two site clusters is not entirely clear, although the evidence suggests they were approximately contemporary. If the two site clusters were occupied at slightly different times, they may reflect 1) two stages in the migration into the area of a single group, or 2) two different thrusts into the Red Rock Plateau by the same or different bands. If the site clusters were in fact occupied contemporaneously, they probably represent 1) the year-around "home base" of two small, probably related, bands, or 2) seasonally occupied site locations used by the same band. The hypothesis of seasonal occupation is supported by ethnographic analogy to the San Juan Paiute, who took shelter in caves in summer, but built crude houses in the winter when they moved to higher and colder areas to gather and live off stored pinyon nuts. Other southern Paiute groups who built shelters year around always made more substantial ones for their winter camps in the highlands (Kelly 1964). Furthermore, if the upper Castle Wash sites were established primarily for wintering during years of good pinyon nut harvests, they would have been occupied only every second or third year, which would account for the apparently less intensive White Dog occupation of Castle Wash.

Although the hypothesis of seasonal or cyclical occupation is an intriguing one, and is consistent with other evidence that the highlands were an important food-collecting locale, there is little relevant direct evidence by which its validity may be judged. Analysis of the recovered plant and animal remains with an eye to determining when they were collected might yield data on seasonal occupation, but this
analysis has not been undertaken, and would be complicated at most sites by the chances of mixture with Pueblo debris. Given the current data, the most conservative explanation of the relationship of the two site clusters is probably that each was the year-around base for a single small band, without specifying whether or not these occupations were precisely contemporaneous.

Even if I were to abandon the hypothesis of seasonal occupation presented above, I could still relate one of the differences between the two site clusters to an ecological variable. The occurrence of a house at the Castle Wash site cluster but not in Moqui is quite likely to be due to the fact that upper Castle Wash is higher, more open, and hence colder in the winter; houses would be adaptive for any group wintering there, whether or not they spent the summer in other locations.

Because of my frankly ecological orientation in this paper, I run the risk of presenting only one of several alternative explanations for the observed phenomena; I should thus extend myself to point out possible alternative non-ecological determinants. In the case of the White Dog settlement pattern, this is difficult, for it does appear to be determined largely by environment and subsistence technology. The occurrence of habitation sites only in areas accessible to the highlands, the predominant use of natural shelters instead of artificial ones, the occurrence of what seem to be hunting and gathering camps, the dependence on flexible containers rather than pottery, the frequency with which hunting equipment and animal bone appears in the deposits, the apparent small size of local groups—all these facts
point to a subsistence pattern of mixed farming and food collecting, and a way of life that was rather mobile and closely adjusted to the exploitation of several micro-environments.

It is just possible, however, that an "outdated" pattern of settlement and resource use was being maintained by the weight of tradition at a time when a more sedentary and socially complex way of life was possible because of the presence of domesticated plants. In other words, if maize and squash agriculture had been only recently introduced, the people may not yet have realized the full implications of the new subsistence base, and may not yet have adjusted their pattern of life accordingly. Perhaps this is the reason that the minor arts, such as finger-woven fabrics, and personal ornaments, show such an elaboration at this time. The increased energy supply from domesticated plants was still being channeled along the old pathways—into the elaboration of twined sandals and bags instead of into pottery-making, into the production of necklaces and amulets instead of into house-building or the creation of social structures and rituals capable of integrating large numbers of people. Data on the antecedents of the White Dog phase, on the date at which cultigens were introduced, and on their adaptedness to the area are needed, however, for any real evaluation of this hypothesis.
Chapter 5

THE KLETHLA AND HORSEFLY HOLLOW PHASES

After the people of the White Dog phase withdrew from the Red Rock Plateau, the region seems to have remained uninhabited until the late eleventh or early twelfth century, when Pueblo sites of the Klethla phase appear. This phase was in turn followed in the thirteenth century by the Horsefly Hollow phase, after which the region was again abandoned by the Anasazi, except for occasional brief visits by small parties, during the Jeddito and Sikyatki phases. Both the Klethla and Horsefly Hollow occupations will be considered in the same rather than separate chapters of this paper because they are similar in many respects; their differences can best be pointed out by discussing them in direct juxtaposition. Furthermore, the seriation method used to investigate temporal differences among components requires the concurrent consideration of relative differences in pottery type frequencies among a number of components of both phases.

PHASE DEFINITIONS

The identification of components of the White Dog phase in the Red Rock Plateau was not difficult because their artifact assemblages contrasted strongly with the Pueblo materials from this area, and because they differed little from the northeastern Arizona materials upon which the phase definition was based. The period of heavy occupation that followed the White Dog phase is less easy to deal with. In my opinion,
this occupation consists of two successive phases, probably separated by a short time span in which the area was abandoned or only lightly occupied. The first phase appears to be an extension into the Red Rock Plateau of the Klethla phase, which occurs widely in northeastern Arizona and southeastern Utah, and which was first named by Colton (1939) on the basis of materials from northeastern Arizona. The second phase, which has not previously been described, I have called the Horsefly Hollow phase, after a site in Lake Canyon. It seems to be the result of a mixture, in the Red Rock Plateau, of elements deriving from 1) the Tsegi phase of the Kayenta branch (ibid.) and 2) a variant of the Mesa Verde branch resembling the Mesa Verde phase itself (Reed 1944; Hayes 1964). It was difficult to decide whether to treat this second occupation as a single phase or to attempt to segregate the material into two phases. My decision to treat it as a single phase is a provisional one; the problem warrants further investigation, but I did not undertake it because this dissertation is concerned with a different problem. It seemed both archeologically reasonable and expedient to handle this second Pueblo occupation as a single phase (Horsefly Hollow) because 1) the main kind of variation so far found among the sites of this occupation is geographical variation in pottery type frequencies—Mesa Verde branch types are more common in the north and east, Kayenta branch types in the south and west; 2) there did not seem to be variation in other classes of artifacts or site features that correlated with the differences in pottery; and 3) variations in settlement pattern also did not seem to follow the geographical variations in pottery types. Since this study is focused on settlement and subsistence
patterns, it seemed most convenient and not methodologically unreasonable to treat this occupation as a single phase. These questions will be discussed somewhat more fully later on in this section.

My assertion that the Klethla and Horsefly Hollow phases represent two separate occupations, or at least, two distinct peaks of occupational intensity, depends partly on my absolute dating of the Red Rock Plateau sites and partly on evidence of discontinuities from the seriation study and from specific sites. Since no wood datable by dendrochronology was found in the sites, and radiocarbon tests were made only on Basket Maker materials, my absolute dating has had to be indirect, through the identification in my collections of pottery types that have been found in association with datable wood in sites outside the Red Rock Plateau. Fortunately, most of the types of pottery found in the Red Rock Plateau sites have been dated elsewhere in this way.

This kind of correlational dating of course requires the assumption that specimens of the pottery types in question are of the same ages in the Red Rock Plateau as in the areas where the types were actually dated. I believe this assumption to be valid, but this belief is not shared by all the other archeologists who have worked with the Red Rock Plateau materials. The problem is that in many of the Red Rock Plateau sites, specimens of types elsewhere dated to different periods occur together in the same deposits and levels, without stratigraphic differences. Sharrock et al. (1961: 14-16; 1963: 18-21) for example, explain this situation as being the result of cultural lag or "type survival," hypothesizing that in the Red Rock Plateau, far from the main Anasazi culture centers, earlier pottery types continued in
use alongside later ones.

In my opinion, most of these situations are the result of long-term occupations or re-occupations, complicated by mechanical mixture due to the soft sandy soil, plus the earth-churning activities of the aborigines and of non-human agencies. The use of inappropriate type names may also in some cases have contributed to this picture of the co-existence of "early" and "late" types (see Appendix 1, especially the discussion of Kiet Siel Gray, crushed-rock tempered plain gray, Mesa Verde Corrugated, and Mesa Verde Black-on-white).

Because of the actual or possible differences of opinion noted in the preceding paragraphs, I feel constrained to present in some detail the evidence for my phase distinctions and for the dates assigned to the phases. The need for a rather full discussion of these topics is further demanded by the fact that no previous attempts have been made to subdivide the Pueblo III occupation of the Red Rock Plateau into phases. Other discussions have treated it as an undifferentiated unit, or have grouped the sites into alphabetically or numerically labelled periods set up to deal with the particular group of sites under discussion (see, for example, Lipe et al. 1960: 6). None of the attempts at periodization have been based on the findings of all five seasons' work in the region. Furthermore, the phase distinctions I wish to make are quite important to the main theme of this paper. It appears to me that there were important differences between the early Pueblo III Klethla phase and the later Pueblo III Horsefly Hollow phase in the way the Red Rock Plateau environment was utilized, as reflected in differing settlement patterns.

In the succeeding sections, I present the evidence upon which I
base my division of the major Pueblo occupation of the region into two phases, and attempt to show that these distinctions were objectively arrived at. First, I examine my hypothesis that temporally different complexes of pottery do exist in the region, despite numerous cases of intermixture. The initial step in this examination was to see if there was evidence of relative temporal differences among the Red Rock Plateau pottery collections if they were considered in isolation, apart from any attempt to correlate them with dated pottery type sequences in adjacent regions. Seriation was attempted (Fig. 7), using the pottery collections from all the Red Rock Plateau sites that had yielded more than 100 identifiable sherds (excluding pottery clearly belonging to the Jeddito and Sityatki phases and a few other rare types, as discussed below). The results of the seriation were not entirely clearcut because of the nature of the collections, but there was evidence for the existence of relative temporal differences that paralleled the temporal differences among types in adjacent regions. Having shown that the patterns of pottery type association in the Red Rock Plateau do not support the theory of type survival, I then turn in the next section to absolute dating. Information on the absolute dating of all the types found in the Red Rock Plateau is summarized, and estimates of the temporal position of the Klethla and Horsefly Hollow occupations are derived.

In the section following those on dating—Interregional Comparisons and Phase Definitions—I examine the exterior relationships of the Red Rock Plateau materials and show how I arrived at 1) my identification of the earlier materials with the Klethla phase and 2) my
correlation of the Horsefly Hollow phase with the Tsegi phase on the
one hand and a variant of the Mesa Verde phase on the other. (The
Horsefly Hollow people seem to have been in contact with the people of
both these phases.) For the reader's background information, I present
brief reviews of the characteristics of the Klethla, Tsegi, and Mesa
Verde phases, as well as a description of the newly-defined Horsefly
Hollow phase. My assessment of the exterior relationships of the Red
Rock Plateau phases depends rather heavily on pottery, but other traits
are also considered insofar as possible.

Seriation of Pottery Collections

The discussion in this section will be oriented around the seria-
tion of 66 pottery collections from 57 Red Rock Plateau sites (Fig. 7).
As Spaulding (1960: 81-2) has pointed out, the seriation of archeologi-
cal assemblages is one way in which measures of similarity among assem-
blages may be used—a special case in the general category of the com-
parison of assemblages. Instead of using measures or estimates of
similarity for grouping assemblages or collections into clusters (as
shown, for example, in Kroeber 1940), seriation employs these measures
to arrange the assemblages in a linear order of maximum formal continu-
ity by placing each assemblage between the two others that are most
similar to it. The assumptions behind this are that cultural change is
more or less gradual and non-repetitive, and that similar assemblages
have similar dates; hence, the linear arrangement of assemblages in a
sequence of maximum formal continuity will also be a temporal arrange-
ment. There are, of course, factors other than temporal change which
in some cases may affect the resemblances between assemblages, and these have to be taken account of and controlled for.

In attempting to seriate the Red Rock Plateau pottery collections, I have used the popular graphical technique of seriation devised and promoted by James Ford (Ford and Willey 1949; Phillips et al. 1951; Ford 1962). This technique does not depend on the calculation of an explicit numerical index of similarity between assemblages, but merely on an estimate of similarity arrived at by visually comparing the pottery type frequencies of each collection. Rapid inspectional comparison of the type frequency profiles of the various collections is made possible by plotting the type frequencies for each collection on a strip graph; these graphs may then be placed in different sequences until the sequence showing maximum continuity is found.

On each strip graph (Fig. 7), the various pottery types are shown as horizontal bars; the length of the bars varies with the frequency of the type. These strip graphs differ from ordinary histograms in that the bars are horizontal and are laid end-to-end rather than being placed vertically and side-by-side. This feature facilitates comparisons between frequencies of the same type in different collections. The investigator thus may inspect the frequency distribution of each type as the sequence of collections is built up. If, as the seriation method assumes, change in type frequencies has been continuous and regular, rather than wildly fluctuating, then the correct sequence of collections should result in the sequence of bars for each type taking the form of a "normal" or unimodal frequency distribution. Marked temporal gaps in the sequence may destroy the smoothness of the
frequency distributions, but will not affect the ordering achieved unless all continuity is lost, in which case the investigator is left with two separate sequences, which he must relate temporally by means other than seriation (Tolstoy 1958: 11-12).

Numerical ways of seriating collections of types (e.g. Robinson 1951; Dempsey and Baumhoff 1963) are perhaps less subjective, but require much more labor to carry out, and have the disadvantage of showing the basic type frequency data and type popularity trends numerically rather than graphically, so they are less easy to comprehend at a glance. Furthermore, the numerical methods do not give the type frequency data and trends on the same chart with the ordering of the collections, as does the graphical method. For these reasons, the graphical technique was used.

Characteristics of the Sample

The pottery collections graphed in Fig. 7 come from only 57 of the several hundred Red Rock Plateau sites that yielded Pueblo III pottery. Some of the site collections were divided into several parts, and these were graphed and seriated separately. All 66 collections finally seriated contained at least 100 sherds of the types employed in the study; no Red Rock Plateau site that yielded more than 100 sherds of these types was excluded (although four are graphed separately in Fig. 7 because their type profiles are so aberrant).

The group of types employed in the study encompasses most of the pottery actually found at the 57 sites. Omitted were rare trade items, as well as a number of descriptive categories set up from time to time
to categorize specimens that could not be placed or even squeezed into existing types. Some of the type labels and sherd counts do not agree with those presented in the original excavation reports because, given the chance to survey the entire five seasons' yield of pottery, I could not refrain from making some changes I felt were needed to make the classification more consistent and more sensitive to temporal and cultural (i.e., Kayenta vs. Mesa Verde branch) differences. The basis for the classification used herein is given in some detail in Appendix 1.

My dependence, in this basic seriation study, on only a small proportion of the hundreds of Pueblo sites recorded in the region will probably not reduce the validity of the study, as might first be assumed. Although this group of sites is only a fraction of the total, it includes virtually all the larger sites located by the surveys, as well as most of the sites excavated by the Glen Canyon Project in this region. The survey was thorough enough so that most of the larger sites accessible to discovery probably were located; even though a number of similar sites undoubtedly have been buried or eroded away over the years and thus made inaccessible to recovery, I would estimate that the larger sites discovered represent a majority of those ever present. Furthermore, since nearly all these 57 sites were excavated, we have a detailed record of their artifacts, stratigraphy, and features, whereas nearly all the hundreds of other sites are known only from the surficial observations made by the survey teams.

Sources of Variation

Turning now to the seriation charts shown in Fig. 7, I note that
they seem to reflect a few major patterns of variation that are repeated from one sub-region to the next, and that there is also a great deal of minor, less-patterned variation. We are of course most interested in the major patterns, and it is my contention that these are primarily the result of temporal change, and to a lesser extent, of geographical variation. Before these explanations can be accepted as valid, however, other possible explanations for the observed variation must be eliminated. It seems to me that the possible sources of inter- and intrasite variation in the pottery type profiles include the following:

1) sampling errors, 2) inconsistent or mistaken artifact classification, 3) functional differences, 4) local socio-cultural differences, 5) geographical variation, and 6) temporal variation. I will briefly discuss each of these sources of variation in turn, attempting to assess their effects on the patterns of similarity and difference shown in the Fig. 7 seriation charts. This discussion follows, in a general way, the pattern set by Tolstoy (1958) in his presentation of seriated pottery collections from the Valley of Mexico.

1. **Sampling error.** This source of variation undoubtedly is operative, but it is difficult to assess. The first question at stake in considering the topic is this: Does the site sample provide an accurate record of the ceramic history of the region? Or, in other words, are some pottery types or complexes underrepresented because they are associated with sites not likely to enter the sample—e.g., small sites, or sites located where they are likely to be destroyed or otherwise made inaccessible to discovery? Certainly not all the sites ever present in the Red Rock Plateau were discovered; admittedly the
seriated sample is biased toward the larger and better preserved sites.

As implied in earlier discussions, many sites located on the floors of the main canyons (Lake, Moqui, and Glen Canyon proper) must have been eroded away, and others probably have been buried by alluvium or sand dunes. I think our sample of canyon-floor sites is in general more nearly representative than does Jennings (1963; n.d.), but it is undeniable that canyon floor sites are probably underrepresented by comparison with those located on the canyon sides or rims. This sampling differential is relevant to the pottery seriation because the Klethla phase sites seem to have been located on the canyon floors proportionately more often than were the Horsefly Hollow sites. Thus I would expect the earlier sites to be somewhat underrepresented in the sample. This bias probably obscures to some extent the magnitude of the Klethla occupation, but probably does not much affect our picture of the main patterns of ceramic distribution and change, since enough Klethla sites survived to give us a good idea of the pottery type frequencies generally current during this time.

Having discussed the site sample, we must now deal with the sampling of the sites. Two questions that should be discussed in this connection are as follows: 1) Do the contents of each site accurately reflect the pottery complex in general use by the people who occupied the site? 2) Does the pottery sample collected by the archeologist accurately reflect the actual contents of the site? The probability of a positive reply to the first question rises with the total size of the site (and with the range of activities carried out there—see discussion of functional variation). The probability of an affirmative response
to the second question increases with the thoroughness with which the
site was sampled. Within the sample itself, the more popular types
should be less subject to chance variation of both sorts, since they
are more likely to be 1) left by the people in the first place and
2) encountered by the archeologist when he makes his collections.

As a guide to the reader in evaluating the samples with which I
am dealing, I have noted, on the right-hand margin of Fig. 7, the sherd
totals for each graphed pottery collection, and have indicated, by
inscribing "E" or "s" after the site number, whether the sample derives
from excavation or from surface survey. The actual contents of exca-
vated sites should be fairly well represented by the samples, since all
sherds encountered in excavation were collected, the sites are highly
localized, and excavation, if undertaken at all, was generally carried
out over fairly extensive portions of the site. If a small collection
came from an excavated site, this usually means that the site itself
contained little pottery. In proportional terms, the smaller sites were
usually more thoroughly excavated than the larger ones. (A number of
sites were originally reported as having been "tested" only. This
rubric, subsumed under "E" in Fig. 7, usually was assigned not because
excavations were confined to only a small part of the site, but because
they did not reveal structures or deposits sufficiently complex to
warrant detailed reporting.)

In general, the collections made by survey only are from small
sites—those judged too small or simple to warrant excavation. In many
cases, the survey teams were able to pick up all the sherds that
appeared on the site surface. In cases where sherds were too abundant
to permit this, the surveyors picked up what they felt was a representative sample. In some cases, they may have unconsciously favored the "pretty" white and orange wares in their collecting efforts. I suspect, although I cannot prove, that two of the "aberrant" pottery profiles (Sa687 and Sa740) graphed at the top of Fig. 7 result from this kind of unconsciously selective sampling. Both samples have extremely low gray ware counts relative to the white and orange wares.

In conclusion, the pottery frequencies shown in Fig. 7 probably reflect considerable variation due to chance factors in the sampling process, as for example when the collection from a small site consists of sherds from only a few large but thoroughly smashed and scattered vessels, or when there was an unconscious selection by the archeologist of particular kinds of pottery. For interpreting the differences between individual pairs of strip graphs, the factor of sampling error must be taken into account, even if only by rough estimates of its probability derived from knowledge of the total sample size and of manner of collection. I see no way, however, in which this factor could be responsible for the major trends in type frequency change evident in Fig. 7. Since these major variations are my main interest here, I see no need to make a more arduous attempt to measure the effects of sampling error.

2. Inconsistent Classification. Obviously, if type definitions vary from one collection to the next, it will affect the seriation. As partially documented in Appendix 1, I spent a good deal of time in the winter of 1962-63 attempting to ensure the consistency and accuracy of the pottery classification used at the 57 sites under study. I am sure,
however, that some minor inconsistencies remain; I may even have intro-
duced some new ones by my restudy of the specimens. I believe, however,
that the classification as it now stands is an unimportant source of the
variation seen in the seriation charts.

3. **Functional variation.** Brown and Freeman (1964; also Freeman
and Brown 1964) show that type frequencies at the Carter Ranch pueblo
varied from one part of the site to the next, presumably because dif-
ferent kinds of pottery tended to be used in different activities,
which in turn were carried out in different parts of the site. It has
long been recognized that similar variation sometimes obtains between
sites, as for example, when cemeteries yield different kinds or fre-
quencies of artifacts than do the associated habitation sites. This
phenomenon probably accounts for few large variations among the fre-
quency profiles of the sites I am dealing with here, but it undoubt-
edly has some effect. Two of the "aberrant" sites graphed separately
at the top of Fig. 7 (Sa540 and Sa316) probably are cases of this sort
of variation. Both were characterized by extremely low percentages of
the gray ware types, which are usually far more abundant than the
decorated wares. Both sites were excavated, and since the excavation
crews always picked up all sherds encountered, the low frequency of
gray ware cannot be due to selective collecting that favored the
decorated wares. These two sites probably were devoted to activities
at which large containers and/or cooking vessels (usually made of gray
ware) were not needed, or conversely, where there was an especially
high demand for "culinary" vessels, which were made of the decorated
wares. This question is further discussed later in this chapter under
the topic of site types.

4. Local socio-cultural differences. Longacre (1964b) has suggested that differences in the frequency with which certain design elements (modes) occur at several room blocks in the Carter Ranch pueblo are due to the existence there of several localized matrilineal descent groups. He reasoned that because the pottery was made by women, and a matrilocal residence rule would keep female lineal relatives together, the transmission of information about pottery design would be centered in the localized matrilineage; each matrilineage would be likely to develop slightly different preferences for the design modes in general use throughout the pueblo. Thus different blocks of dwelling rooms would show slightly different frequencies of the design modes. Longacre indicates that the design differences would not have been detected if the comparisons between dwelling units had been made in terms of types rather than modes. I suspect this is generally true for this kind of subtle sociologically-based variation, at least in the egalitarian Pueblo Southwest, where the social groups within the community usually differ little in political power, status, access to resources and material goods, etc. Since my seriation employs types rather than modes, lineage preferences such as Longacre detects would probably not affect my type profiles. In any case, the kinds of variation in type frequency found within sites and between neighboring sites did not seem to correlate with specific blocks of dwellings; if not temporal, these differences seemed largely to be the result of sampling error, or in a few cases, of functional difference. Brainerd (1951: 307) did find some evidence of the association of different types of pottery with
different social strata at Maya sites, but his example is from a complex society which maintained great status differences, a far cry from the kind of society with which I am working.

The migration of a new group into an area might create a situation where one part of a site or site cluster was occupied by people using one kind of pottery, another part by people with a different kind. Haury has given several Southwestern examples of this sort of situation. At the Los Muertos site in southern Arizona (Haury 1945), the Hohokam and Salado peoples seem to have lived side-by-side, maintaining their cultural distinctiveness. They disposed of their dead in different ways, and deposited them in different parts of the site, with different kinds of pottery as offerings. An even more convincing example is from Point of Pines, east-central Arizona, where Haury (1958) found, in a large "Mogollon" Pueblo, a block of rooms that had been occupied by a group of migrants from the Kayenta area of northeastern Arizona. The migrant group maintained a number of distinctive traits, including the manufacture of the same type of pottery they had made in their homeland.

It might be suspected that this kind of situation--culturally plural communities--would have existed in the Red Rock Plateau during the Horsefly Hollow phase, because sites of this phase characteristically have pottery of both the Mesa Verde and Kayenta typological traditions. Little or no evidence of cultural pluralism was found, however; the same people seem to have been using both kinds of pottery. The horizontal distributions of the sherds showed no definite tendency for Mesa Verde and Kayenta types to segregate spatially within a single site, or among neighboring sites, during the Horsefly Hollow phase.
This evidence of distributional homogeneity comes largely from refuse or room deposits, which may reflect fairly long spans of time and which are subject to mechanical admixture. More specific evidence of the close association of Kayenta and Mesa Verde types comes from deposits which reflect single events or very short time spans, and from which chance admixture is excluded.

At the Ivy Shelter site (Sa738), a small Horsefly Hollow phase cemetery in Moqui Canyon (Sharrock et al. 1963: 114-25), one burial contained three bowls, all of Kayenta types, while a second burial had two Mesa Verde Black-on-white bowls. This seeming Kayenta-Mesa Verde segregation was contradicted, however, in the third pottery-yielding burial; it had a Mesa Verde Black-on-white mug resting inside a Kayenta type (Moenkopi Corrugated) jar. Furthermore, the fact that these three burials all lay close together in the same small cemetery (the only true cemetery found in the Red Rock Plateau) suggests it was being used by the same group of people. At the Horsefly Hollow site (Sa544) in Lake Canyon (Sharrock et al. 1961a: 39-66), a large Tusayan Black-on-white (a Kayenta type) sherd covered the head of a Horsefly Hollow phase burial, while a Mesa Verde Black-on-white jar appeared in the fill just above it, and probably was part of the grave goods. The Horsefly Hollow site also yielded a large number of buried storage jars that probably were in use contemporaneously. The jars were of both Mesa Verde and Kayenta types, each in substantial proportion; their spatial distribution appeared to be random with respect to the Mesa Verde-Kayenta dichotomy. Since all the jars were found in situ, mechanical admixture could not have produced this 'mixed' distribution.
As pointed out above, within a single local area, Horsefly Hollow phase sites usually had similar proportions of Mesa Verde and Kayenta pottery. There were, however, a few exceptions. In Forgotten Canyon, the Crumbling Kiva site (Sa597) had very little Mesa Verde pottery, while this is quite common at Defiance House (Sa598), located less than a mile upstream. Also, Rogers House (Sa554) is the only Horsefly Hollow site in Lake Canyon that completely lacks Mesa Verde Black-on-white. These cases suggest there may have been some site-to-site segregation of the two kinds of pottery within a single area, but the evidence is not very convincing. Both Crumbling Kiva and Rogers House yielded only small sherd samples (110 and 207 respectively), so their departure from the norm could well be the result of sampling error.

5. Geographical variation. Although in the Horsefly Hollow phase, the proportion of Mesa Verde to Kayenta pottery does not seem to vary much within limited local areas, this proportion does change significantly as one moves across the Red Rock Plateau region from southwest to northeast. In the northern and northeastern parts of the area—Upper Glen Canyon and Upper Castle Wash—Mesa Verde pottery is predominant in the Horsefly Hollow components. In the southwestern part of the area—Wilson Canyon and environs—Kayenta pottery is by far the more abundant. The intermediate areas—Forgotten, Moqui, and Lake Canyons—fall somewhat in between the extremes, with fairly large proportions of both kinds of pottery. Although the proportions vary, mixture of Kayenta and Mesa Verde pottery is, however, the general rule throughout the area. Furthermore, the bulk of the sites fall in the intermediate area where the proportions approach parity.
The cause of this geographic variation in Horsefly Hollow ceramics is not entirely apparent. Undoubtedly, the people in the Upper Glen Canyon and Upper Castle Wash had considerable contact with the people of the Mesa Verde phase (Beef Basin variant) who occupied the highlands to the north and east. Likewise, the Wilson Canyon area inhabitants must have fairly often encountered people of the Kayenta branch Tsegi phase to the south. The intermediate areas of the Red Rock Plateau probably had contacts in both directions. In fact, it seems quite likely to me that the Horsefly Hollow phase was formed by people coming into the Red Rock Plateau from both the northeast and the south, who then settled together in the same communities. This culture-historical problem will be touched on again in the section on historical inferences.

Geographic variation in ceramic profiles among the Kleethla phase sites is much less. The principal geographic trend in Kleethla pottery is that painted sherds are proportionately less common in the northern part of the area—specifically in the Forgotten Canyon and Upper Glen Canyon sites—than in any of the other areas. My guess is that most of the painted pottery was manufactured in the larger communities—probably in Lake Canyon and Castle Wash—or was made outside the Red Rock Plateau entirely, either to the south, or east, or both. In any case, the northern Red Rock Plateau sites would be on the end of a long supply line, which would tend to discourage usage of painted vessels. This is purely an ad hoc explanation, of course, and there are other possible explanations. Technical studies of the composition of the pottery and of local clays throughout the area might yield evidence.
adequate to test the hypothesis, but these studies have not been done and there are no current plans to do them.

Although geographic variation exists in both phases, and is especially marked in the Horsefly Hollow, this source of variation did not affect the seriation to any important extent. By following the standard practice of breaking the larger area up into a number of smaller regions for the purpose of seriation, the geographic variation within any one sequence was held to a minimum.

6. Temporal variation. Having taken into account the variation attributable to the five previously-discussed sources, there remains considerable major patterned variation. I believe this is most easily explained as being the result of temporal change in pottery styles and their frequencies. This interpretation is supported by internal evidence from the seriation charts. Although there are some discontinuities and a great deal of "noise" from minor variations, in general the arrangement of strip graphs so that the distribution of one major type forms all or part of a normal frequency curve results in other types being so distributed. This is the result expectable if the differences among collections are primarily due to temporal change, and if the assumptions about cultural change that underlie the seriation method are correct (see Phillips et al. 1951; Ford 1962, for extended discussions of these assumptions).

The ordering of collections shown in Fig. 7 receives weak support from stratigraphy; at the Buried Olla site (Ga367), the lower (2) and upper (1) levels differed considerably in pottery profiles, and were significantly separated on the Forgotten Canyon area seriation chart;
their seriated position reflected their stratigraphic relationship. At Red Ant Kiva (Sa675) in Moqui Canyon, the lower levels of Area 1, including the fill of Structure 1, yielded somewhat more Klethla phase pottery than did the upper levels, but the samples were too small to meet the minimum sample size limit used in the seriation. (Two horizontally separated areas of this site were seriated, but the differences appear minimal.) Collections from superposed levels at other sites were examined, but found not to differ significantly, so they were lumped together for the purposes of the seriation study.

The ordering does tend to support my assumption, stated earlier, that the pottery types identifiable in the Red Rock Plateau have in general the same associations with one another and the same dates relative to one another that they have in the areas where they were first defined. This interpretation, plus the small amount of stratigraphic evidence noted above, is the basis for the time orientation of the ordered collections. (A seriation of this sort of course shows the direction of change but does not show which end of the sequence is the earlier.)

Examining the various sub-regional charts, the principal temporal trends in type frequencies seem to me as follows: The sites placed earliest show high frequencies of Tusayan Corrugated, Sosi-Dogoshzi Black-on-white, Tusayan-Medicine Black-on-red, unidentified decorated Tsegi Orange Ware, and unidentified Tusayan White Ware. Black Mesa Black-on-white is also present in many of the sites near the "early" ends of the charts, but never in large amounts. The only geographic sub-region in which sites with a profile of this sort do not appear was
the Wilson Canyon area.

As we move up through the sequence, sites with a different pottery complex are found. This complex shows high frequencies of Moenkopi Corrugated or Kiet Siel Gray, or sometimes both, Tusayan and Betatakin Black-on-white, Tusayan Polychrome, unidentified undecorated Tsegi Orange Ware, Mesa Verde Corrugated (both Mesa Verde and Loper varieties), Mesa Verde Black-on-white (Loper variety), and unidentified Mesa Verde White Ware. The combined types Kayenta Black-on-white, Kiet Siel Polychrome, and Kayenta Polychrome appear rather rarely, but generally in sites at the upper end of the sequence. Within the part of the sequence dominated by this complex, the following minor trends emerge: 1) In the areas where both Moenkopi Corrugated and Kiet Siel Gray are found in quantity, Moenkopi "peaks" earlier. 2) The Loper variety of Mesa Verde Corrugated also reaches its highest frequency later than Moenkopi, but its temporal relationship to Kiet Siel Gray is not clear: Kiet Siel peaks later in the Wilson and Moqui Canyon areas, but not in Lake. 3) The Loper variety of Mesa Verde Black-on-white appears throughout the Red Rock Plateau to have its highest frequency slightly before that of Mesa Verde Corrugated, Loper variety.

Although the type frequency curves inferred from the strip graphs resemble the theoretical model of smooth "normal" distributions, there are numerous deviations. Some of these are undoubtedly the result of the action of the non-temporal factors noted above, particularly sampling error and functional variation. But many of the remaining deviations probably result from the fact that some samples represent relatively long occupations, while others represent short ones.
Ideally, of course, a seriated sample should record the pottery types in use at a site at a single instant in time. In fact, this ideal is never met; the archeologist can only hope that each sample represents a time period short enough so that pottery fashions changed relatively little throughout its duration.

I believe quite a few of the samples I have used depart significantly from the ideal. That is, they are "mixed"; they either result from long occupations that span most of the period represented by the totality of samples, or they result from several short occupations of the same site at well-separated times. That this should be so is not surprising because the number of potential site locations in the Red Rock Plateau was limited by 1) the extreme localization of fields and domestic water supplies and 2) the fact that most canyons are narrow and deep, with little space for habitation between the occasionally-flooded alluvial floor and the steep rocky canyon walls. (It may perhaps be argued that I should not have attempted to seriate samples of this sort. My reply is that [1] most of the samples in question appear to result from a single fairly short period of heavy occupation with occupations at other times making a relatively small contribution, and [2] despite the difficulties, the method of seriation seemed to be the only way to arrive at an independent local chronology in the absence of both direct absolute dating and of stratigraphy.)

The use of samples reflecting long time spans introduces considerable distortion into the frequency curves of the individual types, resulting in a false "stretching out" of their apparent temporal distributions. A good example of this is the distribution of the combined
types Kayenta Black-on-white—Kiet Siel—and-Kayenta Polychromes in the Lake Canyon chart. As noted in Appendix 1, all three types are very distinctive and difficult to confuse with anything else, and they appear to be useful as horizon markers, since they are not found anywhere before about 1225-1250 A.D. (Colton 1956). Yet in the Lake Canyon chart, this category, although it occurs at only a few sites, is scattered throughout the sequence. This is primarily because of its occurrence at Dead Tree Flats (Sa627), a site that yielded a very large sherd collection, and whose main occupation seems clearly to fit at the early end of the sequence. The Kayenta Black-on-white found at the site (the polychromes did not appear here) must represent a sparse later occupation, perhaps no more than a temporary camp or even the breakage of a single vessel. Since Dead Tree Flats is located in an area where both early and late sites are densely concentrated, a small amount of re-use during the later period must have been almost inevitable.

The use of long-term samples thus may give the seriation charts for a region an appearance of continuity between early and late occupations that is not altogether accurate. An enlightening example is provided by an analysis of the Steer Palace site (Sa454) of the Castle Wash area (Fig. 7). The four seriated samples from this site span virtually the entire sequence for this region. Sample 1, largely from Refuse Deposit 1 but including a burial and a pithouse located near the edge of the site, stands at the early end of the sequence, while Sample 2, from Refuse Deposit 2, stands at the late end. Samples 3 and 4, which are from the fills of a kiva and other structures located between
or adjacent to the two refuse deposits, fall into intermediate positions in the sequence. The refuse deposits and the burial were clearly formed during the time the site was occupied; the picture of site history they provide is of two separate occupations. The fills of the structures, on the other hand, were formed by natural processes after the structures had been abandoned. Since they come from structures adjacent to the two main refuse deposits, Samples 3 and 4 may well consist largely of pottery derived from both deposits and incorporated into the fill through slope-wash or other natural processes. The result is that the pottery profiles of Samples 3 and 4 appear intermediate or transitional between those of Samples 1 and 2. In my opinion, Samples 3 and 4 represent not temporally transitional occupations but merely the results of mechanical admixture during the filling of the structures after they were abandoned. (The pithouse included in Sample 1 must also have been filled by natural agencies, but it is located in a part of the site that was not heavily used during the later occupation, and it may in any case have already been filled by this time.)

At the Steer Palace site, it thus proved possible to isolate essentially "pure" or short-term samples in some areas, while other areas yielded samples probably resultant from several periods of occupation. These long-term samples occupy an intermediate or transitional place in the sequence, but probably do not represent an actual transitional occupation--only the mechanical admixture of materials left during the early and late occupations.

Discontinuity between the Klethla and Horsefly Hollow phase pottery
frequencies is also apparent in the Lake Canyon seriation chart. Here, the best ordering of the collections shows the early types Sosi and Dogoszhi Black-on-white gradually building up to a high frequency, then abruptly declining to low frequency and spotty occurrence. At about the same point in the sequence that this break occurs, Tusayan-Betatakyn Black-on-white appears rather suddenly in high frequency, as does Mesa Verde Black-on-white.

Much of the apparent continuity and many of the "transitional" collections that appear in the other areas may be the result of mechanical admixture of the sort that seems to have taken place at the Steer Palace site. The problem of a transitional period versus the "mixing" hypothesis will be further discussed under absolute dating. In general, it is my impression, based on the totality of available evidence, that the Klethla and Horsefly Hollow phase occupations were generally distinct and were separated by a period in which the region was only lightly occupied, if at all. Some of the long-lived types that appear in the Klethla phase seem to have carried over into the Horsefly Hollow phase, thereby bridging the gap. For example, Tusayan Black-on-red and Tusayan Polychrome, Tusayan and Moenkopi Corrugated, and Flagstaff Black-on-white appear in some of the "pure" collections at both ends of the sequence, as well as in the middle. Many of the transitional collections in the Fig. 7 sequences seem, however, to be the result of thorough mechanical admixture of artifacts from different periods, or of the failure in excavation and survey to design sampling units that would reveal existing stratigraphic or horizontal differences in pottery type frequencies. (In defense of the methods used by the Glen
Canyon Project archeologists, I must say that in general, a multiplicity of provenience distinctions was made. Furthermore, mechanical admixture of artifacts was favored by the nature of the sites; they are usually shallow, have loose sandy fill, and show evidence of soil disturbance by rodents and by the prehistoric human inhabitants. Rowe's (1961: 326) judgement that "stratified sites are rare everywhere, and ones that will yield an absolutely certain cultural sequence are even rarer" certainly seem applicable to the Red Rock Plateau region.)

Conclusions

The evidence indicates that the major factors governing variation among the pottery collections seriated in Fig. 7 are 1) temporal change and 2) geographic variation. Since the geographic variation is regularly patterned, it was easily controlled by seriating the samples from each region separately. Time is thus the dominant source of the differences among samples, and hence controls the ordering of samples in a given area. The principal chronological inferences that can be made from inspecting the patterns of change in the various areas are as follows:

1. At the earliest sites, the following types or descriptive categories of pottery are dominant: Tusayan Corrugated, Sosi-Dogoszhi Black-on-white, Tusayan-Medicine Black-on-red, unidentified Tsegí Orange Ware, and unidentified Tusayan White Ware. This complex can be assigned to the Klethla phase occupation.

2. The latest sites, which belong to the Horsefly Hollow phase, show high relative frequencies of Moenkopi Corrugated and/or Kiet Siel
Gray, Tusayan Black-on-white, Tusayan Polychrome, unidentified undecorated Tségi Orange Ware, Mesa Verde Corrugated, Mesa Verde Black-on-white, and unidentified Mesa Verde White Ware. There also are occasional occurrences of Kayenta Black-on-white, the four-color polychromes, and Tségi Orange with its close relatives, Tségi Black-on-orange and Red-on-orange. The three Mesa Verde types are heavily dominant in Castle Wash and Upper Glen Canyon sites, but diminish in frequency to the south and southwest.

3. Many collections also show substantial proportions of types from both the complexes described above. These could either be collections resulting from short but temporally transitional occupations, from long-term continuous occupations, or from a series of separate short occupations over a long time. The available evidence, both from correlation with absolutely dated occurrences of these types elsewhere and from discontinuities that appear in the Lake Canyon seriated sequence, indicates to me that the second explanation—repeated occupation—probably applies to the greatest number of these cases. Stratigraphic separation of the occupations was not found because there was mechanical mixing of deposits, probably complicated in many cases by the fact that there was little buildup of soil at the site during or between the periods of occupation. In addition to the spurious appearance of continuity introduced by mixture, there seems also to have been real continuity between the two occupations in the sense that some pottery types had life-spans that bridged the gap between occupations. Thus in my estimation the Horsefly Hollow and Kiethla phases were essentially distinct occupations, separated by a short time in which the
Fig. 7. Seriation of Pueblo III Pottery Collections from the Red Rock Plateau
(Gray ware types are shown at one-half the scale of all other types.
Whole vessels are given an arbitrary weight of 10 sherds.)
the Red Rock Plateau
of all other types.
0 sherds.)
Red Rock Plateau was abandoned or only lightly occupied.

4) The relative ordering of pottery types achieved in the seriation parallels the relative ordering in which these types appear in regions outside the Red Rock Plateau. The hypothesis of "type survival" is not confirmed when the data from all the larger pottery-bearing sites is assembled and compared. Both early and late types appear together in some collections, but other collections from the same local area or even from a different part of the same site are relatively "pure." For the type survival hypothesis to apply to these situations, one would have to assume that cultural lag occurred only at some sites and parts of sites, and not at others. Mixture, rather than type survival, seems the best explanation for the anomalous collections, following the interpretive rule suggested by Rowe (1961: 325).

If certain features which occur together in a deposition unit at one site, or one part of a site, are found to occur separately at other sites or other parts of the same site, mixing in the first case is indicated.

**Interregional Comparisons and Phase Definitions**

**Original Definition of the Klethla Phase**

The pottery characteristic of the earlier Pueblo sites in the Red Rock Plateau has its closest typological affinity with the pottery of the Klethla phase of the Kayenta branch. Before discussing the assignment of Red Rock Plateau material to the Klethla phase, I will briefly
review its characteristics as defined by Colton (1939: 58) on the basis of materials in northeastern Arizona.

Colton (ibid.) named the Klethla phase for the Klethla Valley, located just southwest of Marsh Pass. The phase was assigned to the Kayenta Branch of the Anasazi; it developed out of the Black Mesa phase and was succeeded by the Tsegi phase. At the time Colton wrote, no excavated Klethla sites had been reported in the literature, although some of the sites excavated by Guernsey and Kidder (Kidder and Guernsey 1919; Guernsey 1931) appear to have contained components of this phase. Since 1939, excavation reports of sites attributable entirely or in part to the Klethla phase have been published by Beals, Brainerd and Smith (1945), King (1949), and Smith (1952). A number of the sites excavated by the Glen Canyon project, both in and outside the Red Rock Plateau, also appear to belong to the Klethla phase. Colton (1939: 58) lists the following phase determinants, to which I have added occasional qualifiers.

**Pottery:**


b) Indigenous table type: Sosi Black-on-white, Flagstaff Black-on-white. [The peak frequency of Flagstaff Black-on-white follows that of Sosi; there is enough overlap so they often occur together, but sometimes they do not.]

c) Associated: Tusayan Black-on-red, Citadel Polychrome.

[I do not know why Colton did not list these types as]
indigenous, since in the description of the Tsegi phase that follows, he considers closely related orange ware types as native to the Kayenta area. It also now seems clear that Tusayan Polychrome first appeared during the Klethla phase, judging from the dates assigned it by Colton in his 1956 study of Tsegi Orange Ware.]

**Architecture:** [There is probably more variation in architecture than Colton indicates.]

a) Small masonry pueblo.

b) Circular kiva with ventilator and deflector [and sometimes with recess and/or bench.]

**Stone:** Scoop metate. Full grooved axe.

**Wood:** Digging stick, bow and arrow, loom.

**Fiber:** Yucca, cotton, etc.

**Food:** Corn, beans, pumpkins, etc.

**Disposal of the dead:** Inhumation, flexed.

**Physical type:** Brachycephalic, deformed [skulls].

The Klethla Phase in the Red Rock Plateau

Of the diagnostic Klethla phase decorated pottery types, only the earlier ones—Sosi Black-on-white and Tusayan Black-on-red—are present in abundance in the Red Rock Plateau. Flagstaff Black-on-white is very rare, and Citadel Polychrome is far from abundant. It appears that the Klethla phase extended into the Red Rock Plateau only during the first part of its duration.
Most of the other traits listed by Colton are present in one or the other of the Red Rock Plateau sites in which early Klethla phase pottery is dominant. Notched axes (some of which may be hoes) are more common in the Red Rock Plateau than grooved axes, but axes of all sorts are rare. Architecturally, the early Pueblo sites with Klethla pottery in the Red Rock Plateau do not measure up to the "unit Pueblo" pattern described by Colton. Multiple occupations pose a problem here because it is often difficult to tell which occupation a particular building belongs to; that is, to determine which structures are associated with the early Klethla pottery complex. From the evidence available, however, it seems clear that separate residential pithouses, both shallow and deep, were being built in the Red Rock Plateau at this time, along with kivas and (probably) small above-ground masonry structures. This is probably not so striking a departure from the nuclear area Klethla pattern as might be assumed; Bliss (1960) has suggested, on the basis of fieldwork during the late 1950's, that the separate domiciliary pithouse not only survived into the Pueblo III period in the Kayenta area, but was the most common type of dwelling during this time. Also, Ambler et al. (1964) and Lindsay et. al. (n.d.) have described instances of Pueblo III Kayenta residential pithouses associated with surface masonry buildings.

In conclusion, the characteristics of the Klethla phase, as described for areas to the south and southeast, seem well enough represented in some of the Red Rock Plateau sites to justify their classification in this phase. The full Klethla pottery complex is, however, not present in the Red Rock Plateau, probably because only the earlier
part of the Klethla phase is represented there.

Exterior Relationships of the Horsefly Hollow Phase

Although the Klethla phase was defined outside the Red Rock Plateau, its definition fits a group of sites from this region with little or no modification. The Horsefly Hollow phase, on the other hand, was set up on the basis of findings in the Red Rock Plateau, and may not occur elsewhere.

The Red Rock Plateau, sometime in the thirteenth century, appears to have become a contact zone between the Tsegi phase of the Kayenta branch and a local variant of the Mesa Verde branch resembling, but not identical to, the Mesa Verde phase itself. The Horsefly Hollow phase was the outcome of this cultural contact and mixture. Judging by the evidence of pottery, the Horsefly Hollow components from the northern and eastern parts of the Red Rock Plateau maintained close ties with Mesa Verde settlements outside the area, while those from the south and west show their strongest relationship with the Kayenta branch, Tsegi phase. Few Horsefly Hollow components, however, show only one element or the other; a mixture is typical. For this reason, it seemed reasonable to classify all the sites of this period into a single phase, rather than to try to segregate them into separate Mesa Verde and Kayenta branch phases. Furthermore, the geographic variation in pottery frequencies does not seem to be accompanied by corresponding variation in other traits. Similar kinds of projectile points, ground stone tools, styles of masonry, etc. are found throughout the Red Rock Plateau. Site plans are extremely variable but these variations do not seem to
correlate with differences in pottery types or to vary systematically through space. The differences in settlement patterns that occur from one place to the next seem to correlate primarily with physiographic variables, rather than with distance from the ethnic boundary. This is not to say that it would never be useful to attempt a phase distinction between the predominantly Mesa Verde and predominantly Kayenta sites, but merely that for the purposes of this study it seemed neither necessary nor convenient to do so.

To provide background information, I will briefly review, in the following paragraphs, the Tsegi and then the Mesa Verde phases, as they were defined in the nuclear Kayenta and Mesa Verde areas respectively. Following this, I will describe the Horsefly Hollow phase, noting its similarities to and differences from the correlative nuclear area manifestations.

The Tsegi phase was named (as "Sagi") by the Gladwins (1934), but Colton (1939: 58-9) first described it systematically. The name of course derives from Tsegi Canyon in northeastern Arizona, and the phase description is based primarily on the large, well-known (but poorly reported) cliff ruins of that locality, such as Betatakin and Kiet Siel. More recently, Beals, Brainerd and Smith (1945) have reported their excavations at a large open site (RB 568) that appears to be of this phase. Several sites recently excavated by Museum of Northern Arizona Glen Canyon Project crews in the highlands south of the Red Rock Plateau are probably Tsegi phase occupations, although they were not classified as to phase in the descriptive excavation reports (Ambler et al. 1964; Lindsay et al. n.d.).
Colton's listing of determinants for the Tsegí phase follows, with my comments in brackets:

**Pottery:**

a) Indigenous utility type: Tsegí Gray. [This type is now called Kiet Siel Gray. It also appears that Moenkopi Corrugated certainly and Tusayan Corrugated probably lasted well into this phase, although the peak frequency of the latter, and perhaps of both, was probably earlier.]

b) Indigenous table type: Tsegí Orange, Tsegí Red-on-orange, Tsegí Polychrome, Dogoszhi Polychrome, Kayenta Polychrome, Kiet Siel Polychrome, Kayenta Black-on-white, Tusayan Black-on-white. [Tusayan Polychrome also occurs throughout. Not all the types listed occur together throughout the phase; they can be roughly grouped into an early complex of which the most important types are Tusayan Black-on-white, Tusayan Polychrome, and Dogoszhi Polychrome, and a later complex which includes the three types named plus Kayenta Black-on-white, Kayenta Polychrome, and Kiet Siel Polychrome.]

**Architecture:**

a) Large cliff pueblos. [The pottery complex Colton lists is also associated with small sites, which in most areas are much more common than large ones during this phase; it also is found at pueblos built
in the open as well as in cliff shelters. There is great variation in site and room plan from one site to the next. Masonry is often of poorly-shaped stones, laid up with large quantities of mud mortar. On occasion, adobe and jacal walls were incorporated into a basically stone masonry structure.

b) Circular and rectangular kivas.

**Stone:** Grooved metate [actually, the flat metate set in a bin appears to be much more common]; two-hand mano; full-grooved axe. [The characteristic arrow point is small, triangular, stemless and unnotched.]

**Wood:** Digging stick, bow and arrow, loom.

**Fiber:** Cotton.

**Food:** Corn, beans, pumpkin.

**Domestic animals:** Dog, turkey.

**Disposal of the dead:** Inhumation, flexed.

**Physical type:** Brachycephalic deformed.

"Mesa Verde" was first explicitly used as a phase name by Reed (1944), in replacement of the Gladwins' (1934) suggested name of Montezuma phase, for reference to the terminal segment of the Mesa Verde branch in the Mesa Verde proper and environs. Although the Gladwins' name has priority, Reed's usage has apparently been accepted by the archeologists currently working with Mesa Verde branch materials, for Hayes (1964) classifies his latest material from the Wetherill Mesa survey into a Mesa Verde phase.

The Gladwins (1934) were the first to partition the Mesa Verde
tradition into phases. Their delineation of the Montezuma phase consisted only in noting that the diagnostic pottery types were Mesa Verde Black-on-white and Grey Indented Corrugated with a flaring rim, and that Great Pueblo cliff-dwellings were the characteristic architectural forms. The phase must have been based primarily on the large well-preserved and (superficially) well-known ruins dating from the terminal occupation on the Mesa Verde proper, most of which had been excavated by Nordenskiöld (1893) or Fewkes (many papers, concentrated in the period 1909-1925, mostly in various Smithsonian Institution publications and American Antiquity). Since the Gladwins wrote in 1934, there have been several small-scale excavations in sites of this phase on the Mesa Verde (O'Bryan 1950; Lancaster et al. 1954; Luebben et al. 1960, 1962; Rohn 1963) as well as the extensive work of the Wetherill Mesa project, the basic site reports of which have yet to appear. A series of special studies (Osborne 1965) and a survey report (Hayes 1964) on the findings of this project have been published, however. Also available are several major reports describing materials that relate to the Mesa Verde phase from areas outside the Mesa Verde proper (for example Morris 1939, Reed 1958).

The best concise description of the Mesa Verde phase is that of O'Bryan (1950: 110-11), who followed Gladwin in calling it the Montezuma phase. O'Bryan relied on the same basic diagnostics as had the Gladwins, but gave a fuller account, based on a more recent knowledge of Mesa Verde archeology. In quoting O'Bryan below, I have added a few comments, most based on Hayes (1964) recent report of the intensive survey of Wetherill Mesa.
The great cliff-dwellings in Mesa Verde National Park are representative of the [Mesa Verde] phase, the culmination of the Mesa Verde branch. Less spectacular but contemporaneous unit and compound pueblos occur on Mesa Verde, and in adjoining areas where suitable caves are rare or lacking entirely. [On Wetherill Mesa, about 65 percent of the sites of this phase were in shelters in the cliffs, a higher percentage than in any previous phase. The average size of open sites was seven rooms, while sheltered sites averaged ten rooms. The median site size in both categories is undoubtedly somewhat less, because of the skewing effect on the average of the few extremely large sites.]

The [Mesa Verde] phase was characterized architecturally by unit and compound pueblos of stone masonry... The rooms, often two- or three-storied, were usually grouped northwest of the kivas... The kivas were enclosed by walls or tiers of rooms; often kivas and rooms, [and] sometimes an adjoining tower, were connected by tunnel passageways... Two new details of construction involved the method of dressing stone: the exposed surface of each block was dressed by repeated blows of a pecking stone to produce a dimpled effect; and the courses of stone often were stabilized by the insertion of rows of small
spalls in the mortar... [Hayes notes that although the typical Mesa Verde "keyhole" shaped, pilastered kiva continued to be most popular in this phase, a few square kivas also occurred. He also shows that pecked building stones first appear in the preceding McElmo phase, and that many Mesa Verde phase sites had very rough masonry, some of it resembling, to me at least, the masonry generally found in Tsegi phase sites in the Kayenta area.]

Stone implements of the [Mesa Verde] phase included: side-notched chipped points, drills, very few scrapers, leaf-shaped and side-notched knives. Pecking stones were plentiful; handstones and floor-polishers rare. Grooved mauls were replaced (excepting a few large quarrying mauls) with grooved hammers of igneous rock; axes were full grooved, occasionally double-bitted... The plentiful bone implements were identical with those...of the preceding phase; scrapers made of deer scapulas increased in frequency. Stone pendants, disc beads, lignite buttons, and some turquoise beads and inlays comprised most of the ornaments; marine shells were rare.

The domestic dog was known but not numerous;
turkeys were kept for meat [and] feathers, and the bones were used as raw materials for tools. Hunting remained of secondary importance to agriculture.

Mesa Verde Black-on-white pottery reflected a local standardization of form and design unusual even in the Southwest. Mugs, hollow-handled ladles, kiva jars with a rim moulded to facilitate sealing, thick-rimmed bowls, spherical and submarine-shaped canteens, all well-polished and decorated with heavy geometric designs in organic paint, make up a pottery style easy to recognize. The standard utility vessel was the narrow-mouthed corrugated jar [Mesa Verde Corrugated]...

Cemeteries of the [Mesa Verde] phase remain undiscovered. A few...burials have been found... . Skulls show lambdoidal and occipital deformation, usually symmetrical.

Definition of the Horsefly Hollow Phase

The Horsefly Hollow phase takes its name from a large Lake Canyon site (Sa544) where the major occupational deposits yielded large quantities of both Mesa Verde and Kayenta branch pottery. By and large, the Horsefly Hollow ceramic complex seems to be a mixture, rather than a fusion, of ceramic traditions that exist separately outside the Red Rock Plateau. That is, most specimens could be classified as definitely belonging to a type with Mesa Verde relationships, or to a definite
Kayenta branch type. There were few examples that seemed to reflect the merging of the two ceramic traditions. (The fact that evidence for this sort of merging is so scarce leads me to believe that the Horsefly Hollow phase was of quite short duration.)

If, as I have previously suggested, the Red Rock Plateau had been largely abandoned at the close of the Klethla occupation, the Horsefly Hollow occupation would necessarily have been the result of new population moving into the region from adjacent regions. It seems likely that the Mesa Verde branch ceramic tradition was introduced by migrants from the north and east, while new inhabitants coming in from the south and southeast brought in Kayenta pottery. The pottery shows no ties to the area west of the Colorado; this area probably had been abandoned by this time and therefore could not have been a source of population. The new inhabitants of the area seem to have come together peacefully into the same communities, regardless of their area of origin, much as did the various populations who entered the "Black Sand" area near Flagstaff in the late eleventh and early twelfth centuries, after the fall of a blanket of volcanic ash from Sunset Crater had made the area more productive agriculturally (Colton 1946). An alternative theory of the origin of the Horsefly Hollow phase might have Kayenta people occupying the region, but for some reason getting large amounts of Mesa Verde pottery by trade in their more northerly communities, or vice versa. Sharrock et al. (1961a:16) suggest that intermarriage may account for the geographic variation in pottery distribution, presumably by women (the pottery makers) being brought into the area from different directions. This would assume, however, a patrilocal or
neolocal residence rule, for which ethnographic analogy to modern Puebloans offers little support.

Moving on to specific features of the Horsefly Hollow phase, I will deal first with the pottery. The Kayenta types most common are those of the early part of the Tsegi phase, specifically Moenkopi Corrugated, Kiet Siel Gray, Tusayan Polychrome, Tsegi Orange, and Tusayan Black-on-white. Later Tsegi phase types such as Kayenta Black-on-white and the four-color polychromes (Kiet Siel and Kayenta) are found in some Horsefly Hollow sites but are seldom abundant. The Red Rock Plateau specimens of these types are formally quite like the specimens found south of the San Juan in the area of the Tsegi phase proper.

The bulk of the pottery assignable to the Mesa Verde ceramic tradition clearly resembles the two principal Mesa Verde phase types—Mesa Verde Black-on-white and Mesa Verde Corrugated. In only a minority of the specimens, however, were these resemblances detailed enough so that they could confidently be assigned to the original type categories. Most of the Horsefly Hollow material of Mesa Verde ceramic tradition showed consistent differences from the standard type descriptions (Abel, 1955; Hayes 1964); hence, it was classified into local varieties—Mesa Verde Black-on-white, Loper variety, and Mesa Verde Corrugated, Loper variety. The variety name is from the Loper Ruin (Sa364), a site where this material was first recognized as a distinctive local variant, and where it occurs in abundance. The special characteristics of these varieties are set forth in Appendix 1.

The pottery from outside the Red Rock Plateau that most closely resembles these Loper varieties comes from excavations in Beef Basin
(Rudy 1955), an area about 25 miles to the northeast. Beef Basin is in the highland zone, and has numerous sites (though none seems to be extremely large); quite likely it is one of the areas from which some of the Horsefly Hollow population came. I suspect that a program of survey and excavation in the region north and east of the Red Rock Plateau would turn up additional material of this sort, and would help to clarify the origins of the Mesa Verde element in the Horsefly Hollow phase.

Sites of the Horsefly Hollow phase are commonly located in shelters in the cliffs, or sometimes on sandstone prominences near the canyon rim; a few canyon floor sites were noted, and others may have been eroded away or silted over. None of the sites is large. There is great variation in architectural form: site types include numerous small cliff-dwellings with or without kivas, a few pit-houses on the canyon floor, an orthodox L-shaped pueblo and kiva complex built in the open; campsites, a special storage cave, possible defensive sites, a burial cave, a walled plaza with a few rooms at one end, and (probably) numerous temporary windbreak structures and isolated masonry granaries. Individual rooms vary greatly in size, shape, and mode of construction. Certainly one reason for this is that most rooms are built against a cliff wall, ledge, talus slope, or some other irregular surface. Masonry is generally of poor quality, especially where tabular building stone is not available. Where irregular lumps of rock were used, they were laid up with much mud mortar; the result resembles the masonry of the Tsegi phase cliff dwellings in northeastern Arizona. If tabular building stone was available, however, the masonry is much neater in appearance, and much less mud was used. In cliff-dwellings, jacal
walls or partitions are fairly common, as they are in the Tsegi phase sites. Multi-storied structures are very rare. Most construction, particularly in shelters, gives the impression of having been done shoddily and perhaps hastily.

The typical stone arrow point is the triangular unnotched Tsegi phase variety, rather than the side-notched Mesa Verde form (this also seems to be true for the related sites of the Mesa Verde branch in Beef Basin). Untipped hardwood arrow foreshafts are also found. Other chipped stone tools include well-made medium and large unstemmed knives, various coarsely-made bifacial cutting and scraping tools, and large extremely crude choppers made on river cobbles. Hammerstones are abundant. Chipped stone tools of all kinds appear proportionately more common in Horsefly Hollow sites than in the nuclear area sites of the Tsegi and Mesa Verde phases.

The most common ground stone tools are two-hand manos, nearly all of which were probably used on flat metates set in mealng bins. Axes are very rare; only a few poorly made full-grooved and notched specimens were found. No mauls were found. A few well-made tchamahias occur. Several ground stone pendants were recovered, but they are rare, as are personal ornaments of any sort.

Corn, beans, and squash were the staple foods, but the diet very likely also included wild plant foods such as beeweed, prickly-pear cactus, various chenopods and amaranths, the juicy stems of certain grasses, and perhaps cottonwood buds and catkins (Martin and Sharrock 1964). A few of the wooden digging sticks used in cultivation were found. These were sometimes tipped with a spatulate blade of mountain
sheep horn. Cotton clearly was grown in the area, and spinning and weaving were probably important activities, judging by the frequency with which cotton fibers, bolls, weaving tools, loom anchors, and scraps of cloth are found when conditions of preservation permit.

Animal bone seems to be more abundant than in the large nuclear area sites, probably reflecting the greater availability of game in this lightly-populated region. Bighorn sheep were the most important game animals, followed by deer, rabbit, and beaver. Turkey bones are rare, and it is questionable that this animal was kept as a domesticate in this region. Animal bone was used for a rather nondescript variety of awls, punches, scrapers, and a few ornaments.

Only a few burials were found, some in room fill, others in a burial cave. Children were sometimes interred on cradleboards, adults in flexed or semi-flexed position. Skulls show "intermediate lambdoid" deformation—neither vertical enough to be occipital nor sharply oblique enough to be called lambdoid (Reed 1963).

ABSOLUTE DATING

As previously noted, the Red Rock Plateau sites yielded no dendro-chronologically datable wood, and no radiocarbon specimens from Pueblo sites were dated. Hence, the only feasible approach to absolute dating is to correlate Red Rock Plateau artifactual material—in this case pottery—with similar dated material from neighboring areas. Such correlation of course assumes that the Red Rock Plateau pottery specimens are of the same age as their correlates in the other areas. It seems to me that this assumption can reasonably be made because 1) the Red Rock
Plateau pottery shows detailed formal similarity to the pottery of adjacent regions and 2) the pottery seriation, discussed in the previous section, indicated that the relative ages and the associations of pottery types were the same in the Red Rock Plateau as in surrounding areas.

For temporal correlations, the most relevant data should be from sites which are geographically close to the Red Rock Plateau, which have the same types of pottery, and which have yielded tree-ring dates. Fortunately, two groups of sites meet these requirements. The first site group is in Beef Basin, 20-25 miles northeast of the Red Rock Plateau (Rudy 1955), and the second is only 5-15 miles to the south, just across the San Juan in the highlands on the north and east flanks of Navajo Mountain (Lindsay et al. n.d.). Below, I will discuss the dates from these sites and their implications for dating the Red Rock Plateau materials.

1) Beef Basin. Five specimens from three sites proved datable, with outside ring dates of 1213vv, 1214vv, 1232v, and 1233B (Bannister 1964). The symbols "vv," "v," and "B" mean, respectively, "very variable," "variable," and "bark date." Bark dates give the true age at which the tree died, presumably from cutting, while the variable dates are from eroded specimens in which an unknown number of outside rings are missing. "v" dates are likely to be closer to the original time of cutting than are "vv" dates.

The pattern of dates suggests that the structures which yielded the tree-ring specimens were built sometime during the 1220's and/or 1230's, with the evidence favoring the early 1230's. As discussed
elsewhere, particularly in Appendix 1, the Beef Basin sites contained pottery quite similar to the Mesa Verde element in the Horsefly Hollow ceramic complex. A sample of pottery from the Ridge site (Sa45) in Beef Basin showed, for example, high proportions of the Loper varieties of Mesa Verde Corrugated and Mesa Verde Black-on-white—the types that dominate the Mesa Verde portion of Horsefly Hollow ceramics. The Ridge site produced one date of 1232v and two earlier vv dates. (The other sample of Beef Basin pottery I examined closely—from Sa37—was not associated with datable wood.)

Because the Mesa Verde pottery from Beef Basin and the Red Rock Plateau is so much alike, I do not hesitate to infer that the Horsefly Hollow phase dates in part, at least, to the 1230's. This inference is consistent with the dates of about 1200-1300 generally assigned the pottery types Mesa Verde Corrugated and Mesa Verde Black-on-white (see Fig. 8 and Table 5.)

2) Northern and eastern flanks of Navajo Mountain (Lindsay et al. n.d.). The first date to be discussed is one of 1110vv from a house post in the site NA7537. The pottery at this site, which Lindsay et al. believe reflects a short occupation, very much resembles the pottery complex of the Klethla sites in the Red Rock Plateau. Lindsay et al. assign NA7537 to the early part of the 1100's on the basis of the single tree-ring date noted above plus dates determined elsewhere for the pottery types found there. Their discussion is as follows.

NA7537 was obviously occupied after the introduction of Sosi and Dogozhii Black-on-whites
and before the introduction of Flagstaff
Black-on-white. Utilizing Colton's (1955, 1956) dating of various pottery types, it appears that the site was occupied between A.D. 1070 and 1125. Utilizing Breternitz's (1963) more recent evaluation of pottery dates, the occupation would be dated as between A.D. 1075 and slightly earlier than 1100. However, a wall post from Room 4 yielded an outside [date] of 1110vv showing that the site was occupied until at least that time. Breternitz's beginning date of 1100 or earlier for Flagstaff Black-on-white in the Flagstaff, Arizona area is therefore apparently not applicable to the Navajo Mountain area, so it is wiser to utilize the temporal range derived from Colton. Since only a few Black Mesa Black-on-white sherds were found, it seems likely that the occupation of NA7537 began after 1100, lasted until sometime after 1100, and was confined to a relatively short period.

It should be noted that a south to north time gradient for the appearance of Flagstaff Black-on-white is not unreasonable, because this type's design style seems to have ties to Hohokam pottery to the south (Beals et al. 119-20) and the type as such probably originated in the Flagstaff area.

NA7537 and at least some of the Klethla sites in the Red Rock Plateau must have been occupied contemporaneously, because their pottery assemblages are so similar. However, the Red Rock Plateau Klethla
occupation, taken as a whole, probably lasted somewhat longer than did the occupation of NA7537; Flagstaff Black-on-white is found at some of the Red Rock Plateau sites of this phase, although never in abundance.

Four other sites reported by Lindsay et al. (n.d.) from the region north and east of Navajo Mountain yielded tree ring dates, as follows:

NA5815: Five specimens, ranging from 1260v to 1262vv, no bark dates.

NA7519A: 17 specimens, ranging from A.D. 1223v to 1284B, with one other bark date at 1278B.

NA7520B: Four specimens, ranging from 1262v to 1268B.

NA4075: Two specimens, 1264v and 1268B.

All these sites seem to have been built and occupied largely after 1260; Lindsay et al. also present good evidence that the main period of occupation at NA7519, the largest of the four sites, was after 1270. The pottery at these sites generally resembles the Kayenta or Tsegi phase element of the Horsefly Hollow ceramic complex in the Red Rock Plateau--Kiet Siel Gray, Moenkopi Corrugated, Tusayan Black-on-white, and the various late Tsegi Orange Ware types employing less than four colors are common in both areas. The principal differences lie in 1) the much greater frequency in the Navajo Mountain sites of types dating post-1250—that is, Kayenta Black-on-white and the four-color polychromes—and 2) the virtual absence, in these sites, of Mesa Verde pottery. Lindsay et al. identified a few sherds of Mesa Verde
Black-on-white, but proportionately they make up a very small fraction of the total black-on-white pottery.

Pottery correlations thus lead to the conclusion that the occupation of these four Navajo Mountain sites started about the time the Horsefly Hollow occupation of the Red Rock Plateau was ending. The Horsefly Hollow phase should thus be largely pre-1260 or perhaps even pre-1250; a few sites probably were occupied after these dates, but most probably were not.

In summary, the tree-ring dates from the two groups of sites just discussed indicate, through correlation, that the Klethla occupation probably started in the early 1100's, and that the Horsefly Hollow occupation was probably in full swing by the 1230's, but did not last much past 1250 or 1260. Although this gives us approximate dates for these occupations, additional information is needed to fix the upper time boundary of the Klethla occupation, and the lower boundary of the Horsefly Hollow.

A third group of sites near the Red Rock Plateau, even though it did not provide tree-ring dates, furnishes important information on this problem. This site cluster, located on Cummings Mesa (Ambler et al. 1964), included a number of sites with pottery complexes similar to those of the Red Rock Plateau, which lies 10-15 miles to the northeast. In addition, however, there were many Cummings Mesa sites that yielded substantial amounts of Flagstaff Black-on-white, a type that is quite rare in the Red Rock Plateau. In the Cummings Mesa survey, Flagstaff Black-on-white was the second most abundant black-on-white type collected, and was important in several of the excavated sites,
including the largest, Surprise Pueblo (NA7498), where it was second only to Tusayan Black-on-white among the black-on-white types present. Ambler et al. assign a date of about 1120-1215 to Flagstaff Black-on-white; on the basis of the discussion in Lindsay et al. (n.d.) quoted above in connection with the tree-ring date from NA7537, I estimate the dates of this type in the Glen Canyon area to be slightly later, perhaps 1130-1220.

In any case, the importance of the Cummings Mesa findings in this discussion is that they show that Flagstaff Black-on-white was in common use quite near the Red Rock Plateau at one time—probably from the mid-1100's to the early 1200's. The fact that this type is very rare in the Red Rock Plateau suggests to me that this region was uninhabited or was at most lightly occupied during the time when Flagstaff Black-on-white was at peak frequency, probably in the last half of the twelfth century. Thus the Klethla occupation could not have lasted much past the middle 1100's, and the Horsefly Hollow occupation could not have begun much before the early 1200's. The discontinuity earlier pointed out in the Lake Canyon seriated sequence (Fig. 7) would seem to correlate with the period of abundance of Flagstaff Black-on-white, since this type appears in small quantities both before and after the break.

A final approach to dating the Red Rock Plateau phases is to compare their ceramic complexes to the dated pottery chronology for the region, and to find, by matching, the period at which the complexes best fit the chronology. Table 5 summarizes the efforts of several recent authors to assign absolute dates to the pottery types in
Table 5. Estimated Absolute Dates for Pottery Types

<table>
<thead>
<tr>
<th>Pottery Types</th>
<th>Dating Estimates by Various Authors</th>
<th>McGregor 1965</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiet Siel Gray</td>
<td>1274–1300 1200–1300 1175–1300</td>
<td>1175–1300</td>
</tr>
<tr>
<td>Tusayan Corr.</td>
<td>950–1275 950–1300; most abundant 1050–1150</td>
<td>950–1275 1050–1150 950–1300</td>
</tr>
<tr>
<td>Black Mesa B/W</td>
<td>900–1100 875–1130; most abundant 1000–1130</td>
<td>900–1100 785–1130 1000–1100 875–1130</td>
</tr>
<tr>
<td>Sosi B/W</td>
<td>1070–1150 1075–1200; not well dated</td>
<td>1070–1150 1075–1200 1075–1200</td>
</tr>
<tr>
<td>Dogoszhi B/W</td>
<td>1070–1150 1085–1200</td>
<td>1070–1150</td>
</tr>
<tr>
<td>Flagstaff B/W</td>
<td>1125–1200 1085 or 1100 to 1275; most abundant 1100–1200</td>
<td>1120–1215 1100–1275 1100–1200 1130–1220</td>
</tr>
<tr>
<td>Tusayan B/W</td>
<td>1225–1300 1125 or 1150 to 1300; most abundant 1250–1300</td>
<td>1190–1300 1200–1300 1250–1300 1150–1300</td>
</tr>
<tr>
<td>Betatakin B/W</td>
<td>1250–1300 Probably a late variety of Tusayan B/W</td>
<td>1220–1300 1200–1300 1250–1300 1220–1300</td>
</tr>
<tr>
<td>Pottery Types</td>
<td>Dating Estimates by Various Authors</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Kayenta B/W</td>
<td>1250–1300</td>
<td>ca. 1260–1300</td>
</tr>
<tr>
<td>Medicine B/R</td>
<td>1050–1100</td>
<td>1075–1125; not well dated</td>
</tr>
<tr>
<td>Tusayan B/R</td>
<td>1050–1150</td>
<td>1050–1200; most abundant 1050–1150</td>
</tr>
<tr>
<td>Cameron Poly.</td>
<td>1050–1100</td>
<td>1065 or 1075 to 1150; very poor evidence</td>
</tr>
<tr>
<td>Tsegi B/O</td>
<td>1225–1300</td>
<td>1125–1300; most abundant near end of range</td>
</tr>
<tr>
<td>Tsegi 0.</td>
<td>1250–1300</td>
<td>1150 or 1200 to 1300; Tsegi 0, B/O, R/O have similar dates</td>
</tr>
<tr>
<td>Tsegi R/O</td>
<td>1225–1300</td>
<td>1150–1300</td>
</tr>
<tr>
<td>Tusayan Poly.</td>
<td>1150–1300</td>
<td>1100–1300</td>
</tr>
<tr>
<td>Dogoszhi Poly.</td>
<td>1250–1300</td>
<td>Probably a late variety of Tusayan B/R</td>
</tr>
<tr>
<td>Pottery Types</td>
<td>Dating Estimates by Various Authors</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Kayenta Poly.</td>
<td>1250-1300</td>
<td>1265-1285, at a minimum</td>
</tr>
<tr>
<td>Kiet Siel Poly.</td>
<td>1225-1300</td>
<td>1250-1285, probably begins earlier</td>
</tr>
<tr>
<td>M. V. Corr.</td>
<td>1200-1300</td>
<td>1200-1300</td>
</tr>
<tr>
<td>Mancos B/W</td>
<td>950-1150</td>
<td>ca. 1025-1200; most abundant 1075-1125</td>
</tr>
<tr>
<td>M. V. B/W</td>
<td>1200-1300</td>
<td>1200-1300; not well dated</td>
</tr>
</tbody>
</table>
Fig. 8. Absolute Dating of Klettha and Horsefly Hollow Pottery Complexes
question. The dates I have settled upon as the ones most likely to be correct are given in the last column of this table. These dates are in turn used to construct the regional pottery chronology shown in Fig. 8. In general, the dates I have used follow those of Breternitz (1963); he reviewed all the relevant associations of tree-ring specimens with pottery for the entire Southwest. Where dates suggested by Ambler et al. (1964) conflict with those of Breternitz, I generally have followed Ambler et al. on the grounds that their work is more recent and relates more closely to the Red Rock Plateau materials. As noted above, I differ slightly from both the above sources in my dating of Flagstaff Black-on-white, as a result of reading the even more recent discussion in Lindsay et al. (n.d.).

In Fig. 8, the absolute dates used for the various pottery types are graphically summarized; the diamond shape of the graph for each type is intended to show the estimated time of the type's greatest popularity. Since all the graphs are the same width, no allowance is made for the varying overall abundance of the various types; thus at a given point in time, Type A might be at peak frequency, yet actually be less abundant in terms of sherd counts than Type B, even though B had already passed or had not yet reached its peak.

My conclusions on the dating of the Klethla and Horsefly Hollow occupations are also indicated in Fig. 8. The complex of types most often found at the Klethla phase sites in the Red Rock Plateau matches the pottery chronology best at about 1120 to 1130. Most variation among the Klethla sites can be accounted for by extending the time boundaries 20 years each way, to 1100 and 1150. That is, if we plotted all the
Klethla assemblages against the pottery chronology of Fig. 8, nearly all these assemblages would fall in the 50-year time span centering on 1125. When the Horsefly Hollow assemblages are matched against the master chronology, the best fit occurs in a 50-year period bounded by 1210 and 1260, and centering on 1230. Of course, I cannot be sure that the Klethla and Horsefly Hollow occupations spanned the entire 50-year periods I have assigned them; they may have, but again they may not. Furthermore, a few sites may have been occupied outside these periods. I believe, however, that the bulk of occupation in these two phases must have come within these two 50-year periods.

ASSIGNMENT OF COMPONENTS TO PHASES

Because of the large amount of site reoccupation and the mechanical admixture of the deposits left by these occupations, it is difficult to locate "pure" components of the two phases we are concerned with here. In a strict sense, most of the sites seriated in Fig. 7 are multiple-component sites. In practice, however, sites or deposits whose artifacts are predominantly of one or the other phase can be treated as single components.

In Table 6, this rule is used to group by phase the sites and parts of sites seriated in Fig. 7. Pottery types were, of course, the diagnostic criteria. In most areas, it was necessary to place some sites or parts of sites in a "mixed" category, because they had yielded substantial amounts of the pottery types characteristic of both phases.

Some explanation of the category "Sampling Units" used in Table 6 is necessary. During the restudy of the pottery from these sites, the
distribution of types within each site was surveyed to see if there were significant variations in occurrence from one level, structure, or area to the next. If none could be detected, all the pottery from the site was treated as a single assemblage; in such cases the sampling unit is recorded as "total" in Table 6. This lack of demonstrable distributional variation is present in the sites and parts of sites classed as "mixed," and hence multi-component, as well as in the units that are single components. I believe in most cases this is the result of mechanical admixture, in sandy fills, of the artifacts left by separate occupations; some such cases may, however, be due to truly transitional occupations.

When significant variation in intrasite pottery distribution was found, the site collection was subdivided following the distributional differences noted. Thus, for example, the Horsefly Hollow site was divided into two components because a characteristically Klethla pottery complex appeared in one area, while the rest of the site was dominated by Horsefly Hollow pottery. In cases such as this, the various excavation units that make up each component are listed in the "Sampling Units" column in Table 6. At the Horsefly Hollow site, the Klethla component (Sa544-2) was identified by the fact that Klethla pottery was significantly concentrated in Structure 1 and in the adjacent G through M sections of Trench 1.

The sites seriated in Fig. 7 and listed in Table 6 comprise, as has already been noted, only a fraction of the total Pueblo III sites from the Red Rock Plateau. Should not some attempt be made to classify the remainder of these sites as to phase? I am forced at present to
Table 6. Components of the Klethla and Horsefly Hollow Phases

<table>
<thead>
<tr>
<th>Area and Phase</th>
<th>Site No.</th>
<th>Site Name</th>
<th>Sampling Units</th>
<th>Principal Publ. Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson Canyon Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Horsefly Hollow</strong></td>
<td>Sa643</td>
<td>Mosquito Cave</td>
<td>Total</td>
<td>Lipe <em>et al.</em> 1960</td>
</tr>
<tr>
<td></td>
<td>Sa633</td>
<td>Widow's Ledge</td>
<td>Total</td>
<td>Sharrock 1964</td>
</tr>
<tr>
<td></td>
<td>Sa509</td>
<td>No name</td>
<td>Total</td>
<td>Weller 1959</td>
</tr>
<tr>
<td></td>
<td>Sa635</td>
<td>Mistake Alcove</td>
<td>Total</td>
<td>Sharrock 1964</td>
</tr>
<tr>
<td></td>
<td>Sa377</td>
<td>Fence Ruin</td>
<td>Total</td>
<td>Lipe <em>et al.</em> 1960</td>
</tr>
<tr>
<td></td>
<td>Sa637</td>
<td>Grimm site</td>
<td>Area 2</td>
<td>Lipe <em>et al.</em> 1960</td>
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<tr>
<td>Lake Canyon Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Klethla</strong></td>
<td>Sa693</td>
<td>Ax Groove Alcove</td>
<td>Total</td>
<td>Sharrock <em>et al.</em> 1961a</td>
</tr>
<tr>
<td></td>
<td>Sa565</td>
<td>No name</td>
<td>Total</td>
<td>Fowler 1961</td>
</tr>
<tr>
<td></td>
<td>Sa651</td>
<td>No name</td>
<td>Total</td>
<td>Fowler 1961</td>
</tr>
<tr>
<td></td>
<td>Sa544-2</td>
<td>Horsefly Hollow</td>
<td>Trench 1, G-M; Struct. 1</td>
<td>Sharrock <em>et al.</em> 1961a</td>
</tr>
<tr>
<td></td>
<td>Sa627</td>
<td>Dead Tree Flats</td>
<td>Total</td>
<td>Sharrock <em>et al.</em> 1961a</td>
</tr>
<tr>
<td>(aberrant)</td>
<td>Sa620</td>
<td>Weir's Mural</td>
<td>Total</td>
<td>Sharrock <em>et al.</em> 1961a</td>
</tr>
<tr>
<td></td>
<td>Sa540</td>
<td>Pahgarit Dune</td>
<td>Total</td>
<td>Sharrock <em>et al.</em> 1961a</td>
</tr>
<tr>
<td><strong>Mixed Klethla-</strong></td>
<td>Sa316</td>
<td>The Fortress</td>
<td>Total</td>
<td>Sharrock <em>et al.</em> 1961a</td>
</tr>
<tr>
<td><strong>Horsefly Hollow</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(aberrant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horsefly Hollow</td>
<td>Sa672</td>
<td>No name</td>
<td>Total</td>
<td>Fowler 1961</td>
</tr>
<tr>
<td></td>
<td>Sa664</td>
<td>No name</td>
<td>Total</td>
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</tr>
<tr>
<td></td>
<td>Sa695</td>
<td>Stevens Terrace</td>
<td>Total</td>
<td>Sharrock <em>et al.</em> 1961a</td>
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</tbody>
</table>
Table 6 (cont'd). Components of the Klethla and Horsefly Hollow Phases

<table>
<thead>
<tr>
<th>Area and Phase</th>
<th>Site No.</th>
<th>Site Name</th>
<th>Sampling Units</th>
<th>Principal Publ. Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sa544-1 Horsefly Hollow</td>
<td></td>
<td></td>
<td>Struct. 2-11; Trench 1, A-F.</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>Sa623 Lyman Flat</td>
<td></td>
<td></td>
<td>Struct. 3-6, Trench 1</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>Sa619 Gourd House</td>
<td></td>
<td></td>
<td>Total</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>Sa673 No name</td>
<td></td>
<td></td>
<td>Total</td>
<td>Fowler 1961</td>
</tr>
<tr>
<td>Sa622 Oven Alcove</td>
<td></td>
<td></td>
<td>Total</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>Sa662 Grid Alcove</td>
<td></td>
<td></td>
<td>Total</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>Sa543 Toad Shelter</td>
<td></td>
<td></td>
<td>Total</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>Sa554 Rogers House</td>
<td></td>
<td></td>
<td>Total</td>
<td>Sharrock et al. 1961a</td>
</tr>
<tr>
<td>(aberrant) Sa687 No name</td>
<td></td>
<td></td>
<td>Total</td>
<td>Fowler 1961</td>
</tr>
</tbody>
</table>

**Moqui Canyon area**

| Klethla                      | Sa782    | No name         | Total                           | Day 1963                  |
| Sa681 Rehab Center           |          |                 | Total                           | Sharrock et al. 1963      |

**Mixed Klethla and Horsefly Hollow**

| Sa675 Red Ant Kiva           |          |                 | Trench 1, 0-60"; Sharrock et al. 1963 |
| Sa583 Echo Cave              |          |                 | Trench 2; Strata 2-3; Struct. 2    |

| Horsefly Hollow              | Sa576    | Shady Alcove    | Total                           | Lipe et al. 1960          |
| Sa786 No name                |          |                 | Total                           | Day 1963                  |
| Sa585 Doll Ruin              |          |                 | Total                           | Lipe et al. 1960          |
| Sa730 No name                |          |                 | Total                           | Day 1963                  |
| Sa729 Flatrock House         |          |                 | Total                           | Sharrock et al. 1963      |
Table 6 (cont'd). Components of the Klethla and Horsefly Hollow Phases

<table>
<thead>
<tr>
<th>Area and Phase</th>
<th>Site No.</th>
<th>Site Name</th>
<th>Sampling Units</th>
<th>Principal Publ. Reference</th>
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<tbody>
<tr>
<td></td>
<td>Sa736</td>
<td>Bernheimer Alcove</td>
<td>Total</td>
<td>Sharrock et al. 1963</td>
</tr>
<tr>
<td></td>
<td>Sa678</td>
<td>Copter Ledge</td>
<td>Total</td>
<td>Sharrock et al. 1963</td>
</tr>
<tr>
<td></td>
<td>Sa781</td>
<td>Tamarix Dune</td>
<td>Total</td>
<td>Sharrock et al. 1963</td>
</tr>
<tr>
<td></td>
<td>Sa679</td>
<td>Hiboy House</td>
<td>Total</td>
<td>Sharrock et al. 1963</td>
</tr>
<tr>
<td>(aberrant)</td>
<td>Sa740</td>
<td>No name</td>
<td>Total</td>
<td>Day 1963</td>
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</table>

For Forgotten Canyon Area

<table>
<thead>
<tr>
<th>Klethla</th>
<th>Ga367-1</th>
<th>Buried Olla site</th>
<th>Level 2</th>
<th>Lipe et al. 1960</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sa366</td>
<td>Husteds Well</td>
<td>Total</td>
<td></td>
<td>Lipe et al. 1960</td>
</tr>
<tr>
<td>Sa368</td>
<td>Backyard site</td>
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<td>Lipe et al. 1960</td>
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</table>

Mixed Klethla and Horsefly Hollow

<table>
<thead>
<tr>
<th>Ga367-2</th>
<th>Buried Olla site</th>
<th>Level 3</th>
<th>Lipe et al. 1960</th>
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</table>

Horsefly Hollow

<table>
<thead>
<tr>
<th>Sa597</th>
<th>Crumbling Kiva site</th>
<th>Total</th>
<th>Lipe et al. 1960</th>
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<tr>
<td>Sa598</td>
<td>Defiance House</td>
<td>Total</td>
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Upper Castle Wash Area

<table>
<thead>
<tr>
<th>Klethla</th>
<th>Sa1010</th>
<th>Scorup Pasture</th>
<th>Total</th>
<th>Sharrock 1964</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sa454-1</td>
<td>Steer Palace</td>
<td>Struct. 6; Burial 1; Refuse Depos. 1; Trench E. of Kiva</td>
<td>Sharrock 1964</td>
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Table 6 (cont'd). Components of the Klethla and Horsefly Hollow Phases

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<th>Site No.</th>
<th>Site Name</th>
<th>Sampling Units</th>
<th>Principal Publ. Reference</th>
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<tbody>
<tr>
<td>Sa323-2</td>
<td>The Watchtower</td>
<td>Trench 1, A-F</td>
<td>Sharrock 1964</td>
<td></td>
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<tr>
<td>Sa463</td>
<td>No name</td>
<td>Total</td>
<td>Day 1964</td>
<td></td>
</tr>
<tr>
<td>Sa344-2</td>
<td>No name</td>
<td>Trench 1</td>
<td>Day 1964</td>
<td></td>
</tr>
<tr>
<td>Mixed Klethla and Horsefly Hollow</td>
<td>Sa323-1</td>
<td>The Watchtower</td>
<td>Trench 1, G-I; Struct. 1</td>
<td>Sharrock 1964</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>Sa454-3</td>
<td>Steer Palace</td>
<td>Struct. 1</td>
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<td>(Kiva)</td>
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<td>Sa444-1</td>
<td>Green Water Spring site</td>
<td>Cut 1</td>
<td>Sharrock et al. 1963</td>
</tr>
<tr>
<td></td>
<td>Sa344-1</td>
<td>No name</td>
<td>Kiva</td>
<td>Day 1964</td>
</tr>
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<td>Horsefly Hollow</td>
<td>Sa444-2</td>
<td>Green Water Site</td>
<td>Struct. 1</td>
<td>Sharrock et al. 1964</td>
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<tr>
<td></td>
<td>Sa454-2 and 4</td>
<td>Steer Palace</td>
<td>Refuse Depos. 2; Struct. 2-5</td>
<td>Sharrock 1964</td>
</tr>
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<tr>
<td></td>
<td>Sa323-3</td>
<td>The Watchtower</td>
<td>Struct. 6-7 Fill</td>
<td>Sharrock 1964</td>
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<td>Upper Glen Canyon Area</td>
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<td></td>
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</tr>
<tr>
<td>Klethla</td>
<td>Sa564</td>
<td>Daves site</td>
<td>Total</td>
<td>Lipe et al. 1960</td>
</tr>
<tr>
<td></td>
<td>Sa701</td>
<td>Creeping Dune site</td>
<td>Total</td>
<td>Sharrock et al. 1961b</td>
</tr>
<tr>
<td></td>
<td>Ga439</td>
<td>No name</td>
<td>Total</td>
<td>Lister 1959</td>
</tr>
<tr>
<td>Mixed Klethla and Horsefly Hollow</td>
<td>Sa413</td>
<td>Forked Stick Alcove</td>
<td>Total</td>
<td>Lipe et al. 1960</td>
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Table 6 (cont'd). Components of the Klethla and Horsefly Hollow Phases

<table>
<thead>
<tr>
<th>Area and Phase</th>
<th>Site No.</th>
<th>Site Name</th>
<th>Sampling Units</th>
<th>Principal Publ. Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horsefly Hollow</td>
<td>Sa566</td>
<td>Ledge Ruin group</td>
<td>Total</td>
<td>Lipe et al. 1960</td>
</tr>
<tr>
<td></td>
<td>Sa364</td>
<td>Loper Ruin</td>
<td>Total</td>
<td>Lipe 1960</td>
</tr>
</tbody>
</table>
answer this question in the negative, because 1) all the remaining sites yielded less than 100 sherds of the types useful in phase determination; 2) the frequency of reoccupation and mixture make it difficult to determine how many components are present at a site if only small sherd samples are available; 3) time was not available to restudy the gray ware classification in the smaller samples, making them difficult to evaluate on the same basis as the larger samples; and 4) few of the sites yielding the smaller samples were excavated, so that information on intra-site distributional variation in pottery is non-existent.

PHASE DISTRIBUTIONS

Distributions Within the Red Rock Plateau

Sampling Problems

As noted in the discussion of the assignment of sites to phases, only the sites or parts of sites that yielded reasonably large pottery collections can with confidence be assigned to one or the other phase. Therefore, I will use the sample listed in Table 6 and Fig. 7 as the basis for my discussion of the distribution of the Klethla and Horsefly Hollow phases in the Red Rock Plateau. In my opinion, this restricted sample will give as accurate a picture of phase distributions as would a larger one, for the following reasons: 1) This sample contains nearly all the larger Pueblo sites discovered, and hence includes the greater part of the artifactual material, site features, and other data that were recovered or recorded. 2) The restricted nature of site
locations and the thoroughness of the survey make it probable that the sample contains the bulk of the larger sites accessible to discovery at the time the Glen Canyon project was in operation.

The major problem in studying phase distributions is that a number of sites once present in the area may have been destroyed by arroyo-cutting, or have perhaps been covered up by sand dunes or alluvium. I do not believe the sample has been as seriously diminished as does Jennings (1963: 11-12; n.d.), but the problem clearly does exist. In the following paragraphs I attempt briefly to assess the effects of geologic factors on the site samples from the various sub-regions of the Red Rock Plateau.

Moqui Canyon is the area where alluviation and arroyo cutting during and after the Pueblo occupations have been the most active and where the greatest relative loss of sites may be expected to have occurred. This canyon is narrow throughout most of the area where alluvium occurs; therefore the deep arroyo has removed a relatively large part of the alluvial fill. Furthermore, the evidence from Red Ant Kiva (Sa675) and Tamarix Dune (Sa781) shows that considerable aggradation took place during or after the main period of Pueblo occupation. If, as the evidence indicates, this aggradation occurred throughout the canyon, then many of the sites on the lower parts of the canyon floor would have been buried. In my opinion, however, Moqui is the only canyon in the Red Rock Plateau in which there is evidence that substantial floodplain aggradation occurred during or after the Klethla phase.

Lake Canyon is rather narrow in its lower part, and here arroyos
have removed much of the fill, and probably, a number of sites. The upper part of the canyon is broader, and a relatively small proportion of the fill has been eroded away here. In the East Fork of Lake Canyon, and in the main canyon above old Lake Pahgarit, the arroyos are shallow and most of the fill intact. Alluviation does not seem to have occurred, at least not over the entire canyon, during or after the Klethla phase. A number of canyon floor sites—for example Sa544, Sa540, and Sa620—have substantial Klethla components, the traces of which occur at the surface. The Pahgarit Dune site (Sa540), for example, is on the shore of old Lake Pahgarit, and Klethla pottery occurs on the surface down to what must have been the old water level. At the Dead Tree Flats site (Sa627), the level of Klethla occupation was covered with a deposit apparently laid down in a pond or swamp, but this material was only one to two feet thick. This waterlaid deposit could easily have accumulated as the result of purely local ponding behind a sand dune or a beaver dam, and need not indicate an overall buildup of the floodplain. The six inches to two feet of eolian sand that covered the pond deposit was probably blown onto the site after the Lake Canyon arroyo was cut and the floodplain water table dropped in the early twentieth century. Despite the deposits overlying the original level of occupation, Klethla pottery was abundant on the surface and the site was easily recognized from surface evidence alone. The Lyman Flat site (Sa623) also yielded buried structures (ibid.: 101-7), but these are located at the base of the sloping talus-covered canyon wall, and probably were buried by colluvium rather than alluvium. Another area of this site (the "west dune"), which is
out on the alluvial body proper, produced Klethla pottery at and just under the surface.

Upper Castle Wash and Steer Pasture Canyon are rather like Upper Lake Canyon—relatively shallow and broad canyons, with shallow arroyos and alluvial fill relatively intact in many places. In general, the chances for site destruction by arroyos are less here than in Moqui or the narrow lower part of Lake. There also is no evidence from the Upper Castle Wash area that floodplain aggradation took place during or after the Klethla phase; a number of Klethla occupations are found at the surface on the canyon floor. A greater threat to site recovery are sand dunes, which are active in parts of this area, and may have buried a few sites.

In comparison to the Lower Glen Canyon, the Upper Glen is broader and is filled more with colluvium and fan deposits than with alluvium, so relatively less of its floor is subject to either erosion or to alluviation. The Creeping Dune site (Sa701), for example, is located on fan and eolian deposits well above the flood plain and over a mile from the river in an especially wide part of the canyon called the Little Rincon. The alluvial floodplain in the Upper Glen Canyon clearly has not been aggrading since the start of the Klethla phase, because there are sites of this phase atop it (for example, Sa564, Ga367, and Sa368). Erosion of the Tsegi-equivalent alluvium is going on, but not as rapidly as in the side canyons; the Colorado in Glen Canyon is just barely able to move the load of sediments now being supplied by its tributaries. Some sites undoubtedly have been destroyed by river erosion, however.
The remaining areas—Wilson, Slickrock (included in the Wilson Canyon area), and Forgotten Canyons—are all short drainages with rather steep gradients, in which neither alluvial bodies nor arroyos are very well developed. Slickrock Canyon has no arroyo at all (Sharrock 1964: 22). Hence, the site sample from these areas should be relatively unaffected by geological factors.

In all the areas discussed above, the sites most susceptible to loss through erosion or burial are those located on the canyon floor, particularly where the canyon is narrow. Sites located on the taluses, benches, and ledges, and in the alcoves, of the canyon walls had a better chance of being preserved; in fact, our sample of the larger such sites should be nearly complete. Since there is evidence that proportionately more of the Klethla than of the Horsefly Hollow sites were located on the canyon floors, the Klethla sites are probably underrepresented in the sample. I believe this is not serious enough to obscure the general pattern of distribution, but it may bias our estimate of the intensity of occupation during this phase in some areas. I will refer to this problem again when evaluating the distribution of Klethla sites.

Klethla and Horsefly Hollow Phase Distributions

Although sites are much more widely distributed in the Red Rock Plateau during both these phases than in the much earlier White Dog phase, there are some important distributional differences between the Klethla and Horsefly Hollow occupations. The Klethla people seem to have settled largely in the few spots—such as Lake Canyon, Upper
Castle Wash, and Upper Glen Canyon—where the canyons are relatively open and accessible, and where there are rather broad patches of soil, usually alluvial, but sometimes colluvial or eolian. The Horsefly Hollow occupants also settled these areas, but in addition made rather heavy use of some of the deep, narrow, relatively inaccessible canyons—such as Moqui, Wilson, Slickrock, and Forgotten—that had been slighted by the earlier Pueblos. These differences in distributional pattern can be examined in Figs. 9 and 10, and Table 7.

Table 7 shows the distribution, by area, of the pottery types diagnostic of the two phases. Subject to the sampling problems discussed below, the varying type frequencies provide a rough measure of the relative intensity of occupation in the various subdivisions of the Red Rock Plateau during the two phases. Groups of diagnostic types were totalled instead of the collections assigned to each phase (Table 6), because a number of these collections showed some admixture of the pottery of both phases. (Phase assignment was based on the quantitative predominance of one pottery complex over the other.) In addition, a few collections were so thoroughly mixed that they could not be assigned to a single phase. The use of types rather than collections in Table 7 allows all 57 of the sites that were studied to be represented, and should thus provide a truer picture of phase distribution. A few of the types listed as diagnostic of one phase probably continued in small frequencies into the other, but I feel the error introduced in this way is less than would have resulted from the use of partially mixed collections and the exclusion of heavily mixed ones.

The principal concentrations of Klethla sites are in Lake Canyon,
Fig. 10. Distribution of Horsefly Hollow Components in the Red Rock Plateau
<table>
<thead>
<tr>
<th>Types</th>
<th>Areas</th>
<th>Wilson Canyon Area</th>
<th>Lake Canyon Area</th>
<th>Upper Castle Wash Area</th>
<th>Moqui Canyon Area</th>
<th>Forgotten Canyon Area</th>
<th>Upper Glen Canyon Area</th>
<th>Totals</th>
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<td>27</td>
<td>3983</td>
<td>2773</td>
<td>612</td>
<td>1639</td>
<td>1</td>
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<td></td>
<td>Sosi B/W</td>
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<td></td>
<td>Dogoszhi B/R</td>
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<tr>
<td></td>
<td>Citadel Poly.</td>
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<td>4059</td>
<td>919</td>
<td>634</td>
<td>2199</td>
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<tr>
<td>Phase</td>
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<td></td>
<td>Betatakin B/W</td>
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<tr>
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<tr>
<td></td>
<td>Loper var.</td>
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</tr>
</tbody>
</table>

-225-
the Upper Castle Wash area, and in Upper Glen Canyon. The sites at the mouth of Forgotten Canyon are actually in or very close to Glen Canyon, so they may be grouped with the Upper Glen Canyon sites as well. The heaviest Klethla occupation clearly seems to have been in Lake Canyon; a little more than a third of the diagnostic Klethla pottery came from this area (see Table 7). Within Lake Canyon, the Klethla sites tend to cluster in the open area around old Lake Pahgarit and in the broad flats of East Fork just above this tributary's junction with Lake Canyon proper. Klethla sites are relatively less abundant in the lower, more entrenched part of Lake Canyon below the mouth of East Fork. This may or may not be due to the greater chance of site destruction by erosion in the lower as opposed to the upper part of the canyon. In this regard, it is interesting to note that the largest Klethla site in this area—Dead Tree Flats (Sa627)—is located in lower Lake Canyon. This suggests that the peopple of the Klethla phase did not shun the lower part of the canyon, and that the differential distribution noted above is probably the result of differences in site preservation from one area to another.

The apparently light Klethla occupation in Moqui Canyon may also be the result of the burial or destruction of canyon floor sites. One of the two most clearcut Klethla sites from Moqui is located upstream from the main body of alluvium (Sa782), while the other (Sa681) is in a high cave. In the part of the canyon where the alluvium is thick, the only canyon floor site that yielded a substantial amount of Klethla material was Red Ant Kiva (Sa675); this site was buried in alluvium and was discovered only by chance. On the other hand, Moqui Canyon is
longer than either Lake or the habitable portion of Castle Wash, and has at least an equal number of attractive and easily accessible site locations just above the canyon floor. If the Klethla occupation in Moqui was as heavy as it evidently was in Lake or Castle Wash, then surely more traces of it would appear in site locations not subject to alluviation. In conclusion, I infer that the Klethla occupation of Moqui Canyon probably was heavier than our present site sample indicates, but that it probably was not as heavy as in the most favored areas—Lake Canyon and Upper Castle Wash.

A striking feature of the Klethla distribution is the near absence of evidence of this phase in the short deep narrow canyons—Wilson, Slickrock, and the upper part of Forgotten. Since alluviation and arroyo-cutting were not very active in these areas, so that site preservation is good, the lack of Klethla pottery must reflect an avoidance of these canyons by the Klethla people. If my interpretation of the Klethla occupation in Moqui Canyon—that it was not very intensively utilized during this phase—is correct, then we may conclude that the Klethla people definitely tended to avoid all the deeper and narrower canyons, not just the short ones of this sort.

If the pottery type frequencies of Table 7 are at all reliable guides to the relative intensity of occupation in a region, then the following conclusion can be drawn. The rather open areas favored by the Klethla people were also intensively occupied by their Horsefly Hollow successors, but these latter inhabitants also spilled over into the deeper narrower canyons that had been neglected in the Klethla phase.
Phase Distributions Outside the Red Rock Plateau

Klethla Phase

In the Klethla phase, Kayenta branch culture was found over a large area, mostly south, west, and northwest of the branch's "center" in the Tsegi Canyon-Kayenta area proper. During this phase, there began a decline in Kayenta population and territory which continued through the Tsegi phase and culminated in eventual depopulation and abandonment of all the old Kayenta domain except the Hopi country. This process of territorial abandonment seems to have started in the northern part of the area; early Klethla sites appear both north and south, but late Klethla sites (marked by the abundance of Flagstaff Black-on-white and Citadel Polychrome) are rare in the north.

In more precise terms, the distribution of the Klethla phase can be bounded by a line drawn southwest from the Kayenta area proper across Black Mesa to the Little Colorado Valley, northwest down the Little Colorado to the Upper Grand Canyon, north to the Coombs site at Boulder, Utah, thence east to the area around Natural Bridges National Monument, and finally south again to the Kayenta area proper and the northern part of Black Mesa.

In cultural terms, the Klethla phase is bordered on the northeast and east by the Mesa Verde branch, on the southeast by the Tusayan sub-branch of the Kayenta (formerly accorded full branch status), on the southwest by the Sinagua and Cohanina branches, on the west by the Virgin branch (or Kayenta sub-branch), and on the north and northwest by the Fremont culture. The Kayenta Anasazi of the Klethla phase were actively interacting with the peoples surrounding them, as indicated by
the fact that the geographical boundaries of this phase nowhere appear to be extremely sharp; they are zones of mixture and interdigation rather than clearcut lines. There are some differences between the various culture-boundary situations, however. The most difficult boundaries to define are the western and southeastern ones, where the Klethla people were in contact with groups belonging to the Virgin and Tusayan sub-branches, respectively. Kayenta pottery types shade gradually through space into the Virgin and Tusayan types, the changes being largely ones of progressive shifts in the frequencies of particular modes. The formal contrasts between Kayenta and Mesa Verde, Fremont, Cohonina, and Sinagua pottery are much greater; these boundaries appear to be characterized by zones of admixture of distinct types belonging to different ceramic traditions.

The Klethla phase occupation of the Red Rock Plateau seems to have been during the earlier half of this phase, when its area of distribution was at a maximum. The Red Rock Plateau Klethla sites are located near the northern and eastern margins of the area of maximum Klethla phase distribution, but they do not seem to have been at the actual margin. Sites that appear to be predominantly of the early Klethla phase have been found to the northwest near Boulder, Utah (principally the Coombs site), and to the northeast, near Natural Bridges National Monument (this statement is based on my observation of survey collections made in this area by Philip Hobler). Fremont culture trade sherds appear at some of the Upper Glen Canyon sites, but they are by no means common enough to suggest a cultural boundary situation was present (these trade sherds usually comprise less than one percent of
the pottery at the Red Rock Plateau sites where they occur).

Either during or shortly after the early Klethla occupation of the Red Rock Plateau, the area covered by this phase began to contract, probably starting from the north. The abandonment or very light occupation of the Red Rock Plateau during late Klethla times (the late 1100's) may correlate with this contraction.

Mesa Verde and Tsegi Phases: Relatives of the Horsefly Hollow Phase

Because the Horsefly Hollow phase appears to be confined to the Red Rock Plateau, we have already treated its known distribution fully. To place it in a broader perspective, however, it will be useful to consider the distribution of its closest relatives—the Tsegi and Mesa Verde phases. These phases appear to be the sources of the amalgam I have labelled the Horsefly Hollow phase; furthermore, after the formation of the Horsefly Hollow phase, they continued in existence alongside of and probably in contact with it.

The Tsegi phase is much more restricted in distribution than the earlier Klethla phase of the Kayenta branch; by the middle 1200's, the Tsegi phase was confined to an area bounded approximately by the southern Glen Canyon on the west, the San Juan on the north, the Chinle Wash on the east, and a line drawn from northern Black Mesa to the Glen Canyon damsite on the south. After 1250, the phase contracts even more, probably being confined largely to the Navajo Mountain—Rainbow Plateau—Tsegi Canyon area. During the Tsegi phase, much of the area around its territory was probably uninhabited, especially during its later years (a fact that may help account for the climax in stylistic
distinctiveness achieved by Kayenta potters during this phase). Boundaries were shared with other Pueblo cultures probably in only a few places. Contact must have been maintained between the Tsegi phase sites at the north edge of Black Mesa and sites of the Huckovi phase (of the Tusayan sub-branch) in the Hopi Country at the south edge of this highland. In the Red Rock Plateau, the Tsegi and Mesa Verde phases were in contact through the medium of the Horsefly Hollow phase; the lower Chinle Valley was probably one of the few other areas of Tsegi-Mesa Verde phase contact.

In light of the restricted distribution of the Tsegi phase, and the obvious trend toward contraction of Kayenta territory from early Kleethla through Tsegi times, it seems anomalous that the Red Rock Plateau should have received a new increment of occupation from the Kayenta area during the early part of the Tsegi phase. This problem will be further discussed in the next section, Historical Inferences.

The precise distribution of the Mesa Verde phase proper is not well known, or at least is not well described in the literature. It does seem apparent that it was present over rather large areas of southwestern Colorado and southeastern Utah north of the San Juan. There are a few hints that during the time of the Mesa Verde phase (ca. 1200-1300), the Mesa Verde branch was expanding south and southwestward into areas previously held by the Kayenta. This will be further discussed in the next section.
HISTORICAL INFERENCE

The Northern Southwest

Because the Klethla and Horsefly Hollow occupations of the Red Rock Plateau appear to be largely the result of people moving into the area from elsewhere, and because climatic changes and other factors that could have influenced these movements seem to have affected a much larger area, it would be misleading to try to discuss the culture history of the Red Rock Plateau as if it were isolated. For these reasons, a brief survey of the history of population movements in the northern Southwest as a whole, and their possible causes, is in order.

Aikens (n.d., quoted in Jennings n.d.) presents a persuasive argument that an undifferentiated Anasazi "basic" culture spread rapidly over the northern Southwest in the Basket Maker III period (ca. 500-700 A.D.), and that regional differentiation in formal traits such as pottery styles—and other "branch" diagnostics—developed largely after this time. He furthermore argues that the demonstrable increase in the number of sites in the northern Southwest during the Pueblo I and II periods resulted, not from migration out of a few Upper San Juan "centers" but from rapid indigenous growth of the numerous local populations established earlier in favorable valley locations over many parts of the area. During the Pueblo II period, these local populations expanded "out of the relatively few available valley environments into the surrounding and heretofore unoccupied uplands" (ibid.). Aikens' assertions about rapid population growth are supported by Colton's (1960: 106) estimates of population change through time in the north-eastern quarter of Arizona. Basing his calculations on the sites
located by the extensive surveys of the Museum of Northern Arizona, Colton estimates there was a population increase of the magnitude of 700 or 800 percent between A.D. 600 and 1000 in northeastern Arizona.

Galinat and Gunnerson (1963) relate population growth in the northern Southwest during this period to the development of a better variety of corn, Maiz de Ocho, which was the result of the blending of the local Southwestern variety of Chapalote with an eight-rowed Mexican variety, Harinoso de Ocho, which in turn had developed as a result of the introduction into Mexico of a race of corn from the highlands of South America. The new variety, Maiz de Ocho, proved more drought-resistant, needed a shorter growing season, and gave higher yields than the Chapalote corn previously used in the Southwest. The greater environmental tolerance of Maiz de Ocho modified the environmental limitations on Anasazi farming; it made possible successful farming in high, cool, moist zones and perhaps to some extent in the low, hot, dry zones previously closed, and it opened up large cool areas on the northern edge of the Southwest. The new eight-rowed variety of maize began to appear in the Mogollon Rim area about 700 A.D., and within the next two or three hundred years it had spread all over the northern Southwest. Fremont Dent, the basic corn of the Fremont culture on the northern periphery of the Southwest, appears to be a specially adapted northern form of Maiz de Ocho. Galinat and Gunnerson believe that the introduction of a better variety of maize led to rapid population growth, both because the new maize gave higher yields, and because it permitted the expansion of Anasazi farmers into new environmental zones.

The climatic evidence reviewed in Chapter three indicated that the
years between at least A.D. 800 and 1100 A.D. were relatively warm in
the northern Southwest—Baerreis and Bryson's (1965) Neo-Atlantic
period. The result would have been to open up the higher and more
northerly areas previously closed to Anasazi farmers because of their
short growing season. The Neo-Atlantic period thus apparently coin-
cided with the spread of a better variety of corn, with similar effects
—population growth and movement into the higher and more northerly
areas.

I would emphasize perhaps more than Aikens would the occurrence of
population movements in the Pueblo I and II periods. I think Aikens'
general point is valid—that there is no need to postulate migration
from only a few upper San Juan centers to explain the "Pueblo II expan-
sion"—but the climatic and botanical evidence cited above indicate to
me that population increase was probably also accompanied by consider-
able population movement, as the villages which had originally been
located in only the most favored environments grew and fissioned. The
resultant small founder groups not only expanded into the higher and
possibly the lower parts of their home regions, but migrated north into
areas not previously occupied by farmers. The result was the filling
up of the more northerly parts of the Southwest, along with a relative
increase everywhere in the utilization of the high, moist, and cool
environments.

It seems clear that the population maximum in the northern South-
west lasted at most about one or two hundred years. Sometime between
1100 and 1200, and perhaps a bit earlier in a few areas, population
began to decline, until by the end of the 1200's, the entire northern
Southwest was virtually abandoned. Contraction of the area occupied by the Kayenta culture seems to have started from the north sometime in the middle 1100's. Early Klethla phase sites are abundant in the northern sector, but late Klethla sites (post-1150) are not. If one lumps the Virgin sub-branch with the Kayenta, it appears that the western part of the range contracted sharply at this time too, for there seem to be few if any Virgin branch sites dating after about 1150 (Aikens n.d.). The Fremont culture of the northern periphery seems also to have flourished only between about A.D. 1000 and 1150, and definitely had ceased to exist by 1200. In late Klethla phase times, between about 1150 and 1200, there still was substantial occupation in the southern part of the Kayenta area—from the San Juan south and southwest to the Little Colorado and the Flagstaff region. But in the early 1200's the population of this area began to decline also, until by about 1250, the Kayenta branch had largely withdrawn to the high canyonlands of the Tsegi Canyon–Navajo Mountain area in the east central part of its former territory. By 1300, even this area had been abandoned.

Much of the Kayenta population decline was probably due to decreased birth rates and increased death rates, but some was undoubtedly caused by migration out of the area. The population of the Hopi Country was swelled by Kayenta migrants in the late 1200's and 1300's, and there is evidence that some groups migrated even further south (Haury 1958).

The story of the abandonment of the territory of the Mesa Verde branch is not so well known, but seems generally similar. The precise
northern and northwestern limits attained by the Mesa Verde branch prior to the 1200's have not been determined, but it seems clear that they extended well to the north of the Mesa Verde proper, and northwest at least as far as Elk Ridge, and probably as far as Beef Basin. In the 1200's, there is considerable evidence of a southward shift of the southern Mesa Verde frontier, as Mesa Verde people moved into areas previously occupied by the Kayenta. In the lower Chinle drainage of northeastern Arizona, sites such as Poncho House (Guernsey 1931; Hargrave 1935), Three Turkey House (Colton 1939b) and Painted Cave (Haury 1945) have yielded substantial amounts of late Mesa Verde pottery. Beals et al. (1945: Table 1) note that a late Pueblo III site on Black Mesa had a considerable fraction of black-on-white pottery that showed Mesa Verde influence, but they do not discuss this. The building activity in the early 1200's in Beef Basin and the Mesa Verde movement into the Red Rock Plateau at about the same time may record Mesa Verde movements westward and southwestward from the Elk Ridge highlands to lower elevations nearer the Colorado. There also is evidence of Mesa Verde branch expansion southward into the area previously occupied by the Chaco branch, as documented at Pueblo Bonito (Judd 1954) and Aztec (Morris 1919, 1924, 1928), but this seems to have been slightly earlier, in the 1100's.

It is not clear whether these generally southward movements of Mesa Verde peoples during Pueblo III times are concurrent with the abandonment of the northernmost Mesa Verde outposts, but they probably are; at least the thirteenth century movements south probably are concurrent with contraction from the north. The highland of the Mesa
Verde proper seems to have been one of the last areas to be abandoned. Tree-ring dates indicate building was still going on there in the last third of the thirteenth century (Wormington 1956: 96). The peak population of the mesa top was probably reached in early Pueblo II times; Hayes (1964: 86-111) thinks a long slow decline in the population of the mesa top may have started as early as 1000 A.D. The Rio Grande area probably received many of the Mesa Verde people who migrated southward and southeastward during the final stages of the abandonment of the northern Southwest (Reed 1946).

The causes of the abandonment of the northern Southwest during the 1100's and 1200's have been the object of a great deal of speculation; this is one of the classic problems of North American archeology. Most of the specific theories that have been offered to explain the abandonment fall into one of three classes, by their emphasis on 1) climate change and its effects, especially arroyo-cutting; 2) conquest of the area by hostile nomads, or 3) intra- or inter-community strife among the Puebloans themselves. Much of the relevant literature is summarized or at least referred to by Jett (1964).

In my opinion, factionalism or fighting between Pueblo communities is not by itself sufficient to explain the abandonment of such a vast area, given the evidence that the Pueblo cultures were politically fragmented and lacked efficient fighting weapons. The outcome of such fights might be that the loser would move away, but there seems to be no reason why both parties to the dispute should do so. The level of hostility within and between Pueblo communities may well have increased during the unsettled twelfth and thirteenth centuries, however, and
this may have helped accelerate a trend to southward migration out of
the area given direction by climate change or incursions of hostile
nomads. (Davis [1965] outlines a theory of this sort in her note on
"Small pressures and cultural drift as explanations for abandon-
ment... .")

Nomadic invaders seem a plausible cause of the abandonment of the
area, but this theory suffers from a lack of concrete evidence. Hester
(1962), after reviewing all the available evidence on the Navajo entry
into the Southwest, came to the conclusion that they do not seem to
have come into the area until the late fifteenth century. Shoshoneans,
probably Paiute, were in contact with the extreme westernmost Anasazi
settlements in southern Nevada in the early 1100's (Shutler 1961, Euler
1964), but there is no evidence of Shoshonean-Anasazi contact further
east until the historic period. Goss (1965) shows that the Ute are
linguistically much closer to the Southern Paiute than had previously
been supposed, and gives evidence that they probably did not reach the
Four Corners area until about 400 years after the Anasazi had deserted
it. The well-known increase, during Pueblo III times, in the number of
sites located in defensive positions has often been cited in favor of
the theory of hostile nomad invasions, but the shift to defensible
locations may just as well have been due to an increase in inter-
community hostility, due to the increasing scarcity of suitable lands,
and to the existence of uprooted Pueblo groups looking for new places
to settle. Even though the theory of nomadic invasions has little sup-
porting evidence, it cannot, however, be disproved at this point.

Several types of climatic change--cooling temperatures, a shift to
wetter winters and dryer summers, and prolonged drought—have been invoked by various authors to explain the abandonment of the northern Southwest. The initiation of arroyo-cutting by climatic changes is a factor in some of these theories, but there is disagreement as to precisely what kind of climatic conditions trigger arroyo-cutting.

A cooling trend would clearly be disadvantageous to Anasazi farmers, because it would shorten the growing season, thus endangering crops grown at the higher elevations and in the more northerly parts of the area. Woodbury (1961) believes this kind of climatic change was a principal factor in the abandonment of the northern Southwest. As I have pointed out in Chapter three, Baerreis and Bryson's (1965) postulated Pacific climatic episode, which began in the Southwest sometime between A.D. 1100 and 1300, was apparently accompanied by cooling temperatures. It also caused a shift in the seasonal distribution of rainfall toward wetter winters and dryer summers, apparently because the polar Pacific air masses intruded much farther to the south and east than they previously had (or than they do at present).

Some theorists (principally Martin and his students—see Martin 1963a and b, Martin et al. 1961, Schoenwetter 1962) believe that this sort of shift in the seasonal rainfall distribution was the factor that set off the cycle of arroyo-cutting in the Southwest that marks the twelfth and thirteenth centuries. Another group of workers (e.g., Bryan 1954, Antevs 1955) believe that the principal factor in initiating arroyo-cutting is drought, which decreases the amount of ground cover and hence increases the amount and erosive power of runoff after storms. There seems to be somewhat more evidence in favor of this
latter position. In any case, there is general agreement that a cycle of arroyo-cutting did occur in the Southwest during the twelfth and thirteenth centuries, that it was related in some way to climatic change, and that it must have had disastrous effects on those Puebloans who were dependent on flood-water farming in narrow alluvium-filled valleys.

Drought has often been stressed—usually in conjunction with its role in causing arroyo-cutting—as an important factor in the abandonment of the northern Southwest (Reed 1944). The so-called "Great Drought" of the late 1200's is sometimes given a prominent place in such theories (Hack 1942). Drought would of course affect the dry-farmers in the highlands who were dependent on rainfall, and would also tend to decrease spring-flow in the canyons. The Great Drought probably deserves less emphasis than it has received, if Fritts et al. (1965) are correct in believing that there were at least six other droughts of comparable seriousness in the Four Corners area during the Basket Maker III through Pueblo III periods. Although it is clear that any prolonged drought would have a deleterious effect on Pueblo farming, not all these six other major droughts were accompanied by arroyo-cutting, and none correlates with the abandonment of vast areas, although all six may well have spurred local population movements. The Great Drought was probably the "last straw" for the relatively small Anasazi populations remaining in the northern Southwest during the late 1200's, but it obviously could not have caused the general population decline in this area that had started 100 to 200 years earlier.

I am inclined to attribute the abandonment of the northern
Southwest during the twelfth and thirteenth centuries to a "squeeze" put on the people by several different climatic or climate-controlled factors: 1) cooler temperatures resulting from the onset of the Pacific climatic interval, which would have greatly increased the risks of farming at high altitudes and in the northern part of the area, 2) arroyo-cutting, which clearly occurred during this time, and which would have drastically reduced the farming potential of relatively low-lying narrow flood-watered alluvial valleys, where rainfall was inadequate for dry-farming; and 3) severe droughts in both the late twelfth and late thirteenth centuries, which would have inhibited dry farming at high altitudes and spring-water farming at low levels. Arroyo-cutting seems to be related to either the new rainfall regime of the Pacific episode, or to drought, or to both (as I suggest in Chapter three, it may be related to dry times during periods of transition from one climatic episode to the next). In any case, the precise cause of arroyo-cutting is not really relevant to the abandonment problem as long as it can be shown to have occurred and as long as it is not being used as evidence for any particular kind of climate change. The periods of drought are not necessarily related to the shift from one climatic episode to another; profound droughts seem to have occurred repeatedly in the Southwest regardless of the basic weather pattern that was present. None of the three factors listed above would probably have been enough by itself to cause total abandonment of the area, but the cumulative effect of the three, coupled with the social disruption they generated (Davis 1965), were probably sufficient.

The people who left the northern Southwest seem to have settled in
areas where the three factors listed above had minimal effects: 1) in valleys along large but manageable flowing streams, such as the Upper Little Colorado and Upper Rio Grande and some of their tributaries, where enough water was available for irrigation to make the people independent of rainfall fluctuations, and where the elevations were low enough to provide an adequate growing season, 2) in areas such as the Hopi Country where special physiographic features reduced the effects of arroyo-cutting and made possible the continuance of flood-water and spring-based farming on a relatively large scale, at elevations where the growing season was of adequate length, and 3) to some extent, in the highlands south of the Mogollon Rim, which were high enough to furnish adequate rainfall for some dry-farming, but far enough south so that the growing season remained long enough to permit crops to mature.

This hypothesis, or series of linked hypotheses, about climatic factors in the abandonment of the northern Southwest could be tested if we had better data on the distribution of sites by altitude, physiographic situation, and time period for various parts of the affected area. Intensive regional surface surveys designed to locate a large proportion of the existent sites in regions of substantial altitudinal and physiographic variation should be the most productive method of investigation. Hayes' (1964) survey of Wetherill Mesa and the Cummings Mesa surveys of Ambler et al. (1964), though confined to mesa-top settings, are models of this general kind of approach.

The Red Rock Plateau

In the first part of this chapter, evidence was presented that
between about 1100 and 1260 A.D., the Red Rock Plateau was occupied by two distinct phases of culture. The earlier was the Klethla phase of the Kayenta branch; this occupation seems to have taken place largely in the period 1100-1150. Sites of this phase are concentrated in Lake Canyon, Upper Castle Wash, and the Upper Glen Canyon (Fig. 9), all areas where the canyons are relatively accessible and open, where large patches of alluvial and in some cases other types of soil are available, and where water from floods, springs, seeps, or subsurface sources is available to augment the scanty moisture supplied by direct rainfall. After what seems to be a period of abandonment or very light occupation, the region was again heavily occupied, largely between about A.D. 1210 and 1260. This phase, called Horsefly Hollow after one of its most productive sites, appears to be the result of movements into the region from the northeast or east by people who used pottery of the Mesa Verde tradition, and by people from the south, who brought pottery of the Kayenta branch. Despite diverse origins, the new occupants of the area seem to have formed culturally and socially homogeneous communities.

During the Horsefly Hollow phase, the agricultural resources of the Red Rock Plateau seem to have been somewhat more extensively exploited than in the Klethla phase. Horsefly Hollow sites are abundant not only in the open canyons where the Klethla people had concentrated, but in the deeper narrower canyons such as Moqui, Wilson, Slickrock, and Forgotten (Fig. 10), where farmers had to use smaller and more scattered patches of soil. The only canyons not occupied in this phase were ones deficient in water (such as Red, Cedar, and Knowles), or in soil, or both.

It seems obvious that the peoples responsible for these two
occupations entered the Red Rock Plateau primarily to farm; this is indicated by the distribution and character of the sites and the kinds of food remains found in them. This hardly constitutes an adequate explanation of the occupations, however. The question that we must attempt to answer here is this: Why did these movements into and out of the region occur when they did? In the following paragraphs, I will attempt to answer this question, considering each phase in turn.

The Klethla Phase

After a sparse Basket Maker II occupation, the Red Rock Plateau, and in fact the Glen Canyon basin as a whole, seems to have been largely unoccupied until the beginning of the Klethla phase, about 1100 A.D. The only traces of Basket Maker III through Pueblo II period occupation that appear in the Glen Canyon area are on its highland borders, largely those to the south and east (Fig. 2). Basket Maker III sites have been found near Natural Bridges National Monument (Schroeder 1965), and in upper Navajo Canyon (Ambler et al. 1964: 95). A single Basket Maker III component was found on Cummings Mesa (ibid.: 87-97) in a site that apparently was occupied intermittently as a camping place over a period of about 1000 years; the Basket Maker pottery found there probably records visits by travellers. A Basket Maker III-Pueblo I period site was excavated on Cedar Mesa (Sharrock 1964: 75-7) and Pueblo I sites have been found in the upper Navajo Canyon drainage (Miller and Breternitz 1958; Morss 1931). Pueblo II sites (i.e., Black Mesa phase; pre-1100) are found in upper Navajo Canyon (Miller and Breternitz 1958; Morss 1931), in the highlands just east of Navajo Mountain (A. Lindsay,
personal communication) and in a few spots south of the San Juan just upstream from Clay Hills crossing (ibid.). Site Sa314 on Cedar Mesa (Day 1964) appears to me to have a pottery complex just slightly earlier than the characteristic early Klethla sites of the Red Rock Plateau. Judging by the relative abundance of Black Mesa Black-on-White found in the deposits, the Coombs site (Lister et al. 1960: 237) on the northwestern margin of the Glen Canyon area must have been established before 1100, probably by 1075 (ibid.: 5).

The early 1100's seem to have been a time of substantial population movement into and population growth in the Red Rock Plateau and other parts of the Glen Canyon area as well. Early Klethla sites dating from about 1100-1150 are relatively abundant not only in the Red Rock Plateau, but on Cummings Mesa (Ambler et al. 1964), and in the San Juan Canyon (Adams and Adams 1959). The very extensive occupation of the Kaiparowits Plateau seems to be largely confined to this period. The Coombs site apparently flourished between about 1075 and 1150 or 1160, judging by the pottery styles present. It may have continued to be occupied for a few years after this, but if so, only very lightly. The contemporaneity of the Coombs site with the 1100-1150 occupation of the Red Rock Plateau is shown by the occurrence of the distinctive Coombs variety of Tusayan Corrugated as trade ware in several of the Upper Glen Canyon sites of the early Klethla phase. Elsewhere in the Glen Canyon region, a number of scattered sites from the Escalante drainage and the Lower Glen Canyon also seem to date from early Klethla times. The Klethla occupation of the Red Rock Plateau thus seems to have been part of a general movement of Kayenta peoples into the Glen
Glen Canyon region.

It is apparent from a glance at the dendro-climatic record (Fig. 5) that this movement occurred during the last half of a 100-year period of favorable climate, which lasted from about A.D. 1050 to 1150, and which was bracketed by periods of rather severe and prolonged drought. The 1050-1150 period seems to be the longest favorable stretch in the entire 1520-year record; in no other comparable period was ring growth so consistently above the mean growth trend. The few below-average years within this period are in the last third of the eleventh century; following this, between A.D. 1096 and 1148, the graph line does not dip below the mean growth trend at all. This latter interval of approximately 50 years, during which the Klethla occupation of the Red Rock Plateau seems largely to have occurred, is perhaps the most favorable period of similar length in the entire record. Its principal rivals are the 40-year intervals from about 665 to 705, from 1050 to 1090, and from 1690 to 1730.

The Klethla occupation of the Red Rock Plateau and of the Glen Canyon basin as a whole thus seems to correlate with a period of unusually high precipitation. Certainly spring-flow and moisture held in sand dunes and alluvium during such a period would have been more abundant than at present, making the canyons of the Red Rock Plateau attractive to primitive farmers. But this presumably would be true in other wet periods as well. Why then was the Red Rock Plateau not occupied in earlier times of increased moisture, such as the one between about A.D. 665 and 705, or in the late 1000's? There seem to me to be three plausible hypotheses, which I shall outline in the following
paragraphs.

1. The first hypothesis is that the occupation of the Red Rock Plateau (and probably, of the rest of the Glen Canyon basin) during the early Kleethla phase is the result of the attainment of maximum population in the highland areas to the east and south such as the Rainbow Plateau, Cedar Mesa, and southern Elk Ridge. Since the Red Rock Plateau is low-lying and large stretches are extremely arid, it was not especially attractive to the Puebloans. Hence, it was not occupied until the already-settled and more favorable highlands to the south and east had been "filled up" with population. Even then, it was not occupied until an especially long period of well above-average precipitation. The relatively-attractive 7000-foot highlands of the Glen Canyon basin, such as the Kaiparowits Plateau and the eastern Aquarius Plateau, are separated from the source area of Kleethla immigration by stretches of arid canyon lands; hence, they were not occupied until the population of the eastern and southern highland areas spilled over into the Glen Canyon basin.

I have noted that Basket Maker III farmers were present in the highlands south and east of the Red Rock Plateau, probably as early as the 665-705 wet period mentioned above. The people in the area at that time were probably still so few that whatever population increase a 40-year moist period might allow would still not be sufficient to cause an overflow into the relatively low-lying Glen Canyon basin. It should be kept in mind also that an increase in rainfall sufficient to make the marginal canyon lands more attractive would probably also open up new parts of the highlands to occupation. Populations already established
in the highlands would presumably spread into these newly available areas before moving north or west into the empty Glen Canyon area. Essentially the same argument should apply to the wet period in the late 1000's. Population in the highlands to the south and east must have been higher than in Basket Maker III times, but it must be recalled that the environmental niche available to Anasazi farmers had also expanded greatly since that time as a result of a) the introduction of more adaptable corn, b) the onset about 800 A.D. of the Neo-Atlantic climatic episode, c) the period of above-average precipitation starting about 1050 and perhaps of d) the development of better farming methods. Hence, the highlands should have been able to support more people than in Basket Maker III times. Although Colton (1960) indicates that population growth in northeastern Arizona reached a plateau about 1000 A.D., it does not seem unreasonable to suppose this point was attained somewhat later farther north, particularly since the improved maize, which came up from the south, would have appeared slightly later in Utah than in Arizona, and since the southern Utah area probably had fewer people at the time the new botanical and environmental factors began to aid population growth.

2. A second hypothesis is based on the assumption that the Pacific climatic episode, with its cooler climates, took effect about 1100 A.D., which is the date Woodbury (1961) postulates for the onset of a cooling trend. Baerreis and Bryson (1965) of course believe the Pacific episode started somewhat later, about 1250. In any case, the effect of a cooler climatic regime would be to inhibit occupation of the highest areas, and hence to force part of the highland population to move
either to a lower altitude or to abandon the area entirely and move south. The immigration into the Red Rock Plateau during the early 1100's could thus be the result of partial depopulation of the highlands at this time. On the Kaibab Plateau, located well to the southwest, Hall (1942) indicates that the population of the Walhalla Glades area, at approximately 8000 feet, reached a peak about 1100 A.D., and then sharply declined. It is difficult to evaluate his evidence, however, for he does not tabulate pottery occurrences by site.

The fact that the Glen Canyon area highlands were colonized about the same time as the lowlands would seem to contradict this hypothesis, especially since the occupation of the Kaiparowits Plateau, at 7000 feet, seems to be more intensive than the concurrent early Klethla occupation of Cummings Mesa, at 5500–6000 feet, just across the Colorado River. All the Glen Canyon area highlands are, however, lower and probably warmer than the extensive highlands south and east of the area, such as the Kaibab Plateau, Rainbow Plateau, and Elk Ridge. This theory, like the first one, could be tested if we had some knowledge of the frequency of sites by period and by elevation in the areas south and east of the Glen Canyon area.

3. A third possible explanation for the peopling of the Red Rock Plateau during the early 1100's is that the development at or just prior to this time of more effective water control techniques might have promoted increased utilization of the canyons. Rohn (1963) and Hayes (1964) indicate that water and soil conservation structures probably begin to appear on the Mesa Verde sometime during the Pueblo II period. The more complex structures seem to be late Pueblo II and
Pueblo III. Schwartz (1963, 1965) has found abundant evidence that a variety of water control structures were in use during the short Kayenta occupation of the upper Grand Canyon, which he dates at from about 1050 to 1150 A.D. with the population peak in the latter 50 years.

The development of new techniques for irrigating fairly large plots from springs would have been especially important in the Red Rock Plateau area because of the numerous springs there. One of the three largest Klethla sites in the region, the Creeping Dune site (Sa701) does in fact have what appears to be a complex spring–water irrigation system, involving the use of a large masonry collecting reservoir and an extensive system of ditches with control gates (Sharrock et al. 1961b). This site is the only one in the area at which substantial traces of such a system have been found. Sharrock et al. (1963) found several of the characteristic shaped-sandstone control gates near the Greenwater Spring site (Sa444), but no other evidence of an irrigation system. A somewhat different but equally if not more complex system for water management has been located at the mouth of Beaver Creek in the San Juan Canyon, just across the river from the Red Rock Plateau (Lindsay 1961). Here, floodwater from small intermittent streams was conserved and distributed by a system of terraces, grid borders, ditches, and control gates. A possible walled-in spring was also found. The pottery at the site indicates occupation began during the early Klethla phase, and that it may have extended as late as 1250.

These are the only two complex systems of this sort that have been located in the Red Rock Plateau region or immediate environs, so it would not be warranted to conclude that the occupation of the region
was made possible by the development of such systems. On the other hand, smaller and less complex water management structures would have been more subject to destruction (especially in the soft sandy alluvium of the Red Rock Plateau canyons) or they might not have been noticed by the survey teams, so their presence cannot be entirely ruled out. Simple water and soil conservation devices such as check-dams across shallow gullies would of course also have been useful in the highlands as well as the lowlands; Hall (1942) records "agricultural terraces" in the Walhalla Glades area of the Kaibab Plateau which probably date somewhere between A.D. 900 and 1150, and relate to a Kayenta branch occupation. So far, however, structures of this sort have not been found in the highlands of the Glen Canyon area.

In conclusion, it seems to me that the evidence, though rather ambiguous, favors the first hypothesis: that the Red Rock Plateau was occupied by Klethla peoples at a time when the Pueblo population of southern Utah was at its peak, and a long period of above-average rainfall had made the canyons more attractive than they previously had been. The testing of this hypothesis rests not on more work in the Red Rock Plateau itself, but in surveys of the highland areas which must have been the source of the immigration.

The postulated abandonment or rapid decrease in population in the Red Rock Plateau at about 1150 correlates with the apparent decline of the Coombs site, the end of occupation on the Kaiparowits, and in general the abandonment of the whole northern and western part of the Glen Canyon area. Outside this area, as noted, Aikens (n.d., cited in Jennings n.d.) sees the abandonment of the Virgin branch territory as
having occurred about this time, while Schwartz (1963, 1965) has shown
that the Kayenta population of the upper Grand Canyon rapidly declined
after about 1150.

Although the Red Rock Plateau seems to have supported little or no
population during the last half of the twelfth century, and the north-
ern and western parts of the Glen Canyon region were largely empty,
there was continued occupation in the southeastern part of the Glen
Canyon basin. Adams and Adams (1959) and Adams et al. (1961) report a
few late Klethla phase sites from the San Juan and Lower Glen Canyons
respectively, although these sites do not appear to be so numerous as
the early Klethla ones. The survey of Cummings Mesa (Ambler et al.
1964) showed that the occupation established during the early Klethla
phase continued at about the same or perhaps slightly greater intensity
during late Klethla times. As previously noted, late Klethla sites
seem abundantly represented in northeastern Arizona, as far to the
south and west as Flagstaff. The Flagstaff area seems, in fact, to
have experienced a population climax at this time (Colton 1960: 104).
Northeast of the Red Rock Plateau, the Beef Basin area and the Dark
Canyon Plateau at the western end of Elk Ridge may also have been
occupied at this time, but it is difficult to tell, since so little
work has been done here. Baldwin (1949) reports that a large Mesa Verde
Pueblo III site (Utah V:4:6) on the Dark Canyon Plateau (elevation
7000-8000 feet) yielded some Mesa Verde Black-on-white as well as a
few trade sherds of Tusayan and Citadel Polychrome; this hints at a
date of the late 1100's or early 1200's for this site.

Turning to the climatic evidence, the record of ring growth in
Douglas fir at Mesa Verde (Fig. 5) indicates that a severe drought of about 40 years' duration began about 1150. At only one point does the graph line extend even slightly above the mean growth trend line. This drought seems to have surpassed, in length and intensity, the so-called "great drought" of the late thirteenth century, as reflected in the same growth record. Schulman's (1956: Table 49) data, based on samples of all species from all over the Colorado River drainage, are somewhat contradictory, however. They show a period of markedly low ring growth between about 1147 and 1162, but this is followed by a 12-year period of slightly above-average growth, and then by several short spans of alternating above-average and below-average growth indices. I am inclined to favor Fritzts' growth curve (Fig. 5), because of his improved methods of selecting the archeological tree-ring specimens to be used, and of weighting the growth indices. On the other hand, since this curve is derived from Mesa Verde data alone, it may well suffer from purely local climatic fluctuations, although overall it generally checks with Schulman's data from the wider area.

The tree-ring evidence thus gives rather ambiguous support to the hypothesis that drought was the cause of the withdrawal of Kayenta Pueblos from the Red Rock Plateau and the northern and western parts of the Glen Canyon area in general during the last half of the twelfth century. An alternative theory is that cooler climates were present in the area at this time, perhaps because of the onset of the Pacific climatic episode. The fact that the movement out of the Glen Canyon area seems to have been toward the south, and that the area's highlands were largely abandoned would seem to fit this theory. Particularly
suggestive is the evidence that the Kaiparowits Plateau, at about 7000 feet elevation, was abandoned, while the south end of Cummings Mesa, located only a few miles away but 1000 to 1500 feet lower, continued to be occupied and perhaps even grew in population during this time. On the other hand, cooling temperatures alone would not explain the abandonment of the Red Rock Plateau canyons, which must have had fully adequate growing seasons even at the height of the Pacific episode. Also, if large sites were being inhabited at this time on the Dark Canyon Plateau, as Baldwin's (1949) data hint, this would seem to discredit the hypothesis of a shift to a markedly cooler climate; the Dark Canyon Plateau lies to the north of the Glen Canyon area and has an elevation of 7000 to 8000 feet. In conclusion, drought seems the most likely cause for the sharp decline in the population of the Red Rock Plateau around 1150.

The Horsefly Hollow Phase

The marked population increase in the Red Rock Plateau during the early thirteenth century is paralleled by a contemporaneous expansion of the number and size of sites on Cummings Mesa (Ambler et al. 1964). The pottery complex of these early Tsegi phase sites appears to duplicate almost exactly the Kayenta branch element of the Horsefly Hollow phase, with the exception that the very late types such as Kayenta Black-on-white and the four-color polychromes are somewhat more common in the Red Rock Plateau. The number of Cummings Mesa sites occupied during early Tsegi phase times is greater than in the entire Klithla phase occupation there, and the average site size is considerably
larger, indicating a rapid and substantial growth of population during the early 1200's. Also approximately contemporaneous with the development of the Horsefly Hollow phase in the Red Rock Plateau is the construction or enlargement of a number of fairly large pueblo sites in Beef Basin (Rudy 1955); since most of the sites reported by Rudy appear to have been established during the early Mesa Verde phase or at least to have had their heaviest occupation during that time, a marked increase in the population of Beef Basin during the early 1200's is indicated. Baldwin (1949) also noted a number of large pueblos in the other canyons fringing the western edge of the Elk Ridge highland, but it is difficult to tell from his descriptions just when they were occupied. The northern and western parts of the Glen Canyon basin seem to have remained largely unoccupied at this time. Several plausible hypotheses that account for the reoccupation of the Red Rock Plateau during the early 1200's come to mind, and are discussed in the following paragraphs.

1. The increase in the population of the low canyons of the Red Rock Plateau, the medium-level highlands of Cummings Mesa (ca. 5500-6000 feet in the highest and most heavily occupied part), and the canyons of Beef Basin (ca. 6000-6300 feet) may be the result of the onset of cooler climate, which would have forced farmers down from the higher parts of the Rainbow Plateau, Navajo Mountain, and Elk Ridge highlands, leading them to settle in adjacent lower areas, including the Red Rock Plateau.

Hayes (1964) notes that on Wetherill Mesa, the Mesa Verde phase was a time during which sites shifted away from the mesa top to
locations in shelters or on talus slopes just below the rimrock. The numerous soil-and-water-conserving terraces constructed during this phase are also located below the rim or are in gullies near the rim. An important fraction, though not the bulk, of farming was apparently carried on in these terrace locations. Hayes believes the increased use of these terrace plots is due to the exhaustion of the mesa-top soils after several hundred years of intensive use, but it might also be a response to cooler climate, since it represents utilization of the lowest possible parts of the mesa top for farming. Furthermore, Hack (1942: 30) has reported that the Hopi plant their early corn on small trincheras or terraces in steep narrow gullies in order to minimize frost danger. The air circulation in these locations is very good, lessening chances of frost, and the radiation from the walls of the gullies probably helps warm the plants at night.

2. The dendro-climatic record (Fig. 5) shows that the period from about 1190 to 1270 was a time of alternating short periods of above-average and below-average ring growth, indicating that considerable fluctuation in precipitation occurred. By comparison with the 1150-1190 and the 1270-1300 drought periods, however, the early and middle thirteenth century was relatively favorable, though not nearly as good as the 1050-1150 period. Perhaps by about 1200 the rainfall had increased enough, to make the canyons of the Red Rock Plateau more habitable than they had been in the late twelfth century. If precipitation were the sole variable, however, it is difficult to see why the Horsefly Hollow occupation should have been apparently more intensive than the early Klethla occupation, which occurred during a time when rainfall
seems definitely to have been greater and more reliable. If, on the other hand, a cooling trend was also in effect, making parts of the adjacent highlands less inhabitable, the more intensive Horsefly Hollow occupation becomes understandable. That is, reduction in the upper altitudinal limits of Pueblo farming would put more pressure on usage of the lowlands.

3. By the early thirteenth century, arroyo-cutting had probably started in some of the lowland areas of northeastern Arizona and southeastern Utah. This would increase the relative desirability of any well-watered canyon-bottom lands that remained unchanneled. As noted in Chapter three, the canyons of the Red Rock Plateau apparently were not trenched by arroyos during the twelfth and thirteenth century erosional cycle.

4. As previously noted, the Kayenta branch territory, which had contracted from the north during the late Klethla phase, seems to have contracted from the south during the early Tsegi phase, with the area northeast of Flagstaff, probably much of Black Mesa, and other regions being abandoned. Instead of going south with the general trend of population movement at this time, some of the Kayenta groups abandoning these areas may have retreated northward and eastward into the Tsegi Canyon–Rainbow Plateau–Navajo Mountain area, because the canyons of this region were relatively resistant to arroyo-cutting, and because there were fairly extensive medium-level highlands with moisture-capturing eolian soils. Added population from the south would provide further motivation for Kayenta peoples to utilize marginal lowland environments.
In conclusion, it seems probable to me that several and perhaps all of the factors listed above were at work in causing a heavy occu-
pation of the Red Rock Plateau in the early through middle thirteenth century: the highest areas in surrounding regions were probably being depopulated because of a cooling climate, putting more population pres-
sure on the habitable medium-level highlands and the canyons; habitable canyons were being reduced in number through arroyo-cutting, making the unchanneled ones such as those of the Red Rock Plateau more in demand; rainfall had increased enough over that of the previous period to make the Red Rock Plateau canyons inhabitable; and there may have been a certain amount of population increase in the Tsegi Canyon–Navajo Moun-
tain area during the early 1200's, as it became a refuge for some of the Kayenta groups that were being displaced from other regions.

The abandonment of the Red Rock Plateau in the middle or late part of the thirteenth century correlates in a general way with the abandon-
ment of Cummings Mesa; the latter area may have been vacated slightly earlier, as indicated by the lower frequency there of Kayenta Black-on-
white, and the absence of the four-color polychromes. The abandonment of the Red Rock Plateau also correlates roughly with the onset of the Great Drought, which apparently started about 1270 (Fig. 5). If my date of 1260 for the end of the main part of the Horsefly Hollow phase is correct, the synchronicity is close, but not precise. According to the data of Fritts et al. (Fig. 5), the years between 1260 and 1270, just preceding the Great Drought, show above-average ring growth.

Although deep arroyos do not seem to have been cut in the Red Rock Plateau canyons during the twelfth and thirteenth century erosional
cycle, there is a small amount of evidence from Moqui Canyon for a change in stream regimen, with consequent floodplain disturbance, during or not long after the Horsefly Hollow occupation. In Moqui Canyon, where Lance (1963) found evidence there was increased cutting- and-filling by the stream as the upper part of the alluvium was deposited. Over ten feet of alluvium were deposited atop a Klittlea component at the Red Ant Kiva site (Sa675--Sharrock et al. 1963: 97-108; Lance 1963) in Moqui Canyon. Horsefly Hollow sherds appear in the upper part of this alluvium, suggesting that the buildup of the floodplain may have come before the abandonment of the canyon. This evidence is not conclusive, however, because a small Horsefly Hollow site (Flatrock House--Sa729) is situated on a ledge just above the Red Ant Kiva site (Sharrock et al. 1963: 91-6). Pottery from this site, which still is washing down onto the canyon floor, could have become included in the alluvium at any time after, as well as during, the Horsefly Hollow phase. At the other buried site in Moqui Canyon--Tamarix Dune (Sa781), a sherd of Kayenta Black-on-white was found in the fill of an alluvium-covered pithouse, indicating the buildup of the floodplain at this location came during or after the latest part of the Horsefly Hollow phase.

If floods were especially violent during the last part of the Horsefly Hollow phase, or if rapid alluviation was taking place, the canyons would be as uninhabitable as if they were being cut by arroyos. Such phenomena may have occurred at this time in Moqui Canyon, and this may perhaps explain its abandonment; there is no evidence, however, for this kind of floodplain disturbance in Lake Canyon (Lance 1963) nor in
any of the other canyons occupied during Horsefly Hollow phase times. Yet all these areas seem to have been abandoned about the same time—all have yielded at least a few sherds of the late Kayenta types that probably appeared late in the phase.

Another development that could have caused the abandonment of the Red Rock Plateau was the increasing tendency, during the 1200's, for the peoples of the Four Corners area to concentrate themselves into a few large pueblos, often situated in easily defendable locations. The soil and water resources of the Red Rock Plateau were too scanty and scattered to allow really large communities to form; the Horsefly Hollow people may have left to join or to form a larger community somewhere to the south. Lindsay et al. (n.d.) show that several large Kayenta pueblos were built on Segazlin Mesa just east of Navajo Mountain during the late 1200's, probably between about 1270 and 1285.

This review of possible environmentally-related causes for the Klethla and Horsefly Hollow occupations of the Red Rock Plateau has led to the development of a number of hypotheses, but no firm conclusions. The hypothetical reconstruction of the Pueblo III culture history of the Red Rock Plateau that I favor is as follows.

About 1100, the Anasazi population of this part of southern Utah reached a climax, and Kayenta Puebloans spilled over into the Glen Canyon basin, occupying the Red Rock Plateau and a number of other areas, establishing the early Klethla phase there. A long period of above-average precipitation made the low-lying canyons of the Red Rock Plateau habitable at this time. About 1150, the period of favorable rainfall ended, and what was probably a severe drought set in. The Red
Rock Plateau was either abandoned or suffered a considerable population decline, along with most of the northern and western parts of the Glen Canyon basin. Early in the thirteenth century, perhaps because they had been driven out of nearby high-altitude areas by cooling climate, new groups entered the Red Rock Plateau, and there formed the Horsefly Hollow phase. A more favorable rainfall regime may have coincided with this occupation. Mesa Verde groups coming into the area at the start of the Horsefly Hollow phase probably originated in the highlands at the west edge of Elk Ridge, while Kayenta immigrants probably came from the Navajo Mountain area to the south just across the San Juan. After a stay of approximately fifty years, perhaps by about 1260, population began to leave the Red Rock Plateau again, perhaps to found or join some of the large pueblos being built or expanded at this time in the areas to the south and southeast. The onset of the Great Drought may have been a factor in abandonment of the area as well.

About the most definite conclusion I have drawn from this attempt to make sense of Red Rock Plateau culture history is that the path to a better understanding of these population movements lies in further investigations in the nearby highlands from which the populations must have come. Surveys designed to sample the distribution of sites by elevation at different periods should be the most productive method of gathering information about the interrelationships of population growth, movement, and climate change. Here I am essentially echoing R. Woodbury, who in a paper published in 1961 called for attempts to correlate site distributions with altitude as a way of better understanding climatic factors in the prehistory of the northern Southwest.
as a whole. So far his directive seems to have been ignored, at least insofar as fieldwork oriented toward economically gathering this kind of information is concerned.

SETTLEMENT AND SUBSISTENCE PATTERNS

Inferences from Site Clusters

The distribution of Horsefly Hollow and Klethla phase sites in the Red Rock Plateau has been discussed earlier in this chapter under the heading "Phase Distributions." The locations of the larger sites of these two phases were mapped in Figs. 9 and 10. A tabulation of the frequencies, by area, of the pottery types diagnostic of the two phases was presented in Table 7, in order to show differences in the intensity of occupation between different areas of the Red Rock Plateau and between the two phases in these areas. The effects of sampling problems on inferences about patterns of site distribution were discussed, and a few qualified generalizations about site distribution patterns were made. Since the basic data on the location of site clusters has been presented in this earlier section, it is necessary here only to review it briefly, and to attempt to explain the observed settlement pattern—that is, to explain why the site clusters occur where they do and why a somewhat different pattern of site clusters appears in the two phases.

The two main Klethla phase site clusters occur 1) in Lake Canyon, especially in the broad canyon-bottom flats around old Lake Pahgarit and the junction of Lake Canyon with its tributary East Fork (the smaller number of Klethla sites in the narrower downstream part of Lake Canyon may be due simply to a greater erosional loss of sites there);
and 2) in the Upper Castle Wash-Steer Pasture Canyon area. A smaller cluster of Klethla sites occurs at the mouth of Forgotten Canyon; two of these three sites are actually located in Glen Canyon proper, while the third is just inside Forgotten Canyon. There are several other Klethla sites in the Upper Glen Canyon—including a very large one, Creeping Dune (Sa701)—but these sites are scattered and do not really constitute a cluster. The few Klethla sites in Moqui Canyon also are rather scattered. Although this canyon was probably never occupied as heavily as Lake Canyon or Upper Castle Wash, it may have had more occupation in Klethla times than our present scanty sample indicates; arroyo-cutting and post-occupational deposition have been more active in Moqui than in any other canyon, and these processes would probably destroy a disproportionate number of Klethla sites, which tend to occur on the canyon floors.

In the Horsefly Hollow phase, the largest site clusters occur not only in Lake Canyon and Upper Castle Wash, but also in Moqui Canyon. In addition, there are small clusters of Horsefly Hollow sites in Wilson Canyon, Slickrock Canyon, Upper Forgotten Canyon, and at the mouth of Red Canyon. The only isolated sites are Ledge Ruin (Sa566) in Upper Glen Canyon, which may relate to the Red Canyon cluster, the Buried Olla site (Ga367), which may relate to the Upper Forgotten Canyon cluster, and Sa509, in Upper Alcove Canyon. Although Sa509 is close to the Wilson Canyon cluster, it is separated from it by precipitous cliffs at the heads of both Wilson and Alcove Canyons.

The principal differences between the site clusters in the two phases are as follows: 1) There are more Horsefly Hollow clusters, and
more Horsefly Hollow sites overall. 2) The Klethla sites tend to cluster in areas such as Lake Canyon and Upper Castle Wash where the canyons are relatively open and accessible, and where rather large patches of flood-watered alluvial soils are available. 3) The Horsefly Hollow sites are also concentrated in Lake Canyon and Upper Castle Wash, but in addition there are site clusters in some of the deep, narrow, relatively inaccessible canyons—Moqui, Wilson, Slickrock, and Upper Forgotten—where the water supply is also fairly good, but where cultivable soil is in small, scattered, patches.

In discussing the settlement patterns of the Klethla and Horsefly Hollow phases, it is useful first to consider what they have in common, and in what ways they differ from the settlement pattern of the much earlier White Dog phase. It seems evident that both the Klethla and Horsefly Hollow people settled only in areas suitable for farming, where there was both sandy cultivable soil and a water supply above and beyond that provided by direct rainfall (i.e., floods, springs, and seeps). Areas where these two resources do not occur together show little or no signs of occupation. As noted in Chapter four, the earlier White Dog people, who were at least part-time farmers, also settled in such locations, but only in those which in addition were located in the juniper-pinyon zone of the lower highlands (Upper Castle Wash), or which provided ready access to these highlands (Moqui Canyon). The Klethla and Horsefly Hollow people do not seem to have been bound by this last kind of limitation on their settlement. Although Klethla site clusters do not occur in all the canyons where farming could have been carried on, these people do not seem to have chosen site locations
on the basis of closeness to the highlands. The heaviest concentration of Klethla sites is in Lake Canyon, which is separated from the juniper-pinyon zone by miles of barren slickrock desert, and which was largely or entirely ignored by the Basket Makers. The farmers of the succeeding Horsefly Hollow phase seem to have pushed into additional short lowland canyons cut off from the highlands. Thus, although there is considerable evidence that wild plants and animals were used by the Klethla and Horsefly Hollow peoples, the location of their site clusters does not suggest they were to any important extent dependent on the wild food resources of the neighboring highlands. In this respect, they differed from their predecessors, the people of the White Dog phase.

An additional difference between the White Dog occupation on the one hand and the Klethla-Horsefly Hollow occupations on the other is the much greater intensity of the latter, as indicated by the much greater numbers and larger sizes of the Puebloan sites. Thus, although the canyons of the Red Rock Plateau were probably more nearly in the optimum environmental zone for Basket Maker farming than for Puebloan, these canyons supported a much heavier population in Pueblo III times. This is probably due not only to the larger population of the region as a whole during the Pueblo III period, but to the increased productivity of Puebloan domesticated food plants, better farming methods, and more effective storage techniques.

The differences between the Klethla and Horsefly Hollow phases in distribution of site clusters seem to be due largely to the greater magnitude of the Horsefly Hollow occupation. There was probably less population pressure on the Red Rock Plateau during Klethla times; these
people inhabited only the choicest farming spots—principally in Lake
Canyon and Upper Castle Wash, but also here and there in the Upper Glen
Canyon. The Horsefly Hollow people also utilized these areas fully,
but in addition they overflowed into narrow canyons where fields had to
be located on smaller and more scattered patches of soil, and where, I
suspect, there was a greater chance of crop loss from floods, which
would tend to be more confined and hence more violent in the narrow
canyons, and particularly in the short ones which have very steep gra-
dients.

This interpretation accords fairly well with some theories favored
in the "Historical Inferences" section of this chapter. In this sec-
tion, I postulated 1) that the Klethla occupation resulted from a
spilling over of highland peoples into the Red Rock Plateau at a time
when Anasazi population was at its peak and when the climate permitted
a maximum expansion of the zone favorable to Pueblo farming and 2) that
the Horsefly Hollow occupation occurred at a time when cooling condi-
tions were forcing people out of rather extensive high altitude areas,
putting relatively more pressure on usage of the unaffected middle and
low-elevation areas. In this view, the Klethla people had more options
in choosing site locations, and hence settled only the best parts of
the Red Rock Plateau.

An alternative theory is that the increased use by the Horsefly
Hollow people of the deep, narrow, relatively inaccessible canyons of
the Red Rock Plateau is the result of the increasing importance of
defensive site locations. Certainly Moqui, Wilson, Slickrock, and For-
gotten Canyons are better supplied with high ledges, alcoves, and talus
tops than are Lake Canyon and Upper Castle Wash, which are relatively shallow. Furthermore, it is not hard to show (see Tables 8 and 9) that in all parts of the Red Rock Plateau, Horsefly Hollow sites tend to be in more elevated and less accessible, and hence presumably more easily defended locations than do the Kletlha sites. Thus, a definite preference for defensive site locations seems to be present in the Red Rock Plateau during the Horsefly Hollow phase; a similar preference in fact seems to be widespread in the northern Southwest at this time.

There are, however, several lines of evidence from the Red Rock Plateau that tend to cast doubt on the defensive theory as an explanation of the greater settlement in Moqui, Slickrock, Wilson, and Upper Forgotten Canyons during the Horsefly Hollow phase. In the first place, Moqui is the only one of these canyons with enough land to support a substantial population; the other canyons could support only small groups, which would be vulnerable to attack because of their small size, no matter how well they were fortified. Second, as already indicated, the most heavily-occupied area during the Horsefly Hollow phase was Lake Canyon, the area with the fewest naturally defensible site locations. Finally, the Horsefly Hollow site itself, a large storage cave, is located at canyon floor level, with no traces of any defensive structures, or even of any directly associated residential structures (although Toad Shelter--Sa543--a small residential site, is located only a few hundred yards away). Judging from the storage capacity of the Horsefly Hollow site, it must have served a considerable number of families; destruction of this site while it was full of stored corn would probably in a single stroke have harmed a large part of the Lake
Canyon community. Because of the importance of this site, it would appear that some attempt would have been made to fortify it if in fact there were serious threats from hostile peoples at this time.

Inferences from Site Characteristics

The basic data for the discussions in this section are presented in Tables 8 and 9. I will first discuss the sample of sites and the classification of site characteristics used in these tables. Next, I will discuss, one phase at a time, the data on site characteristics and their variation from one cluster to the next, and I will attempt to draw out inferences about the determinants of settlement in each phase. Finally, there is a comparison of the two phases in terms of their principal site characteristics and settlement patterns.

The Site Sample and the Classification of Site Characteristics

Data on the distribution and associations of various site characteristics are presented in Table 8, and are summarized, by area and phase, in Table 9. The site sample used here is the same one of 57 sites, some multi-component, that has been relied upon in earlier discussions of dating, phase distribution, and location of site clusters (see Figs. 7-10 and Tables 6-7). As noted earlier in the chapter, this sample consists of all the Red Rock Plateau Pueblo III sites that yielded 100 or more sherds of a list of frequently-occurring pottery types. The assignment of sites and parts of sites to one or the other phase is the same in Table 8 as in Table 6, with the exception that in Table 8 I have tried to eliminate the category of "mixed" assignments.
Table 8. Physiographic Setting, Architectural Features, and Principal Functions of Selected Klethla and Horsefly Hollow Sites

<table>
<thead>
<tr>
<th>Area</th>
<th>Wilson Canyon Area</th>
<th>Lake Canyon Area</th>
<th>Horsefly Hollow</th>
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<td>Horsefly Hollow</td>
<td>Klethla</td>
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<td>693 (E) 565 (E) 651 (E) 544-2 (E) 627 (E) 620 (E) 540 (E) 316 (E) 672 (E)</td>
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<td>cove cove cove cove</td>
<td>cove cove cove cove cove cove cove cove cove</td>
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<tr>
<td>Shelter</td>
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<td>al-</td>
<td>al-</td>
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<tr>
<td>With Hearth</td>
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<td>2 1?</td>
<td>2</td>
</tr>
<tr>
<td>Without Hearth</td>
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<td>Insubstantial Rooms</td>
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</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Without Hearth</td>
<td>4</td>
<td>2</td>
<td>1?</td>
</tr>
<tr>
<td>Kivas</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Exterior Hearths</td>
<td>2 1 1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Storage Structures</td>
<td>6 4? 2 2</td>
<td>6</td>
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</tr>
<tr>
<td>Defensive Structures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sherb Count</td>
<td>129 448 180 426 159 197</td>
<td>134 160 1076 248 3070 584 161 1199</td>
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<td>C, S^6 C C C R R C, S ^C</td>
<td>C^7 C</td>
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</tbody>
</table>

1 (E), Excavated; 2 (S), Survey only; 3 (M), Badly mixed collection; 4 (C), Campsite; 5 (R), Residential site; 6 (S), Storage site; 7 (G), Group assembly site
Table 8. (Continued)

<table>
<thead>
<tr>
<th>Area</th>
<th>Lake Canyon (continued)</th>
<th>Horsefly Hollow (continued)</th>
<th>Moqui Canyon</th>
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</tr>
<tr>
<td>Architectural Features</td>
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<tr>
<td>With Hearth</td>
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<td>1 1</td>
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<tr>
<td>Without Hearth</td>
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<td>Insubstantial Rooms</td>
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<td>With Hearth</td>
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<tr>
<td>Without Hearth</td>
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<tr>
<td>Kivas</td>
<td>1?</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Exterior Hearths</td>
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<td>1</td>
<td>1 2</td>
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<tr>
<td>Storage Structures</td>
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<td>1</td>
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Table 9. Summary, by Area and Phase, of Site Setting, Architectural Features, and Site Functions.

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1(K.), Klethla phase; 2(H.H.), Horsefly Hollow phase
In Table 6, I was classifying components largely in terms of their pottery collections, which in a few cases were badly mixed; in Table 8, I am classifying primarily architectural features, most of which can be assigned to either one phase or the other, and site settings, which normally do not change from phase to phase at the same site.

The principal weakness of this sample (Table 8) for studying the distribution of site characteristics is that it is a limited sample, heavily biased toward residential sites and large camp sites. Probably most of the examples of these larger sites that were accessible to discovery are in the sample, but there are many small camp sites and numerous small storage sites that are not included because they did not yield substantial amounts of pottery. As pointed out earlier in this chapter, however, assignment of these sites to their proper phase would be difficult because of their small artifact samples, so perhaps attempts to use this additional site data might only be confusing. The reader of this section must keep in mind that far more storage structures and camp sites were found than appear in Tables 8 and 9.

An explanation of the architectural feature labels used in Tables 8 and 9 and Figs. 9 and 10 is in order. Substantial rooms have (or can be inferred to have had) 1) solidly built walls of masonry or sometimes of jacal, 2) roofs, and 3) adequate interior space for comfortable habitation. Most of the "substantial" rooms that were excavated turned out to have hearths, but some did not. Insubstantial rooms appear to be hastily-built, usually have rough dry-masonry walls, and were probably never roofed, at least not in the usual Pueblo pole-and-beam manner. Most of these structures that were excavated lacked
hearths, but a few had them. Many were probably no more than low wind-breaks; some may have had brush superstructures (although there is no evidence for this in dry caves, where such construction would have been preserved). I assigned most of the rooms reported only by survey to the "insubstantial" category; some of these may have been classified differently had they been excavated.

Kivas were in some cases difficult to identify (see Smith [1952: 154-65] for a discussion of "when is a kiva?"); but in general, this rubric was applied to large well-built masonry-lined pithouses which had a deflector, ventilator, and central firepit, and sometimes, pilasters or a southern recess. "Exterior hearths" include fireplaces noted at camp sites as well as those appearing in courtyards and outdoor work areas at residential sites. This category suffers from variations in reporting, and is probably underrepresented at sites known only from survey, and at large canyon floor sites, which seldom were as completely excavated as rock shelter, ledge, or talus-top sites. "Storage structures" is a label applied to cists and small substantially-built above-ground masonry buildings whose interior dimensions or doors were too small to permit comfortable habitation. (Hill [1966: 13-16] has recently shown, on the basis of a number of lines of evidence, that storage rooms at the Broken K pueblo in east-central Arizona tend to be considerably smaller than rooms which had other functions.) Buried pottery vessels, most of which were probably used for storage, were not tabulated.

"Defensive structures" refers to a specific type of building element, which was found at only four sites. This element is a
substantial masonry wall that encloses the front of an alcove or part of an open site, and which is breached only by a narrow door and by small "peep-hole" openings at irregular intervals. The best example is Gourd House (Sa619) a Horsefly Hollow site in Lake Canyon (Sharrock et al. 1961a: 128-41; Figs. 68-9). A number of residential sites were, of course, located in defensible positions on high ledges or taluses, but these were not classed as defensive structures. Some of these high sites, particularly those in Wilson Canyon, Slickrock Canyon, Upper Forgotten Canyon, and to some extent in Moqui, had low walls of rough dry masonry fronting the narrow ledge or talus top on which they are located. These walls might have added to the defensibility of the site, but they could as easily have been constructed as retaining walls or safety devices rather than as defensive structures per se.

Sherd counts are listed in Table 8 to furnish a rough measure of the intensity of occupation at particular sites. Readers should note that all the sherds from a mixed (M) collection are not necessarily contemporaneous with the structures from the site.

The categories under "principal site functions" are rather speculative and provisional. The main division of functions is into residences versus camps. Residential functions are assumed if the site contains one or more substantial rooms with hearths. Camps lack such rooms. Storage and defensive functions are noted when structures of these sorts occur; in some cases storage appeared to be the primary function of a site.

This assignment of functions may not be very realistic; particularly troublesome is the distinction between "residential" and "camp"
sites. Many of the camp sites or camp and storage sites yielded many more artifacts than residential sites with numerous structures. For example, the Widow's Ledge site (Sa633) in Slickrock Canyon has five substantial rooms, seven insubstantial ones, one kiva, and six storage structures, yet only about 450 sherds were found at this site. The Horsefly Hollow component of the Horsefly Hollow site itself had numerous storage structures and several exterior hearths, but no associated "residential" structures at all; the pottery collected at this component, however, added up to more than 3000 sherds. A small Klethla phase camp site (Sa651) in Lake Canyon, which did not even have associated hearths, produced over 1000 sherds. If artifact quantities are any indicator of the length of time a site was occupied and/or the number of people using it, then it seems apparent that in some areas of the Red Rock Plateau, most of the people spent most of their time outside of formal complexes of substantial structures.

In general, architectural features are probably underrepresented in the record at canyon floor sites and at open sites in general because of the greater chance for walls and pits to be buried by drifting sand or alluvium, or to be broken down and scattered by erosion and weathering. Some of the "substantial" rooms found in shelters might have been classified otherwise if they had endured several hundred years of weathering in the open. In general, Klethla phase architectural features are probably underrepresented in the tabulations, because 1) these sites tend to be in the open and on the canyon floors; 2) Klethla sites are older, and hence more subject to damage by the elements or by the activities of later inhabitants; and 3) the Klethla people seemed
to have a predilection for small slab-and-jacal constructions which are
much less resistant to destruction than are masonry buildings.

Thus, inferences based on functional interpretation and analysis
of the distribution of specific architectural features must be tenta-
tive and hedged about with qualifications. It seems better, however,
to attempt inferences with these qualifications in mind than to back
away from the data without trying to interpret it because of the dif-
ficulties involved.

The Klethla Phase

Klethla sites clearly tend to occur in open canyon floor settings
(see Table 9), even where elevated shelters are abundant. None of the
sites of this phase has more than a few structures, and this includes
even sites at which large numbers of artifacts occur. The largest
Klethla site in terms of pottery yield—Dead Tree Flats in Lake Canyon—
had only one substantial room, a large masonry-lined pithouse that may
have been a kiva. This room may in fact have been constructed during a
light Horsefly Hollow occupation of the site, for it closely resembles a
definite Horsefly Hollow pithouse or kiva found at the nearby Lyman
Flats (Sa623) site. The pottery from the floor of the room in question
at Sa627 was so weathered it could not be identified. Because the Dead
Tree Flats site was not fully excavated, it is impossible to tell
whether or not other structures lie buried there. The second-largest
collection of Klethla sherds comes from the Creeping Dune site (Sa701)
in the Upper Glen Canyon at the Little Rincon. Here, a rather elaborate
reservoir and system of ditches had been built to irrigate plots of
land with spring water. Pottery was scattered over a very large area, but only two small room-like structures were found.

Lake Canyon, the most heavily-occupied part of the Red Rock Plateau during Kleethla times, judging by numbers of sites and artifacts, had only a few structures that could be assigned to Kleethla origins. The only definite Kleethla house in Lake Canyon is a small slab-lined pithouse on a dune in front of the Horsefly Hollow site; it apparently had a jacional or pole superstructure. Associated with this house was a small but deep unlined pithouse that gives the appearance of not having been finished.

More extensive building during Kleethla times seems to have gone on in Upper Castle Wash and the Upper Glen Canyon. At the Steer Palace site (Sa454) in Upper Castle Wash, there is an unlined pithouse with a central firepit; five mealng bins are arranged in a semicircle around the firepit. One and possibly two slab-based jacional surface rooms seem to have been levelled and rebuilt by later Horsefly Hollow occupants of the site. At the nearby Scorup Pasture site (Sa1010), a shallow slab-outlined pithouse very similar to the one from Sa544 in Lake Canyon was found. Nearby, under a ledge, were several masonry structures apparently built atop the remains of one or more vertical-slab and jacional structures. A small amount of Horsefly Hollow pottery was found here, indicating that perhaps the rebuilding was done during this later occupation. The largest and best-preserved Kleethla structures in the region are in the Upper Glen Canyon, at Daves site (Sa564) and Ga439. Daves site consists of three well-made coursed masonry rooms built against a large slump boulder. Ga439, which has been excavated by
unknown parties and is reported only from surface observations (Steward 1941a: 335-6; Lister 1959: 120) consists of three or four contiguous surface masonry rooms located near the mouth of Trachyte Creek.

Kivas are rare at the Klethla sites. Other than the questionable one at the Dead Tree Flats site, there are only two structures that may have served as kivas. The most clearly-identifiable one, at the Red Ant Kiva site (Sa675) in Moqui Canyon, is a deep masonry-lined pit structure with a southern recess, ventilator, deflector, and central firepit. These features are repeated at a deep pithouse at the Husted's Well site (Sa366) at the mouth of Forgotten Canyon, but this structure is smaller and is not fully masonry-lined. The only other structure at Husted's Well was a collapsed jacal storage room. Both these kivas are from areas where Klethla occupation seems to have been light.

The probably misnamed Fortress site (Sa316) in Lake Canyon, which I have labelled a group assembly site, may have served some of the functions usually performed by kivas. This site was occupied during the Klethla phase, judging by the fairly common occurrence there of diagnostic Klethla pottery types. The bulk of the pottery, however, is from the Horsefly Hollow phase, and I believe that the masonry structures at the site, and its group assembly function, belong to this later occupation. The substantial masonry rooms and plaza-enclosing wall at Sa316 contrast markedly with the generally small lightly built structures of the Klethla phase in Lake Canyon and elsewhere in the Red Rock Plateau. Furthermore, part of the large wall that surrounds the open plaza is built on occupational trash, indicating that it was constructed only after the site had been occupied for some time. On the
other hand, the peculiar scarcity of gray ware sherds that character-
izes the collections from the "Fortress" seems to be present among the
Klethla as well as the Horsefly Hollow types, suggesting that this
location may have had a special function as early as Klethla times.

One defensive structure may possibly be associated with the
Klethla phase. At the Rehab Center site (Sa681) in Moqui Canyon, one
of the few Klethla sites located in a high cave, a large well-built
masonry wall with peep-holes closes off part of the cave floor. This
wall is very similar to the one at Gourd House (Sa619), a definite
Horsefly Hollow site in Lake Canyon. Since some Horsefly Hollow pot-
ttery does occur in the Rehab Center deposits, it may be that the
"defensive" wall was built during this later phase. It seems anomalous
when compared with the other Klethla structures at the site, which are
lightly built.

Storage structures are rare at Klethla sites, at least in compari-
son to either frequency in Horsefly Hollow sites. Of course, some of
the small coursed masonry granaries that occur throughout the canyons
in sheltered spots may be of Klethla origins. Granaries of this type
are definitely built into some of the Horsefly Hollow sites, but their
associations with the Klethla occupation is not so clear. The only
case of a probable association is at Ga439 in Upper Glen Canyon at the
mouth of Trachyte Creek, where Lister (1959: 120) reports that several
masonry granaries occur under ledges near the site.

Large campsites are relatively more abundant in Klethla times than
in the Horsefly Hollow phase. Few of them are associated with storage
structures. The Buried Olla site (Ga367) is a large campsite that may
have been a stopping place on a popular trail during Klethla times. It is located in Glen Canyon at a point where two streams—Forgotten Canyon and Smith Fork—enter the Colorado River from opposite sides. The boulder fans at their mouths have nearly dammed the river, creating a natural fording place. The two tributary canyons, both of which contain springs, lead in opposite directions away from the Colorado, providing a convenient pathway for east-west travel across the canyonlands area. Several pecked hand-and-toe hold trails were found at steep "jump-ups" in the floor of Forgotten Canyon, indicating that the canyon was used as an avenue for travel. A very large panel of petroglyphs, perhaps the largest in the Glen Canyon, is associated with the Buried Olla site, as if each traveller had left some mark of his passage. The level of the Buried Olla site at which Klethla pottery was dominant contained 10 hearths and several buried storage jars, but no house structures. Later, during the Horsefly Hollow phase, two masonry pit-houses were built, but the site probably continued in use as a trail stop.

In conclusion, the Klethla occupation of the Red Rock Plateau seems to have been rather transitory, for few large or permanent-appearing structures were built. The sampling problems with regard to Klethla structures have already been noted; it is probable that the Klethla people were somewhat more active builders than our record indicates. Even discounting this, however, we are left with little that would indicate the existence of settled populations in substantial villages of the sort that are conjured up by our use of the terms "Pueblo farmers." There seem to me to be two hypotheses that may
explain this situation.

The first is that the canyons of the Red Rock Plateau (with the possible exception of Upper Castle Wash) were only seasonally occupied by the K lethla people, who maintained more permanent habitations at elevations of 6000 feet or more in the surrounding uplands. In the spring, small parties (perhaps only of men) would have left their home villages, travelling several tens of miles across rough desert terrain (again excepting Upper Castle Wash) to the low-lying hot, but well-watered canyon oases of the Red Rock Plateau. These parties would have planted their crops and camped near the fields while the plants were maturing. Some men may have built small houses for shelter. The intensive nature of Pueblo cultivation would have required at least some of the farmers to stay with their crops throughout the growing season or at least to make frequent return visits (see for example Don Talayesva's account of the intensive work required in desert farming—Simmons 1942: 229-32). After harvest, the farmers would presumably return to their home villages with part of the yield, leaving some of it in storage in the canyons to provide food during the next spring.

One attraction of the canyons for this kind of use would be the great length of the growing season there. The success of crops such as early sweet corn would be much more likely, and the canyon fields would be insurance against years when the growing season in the highlands was too short for good crops (unless, of course, drought struck, affecting both highlands and lowlands).

A hint that a seasonal pattern of occupation was being followed comes from Daves site and the Creeping Dune site in Upper Glen Canyon.
At both these sites, pottery is quite abundant, but food-grinding tools are very rare. None at all were found at Daves site, and only seven manos and no metates were recovered at Creeping Dune despite extensive excavations and surface collecting. Since in modern Pueblo culture grinding corn is typically women's work and farming is men's, ethnographic analogy suggests that the occupants of the two sites in question were men, perhaps parties of farmers far from home. It is my impression that corn-grinding tools are also generally rare in the Lake Canyon Klethla sites.

That scarcity of corn-grinding tools is not a generic feature of the Klethla phase is demonstrated by the Steer Palace site in Upper Castle Wash. Here, as previously noted, a pithouse containing five mealng bins was found, and the collections from the site as a whole include many manos and several metates. Some of these tools may of course be from the later Horsefly Hollow occupation of the site. This site is at the lower margin of the highland zone where I am postulating permanent habitation occurred; perhaps it was occupied the year around. The Klethla structures at Steer Palace do seem to be somewhat more elaborate than the ones at Klethla sites elsewhere in the Red Rock Plateau.

The biggest disadvantage of the seasonal occupation theory to me is the almost superhuman logistical prowess it requires of the Pueblo farmer. In order to enjoy during the winter the fruits of his summer labors, he would have had to make several trips back to his home village, carrying heavy loads of corn or other produce over long stretches of dry, rugged, country. Also, food would have to have been stored in
the canyons for use while crops were maturing the following season. Since these caches would have been left unattended, well-built storage structures would have been required to keep out rats, insects, and other intruders. There is little evidence of such storage structures in association with the Red Rock Plateau Klethla sites.

An alternative hypothesis, or really, an alternative point of view, is to see the ephemeral Klethla settlements of the Red Rock Plateau as being more or less typical of the Kayenta Anasazi at this time in their prehistory. This involves discarding our assumption that the typical settlement should be a solidly built village that was continuously occupied for a number of years. Recently, Jennings (1963; n.d.) has questioned this assumption for the Anasazi in general and for the Kayenta and other western Pueblo groups in particular. He suggests that the assumption derives from the Southwestern archeologists' concentration on only the larger sites of all periods, and from the attention given to the very large sites occupied just prior to the abandonment of the northern Southwest (a time when there definitely seems to be a trend to the aggregation of population into increasingly large settlements). I might add that the Southwestern archeologists' familiarity with the large, sedentary villages of modern Pueblo Indians has probably helped lead to the expectation that villages of this sort were also typical in the past. There seems to be increasing evidence that this expectation is not valid, at least not for most of the western part of the Pueblo area prior to late Pueblo III times. This general point of view has been well stated by Jennings (1963: 12-13).
One forgets that [the] huge centers are rare and scattered, found only in very favorable locations.... Could it be that the castellated centers have blinded scholars to the real genius of the Pueblo? Most settlements are small family settlements; they consist of one or two dwellings and a cluster of storage rooms, which can be most descriptively called little ranches or rancherias. The settlement pattern can be described as a scattered single family homestead type. Were these scattered folk the real Anasazi whose genius lay primarily in horticulture, in the ability to grow corn, beans, and squash where water was scant? ...If the Pueblo can be seen as subsistence gardeners representing a culture whose limits were closely geared to some minimal rainfall line, if we can see the Pueblo as expanding and contracting territorially in almost annual response to climatic/rainfall conditions, if we can see theirs as a lifeway viable beyond anything we know now, then perhaps we can understand its survival and better understand its details.... The real Anasazi were clever, ingenious small ranchers whose ability to exploit the environment was equal to, and possibly derived from, the desert culture ancestor whose skills were retained in large degree.

In this perspective, then, the small size and transient quality of
the Klethla occupation is not surprising, but is what would be expected of people who were only semi-sedentary over most of their range. The lack of abundant and well-made house remains in the Red Rock Plateau may be no more than a reflection of this region's relatively warm winters. The numerous early Klethla sites on the Kaiparowits Plateau southeast of the Red Rock Plateau are small and none yielded more than about 1000 sherds during thorough excavation (most produced much less), yet each site has several clearly visible masonry rooms. At 7000 feet, the Kaiparowits is considerably colder, both summer and winter, than the low-lying Red Rock Plateau. Houses would be much more necessary at the higher elevation.

Of the two interpretations presented above, I am inclined to favor the second, which sees the early Klethla occupation of the Red Rock Plateau as not being different in kind from typical Kayenta occupations elsewhere at this time, over the first, which postulates seasonal visits to the region by farming parties from large villages in the adjacent highlands. It seems to me that the hypothesis of seasonal farming requires unrealistic assumptions about the logistic abilities of the prehistoric farmers. The second interpretation, which I have derived from my reading of Jennings on this subject, makes the Klethla occupation less of a special case, and thus requires fewer assumptions.

It seems to me that the ultimate resolution of this problem may depend on further fieldwork in the surrounding uplands. If we find that large Klethla sites such as the Coombs site are not unusual, are not just the product of special environmental and perhaps sociological situations, but are common in the highland areas, then it seems to me
that the hypothesis of seasonal farming parties would be favored. If, on the other hand, the bulk of sites are of the two-or-three-room-plus-courtyard variety so numerous on the Kaiparowits during early Klethla times, then the interpretation derived from Jennings' ideas would be favored.

The Horsefly Hollow Phase

Klethla sites in the Red Rock Plateau (Fig. 9) are commonly located on the canyon floors and in the open. In the Horsefly Hollow phase (Fig. 10), the tendency is just the opposite; sites are most likely to occur in shelters, and on benches, taluses, ledges, or other locations above the canyon floor. Even in the relatively shallow canyons—Lake and Upper Castle Wash—where numerous sites continued to be located on the canyon floor, the proportion of sites so located is less than in the Klethla phase. Horsefly Hollow sites are more numerous; the number of sites of this phase yielding more than 100 sherds is about double that of the Klethla phase. Pottery is not, however, more abundant at the Horsefly Hollow sites in general. In the sample of 57 sites with which I am working, both the mean and median pottery collection sizes are slightly higher for Klethla than for Horsefly Hollow sites. The Horsefly Hollow sites, on the other hand, generally have a much greater number and variety of architectural features.

The various Horsefly Hollow site clusters and isolated sites can be placed in several groupings dependent on the characteristics of their sites (Tables 8 and 9). Lake Canyon is in several ways the most distinctive cluster; the site cluster at the mouth of Red Canyon, and
the Upper Castle Wash cluster each have certain distinctive features also. The remainder of the site clusters and isolated sites fall into a single grouping, which includes the Wilson, Slickrock, Moqui, and Forgotten Canyon clusters, and the isolated sites of Sa509 (Alcove Canyon) and Ledge Ruin (Upper Glen Canyon). With the exception of Ledge Ruin, this last grouping consists of sites located in relatively deep and narrow canyons, as opposed to the relatively broad and/or shallow ones. Because it includes slightly over half the Horsefly Hollow sites under consideration here, I will discuss this grouping first.

1. Wilson, Slickrock, Moqui, and Forgotten Canyon site clusters, plus Sa509 (Alcove Canyon) and Ledge Ruin (Upper Glen Canyon). The most common site in these areas is a small residential pueblo with a variety of architectural features, usually built in linear fashion along a narrow ledge or talus-top, but in two cases (Sa679 and Sa740 in Moqui Canyon) constructed in the open on the edge of a bench or rock peninsula. Of the 21 sites from these areas classified as Horsefly Hollow (Table 8), 13 are of this type.

Characteristically, these sites have: a) one to five substantial living rooms with a firepit and sometimes with a mealng bin, b) a small courtyard or open-air work area, often with a fireplace, and sometimes with a mealng bin or set of loom anchors, c) usually a kiva, sometimes with loom anchors in addition to the regular central firepit, deflector, and ventilator, d) several insubstantially-built rooms, probably never roofed, occasionally containing a hearth or other floor features, and e) several good-sized masonry storage structures, either
sunken or above-ground. There may also be a retaining wall along the front edge of the site, and there usually are petroglyphs, pictographs, bedrock metates, and tool-grinding grooves, etc. The number of pot- sherds recovered from these sites is never very great (with the exception of Doll Ruin [Sa585]), perhaps partly because refuse was usually thrown over the edge of the living area and scattered over a large area of talus or canyon floor. Some of the smaller sites of this sort that were recorded by the survey and even a few that were excavated failed to yield enough pottery to be included in the sample used here. Other kinds of artifacts, such as food-grinding tools, hammerstones, and various chipped stone tools, are sometimes surprisingly abundant, but not always. The small numbers of habitation rooms at these sites suggest that they generally were occupied by only a few nuclear families, probably comprising an extended family or minimal lineage. The smallest sites may have sheltered only a single nuclear family.

The number of these small residential sites to be found in a tributary canyon site cluster seems to vary rather closely with the size of the area available for farming. The smallest tributary canyon, Alcove, had only one small cliff-dwelling large enough to be included in the sample, as did Wilson Canyon, which is somewhat longer. Slickrock and Forgotten Canyons, although they also are rather short, each contained two of these sites. One of the sites in Slickrock (Sa633) and one in Forgotten (Sa598) are the largest examples of residential cliff-dwellings in the Red Rock Plateau.

The largest tributary canyon of the group--Moqui--also has the greatest number of small pueblos. The site sample for this canyon
contains at least five—Sa585, 678, 679, 729, and 736. In addition, Sa740, a site known only from surveys, probably belongs in this category, as does Sa588, an unexcavated site near Sa585 that did not produce a large enough survey collection to be included in the sample of intensively-studied sites. In general, the Moqui Canyon sites listed here tend to be rather small, and they are characterized by uniformly sloppy building techniques. Only four or perhaps five of the seven listed have a kiva. Although all are located above the canyon floor, Sa678 and Sa679 are the only ones in high, easily defensible positions.

Other residential sites from the areas listed here include Tamarix Dune (Sa781), a site in Moqui Canyon which had an unlined canyon-floor pithouse, and the Buried Olla site (Ga367), located in Glen Canyon opposite the mouth of Forgotten Canyon. This site, which had been established as a trailside camping place in Klethla times, was "improved" during the Horsefly Hollow phase by the construction of two small canyon-floor-level masonry houses. In addition to the residential function indicated by the houses, the site probably continued to be used as a camping place as well. One indication of this is that a large masonry enclosed exterior firepit, built in Horsefly Hollow times, contained large quantities of animal bone (mostly bighorn sheep), as if it had been regularly used by hunting parties who had brought in fresh game.

2. Mouth of Red Canyon site cluster. Two sites from the sample of 57 are located here. By far the larger of the two is the Loper Ruin (Sa364), which sits on the edge of a low bluff overlooking the Colorado River and the flats at the mouth of Red Canyon. This site, two-storied
in part, is L-shaped in plan, with five ground-floor rooms and a kiva located in the angle of the L. Under the overhanging edge of the bluff are several substantial masonry rooms, some two-storied, that were probably used for storage. Artifacts, especially pottery, are plentiful around the site. This small "orthodox unit pueblo" such as was once thought characteristic of the Pueblo II stage in general, differs in a number of respects from the small pueblos of the Wilson-Slickrock-Moqui-Forgotten Canyon group. It has better masonry, a more compact floor plan, is in part two-storied, lacks an evident courtyard work area, and lacks the insubstantial unroofed "rooms" common at the other sites. The structural differences may relate partially to the presence near the Loper site of an outcrop of Moenkopi sandstone, a tabular-fracturing rock that makes excellent masonry and that is not generally available farther downstream in the Glen Canyon region. In terms of the number of people the site could shelter, Loper Ruin probably is equivalent to the larger cliff dwellings, such as Widow's Ledge (Sa633) in Slickrock Canyon or Defiance House (Sa598) in Forgotten Canyon. The principal differences are in site plan and construction, rather than size of functions.

The other site in this cluster is Forked Stick Alcove (Sa413), which was occupied to some extent during the Klethla as well as the Horsefly Hollow phase. This small site, located under a low overhang facing the barren floor of Red Canyon, consists of a crudely-built pithouse, a small surface room, and a masonry granary.

3. **Upper Castle Wash site cluster.** The four Horsefly Hollow sites from this area that were included in the sample all were occupied
during the Klethla phase as well, so it was difficult in some cases to determine which structures relate to which occupation. All four sites probably can be classed as residential during the Horsefly Hollow phase. The size of these sites and the variety of structures present—rooms, kivas, and storage structures—is about the same as in the cliff dwellings of the Wilson-Slickrock-Moqui-Forgotten Canyon group. The site plan is also typically loose, with structures or groups of structures being scattered, rather than being built together into a compact unit. The chief differences between these sites and those of the first group are that the Castle Wash sites are located in the open or are incompletely sheltered, and are either on the canyon floor or not far above it. They also generally seem to lack definite outdoor work areas or courtyards, but this may be due to the increased difficulty of defining such areas in open sites located on sandy fill. The differences between the Upper Castle Wash cluster and the first group of clusters may then be related primarily to differences in physiographic setting. Upper Castle Wash is rather shallow as compared with the generally deep canyons of the first group, which offered numerous sheltered and canyon wall site locations.

4. **Lake Canyon site cluster.** The three groupings described above are dominated by sites that have what appear to be residential rooms. Of the 13 Lake Canyon Horsefly Hollow sites large enough to be included in the sample under discussion, however, only four have residential rooms, and all four sites are quite small. Three of the remaining nine sites lack substantial structures altogether, and were considered to be primarily camps. Another five sites showed evidence of camping activities, but also contained storage structures; included in this group is
the largest site in the canyon—the Horsefly Hollow site itself (Sa544). The last of these 13 sites is the previously-discussed "Fortress" (Sa316), which was probably used as a place of group assembly. In addition to these 13 sites, seven other probable Horsefly Hollow phase sites were excavated but did not yield enough sherds to be included in the sample of 57 sites that forms the basis for the discussions in this chapter. Tentative classification of these small sites indicates they do not contradict the pattern shown by the 13 larger sites mentioned above. Two of these less productive sites (Sa373 and 659) can be classed as residential, one (Sa375) as a campsite, three (Sa624, 616, and 615) as camp-and-storage sites, and one (Sa655) as a primarily defensive site. (See Sharrock et al. 1961a and Fowler 1961 for the descriptive reports on these sites.)

Because of the variety of sites found in Lake Canyon, and because of the distinctiveness of this site cluster as compared with the others, I will briefly discuss each of the functional site types that occur there. Emphasis will be on the sites from the basic sample, but I will also bring in some information gleaned from the seven low-pottery-yield sites referred to above.

a. Residential sites. As indicated, these are relatively few in number and are uniformly small; none has more than two substantial rooms with hearths, and artifacts are not particularly abundant. The only ledge or talus-top dwellings in this group are Rogers House (Sa554) and Wasp House (Sa373). (The latter, one of the seven sites from outside the regular sample, is located less than a mile from the canyon mouth, and is the most solidly-constructed residential site in the canyon.
Its low yield of pottery is probably due largely to its having been picked over and potholed repeatedly by members of river float trip parties.) Another elevated residential site that was excavated but did not produce much pottery is Sa659, which consists of two masonry rooms built on the canyon rim upstream from Lake Pahgarit at a point where the canyon is quite shallow. The other three residential sites (Sa543, 623, and 695) are located on the canyon floor.

The residential sites have a generally loose layout, with some or all the structures being built as separate units. Kivas are found only at Wasp House (Sa373) and (probably) at Lyman Flat (Sa623). Storage structures are found at some, but are not as common as at the sites of the Wilson-Slickrock-Moqui-Forgotten Canyon grouping. Since there seems to be a tendency for residential sites to be built on the canyon floor, the sample may be somewhat biased against them, because it is more difficult to discover all the structures of a canyon-floor site, and because below the mouth of the lower East Fork-Lake Pahgarit area, a good part of the canyon floor has been removed by arroyos. This bias could not, however, account for the small average size of the non-canyon-floor residential sites.

b. Camp sites. Sites of this sort large enough to yield substantial artifact collections do not seem to be common in Lake Canyon during the Horsefly Hollow phase. Of the camp sites that were excavated, most contained a few loosely-built structures, probably windbreaks. Exterior hearths were not common.

c. Camp and storage sites. This group includes the Horsefly Hollow site (Sa544), the largest site in the canyon in terms of artifact
yield and by this standard one of the largest in the Red Rock Plateau region. Although it is evident from the hearths and numerous potsherds and stone tools scattered through the fill that the site was a favored camping place, its primary function was probably storage. Eight large masonry-lined storage cists, ranging in diameter from about three to five feet, and up to five feet in depth, were sunk into the sandy floor of a small alcove overlooking the broad alluvial flats of lower East Fork. Several smaller cists were associated with the larger ones, and 13 large storage vessels were also set into the cave floor. Since only a little over half of the sheltered area was excavated, probably other cists and vessels remain. It seems probable to me that the large storage cists held food for individual households or other small residential groups, while the storage jars and small cists may have been the seed corn repositories for individual male farmers. The alluvial flats upon which the cave opens were probably the most extensive and best flood-water farming fields in the canyon—the food stored in the Horsefly Hollow site undoubtedly came from these fields.

The remaining camp and storage sites, most of them located in the lower part of Lake Canyon below the mouth of East Fork, also show primary emphasis on storage. In these sites, however, the storage structures, instead of being on a level with the canyon floor as in the Horsefly Hollow site, are usually in elevated and often poorly accessible positions in dry shelters. The typical storage structures are small tightly-built rooms of masonry or sometimes of jacal.

One of these storage sites—Gourd House (Sa619)—has several small rooms built in a shallow alcove, but also includes a massive masonry
wall, unbroken except for a narrow door and numerous peep holes, that closes off the front of the shelter. The alcove is not high above the canyon floor, but can only be entered by a series of pecked hand-and-toe holds. Inside the rather extensive area enclosed by the wall (which does not reach the cave roof, but stands uniformly about five feet high) is a large firepit and a set of loom anchors. This site appears to have been a place of refuge as well as of storage, unless the wall is viewed as a kind of windbreak which would make the cave more habitable for occasional use.

d. Defensive site. Gourd House, as described above, probably had defensive functions, but this interpretation could perhaps be argued. There does not seem to be much room for alternative explanations of the function of Sa655, one of the "low-yield" excavated sites noted earlier. This site is located on a narrow steep-sided rock peninsula that extended into old Lake Pahgarit from the canyon's right bank. Built across the narrowest part of this peninsula's neck and thus blocking access to it is a rectangular single-room masonry structure about 10 feet wide and 60 feet long. A line of holes pecked in the rock leads from one end of this building down the more gently sloping side of the rock peninsula, suggesting that some kind of fence was built here to complete the work of blocking off entry to the peninsula. The tabular stone from which the rectangular structure was built had been brought from about three-quarters of a mile away. There was no midden deposit, and no other structures were found on the rock peninsula. The few artifacts found at the site consisted of several sherds of characteristic Horsefly Hollow pottery types, plus two sherds of Jeddito
Corrugated. The occurrence of the latter indicates that Hopis stopped at this site, probably during the Jeddito phase. The remains of three small campfires were found inside the building atop a layer of what appeared to be melted roofing clay, wall mortar, and/or plaster, also showing that visits to the site occurred after it was abandoned.

e. Group assembly site. The probably mis-named "Fortress" site (Sa316) sits on the edge of the rim of East Fork Canyon, not far from the Horsefly Hollow site, overlooking the alluvial flats. The site consists of a large walled rectangular plaza, about 75 by 50 feet in dimension, oriented roughly east-west, with two large masonry rooms that open into the plaza built at its west end. The wall around the plaza seems to have been built in several different sections, perhaps by different masons, and over much of its length it seems never to have been high enough to have served a defensive function. In the exact center of the plaza is a circular fireplace between four and five feet in diameter. Each of the two long walls of the plaza is breached by a doorway at its center, just opposite the fireplace. The symmetry of the two rooms exiting onto the plaza, and the fact that there are two symmetrically-opposed outside doorways to the plaza, each giving equal access to the central hearth, suggest that a dual social segmentation was recognized at whatever assemblies were held at this site. Chang (1958: 307) has noted, on the basis of a cross-cultural survey, that segmented communities, usually composed of several lineages, often have a large common plaza or other place of community assembly. The two rooms at the west end of the site both open onto the plaza through separate doorways. One room is slightly larger than the other, but
they are similar in construction. Both doors have sills built up above the level of the room floor and plaza, so that one must step up and over them to enter or leave the room. In one room, this was facilitated by slabs projecting from the wall which served as steps. In both rooms, the fireplace is built against the wall immediately adjacent to the doorway, a mode of fireplace location not observed anywhere else in the Red Rock Plateau. A person stepping up to the plaza from one of these rooms would pass through the smoke of the fire, much as would someone climbing up through the roof opening of a kiva. The rarity of kivas at sites in Lake Canyon as opposed to other parts of the Red Rock Plateau suggests that the two rooms and plaza at Sa316 may have been performing some of the ceremonial functions elsewhere conducted in the kivas associated with small residential sites. A further indication that Sa316 may have had some ceremonial importance is the presence of a rough dry-laid masonry structure in the plaza in front of one of the rooms. This feature, little more than a pile of large stones, is similar to structures that Hayes (1964: 113-14), on the basis of ethnographic analogies, has called "shrines." If the structure at Sa316 is in fact a shrine, it was probably built sometime after the site's abandonment. It may, of course, have been built for no particular purpose by recent Anglo visitors to the site.

A further indication of the unusual nature of Sa316 is the fact that the frequency of gray ware sherds in the collections is unusually low (see Fig. 7, where it is classed as "aberrant"). By far the bulk of the pottery is from painted types, just the reverse of the situation at most sites, where gray ware is dominant. This indicates that the
pottery in use at the site was primarily the rather small decorated bowls and jars, instead of the larger and rougher gray ware jars. If the large gray ware jars were used primarily for cooking, holding water, and for dry storage, and the decorated vessels primarily as eating utensils, then perhaps we may surmise that already-cooked foods were brought to the site from elsewhere and that the storage functions of large jars were not needed because the site was only occasionally occupied. (If Sa316 was in fact a group assembly site, then the unusual pottery frequencies observed there tend to contradict Turner and Lofgren's [1966: 126-7] inference that extremely large gray ware vessels were made for use at gatherings of more than one household.)

Thus in contrast to the other site clusters, the Lake Canyon cluster is characterized by greater segregation of special-function structures. In the other parts of the Red Rock Plateau, the dominant sites are small pueblos that generally include not only residential, but storage and ceremonial-assembly (kiva) structures. In Lake Canyon, on the other hand, there is one large and probably several small specialized storage sites, a large specialized group assembly site, and at least one specialized defensive site. The relatively few sites with residential structures tend to lack associated kivas and storage buildings.

These differences indicate a higher level of community organization was operative in the Lake Canyon area than elsewhere in the Red Rock Plateau during the Horsefly Hollow phase. The storage structures of a small cliff-dwelling such as Defiance House (Sa598) in Forgotten Canyon were probably used only by the one or two households that lived
at this site. The various storage cists at the Horsefly Hollow site, however, must have belonged to a number of different households, none of which resided at the site. The plaza at Sa316 likewise must have been used by a number of different residential groups, none of which lived at the site. The formation of large functionally specialized sites was probably made possible by the greater size and compactness of the Lake Canyon population as compared to other areas, which in turn depended on the greater amount and more compact distribution of the alluvial farm lands in Lake Canyon. Especially important in concentrating population must have been the extensive alluvial deposits in lower East Fork and around Lake Pahgarit; it is significant that the three most functionally specialized sites (Sa544, 316, 655) all occur in this area.

This is not to say that the people of the other canyons lacked social mechanisms for integrating families and households into larger groups, but merely that only in Lake Canyon was it possible for a number of families to farm in a relatively small area so that they could easily come together for various kinds of group activity. In the other areas, farm lands were limited to smaller patches, which usually were strung out at intervals along narrow canyons, so that only a small number of people could conveniently live close to each patch of cultivable soil.

There clearly seems to have been a trend, during the 1200's in the western part of the Four Corners area, for populations previously dispersed in very small residential units to become increasingly concentrated into larger units. On Cummings Mesa, for example, at a time
correlative with the Horsefly Hollow phase in the Red Rock Plateau, sites of 10 to 15 rooms are not uncommon. This trend could, of course, take effect only in areas where resources enabled a fairly large popula-
tion to exist in a fairly small area. Lake Canyon seems to have been such an area in Horsefly Hollow times, judging by the number of sites and artifacts of this phase that occur there (see Fig. 10 and Tables 6-8); the other Red Rock Plateau canyons did not have such concentra-
tions of population and resources. Yet the Lake Canyon population was not clustered residentially into a few large pueblos. Certain func-
tions, notably storage and group assembly-group ceremonial seem to have been localized, but residence apparently was not. Furthermore, dwell-
ing structures of any sort are rare altogether. The central problems, then, of interpreting the Lake Canyon settlement pattern are to deter-
mine 1) why residence did not undergo large-scale localization, as storage and assembly-ceremonial functions seem to have, and 2) where, in fact, the people did live.

These problems are not easy ones to resolve, and I have no satisfac-
tory answers. Speculatively, there are several possibilities. First, the typical dwellings during this phase in Lake Canyon may have been pithouse rooms scattered as isolated structures or in small groups over the canyon floors. This kind of pattern is indicated by the three excavated canyon-floor residential sites—Sa543, 623, and 695. If this is the case, then the salvage crews may simply have missed most of the dwelling places, either because they were covered with blowsand, had been removed by arroyo-cutting, or simply seemed too insignificant to warrant further investigation beyond making a small surface collection.
and reporting another "campsite." A variant of this theory would propose that small campsites were perhaps the characteristic habitational pattern.

Both these surmises assume, however, that Lake Canyon was somehow exempted, not only from the trend toward large multi-room residential sites, but from general regional trends toward increasing use of masonry in building, increasing use of site locations above the canyon floor, and increasing numbers of above-ground structures, trends that are evident not only elsewhere in the Red Rock Plateau, but in surrounding highlands such as Cummings Mesa as well. If we view the evidence from the Red Rock Plateau in isolation, there is some indication that these four trends most readily asserted themselves in isolated areas where populations were small—thus the largest residential pueblos, with the greatest use of masonry and above-ground construction, and with locations generally well above the canyon floor, occur in the most isolated and smallest site clusters—at the mouth of Red Canyon, in Upper Forgotten Canyon, and in Slickrock Canyon. The further implication here is that the concentration of residences, the increased use of masonry and above-ground construction, and the trend to more elevated site locations may all relate to defense, perhaps specifically to the need to have storage structures in safe places, guarded by on-the-spot residents. This argument, however, is seemingly contradicted by evidence from adjacent highland areas. On Cummings Mesa (Ambler et al. 1964), for example, a population concentration probably larger than the one in Lake Canyon was at this time building large multi-room masonry pueblos with both above-ground and pithouse structures, and with storage
and ceremonial as well as residential rooms.

A second hypothesis, not necessarily contradictory to the first, is that the occupation of Lake Canyon was largely seasonal, with small groups coming in to farm from the neighboring canyons or even from outside the Red Rock Plateau. It seems unlikely to me, however, that what must have been the best farming area in the Red Rock Plateau should have been seasonally occupied, while less favorable areas were being occupied the year around.

It thus appears fairly certain that in Horsefly Hollow times, 1) Lake Canyon supported a larger population (for at least part of the year) than did any of the other parts of the Red Rock Plateau, as indicated by the greater frequency of both sites and artifacts of the Horsefly Hollow phase in Lake Canyon, 2) that the various small residential groups occupying Lake Canyon were more socially integrated than comparable groups elsewhere in the region, as indicated by the occurrence of specialized sites that must have served a number of groups, 3) that both the greater population of Lake Canyon and this population's greater degree of social integration were made possible by the concentration of fairly extensive floodplain farm lands in a relatively small geographic area, and 4) that as-yet-unresolved problems are raised by the scarcity of dwelling places in the Lake Canyon site sample.

The most basic division in kind of settlement pattern within the Red Rock Plateau during the Horsefly Hollow phase thus seems to be between the Lake Canyon site cluster on the one hand, and the rest of the site clusters and isolated sites on the other. The less pronounced
differences among the site clusters outside of Lake Canyon seem to boil basically to differences between the clusters that occupy narrow deep canyons and those in relatively broad and shallow ones. The rather atypical site plan and construction of the Loper Ruin (Sa364) may be due in part to an environmental variable, the presence of an especially good building stone, but this is probably not the entire explanation.

**Summary and Conclusions on Subsistence and Settlement**

During the Klethla and Horsefly Hollow phases, as in the preceding White Dog phase, most Red Rock Plateau sites were located in the canyons, and specifically in those canyons where both cultivable soils and a supply of water above and beyond direct rainfall are to be found. The Klethla and Horsefly Hollow people, as shown by the numbers and distribution of their sites (Figs. 9-10, Table 6), made heavier use of the Red Rock Plateau and occupied a greater number of canyons than did the White Dog people (Fig. 6, Table 4). The principal White Dog occupation was in Moqui Canyon and Upper Castle Wash, canyons which are either in the juniper-pinyon highland zone or which provide easy access to it. This distribution of sites probably reflects the mixed subsistence pattern of the White Dog people, who seem to have depended on the wild plant and animal foods of the highlands as well as on the yield of small farm plots in the canyons. The Klethla and Horsefly Hollow people occupied Moqui Canyon and Upper Castle Wash, but in addition, they settled in canyons such as Lake which are cut off from the juniper-pinyon zone by miles of barren slickrock desert. This distribution, plus the much greater abundance of Klethla and Horsefly Hollow sites,
indicate these later Pueblo people were more dependent on farming than were the earlier Basket Makers. This is not to say that the Red Rock Plateau Puebloans made no use of wild plant and animal foods or that they never visited the highlands; this would clearly be false. My point is merely that the distribution of Pueblo sites indicates that access to the highlands was less important, and hence that farming was probably more important, in the Pueblo as opposed to the Basket Maker period.

There also are differences between the Klethla and Horsefly Hollow phases in the locations of their site clusters. The Klethla people settled primarily in Lake Canyon, Upper Castle Wash, and Upper Glen Canyon, all areas where the canyons are relatively broad, shallow, and accessible, and where the alluvial soils are present in fairly large and continuous areas. The Horsefly Hollow people heavily occupied these same canyons, but in addition established site clusters in the narrower, deeper, less accessible canyons such as Moqui, Slickrock, and Upper Forgotten. Here, the cultivable soils tend to occur in narrow strips and sometimes in discontinuous patches. These canyons probably also have more violent floods, which, coupled with the narrowness of the floodplains, must have made trouble for the primitive farmer.

The differences in distribution of the Klethla and Horsefly Hollow site clusters probably reflect greater population pressure on the habitable lowland environments during Horsefly Hollow times, perhaps because of a cooling trend that contracted the habitable portion of the highlands. The population of the Red Rock Plateau seems to have been at a maximum during Horsefly Hollow times, as indicated by the greater
number of sites and artifacts assignable to this phase. The distribution of sites shows also that the agricultural resources of the region were maximally utilized during the Horsefly Hollow phase, for no canyon that possessed both cultivable soil and a good water supply was neglected. In the Klethla phase, on the other hand, sites are not so abundant, and only the most favored parts of the region were heavily settled.

The sites of the Klethla phase often had few or no substantial dwelling structures, and few had kivas. When residential rooms did occur, they tended to be pithouses. The most common type of Horsefly Hollow site was a small pueblo consisting of one to three masonry dwelling rooms with interior fireplaces, an open air courtyard or work area, a kiva, several insubstantially built rooms that may never have been roofed and which usually lacked fireplaces, and several well-built masonry storage rooms or cists.

Both Klethla and Horsefly Hollow residential sites thus are quite small and most were probably occupied by only one or two households, each of which probably consisted of or was built around one or two nuclear families. The small size of the sites probably relates in part to the general dispersion and small size of farm plots. Even in areas such as Lake Canyon and Upper Castle Wash, however, where lands are more extensive and are not particularly dispersed, the residential sites are quite small, suggesting that the people desired to live as close as possible to their fields, and that they preferred to live in small groupings of one or two households. Thus the number of people occupying the average residential site in the Pueblo phases was
probably not much if any greater than the camping or residential group in the White Dog phase. On the other hand, the local community of people from different residential sites who were likely to be in contact with one another must have been considerably larger during the Pueblo phases than in Basket Maker times, at least in most parts of the Red Rock Plateau. Evidence for this statement is the fact that the Pueblo site clusters are larger than the Basket Maker ones, and that during the Horsefly Hollow phase in Lake Canyon, there were apparently large storage, defensive, and group assembly sites serving a community made up of a number of dispersed residential groups. Some of the larger Pueblo campsites, such as Creeping Dune, also suggest usage (though not necessarily concurrent) by large numbers of people. From a comparison of the characteristics of the Klethla and Horsefly Hollow sites several trends can be inferred: 1) From canyon floor site locations in the open to elevated locations in shelters, 2) from a predominance of sites without substantial buildings to a predominance of sites at which such structures occur, 3) a decrease in use of light construction materials such as vertical slabs and jacal, and an increase in use of coursed masonry, 4) an increase in the numbers of kivas relative to total site numbers, and 5) a great increase in the numbers of storage structures at the average site.

These trends at first seem to indicate a greater permanence of occupation for the Horsefly Hollow phase and suggest that perhaps the Klethla occupation was confined to seasonal farming by groups based in the highlands outside the Red Rock Plateau. I am dubious of the seasonal farming hypothesis, however, because of what seem to me to be
the unreasonable assumptions that it requires about the distance Pueblo farmers were willing and able to travel in order to bring home a few bushels of corn. Furthermore, in terms of artifact yield, the Klethla sites on the average are somewhat more productive than the Horsefly Hollow sites, which contradicts a theory of transient occupation.

It also seems apparent that we cannot interpret differences between the Klethla and Horsefly Hollow occupations as if the Red Rock Plateau existed in cultural isolation. If we look at the archeological data for the western part of the Four Corners area as a whole, we see that many of the differences between the Klethla and Horsefly Hollow sites reflect more general trends operative during the 1100's and 1200's. There is clearly a widespread trend at this time toward increased use of masonry and toward defensible site locations. Furthermore, as Aikens (n.d., quoted in Jennings n.d.) has suggested, the kiva may not have become firmly established in Kayenta culture until after 1150 A.D. An increase in storage structures during the 1200's has been documented by Hill (1966) for sites in east central Arizona; he suggests it was due to worsening climate and resultant insecurity about the food supply. This seems a reasonable general explanation for the marked increase in number of storage structures in the Horsefly Hollow phase in the Red Rock Plateau, since the dendro-climatic data indicate that the Horsefly Hollow occupation took place during a period of lighter and less reliable rainfall than did the Klethla occupation. Furthermore, early Klethla sites everywhere seem to be rather small with lightly built structures; with some exceptions, most of the very large sites in adjacent regions are post-1200 in date. Since Pueblo
sites in the Red Rock Plateau tend during both phases to be somewhat smaller and less well constructed than their contemporary counterparts in higher areas, it is perhaps not surprising that the early Klethla sites in the Red Rock Plateau should appear impermanent.

One major architectural and perhaps sociological trend operative in the western Four Corners area during the late 1100's and 1200's that does not seem to be reflected in the Red Rock Plateau sites is the trend toward greater localization of residence structures, resulting in the formation of large multi-room and sometimes multi-kiva pueblos. Aikens (n.d., quoted in Jennings n.d.) sees this trend as the "grouping together of a number of small, lineage-sized unit pueblos to form large pueblo[s marking] the beginning of a transition from lineage to clan organization in this portion of the Southwest."

Since no large multi-room pueblos were found in the Red Rock Plateau, this trend does not seem to have been carried out here. In many parts of the region, it probably could not have taken effect, because available plots of cultivable soil were too small and dispersed to support more than a few people in any one location. But even in areas such as Lake Canyon, where soil and water were both abundant and geographically concentrated, and where site and artifact counts indicate population was large, there are no large residential sites. On the contrary, even the small "unit pueblos" are less abundant proportional to total sites than elsewhere in the region. In Lake Canyon, however, a trend to the social integration of numerous small residential groups is indicated by the occurrence of functionally specialized storage, assembly, and defensive sites that must have been used by a
number of families, and perhaps by several lineages. Why this trend to integration was not accompanied by increased localization of residence remains a mystery.

Perhaps seasonal occupation of Lake Canyon is the answer, but it again is difficult for me to accept this theory, not only for the reasons previously cited, but because it would imply in this case that environmentally less-favored parts of the Red Rock Plateau were being settled on a year-around basis, while Lake Canyon was not. I have also noted that the largest and structurally most complex Horsefly Hollow pueblos occur in the smallest and most isolated site clusters, where the total local populations must have been small; this suggests that perhaps the trend to increased localization and permanence of residence took place first in areas most vulnerable to attack and that the trend is another manifestation of the apparent need for defense that is present in the northern Southwest at this time. Perhaps Lake Canyon, with its larger population, was relatively more secure. This theory seems to be contradicted, however, by the fact that rather large pueblos were being built about this time in adjacent regions such as Cummings Mesa where the local populations were probably greater than in Lake Canyon.
Chapter 6
THE JEDDITO AND SIKYATKI PHASES

Twenty, or about four percent, of the 512 archeological sites recorded by Glen Canyon Project survey teams in the Red Rock Plateau region have indications of Pueblo IV Hopi visitation. These indications are primarily in the form of potsherds of Awatobi and Jeddito Yellow Ware; these wares relate to the Tusayan sub-branch of the Kayenta, and have been manufactured in the Hopi country at the south edge of Black Mesa from about 1300 A.D. until today (Colton 1956). The sites where these wares occur, with the types and amounts of pottery they yielded, are listed in Table 10. The locations of the sites are given in Fig. 11.

The identification of this pottery as being of post-Pueblo III Hopi origin is fairly certain, because such pottery, apart from other more subtle characteristics, has a distinctive yellow paste color that serves to set it apart from the gray, white, and orange wares characteristic of the Pueblo III occupation of the Red Rock Plateau. The main possibility of misidentification arises when gray or white ware sherds have been associated with iron-rich soils or ground water, and have thus acquired a false yellowish cast. Normally this staining does not extend to the core of the sherd, so it may be detected by breaking off a corner of the specimen.

The types identified from the twenty sites are listed below, together with the dates assigned them by Colton (ibid.) and the total number of sherds found for each type:
<table>
<thead>
<tr>
<th>Ware, type, and sherd count</th>
<th>Estimated Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awatobi Yellow Ware</strong></td>
<td></td>
</tr>
<tr>
<td>Jeddito Corrugated (217)</td>
<td>Common between 1300 and 1400, later scarce.</td>
</tr>
<tr>
<td>Jeddito Plain (171)</td>
<td>ca. 1300 to the present.</td>
</tr>
<tr>
<td><strong>Jeddito Yellow Ware</strong></td>
<td></td>
</tr>
<tr>
<td>Jeddito Black-on-yellow (8)</td>
<td>ca. 1325-1600</td>
</tr>
<tr>
<td>Sikyatki Polychrome (1)</td>
<td>ca. 1400-1625</td>
</tr>
<tr>
<td>Unidentified Jeddito Yellow Ware (primarily undecorated body sherds) (47)</td>
<td>ca. 1250 or 1300 to the present.</td>
</tr>
</tbody>
</table>

Since all these types with the exception of the rarest, Sikyatki Polychrome, overlap the periods of both the Jeddito (ca. 1300-1400) and Sikyatki (ca. 1400-1600) phases (Colton 1939: 63-4), it was impossible to assign most of these sites to a single phase.

The fact that Jeddito Corrugated is the most common Pueblo IV type in the Red Rock Plateau suggests that the major period of Hopi visitation was during the Jeddito phase, in the fourteenth century, since this is the time that Jeddito Corrugated was most abundant. This type and the others listed above extend, however, into the Sikyatki phase as well. The presence of a sherd of Sikyatki Polychrome at Forked Stick Alcove (Sa413) definitely shows that at least one trip into the area was made by the Hopi during the Sikyatki phase. Finds in regions adjacent to the Red Rock Plateau indicate that Puebloans made even more recent visits to the Glen Canyon basin. On Cummings Mesa, southeast of the Red Rock Plateau, Ambler et al. (1964: 95-6) have tentatively
### Table 10. Components of the Jeddito and Sikyatki Phases in the Red Rock Plateau

<table>
<thead>
<tr>
<th>Area</th>
<th>Site No.</th>
<th>Site Name</th>
<th>Pottery Types</th>
<th>Sherd Counts</th>
<th>Principal Publication Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson Canyon—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilson Mesa Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa504</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>38</td>
<td>Weller 1959: 646</td>
<td></td>
</tr>
<tr>
<td>Sa506</td>
<td>No name</td>
<td>Jeddito Pl.</td>
<td>5</td>
<td>Ibid.: 646</td>
<td></td>
</tr>
<tr>
<td>Sa508</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>2</td>
<td>Ibid.: 647</td>
<td></td>
</tr>
<tr>
<td>Sa516</td>
<td>No name</td>
<td>Jeddito B/Y</td>
<td>7</td>
<td>Ibid.: 650</td>
<td></td>
</tr>
<tr>
<td>Sa524</td>
<td>No name</td>
<td>Jeddito Pl.</td>
<td>131</td>
<td>Ibid.: 651</td>
<td></td>
</tr>
<tr>
<td>Sa637</td>
<td>Grimm Site</td>
<td>Jeddito Corr.</td>
<td>18</td>
<td>Lipe et al. 1960: 15-9</td>
<td></td>
</tr>
<tr>
<td>Lake Canyon Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sa537</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>2</td>
<td>Fowler 1961: 313</td>
<td></td>
</tr>
<tr>
<td>Sa540</td>
<td>Pagahrit Dune</td>
<td>Jeddito Corr.</td>
<td>52</td>
<td>Sharrock et al. 1961: 280</td>
<td></td>
</tr>
<tr>
<td>Sa541</td>
<td>No name</td>
<td>Jeddito Pl.</td>
<td>8</td>
<td>Fowler 1961: 314</td>
<td></td>
</tr>
<tr>
<td>Sa652</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>2</td>
<td>Ibid.: 323</td>
<td></td>
</tr>
<tr>
<td>Sa655</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>2</td>
<td>Ibid.: 324</td>
<td></td>
</tr>
<tr>
<td>Sa666</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>4</td>
<td>Ibid.: 327</td>
<td></td>
</tr>
<tr>
<td>Sa687</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>6</td>
<td>Ibid.: 330</td>
<td></td>
</tr>
</tbody>
</table>
Table 10. (cont'd) Components of the Jeddito and Sikyatki Phases in the Red Rock Plateau

<table>
<thead>
<tr>
<th>Area</th>
<th>Site No.</th>
<th>Site Name</th>
<th>Pottery Types</th>
<th>Sherd Counts</th>
<th>Principal Publication Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moqui Canyon Area</strong></td>
<td>Sa585</td>
<td>Doll Ruin</td>
<td>Unid. Jeddito Yellow Ware</td>
<td>3</td>
<td>Fowler 1959: 62</td>
</tr>
<tr>
<td></td>
<td>Sa757</td>
<td>No name</td>
<td>Jeddito Pl.</td>
<td>27</td>
<td>Day 1963: 290</td>
</tr>
<tr>
<td></td>
<td>Sa778</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>84</td>
<td>Ibid.: 299</td>
</tr>
<tr>
<td><strong>Upper Castle Wash Area</strong></td>
<td>Sa443</td>
<td>No name</td>
<td>Jeddito Corr.</td>
<td>5</td>
<td>Weller 1959: 627</td>
</tr>
<tr>
<td><strong>Upper Glen Canyon Area</strong></td>
<td>Sa413</td>
<td>Forked Stick</td>
<td>Sikyatki Poly.</td>
<td>1</td>
<td>Lipe et al.: 1960: 127-32</td>
</tr>
<tr>
<td></td>
<td>Sa558</td>
<td>Barren Flats Group</td>
<td>Jeddito B/Y</td>
<td>1</td>
<td>Ibid.: 124-5</td>
</tr>
<tr>
<td></td>
<td>Sa568</td>
<td>Ledge Ruin</td>
<td>Unid. Jeddito Yellow Ware</td>
<td>44</td>
<td>Ibid.: 138-40</td>
</tr>
</tbody>
</table>
identified an occurrence of Bernardo Black-on-yellow, a Hopi pottery type which dates from the early part of the period of Spanish occupation of the Southwest. On Grand Flats, located east of the Red House Cliffs, Matthews (Weller 1959: 594) found sherds of historic period Zia Polychrome from the Rio Grande area. It is not inconceivable, therefore, that Red Rock Plateau sites where long-lived pottery types such as Jeddito Plain or unidentified Jeddito Yellow Ware are found represent visits even more recent than the Sikyatki phase.

Distributionally, the Jeddito-Sikyatki sites tend to occur in the more open parts of the region—at least, the deep narrow canyons seem to have been avoided. No sites of these phases were encountered in Slickrock, Wilson, the lower part of Lake, Forgotten Canyon, or any of the shorter Glen Canyon or San Juan tributaries. There is only one Jeddito-Sikyatki site, yielding only three sherds, in the lower and narrower part of Moqui Canyon. In the Glen Canyon proper, places where the canyon is entrenched in vertical walls of Navajo sandstone seem to have been avoided. The only Pueblo IV sites in the Glen Canyon are at places where it is relatively wide and open—at the Rincon, the Little Rincon, the mouth of Red Canyon, and the Horn. The four sites shown as being in Upper Wilson Canyon are actually not in the deep entrenched part of this canyon, but in the upper part, which is shallow and physiographically belongs with Wilson Mesa.

The frequency with which Jeddito-Sikyatki sites occur in the Wilson Mesa area and in Upper Lake Canyon suggests that at least some may be associated with an old trail, known to Navajos, Utes, Paiutes, and the Anglo settlers of the region today, and probably to the
Puebloans of prehistoric times. This trail, which apparently was followed by the 1929 Bernheimer expedition (Bernheimer n.d.; Morris n.d.) runs from the Navajo Mountain region north across the San Juan, winds around the heads of Wilson and Slickrock Canyons on the margins of Wilson Mesa, and enters Lake Canyon near old Lake Pahgarit. It is also interesting to note that the two Hopi sites in the middle part of Moqui Canyon are in an area where tributary canyons enter from both the north and south, providing a fairly easy crossing of the main canyon. Contemporary stock trails also enter the canyon from both north and south in this area. Moqui Canyon, because of its great depth and because it is rimmed with steep walls of Navajo and Wingate sandstone, is one of the more difficult barriers to north-south travel in the Red Rock Plateau.

Other than pottery, the Pueblo IV Hopi visitors to the Red Rock Plateau left few distinguishable traces. At 15 of the 20 sites where Jeddito-Sikyatki pottery occurs, it is mixed with Pueblo III materials of the Klethla and/or Horsefly Hollow phases. At the five "pure" sites, there are no distinctive artifacts other than the pottery, although a few nondescript manos and scrapers were found. At two of these sites, there were firepits, but at the other three, no structures at all were observed. The most informative of these five sites was Sa757, located in a small tributary of Moqui Canyon (Day 1963: 246-7, 290). Here, petroglyphs depicting hunters, deer pierced with arrows, and a figure that may be a kachina occur on the wall of a shelter. Turner (1963: Fig. 8) depicts a similar petroglyph from the lower Glen Canyon area which he assigns to Pueblo IV or V Hopi (his Style 2) and which
was recognized as being of Hopi origin by his Hopi informants. The only artifacts at Sa757 consisted of a number of sherds from a single Jeddito Plain vessel, a non-distinctive scraper, a few flint chips, a bone awl, and several unworked sheep or deer bones. All of this material was collected from the surface; a test trench revealed no depth of deposit.

As noted above, the remaining 15 Jeddito-Sikyatki sites had previously been occupied during the Pueblo III period. Nearly all these sites had received only light occupation during Pueblo III times; less than half had masonry structures of any sort. The Jeddito-Sikyatki people thus seem to have avoided the larger habitational sites of the earlier occupations. The Jeddito-Sikyatki sites, whether single or multiple component, also tend to be located in the open. Of the 20 sites, only four are in shelters. Defensible locations likewise do not seem to have been favored. Pueblo IV pottery is not abundant at any of the 20 sites (Table 10). Most of the relatively large collections of pottery dating to the Jeddito or Sikyatki phases seem to be from single broken vessels (this would probably include the collections from Sa504, 524, 757, 778, and 568).

It appears from the evidence presented above that the Jeddito-Sikyatki components lack structures other than firepits, and that they have relatively few associated artifacts. All 20 sites probably were camps occupied for a short time by small parties. Some of the sites may have been used repeatedly, but others—for example those from which the entire sherd collection is obviously from a single vessel—were probably occupied only once during Pueblo IV times. There are no sites
which give evidence of having been occupied continuously for a long
time or of having been used by a large group of people.

The picture that emerges from this survey of Jeddito-Sikyatki site
distributions and site characteristics is one of small groups of Hopi
travelling rapidly through or into the region. The small size of the
sites and the probable association of some of them with trails supports
this inference. Possible motivations for Hopi visits to or trips
through the Red Rock Plateau include 1) hunting and collecting, either
in the region itself or farther to the north, 2) trading with peoples
located north or west of the region, or 3) visitation of shrines
established during the Pueblo III occupation of the region.

The third hypothesis—visitation of shrines—was agreed upon by
Turner's (1963: 32) Hopi informants as a distinct possibility. The
possible shrine at Sa316 has already been mentioned in Chapter 5;
norther this one nor others observed in the Red Rock Plateau have
direct associations of Hopi pottery, however. One of the petroglyphs
at Sa757, the previously-described site in Moqui Canyon, may have icono-
graphic significance, but most of the figures depict hunters and game.
Trading expeditions through the region are a distinct possibility,
since the Hopi are known to have traded with the Southern Paiute in
historic times (Kelly 1964) and may have done so prehistorically as
well. It also seems quite probable that at least some of the camps
were used by hunting parties, particularly in light of the hunting
scenes or ritual portrayed at Sa757. The Hopi are also known to have
made long trips to collect needed raw materials (Simmons 1942: 11).
(See for example Don Talayesva's description of an extended trip from
the Hopi town of Oraibi to the Grand Canyon to gather salt; this trip also had ritual significance and involved visiting a number of shrines \[\textit{ibid.}: 232-46\].) It is not clear, however, what raw materials might attract Hopi to the Red Rock Plateau. Its deposits of cherty terrace gravels apparently served a fairly large area prior to 1300, but the distribution of Hopi Pueblo IV sites does not correlate with the distribution of these terraces. In conclusion, there does not seem to be enough evidence to allow us to determine the specific objectives of the Pueblo IV Hopi visits to the region. It does seem virtually certain, however, that the visits were brief, and that farming was not practiced. In view of the scarcity of permanent surface water sources in the surrounding highlands, it may be that travellers found it useful to detour into the canyons to take advantage of their more abundant and easily discoverable springs and water-filled natural rock "tanks."

Because of the lack of precise dating for the Jeddito-Sikyatki sites, it is impossible to correlate the Hopi utilization of the Red Rock Plateau with any specific climatic events. Furthermore, it is by no means clear that the Hopi sites represent a single fairly brief period of utilization; they may well be the result of visits scattered over several hundred years. If, however, I am correct in assuming that the abundance of Jeddito Corrugated in the region indicates that the majority of the Hopi sites date from the Jeddito phase in the fourteenth century, we may note that this period was in general one of relatively abundant rainfall (see Fig. 5) as compared with the preceding thirteenth century. The Neo-Pacific climatic regime would also have been in full swing, presumably with cooler climates and heavier
winter rainfall than today. It is of course clear that the amount of moisture available in the canyons would not have been as important to hunters, traders, and other travellers as it was to farmers, but a moist period would nonetheless increase the number of springs and water-filled rock tanks and would thus decrease the distance the traveller had to go between water sources. A further hint that some of the Hopi visits may have come during a slightly wetter period comes from Sa757, the site in Moqui Canyon previously described. In this shelter, a spring that previously supported a dense growth of reed cane is now dry. It is tempting to speculate that this spring was active at the time the Hopi visited this shelter and that it was the feature that attracted them to this particular spot.

The relatively great number of Pueblo IV Hopi sites in the Red Rock Plateau, considering that this region is nearly 100 miles from the Hopi country, suggests that the Hopi had a traditional knowledge of the area. This in turn may indicate that some of the Pueblo III emigrants from the Red Rock Plateau settled in the Hopi country. Traditional Hopi accounts of their history, although they cannot be taken at face value, do suggest that some elements of the Hopi population came from the area around Navajo Mountain (Turner 1963: 22, 25, 33, 41), which would include the Red Rock Plateau.

Furthermore, the evidence from the Red Rock Plateau that the Hopi were regularly visiting a region recently abandoned by Puebloans and that their campsites were generally in open and indefensible locations suggests that there were no enemy peoples in the Glen Canyon area during Pueblo IV times. It seems to me that this casts further doubt
on the theory that hostile nomads were responsible for the abandonment
of the region at the end of Pueblo III, although it is of course possi-
ble that 1) the hostile peoples left the area or 2) friendly relations
were established between the Puebloans and their former enemies.
Chapter 7

SUMMARY AND CONCLUSIONS

In this thesis, I have attempted to investigate the relationships between Anasazi culture and the natural environment it encountered in the Red Rock Plateau during five phases of culture. In the preceding chapters, I have tried to answer the following two questions (as originally stated in Chapter one): 1) How did Anasazi culture in the Red Rock Plateau adapt to its environment during each of the five phases? In other words, what resources did the people find there, and in what way were they used; also, what were the limitations of the region, in the sense that it prohibited development of characteristics common to Anasazi culture elsewhere? In answering this question, my emphasis has been primarily on settlement patterns and subsistence, in the belief that these areas of culture were most likely to provide data on cultural adaptation to the environment. 2) What role, if any, did environmental factors play in the culture history of the region, particularly in the population movements implied in the several periods of occupation and abandonment, and in the shifting of boundaries between the Kayenta and Mesa Verde branches of the Anasazi?

In the following summary paragraphs, I will first review the general characteristics of the Red Rock Plateau environment, emphasizing those characteristics that functioned as resources or limitations throughout the period of Anasazi utilization of the region. Next, I will summarize my findings on the relationship between Anasazi culture and the Red Rock Plateau environment during each phase (the Jeddito and
Sikyatki phases will be considered together), emphasizing the ways in
which this relationship differed from one phase to the next. Finally,
I will end the chapter with a brief discussion of some of the general
implications of the study that extend beyond the specific answers given
to the questions posed above.

THE RED ROCK PLATEAU ENVIRONMENT

As Gregory (1915: 666–8), Hack (1942), and others have pointed out,
the principal environmental parameters for Anasazi farming in the northern Southwest were 1) sufficient moisture to sustain crops and allow
them to reach maturity (for maize, probably about 15 inches of direct
rainfall a year or its equivalent from natural or artificial flooding),
2) a growing season long enough to allow crops to mature (for maize,
probably at least 120 to 130 days [Hack 1942: 19–20]), and 3) cultivable soil. The last factor—good soil—is relatively widespread,
especially in the highlands, where fertile eolian deposits occur in a
number of places. The conjunction of suitable soil, an adequate water
supply, and an adequate growing season is, however, rather rare.

In the highest parts of the northern Southwest, direct rainfall is
adequate to sustain crops, but the growing season is too short. In the
lowest parts of the area, there is no frost problem, but rainfall is
deficient. The Anasazi farmer could do little to enter the zone of
short growing seasons, except to learn which physiographic situations
within this zone had slightly warmer microclimates. He could compensate
rather effectively, however, for deficient rainfall by 1) locating his
fields where there was a natural water supply above and beyond

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that of direct rainfall, such as in areas regularly flooded by streams, or at springs or seeps, and 2) by building water controlling and conserving devices such as check dams and irrigation ditches. Also operative was a constant natural and perhaps artificial selection for drought-resistant and rapidly-maturing crop varieties, as indicated by the fact that many modern Pueblo crop plants are better adapted to dry climates and short growing seasons than are their relatives in more permissive environments.

Judging by the distribution of Anasazi sites in the northern Southwest as a whole, the most favored elevational zone during most of the prehistoric period was between about 5500 and 8500 feet. Here a "mixed strategy" of some rainfall farming plus some farming based on floods or other natural water-concentrating agencies was probably carried on. Use of artificial water-control structures may also have been widespread, at least in the latter part of prehistoric times. Any dependence on direct rainfall would of course have been risky, because the farmer would be close to the lower margin of adequate rainfall and the upper margin of adequate length of growing season. Slightly cooler and/or dryer climatic intervals could thus have resulted in serious crop failures; as discussed in Chapter three and elsewhere in this study, there is some evidence that such climatic fluctuations occurred in the past and that they affected the distribution of Anasazi populations. Despite the risks, the rewards of successful rainfall farming would probably have been great, because larger areas could be cultivated in this way than by other methods, and with less labor. Floodwater farming was of course also hazardous, particularly on the larger streams,
because if floods were too violent, they could wash out the crops. Furthermore, flood-water farming on alluvial floodplains could be carried on only when the floodplain was stable or aggrading. There is abundant evidence that Southwestern streams occasionally change their regimens to net erosion and entrench themselves in arroyos, perhaps in response to climatic change. Arroyo-cutting would destroy most of the agricultural potential of an alluvial body. Thus the Anasazi farmer faced a number of hazards that might affect his principal means of livelihood. The 5500-8500 foot altitudinal zone seems to have been most attractive, probably because the bulk of cultivable soil deposits are located in this zone, and because it offered maximum opportunity for exploiting several different sources of moisture for crops. The upper if not the lower boundary of this favorable zone must have fluctuated with small changes in climate during the past, as must the favorability of the various physiographic situations within this zone.

The Red Rock Plateau, most of which is considerably less than 5500 feet in elevation (Fig. 4), is thus well below the favored zone of Anasazi occupation. Over most of the region, rainfall is less than ten inches per annum, and summer temperatures are quite high (Table 2), reducing the effectiveness of the scant precipitation even further. The parts of the region which receive only direct rainfall are true deserts and have very scant vegetation; rainfall farming is entirely out of the question.

Special physiographic features serve, however, to concentrate water and cultivable soils in a number of the Red Rock Plateau canyons; these canyons were the focus of Anasazi occupation in the region.
Specifically, the most favorable canyons were those cut into the Glen Canyon group of sandstones—the Wingate, Kayenta, and Navajo formations. The Navajo and Wingate sandstones are permeable and are excellent aquifers, so that springs and seeps are usually abundant at their contact with underlying less permeable formations. These spring-rich contact zones are most often exposed in the walls of canyons cut through the Navajo and/or Wingate formations; hence such canyons have good supplies of surface and ground water.

The Glen Canyon sandstones also provide abundant eolian sand, much of which is trapped in the canyons as it blows across the plateau surface. Large falling dunes are commonly found against the windward walls of the east-west trending canyons. A large amount of this eolian material is reworked and transported by the floods that occur after rains. Where these floods lacked power to flush out all the sand supplied by the wind, thick deposits of alluvium accumulated on the canyon floors. As long as these deposits were stable or aggrading, the floods were not confined to a single channel, but spread out over the floodplains. Most of the Anasazi farming in the Red Rock Plateau must have been carried out on these easily-worked, occasionally-flooded alluvial soils of the canyon floors. Nearly all these alluvial bodies are now deeply trenched by erosion, and thus are unsuitable for cultivation. There is evidence, however, that arroyo-cutting of this magnitude did not occur during the period from about A.D. 200 to 1600 with which this study is concerned.

In addition to providing the source material for alluvium, the dunes and sheets of sand derived from the Glen Canyon sandstones helped
store ground water in the region. There is little runoff from these sandy deposits, so the rainfall they receive sinks below the surface; much of it eventually percolates into the permeable Navajo and Wingate sandstones, and may thus contribute to spring flow. Some of the larger dunes in the canyons also build up a high enough internal water table to support springs at their bases. Thus eolian-transported sand plays an important role in the hydrology of the Red Rock Plateau, much as it does in the Hopi country, as Hack (1942) has shown.

The Red Rock Plateau canyons that are entrenched into the Glen Canyon sandstones thus have much better water and soil supplies than other canyons or than the barren plateau surface between drainages. Most of the archeological sites encountered in the region therefore occur in or near canyons walled with Navajo, Kayenta, and/or Wingate formations. The two Red Rock Plateau canyons (Fig. 3) most richly endowed with soil and water were 1) Lake Canyon, particularly its low-walled and broad-floored portion around old Lake Pahgarit, and 2) the upper part of Castle Wash (including Steer Pasture Canyon) which also is fairly shallow and broad. Moqui Canyon, one of the longest of the Colorado tributaries in the Red Rock Plateau, also is relatively well-supplied with water and alluvium, but is deeper and its floodplain deposits tend to be narrower than those of either Lake Canyon or Upper Castle Wash. The Glen Canyon proper has numerous relatively broad floodplain remnants preserved as low terraces on the inside of bends, but its flood regimen is somewhat different from that of the tributaries. The Colorado's major floods come in the spring, in response to the melting of the snowpack in the Rocky Mountains and high plateaus;
these floods may be prolonged and violent. The floods in the Red Rock Plateau tributary canyons follow any substantial local shower, including those occurring during the summer growing season, when the crops need water most. These floods usually are violent only in the narrower and steeper parts of the tributary canyons and in places where the water is confined within an arroyo.

Other Red Rock Plateau canyons (Fig. 3) which have adequate water and soil are Wilson, Slickrock, Forgotten, and Alcove Canyons, as well as parts of the San Juan Canyon. The area suitable for farming in these canyons is small. Even when the larger tracts of canyon-bottom lands also are included, the total cultivable area within the Red Rock Plateau is quite limited—probably no more than a thousand acres altogether. During the Klethla and Horsefly Hollow phases, and in a few places during the White Dog phase, small Anasazi sites were clustered densely in and around these patches of cultivable soil; because these usable areas were so small and scattered, however, the total population of the Red Rock Plateau as a whole was never large.

The principal attractions of the Red Rock Plateau for the prehistoric Anasazi farmers were undoubtedly the soil and water resources to be found in some of its canyons. The region's unusually long growing season (about 200 days on the average) must also have been attractive. A growing season of this length would virtually eliminate the danger of frost, and would in fact enable food crops to be planted and harvested several weeks earlier than in the highlands. It would also be favorable to the growth of the heat-loving cotton plant, which was poorly adapted to the cool highlands. Cotton bolls and fibers have been found
in a number of dry Horsefly Hollow phase sites in the Red Rock Plateau, and weaving implements and loom anchors are even more common.

Minor factors that probably helped make the Red Rock Plateau attractive, or at least more livable, are as follows:

1) There is an abundance of natural rock shelters, which were favored habitation site locations during the White Dog and Horsefly Hollow phases. Shelters also were commonly used for storage during both these phases and in the Klethla phase as well.

2) There are numerous high Pleistocene gravel terraces near the Colorado and San Juan Rivers which contain pebbles and cobbles of chert, jasper, and other siliceous rocks. These gravels furnished raw materials for chipped stone tools not only for the people of the Red Rock Plateau, but probably for the inhabitants of adjacent regions, as far away as the Tsegi Canyon area (see Turner and Cooley 1960).

3) The canyons incised into the Glen Canyon sandstones, because of their good water supply and varied physiography, have an unusually rich flora, including many plants normally confined to the highlands as well as those of the desert zone and some that are peculiar to the canyons. Thus the inhabitants of the Red Rock Plateau, even though well below the elevational zone normally occupied by the Anasazi, were not deprived of most of the wild plants on which they depended for raw materials, medicines, and supplementary foods. The principal deficiency in the canyon flora, from the Anasazi point of view, must have been the scarcity of pinyon and juniper trees. In the highlands, both were used as firewood and as building timbers; judging from contemporary Hopi ethnography (Whiting 1939), the juniper was also important in a number
of ritual and medicinal applications, and the pinyon was depended upon for a nutritious crop of nuts every few years. There is some evidence that the White Dog phase occupants of the Red Rock Plateau, and perhaps some of the Kleethla and Horsefly Hollow people as well, moved to or at least visited the adjacent highlands in the fall to take advantage of the pinyon nut harvest. Edible wild grass seeds must also have been easier to harvest in large quantities in the highlands.

4) Wild animals were abundant enough in the Red Rock Plateau to permit regular and successful hunting and to ensure that the diet of the region's inhabitants occasionally included meat. Animal bone and hunting gear (usually projectile points) normally occur at the Red Rock Plateau sites and in general seem more common there in relation to other types of refuse than at most of the larger highland sites. The bighorn sheep may have been slightly more abundant in the rugged canyons of the region than in the more open adjacent highlands; at least, this animal seems to have been by far the most common prey of the Red Rock Plateau hunters. Whereas the people of the White Dog, Kleethla, and Horsefly Hollow phases came primarily to farm, hunting may have been the principal motivation for the small Hopi parties that briefly visited the Red Rock Plateau during the Jeddito and Sikyatki phases.

ANASAZI CULTURE IN THE RED ROCK PLATEAU

The White Dog Phase (ca. 200–300 A.D.)

The Basket Maker II stage in the Four Corners area (Fig. 1) represents the earliest demonstrable occupation of this region by peoples possessing domesticated plants. In the western part of the Four
Corners area, this stage is manifested by the White Dog phase, best known from sites near Kayenta, Arizona, from Grand Gulch in south-eastern Utah, and from Cave du Pont in south central Utah. White Dog phase sites seem typically to occur in canyon environments, where spring and flood-water farming on alluvial soils is possible and where natural shelters are abundant. Thus the Red Rock Plateau canyons resemble the typical environments of sites of this phase, although they are somewhat lower in elevation.

The White Dog people, who were the first occupants of the Red Rock Plateau, probably migrated into the region from the Grand Gulch area (Fig. 2), which is only a few miles to the east. If my dating estimates are correct, the White Dog occupation of the Red Rock Plateau was brief, and probably occurred during the third century A.D. After this, the region was unoccupied until the late eleventh or early twelfth century. An important factor in initiating the White Dog occupation of the Red Rock Plateau may have been a prolonged period of somewhat above-average rainfall that occurred during the last part of the second and first part of the third centuries A.D. This period of favorable climate would have promoted population growth among the White Dog people, leading them to seek additional habitable locations, and would also have made the Red Rock Plateau canyons more attractive by raising the water tables and strengthening spring flow. The withdrawal of White Dog people from the region and its subsequent prolonged abandonment are difficult to explain, but may be the result of improvements in cultigens, agricultural techniques, and/or housing that opened up large areas of the open highlands lying between canyons, thus making the
canyon environments relatively less attractive. A decline in the amount and reliability of rainfall in the third and fourth centuries may also be implicated in the abandonment of the region by the White Dog people.

In the Red Rock Plateau region (Figs. 3 and 4), White Dog sites are not plentiful, and occur principally in two small clusters—one in Moqui Canyon, the other in Upper Castle Wash. These areas have natural shelters, good deposits of occasionally-flooded sandy alluvium, and numerous springs. Other canyons with these characteristics were, however, not used by the White Dog people, although later Puebloans found them attractive. The restricted distribution of White Dog sites is probably due to these people's partial reliance on the wild food resources of the juniper and pinyon-covered highlands in and just outside the northeastern part of the Red Rock Plateau. Moqui Canyon and Castle Wash are the only canyons providing easy access to these highlands; the other habitable parts of the Red Rock Plateau are cut off from them by stretches of barren slickrock desert.

The implication of this restricted distribution of White Dog sites is that these people had a mixed food-producing and food-collecting economy in which both kinds of activity were indispensable. The canyon environments where the sites occur were probably best for their small-scale farming, but they also needed access to the highlands east and north of the Red Rock Plateau to obtain the wild foods (especially pinyon nuts) to be found in greater abundance there. A functional analysis of site types present in the two site clusters supports the inference that a mixed food-collecting and food-producing economy was
practiced. In both clusters there are 1) a few habitation sites or base camps, located near the best farming spots, 2) food collecting camps, some apparently located near particularly abundant sources of wild plant food, others perhaps just overnight stopping places for foraging parties far from home, and 3) storage sites, sometimes located at a considerable distance from habitations, where both wild plant foods and the products of outlying fields could be stored. The habitation sites in Moqui Canyon were located in caves and lacked artificial shelters altogether, but those in Upper Castle Wash consisted of one or more fairly substantial shallow pithouses built in the open. The differences in habitation site characteristics may relate to the more severe climate of Castle Wash, which is higher in elevation and more open than Moqui Canyon. The Castle Wash sites may even have been occupied only in the fall and winter during years of good pinyon nut harvests, but this has not been demonstrated and must remain a hypothesis awaiting further testing. The habitation sites in both site clusters are quite small and were probably not occupied by more than two or three nuclear families.

The White Dog material culture also suggests a relatively great emphasis on mobile food collecting. Large, light, flexible, durable containers were used, seed-grinding tools are light and could be made quickly of commonly found stones, and there is a considerable variety of hunting and trapping gear. By contrast, the later Puebloan occupants of the region relied primarily on smaller, less durable, less portable containers (chiefly pottery), used heavy importable metates and manos, with the metates sometimes set permanently into bins, and
had a relatively smaller amount of specialized hunting equipment.

The White Dog subsistence and settlement patterns in the Red Rock Plateau show several striking resemblances to patterns ethnographically recorded for the Southern Paiute bands that frequented parts of the Glen Canyon region in historic times (Kelly 1964). These Southern Paiute bands received domesticated plants sometime during the nineteenth century, but continued to place heavy emphasis on collecting wild foods. Their farming was done in small plots located near springs, usually in sheltered and relatively low-lying canyons. They seldom lived near their fields the year around, preferring to move to the highlands in the fall and winter for harvests of seeds and game. Houses usually were constructed only in the highlands. Like the White Dog people, these Southern Paiute bands did not grow beans; the Southern Paiute, at least, could have obtained the seeds from neighboring peoples, but chose not to do so.

The White Dog phase occupation of the Red Rock Plateau thus seems to have been brief and to have been carried out by small bands of no more than a few nuclear families each. Although cultivated plants were important, older patterns of wild food collecting were also maintained. The settlement pattern appears to be a compromise between the demands of these two subsistence patterns. As compared with later Puebloan occupations of the region, the White Dog settlement involved fewer people, occurred in a more limited part of the potentially habitable portion of the region, and reflected a more mobile life with relatively greater dependence on wild foods.
The Klethla Phase (ca. 1100-1150)

After at least 500 and perhaps as much as 800 years of abandonment, the Red Rock Plateau was reoccupied at the end of the eleventh or early in the twelfth century. The new inhabitants were groups of people belonging to the Klethla phase of the Kayenta branch of the Anasazi. Although other explanations cannot be definitely ruled out, the most probable reason for the movement into the region at this time is that population in the highlands to the east and south increased to the point at which people "spilled over" into the environmentally rather marginal Red Rock Plateau, which previously had been ignored by Puebloans. A contributing factor was an exceptionally long period of consistently above-average rainfall that lasted from about 1050 to 1150 (Fig. 5). This period of favorable climate probably contributed to the buildup of population in the highlands and also must have made the Red Rock Plateau canyons more attractive by increasing their ground water supplies and promoting spring flow.

The Klethla phase occupation of the Red Rock Plateau is only part of a general movement of Kayenta peoples into the Glen Canyon area as a whole. Substantial numbers of early Klethla phase sites were established during the latest part of the eleventh and first half of the twelfth centuries not only in the Red Rock Plateau region, but on the Kaiparowits Plateau, Cummings Mesa, and in the area around Escalante and Boulder, Utah on the southeastern fringes of the Aquarius Plateau (Fig. 2). This period was also the time of maximum northward and westward (if the Virgin branch is considered a Kayenta sub-branch) geographical extent of the Kayenta Anasazi.
About 1150, there seems to have been a rather sharp decline in the Kayenta population of southern Utah, probably as a result of the movement of peoples toward the south. The Red Rock Plateau was either entirely or nearly abandoned at this time, as was the whole northern and western part of the Glen Canyon area. In the Glen Canyon area, Kayenta sites dating to the last part of the Klethla phase (ca. 1150-1200) usually occur only south of the San Juan and east of the Colorado Rivers whereas early Klethla sites are much more widely distributed in the area. This abandonment of a large part of the Glen Canyon area about 1150 correlates with a general southward retreat of the northern boundary of the Kayenta branch as a whole, with the disappearance of the Virgin sub-branch, with the eclipse of the Fremont culture of central Utah, and probably with population decrease on the Mesa Verde. This decline in the Pueblo population of the northern Southwest seems to have continued during succeeding years, until by 1300, the entire area had been almost completely abandoned.

The depopulation of the Red Rock Plateau, and perhaps of other parts of the Glen Canyon area at about 1150 may have been due to the onset, near this time, of a severe and prolonged drought. The tree-ring record at Mesa Verde indicates this drought was of extreme intensity and lasted about 40 years (Fig. 5). Other tree-ring records from the northern Southwest do not record such a severe drought, but do indicate a marked decline in moisture relative to the preceding period.

During the Klethla occupation of the Red Rock Plateau, sites were considerably more numerous than in the earlier White Dog phase. Their distribution was also less restricted (see Figs. 6 and 9). The
principal Klethla site clusters are in Lake Canyon, especially in its broad upper part, and in the Upper Castle Wash area. A smaller site cluster is found at the mouth of Forgotten Canyon, and there are scattered Klethla sites in both the Upper Glen Canyon and in Moqui Canyon. The number of Klethla sites recorded from Moqui Canyon may be misleadingly small—the sample from this canyon has probably been disproportionately diminished by arroyo-cutting and alluviation. Nevertheless, it is doubtful that the Klethla occupation of Moqui Canyon was as intense as in Lake Canyon or Upper Castle Wash.

Klethla sites definitely tend to be concentrated in the few areas where the canyons are relatively accessible and open, and where relatively large patches of flood- and/or spring-watered soils occur. It appears that the Klethla people were occupying only the most favorable parts of the Red Rock Plateau. Other potentially habitable areas, chiefly in the deeper and narrower canyons, were largely or entirely ignored. Wilson, Slickrock, and Upper Forgotten Canyons, for example, do not seem to have been colonized by the Klethla people at all. The deeper and narrower canyons were probably less desirable for farming because their soil deposits occur in smaller and more scattered patches, and because fields planted in these locations are more likely to be ravaged by violent floods.

Klethla sites, like all Red Rock Plateau sites, are small. Most probably were occupied by only a few nuclear families at any one time. Thus, although the total population of the Red Rock Plateau must have been much greater in Klethla than in White Dog times, the typical residential group was probably little if any larger during the Klethla phase.
Favored site locations during the Klethla phase were in the open on the canyon floors rather than in sheltered, elevated positions. Half the Klethla sites from the sample studied lack definite residential structures, and at the remainder, these structures tend to be few in number and to be poorly preserved. Kivas are very rare, and storage structures are not common. The most distinctive Klethla site is Creeping Dune (Sa701), where a large masonry reservoir and a series of ditches had been built to utilize spring water in irrigating several plots of sandy soil. At this site, one of the region's largest in terms of artifact yield and areal extent, there were few traces of residential structures.

The general scarcity of structures at Klethla sites lends itself to several possible interpretations, as discussed in Chapter five. One possibility is that the Red Rock Plateau Klethla sites are not typical residences of this phase, but are predominantly campsites resulting from seasonal occupation by small groups that migrated annually from large villages in the adjacent highlands to take advantage of the Red Rock Plateau's cultivable soils, good water supply, and long growing season. This theory cannot be ruled out at present, but it seems improbable to me because of the logistical difficulties that seasonal farmers would encounter in trying to transport any significant amount of the harvest back to their home villages over miles of barren and rugged terrain. An alternative interpretation would see the Kayenta Anasazi at this point in their history as being normally dispersed in small simple sites, and as living in large substantially-built pueblos in only a few specially-favored locations. Evidence seems to be
accumulating that heavy masonry construction, large multi-room pueblos, and kivas became commonplace among the Kayenta only after about 1150 or 1200. Our expectations of what "typical" Kayenta sites should look like have probably been biased by previous workers' concentration on only the largest sites of all periods, and especially on the large sites of late Pueblo III times. In this alternative interpretation, the Red Rock Plateau Kletlha sites would not appear particularly atypical and there would be no need to postulate seasonal occupation to account for their characteristics.

I am inclined to favor this latter explanation, but it is clear that final resolution of the problem depends on quantitative information that we do not yet have about the size and architectural complexity of early Kletlha sites in the highlands, particularly the highlands south and west of the Red Rock Plateau. This information could probably be gathered by surface surveys. If large pueblos proved to be common, the seasonal farming hypothesis would be favored; if campsites and small single-family rancherias are typical of the highlands, then the second hypothesis would be supported.

In conclusion, it appears that about 1100, numerous small groups of Kayenta Anasazi began coming into the Red Rock Plateau region, probably spurred on by population pressure in the highlands and by a period of exceptionally heavy rainfall that had made the canyon environments attractive. These people settled predominantly in a few unusually good farming areas, ignoring some of the other habitable parts of the region.
Unlike the White Dog people, they do not seem to have needed ready access to the highlands, because isolated lowland areas such as Lake Canyon were heavily occupied. The Klethla people were thus probably more dependent on farming than were the White Dog people, although the Klethla must also have done considerable hunting and gathering. The Klethla sites tend to be small, and substantial permanent structures are uncommon. These sites may perhaps be seasonally-occupied farmsteads satellite to large highland villages, but it seems more likely that they resemble the typical Kayenta settlements of the time—large sedentary villages being atypical and confined to a few especially favorable locations. About 1150, the Klethla people seem to have abandoned the Red Rock Plateau, as well as the rest of the northern and western part of the Glen Canyon area, probably as a result of a deterioration in farming conditions brought on by a severe drought.

The Horsefly Hollow Phase (ca. 1210–1260)

After a 50 or 60-year period of abandonment or extremely light occupation, the Red Rock Plateau received a new influx of population during the early part of the thirteenth century. Anasazi occupation during this period, which lasted about 50 years, was the heaviest ever experienced by the Red Rock Plateau in terms of numbers of canyons utilized, numbers of sites established, and probably, in total population. Occupation in the southeastern part of the Glen Canyon basin also increased during the early thirteenth century. This is best documented from Cummings Mesa (Fig. 2), where sites become both larger and much more numerous at this time. This increase in population does not
extend to the western part of the Glen Canyon area, however. The Kaiparowits Plateau and the southern margin of the Aquarius Plateau (Fig. 2), which had been abandoned during the mid-twelfth century, do not seem to have been significantly reoccupied during the thirteenth century.

Several factors were probably operative in causing population to move back into the Red Rock Plateau area during the early thirteenth century: 1) The extreme drought of the last half of the twelfth century was broken; although precipitation was not as great or as reliable as in the 1050-1150 period, it was sufficient to restore the region's habitability. 2) The environmental niche available to Anasazi farmers was undergoing contraction at the highest elevations, because of the onset of the Neo-Pacific climatic episode with its cooler climates. The loss of previously-habitable high-altitude lands would have put more population pressure on the habitable parts of the medium-level highlands and on the canyons, including those of the Red Rock Plateau. 3) Further loss of habitable environments was underway in the northern Southwest as a result of a cycle of arroyo-cutting that was destroying alluvial floodplains. The canyons that remained unchanneled by arroyos—and this would include the Red Rock Plateau canyons—would thus be relatively more attractive than they previously had been. 4) Finally, there is some evidence that there was population increase in the Navajo Mountain—Tsegi Canyon area during the early thirteenth century, as it became a refuge for some of the Kayenta groups who were abandoning other areas during the continued shrinkage of Kayenta territory. The southern part of the Red Rock Plateau probably absorbed some of
overflow of population from the Navajo Mountain region.

At about the same time that Kayenta branch Anasazi were moving into the Red Rock Plateau from the Navajo Mountain area to the south, Mesa Verde branch immigrants were also entering the region, probably as part of a movement out of the cool Elk Ridge highlands to the northeast (Fig. 2). The Mesa Verde and Kayenta immigrants to the Red Rock Plateau seem to have mingled peacefully, occupying the same communities and probably the same households in many cases. The resultant cultural amalgam, which was probably peculiar to the Red Rock Plateau, was labelled the Horsefly Hollow phase, the name being taken from a large site in Lake Canyon where both Mesa Verde and Kayenta pottery was common and was evidently in use at the same time by the same people.

As noted earlier, the Klethla people had settled primarily in Lake Canyon, Upper Castle Wash, and Upper Glen Canyon, all areas where the canyons are relatively broad, shallow, and accessible, and where the alluvial soils are present in fairly large and continuous areas. The Horsefly Hollow people heavily occupied these same areas, but also settled in the narrower, deeper, less accessible canyons—Moqui, Wilson, Slickrock, Upper Forgotten, and Alcove. In these canyons, the cultivable areas are smaller, more dispersed, and more likely to be damaged by violent floods. The establishment of numerous Horsefly Hollow sites in these less favorable parts of the Red Rock Plateau supports my earlier contentions that 1) the Horsefly Hollow phase was a time of maximum population for the region and 2) because of a cooling climate in the highlands and arroyo-cutting in adjacent regions, fewer potential site locations were available to the Horsefly Hollow than to the Klethla
people, so that the former were forced to make fullest possible use of habitable canyon environments such as those of the Red Rock Plateau.

The Horsefly Hollow sites, as compared with the earlier Klethla sites, tend 1) to be located more often in elevated, sheltered positions than on the canyon floor, 2) to have more structures, with greater use of masonry, 3) to more frequently have kivas, and 4) generally to have considerably more provision for storage. All these differences reflect trends operative throughout the western part of the Four Corners area during the late twelfth and thirteenth centuries. The elevated site locations and perhaps the more substantial structures may be a response to a greater need for defense, either from hostile non-Pueblos, or more likely, from Pueblo groups displaced by climatic deterioration or arroyo-cutting. The increased emphasis on storage may be another manifestation of the same insecurity, as well as an attempt to buffer the effects of climatic fluctuations on the food supply. The greater popularity of kivas and perhaps of heavy masonry construction may be the result of the increasing cultural influence of the Mesa Verde branch, in which these traits seem to be well developed at an earlier stage than among the Kayenta. There is some evidence that the Mesa Verde people were moving south and encroaching on former Kayenta territory in several places at this time.

One major cultural trend apparent in the western Four Corners area during the late 1100's and 1200's that does not seem to become manifested in the Red Rock Plateau is the trend toward the increased aggregation of residential structures into large pueblos. No large sites of this sort were encountered in the Red Rock Plateau. Instead, there are
numerous small residential pueblos, consisting of usually no more than two or three substantial dwelling rooms, an open air courtyard, a kiva, several insubstantial windbreaks or unroofed rooms, and several masonry granaries or storage cists.

In most parts of the Red Rock Plateau, larger sites probably could not have been easily maintained, because the available plots of cultivable soil were too small and dispersed to support more than a few families in any one location. Even in areas such as Upper Castle Wash and Lake Canyon, however, where farming lands are more extensive, the residential sites are quite small, suggesting that the people preferred to live in very small groups close to their fields, and felt secure enough from attack to do so. In Lake Canyon, which clearly seems to have been the population center for the region during the Horsefly Hollow phase, residential sites are in fact relatively scarcer and smaller than anywhere else in the region; campsites and special-function sites are relatively more common. The anomalous character of the Lake Canyon sites cannot be satisfactorily explained at present. One hypothesis for which there is evidence assumes that the primary reason for the trend to larger and more substantial pueblos was defense, and postulates that the Lake Canyon population was large enough so that the people did not feel particularly insecure. Hence the Lake Canyon inhabitants maintained a dispersed residence pattern resembling that of Kletlha times. In favor of this interpretation is the fact that the largest, and in several cases, the most solidly-built pueblos of the Red Rock Plateau occur in the most isolated areas, where populations were smallest and thus most vulnerable to attack. These isolated sites or small
site clusters also tend to be located in the highest, most easily
defensible positions. Although this theory seems to fit the Red Rock Plateau data well enough, it tends to break down in other areas, where large masonry pueblos were being built even where populations were both large and concentrated.

Whatever the solution to the above problem it does seem clear that there was no great increase in the size of the local residential unit in the Red Rock Plateau from Klethla, or even White Dog, times to the end of the Horsefly Hollow phase. In all three phases, most of the residential sites were occupied by no more than two or three nuclear families. This is not to say, however, that the local community of people from different residential units who were in regular contact with one another did not increase in size during the three phases; this increase must certainly have taken place in the more favored areas as site clusters became larger and more densely settled. Good evidence for community integration on a fairly large scale comes from Lake Can-yon during the Horsefly Hollow phase. Here, non-residential, centrally-located, and functionally specialized storage, group assembly, and defensive sites were established to serve a residually dispersed population.

Most of the Horsefly Hollow sites in the Red Rock Plateau seem to have been abandoned by about 1260, although a few may have been occupied somewhat longer. There is little evidence that the withdrawal from the region was anything but gradual and unhurried. If my dating estimate for abandonment is too early by about ten years, which is certainly possible, then the onset of the "great drought" may have been
a factor in the exodus of population from the region. This period of severely diminished rainfall started about 1270 and lasted until nearly the end of the century. The Red Rock Plateau would probably have been difficult to inhabit during this period because of the depletion of ground and surface water.

Another factor in the abandonment of the area may have been an increase in the violence of floods, which would have disrupted floodplain farming. Floodplains in many parts of the Four Corners area were being dissected by arroyo-cutting at this time; the Red Rock Plateau seems to have escaped this fate, but there is evidence from Moqui Canyon that stream regimens may have been to some extent disturbed. In Moqui, the upper part of the alluvium shows increasing evidence of cutting and filling, and contains several Klethla and Horsefly Hollow sites, buried by rapid alluviation. The dating of this disturbance is not precise enough, however, to allow us to say whether or not it correlates with the date the region was abandoned. Furthermore, the alluvial sequence in Lake Canyon shows no record of a change in stream regimen, yet this canyon was abandoned at about the same time as Moqui.

Perhaps the most significant factor in the withdrawal from the Red Rock Plateau at the end of the Horsefly Hollow phase may have been the pressure of the continuing cultural trend toward residence in large multi-family and multi-lineage pueblos. As the thirteenth century drew to a close, the remaining Anasazi populations of the northern Southwest seem increasingly to have clustered in and around these large pueblos. The exodus from the Red Rock Plateau may have been a movement to join or found such large pueblos somewhere to the south. The most probable
objective of such a movement was the Navajo Mountain area, where Kayenta Anasazi lived until nearly the end of the thirteenth century. Lindsay et al. (n.d.) have shown that about 1270, several very large pueblos were built or greatly enlarged in the area north and east of Navajo Mountain. Emigrants from the Red Rock Plateau probably contributed to the formation of such sites, although some may have travelled even further south to the Hopi area. Movement into the larger pueblos would of course not preclude drought or other environmental factors as agents in dislodging the Horsefly Hollow people from the Red Rock Plateau. On the other hand, it seems to me that the pressure to join larger residential communities, if strong enough, could have effectively depopulated the region even in the absence of significant environmental deterioration.

In summary, the Red Rock Plateau was reoccupied during the early thirteenth century by groups of both Mesa Verde and Kayenta branch culture, who originated in the highlands northeast and south of the region, respectively. The mingling of these groups gave rise to the culturally hybrid Horsefly Hollow phase. The population influx at this time was probably due to 1) the ending of the late twelfth century drought and a return to somewhat moister conditions, which made the Red Rock Plateau more habitable, and 2) a general contraction in the area available for Anasazi settlement outside the region, because of arroyo-cutting and the onset of climates cool enough to reduce the habitable area in the highlands; the Red Rock Plateau was unaffected by these changes and was thus relatively more attractive than previously. The region's heavy population during Horsefly Hollow times probably came
close to making maximum use of its farming potential; in addition to
the favorable areas settled during earlier phases, several environmen-
tally marginal canyons were inhabited. Contrary to the general trend
toward larger residential groupings current in the Four Corners area at
this time, the Horsefly Hollow sites remained small, as in the Klethla
and White Dog phases, with probably no more than two or three nuclear
families sharing a site. In most parts of the region, agricultural
resources are so dispersed as to prohibit large-scale localization of
population. Even where farm lands were both abundant and concentrated,
however, as in Lake Canyon, large pueblos were not constructed. Com-
munity integration in Lake Canyon was nevertheless sufficient to main-
tain special storage, assembly, and defensive sites serving all or most
of the canyon's many small residence units. There is some evidence that
in the Red Rock Plateau, residential site size was a function of defen-
sive need; the region's largest pueblos occur in the canyons with the
smallest, and hence most vulnerable, populations. The trend toward
concentration of population into large pueblos may eventually have con-
tributed to the depopulation of the Red Rock Plateau, however. The
region seems to have been abandoned by Horsefly Hollow people about
1260, not long before several very large pueblos were constructed in
the Navajo Mountain area just to the south. It is also probable that
the onset of the "great drought" helped terminate the Horsefly Hollow
occupation.

The Jeddito and Sikyatki Phases (ca. 1300-1600)

After the end of the Horsefly Hollow occupation, the Red Rock Pla-
teau was never again settled by the Anasazi. During the Pueblo IV
period, however, the region was briefly visited a number of times by small parties of Hopi, some of whom may have been descendents of the earlier inhabitants. Twenty of the 512 Red Rock Plateau sites show evidence, in the form of distinctive Jeddito and Awatobi Yellow Ware sherds, of these Pueblo IV Hopi visits. The sites cannot be precisely dated, but there is some evidence that the majority of them are from the fourteenth century.

The Jeddito-Sikyatki components all are small, the amount of Hopi pottery found at them is sparse, and no structures other than a few firepits can be assigned to them. Clearly the occupation of the region during Pueblo IV times was confined to brief stays by small parties travelling rapidly into or through the region. The sites tend to be in the open, are generally on the canyon floor or in otherwise unelevated positions, and usually occur in the broader, more open parts of canyons. Deeply entrenched canyon areas seem to have been avoided. The distribution of sites (Fig. 11) suggests that some may be associated with an old trail that runs from the Navajo Mountain area north across the Red Rock Plateau.

The Pueblo IV Hopi utilization of the Red Rock Plateau obviously did not involve farming, but the precise motivation for the visits is not entirely clear. Petroglyphs at a Hopi site in Moqui Canyon show hunting scenes; Turner's (1963) Hopi informants also suggested that the Pueblo IV travellers may have been visiting shrines, which probably were established during the Pueblo III occupation of the area by their ancestors. Hopi trading expeditions to the Southern Paiute are also documented in ethnography and cannot be ruled out as an explanation.
It is of course possible that the Red Rock Plateau was not itself the destination of the Hopi parties; they may simply have been passing through on their way to other areas. It seems likely to me that travellers might detour into the Red Rock Plateau because of its relatively abundant and easily located sources of surface water.

GENERAL IMPLICATIONS

At the beginning of this study, I posed two related questions focused on different aspects of the relationship between Anasazi culture and the natural environment of the Red Rock Plateau. The first question directed attention toward the character of Anasazi adaptation during each of several phases of culture, and especially toward the ways in which these successive adaptations were reflected in settlement and subsistence patterns. The second question led to investigations of the role of environmental variables in the region's culture history--particularly in the alternation of periods of occupation and abandonment. The preceding sections of this chapter detail the specific conclusions, hypotheses, and speculations generated in my attempts to answer these questions. In the following few paragraphs, I discuss several of the more general implications of my conclusions, implications that extend beyond the specific answers given to the questions that directed the study.

The first point I wish to make is that in studies of cultural adaptations, both the environment and the culture must be considered as part of a single ecosystem. Neither the environment nor the culture alone is sufficient to explain the character of the adaptation; the
properties of both must be specified. For example, the occupation of the Red Rock Plateau by Anasazi farmers seems to have been limited by an environmental variable—the current precipitation regime. The White Dog, Klethla, and Horsefly Hollow occupations apparently occurred during times of normal to above-average moisture, and all were followed, and perhaps terminated, by severe droughts. This indicates that the region probably could not be inhabited by Anasazi farmers during major droughts. Prolonged dryness probably so depleted the surface and ground water supplies of the region that farming became extremely risky. Given enough moisture to allow settlement in the region, however, there was considerable leeway for differing adaptations. The differences between the Basket Maker and Pueblo adaptations to the region, as reflected in their settlement patterns, do not seem to be due to changes in the region's environment, but to cultural differences. The Basket Makers of the White Dog phase, although part-time farmers, also depended heavily on certain wild foods which occur most abundantly in the highlands. Therefore they were well adapted only to those parts of the Red Rock Plateau which provided both the opportunity for farming in the canyons and for easy access to the adjacent highlands. The Klethla and Horsefly Hollow phase Pueblos, on the other hand, were more dependent on farming, and hence could adapt to most of the canyons where cultivable soil and water were found, without regard for their proximity to the highlands. Consequently, the Pueblo occupation of the region was much more extensive than the Basket Maker occupation.

A further characteristic of the systemic relationship between
culture and environment is that the effect of a particular cultural change on adaptation will vary with different environmental conditions, and likewise, a particular environmental change will have different effects if the cultural conditions vary. For example, the onset of a severe drought, which would probably have sufficed to drive farmers out of the Red Rock Plateau, may not have had any effect at all on the use of the region made by Anasazi during the Jeddito and Sikyatki phases. During these phases, occupation was confined to brief visits by small parties of travellers, who needed only to find a few springs or water-filled potholes to survive. Also, periods of above-average moisture seem to have resulted in occupation of the Red Rock Plateau by Pueblo farmers only after population in the surrounding regions had grown to the point where all the more favorable environments were already inhabited and were thus closed to new occupation.

Another implication of this study of culture and environment has been that the Red Rock Plateau, although a relatively well-defined and distinctive physiographic area, cannot be considered in isolation in a study of the history of adaptation of its cultures. These adaptations can be understood only if the region is viewed as part of a much larger ecosystem including at least the surrounding highlands. The Anasazi who occupied the Red Rock Plateau at various times retained cultural ties with the surrounding regions from which they had come, and to which, in some cases, they returned. Cultural trends that occurred in these adjacent regions usually also appeared in one form or another in the Red Rock Plateau if it was occupied, and environmental changes that affected the inhabitants of adjacent highlands in many cases also
had repercussions in the canyons of the Red Rock Plateau. I have postulated, for example, that the reason the Horsefly Hollow occupation of the region was heavier than the Klethla occupation is that during Horsefly Hollow times, a cooling trend and arroyo-cutting had reduced the habitable area of some of the adjacent regions sufficiently to put great population pressure on the remaining habitable canyon lands, such as those of the Red Rock Plateau.

The weakest part of this study is probably the speculative treatment of Anasazi settlement in some of the adjacent highland regions. Most of these areas are still not well enough known to allow firm conclusions to be drawn about their relative population sizes and patterns of settlement at various periods. Some of the hypotheses presented in this volume regarding causes of shifts in settlement and in patterns of adaptation in the Red Rock Plateau can only be tested by further fieldwork in these adjacent regions.
Appendix 1

THE POTTERY CLASSIFICATION

The classification used here is basically the one presented in the Museum of Northern Arizona Ceramic Series (Colton 1955, 1956; Abel 1955). This typology was also followed in the initial identification of the pottery as reported in the various excavation and survey reports dealing with Red Rock Plateau sites (Fowler 1959a and b, 1961; Weller 1959; Lister 1959, 1960; Lipe 1960; Lipe et al. 1960; Sharrock et al. 1961a and b, 1963; Sharrock 1964; Day 1963, 1964). During the life of the Glen Canyon Project, the customary procedure was for the pottery to be classified and the reports written during the fall and winter following each field season. Over the years, the application of the various type descriptions varied slightly, both explicitly and implicitly. Additional distinctions below the type level (for example, "Mancos Corrugated, sand temper") were used in some years, but not in others. The allowable range of variation in a type category was sometimes shifted from one year to the next. Furthermore, several different individuals had a hand in classifying the pottery during the five-year period.

In 1962-63, when I decided to undertake comparison of pottery collections for the purposes of phase identification and dating, I felt that I should review the classification and make it more consistent. In doing this, I limited myself to the larger collections, and eventually settled on the sample of 57 sites mentioned above. As previously noted, I also omitted from consideration rare trade wares and a
number of descriptive categories that were set up for the small number of specimens that could not be related to existing types.

Upon briefly surveying the collections, I concluded 1) that in most of the type categories, most of the identifications had been accurately and consistently made, 2) that the major problems in consistency of identification were in the gray wares, and 3) that I could introduce some additional distinctions that would be useful in the comparisons I wished to undertake. I felt these conclusions were warranted because I had a perspective on the entire five seasons' collections, and also had access to new findings made in surrounding areas during this period by archeologists of the University of Utah, Museum of Northern Arizona, and the Wetherill Mesa project.

The result of my review of the pottery classification is that some of the type labels and type frequencies that appear here differ from those of the original site reports. In the following paragraphs, I list the types used to date the sites (Figs. 7-8; Table 4) and briefly discuss divergences from the original published classifications in use of diagnostic criteria, labels, and/or the assignment of specimens. I also note which types were combined in Fig. 7 for the sake of economy in tabulation, and remark on the appropriateness of these combinations. My lack of comment upon a type indicates I made little or no change in the category definition originally applied or in the assignment of specimens to it.

**Tusayan Gray Ware, Tsegi Series**

**Tusayan Corrugated.** Included in this category are a small number of sherds of Tusayan Corrugated, Coombs Variety (Lister et al. 1960), which is intrusive and probably
originates in the area around Boulder, Utah. Additionally, a few sherds were removed from this category and placed in Mesa Verde Corrugated, Loper Variety, and a fairly large number were taken from Mancos (Mesa Verde) Corrugated and reclassified as Tusayan.

The body of material here included in this type is relatively homogeneous, probably not having as much variation as Colton's (1956) type description would allow. It also is fairly distinctive, though of course grading off into the other sand-tempered corrugateds—Moenkopi Corrugated on the one hand and the Loper Variety of Mesa Verde Corrugated on the other.

The Tusayan Corrugated specimens differ from those of Moenkopi Corrugated by having neat and regular (though usually rather shallow) indentations, generally narrower coils, and a wide-mouthed bag-like form without an everted rim. They differ from Mesa Verde Corrugated, Loper variety, in being thinner, and in having shallower indentations, a much cleaner more sharply fracturing paste, and the distinctive vessel form noted above. Another distinction sometimes useful in this comparison is that in many of the Tusayan Corrugated examples, the interior surface has a rough "pimpled" appearance due to bumps raised by large grains of sand temper. The sand grains usually retain a thin cover of paste.

Moenkopi Corrugated. Very few additions to or subtractions
from this category were made. Moenkopi differs from Tusayan Corrugated in having broader coils, often partially obliterated, and is unindented or with only very shallow or irregular indenting. Jar forms are predominantly globular, with a sharply out-turned or everted rim. It is my impression that in the original classification there was a tendency to place most of the sloppily-made sand tempered corrugated sherds in this category, regardless of other characteristics. It is true that Moenkopi is in general more poorly finished than Tusayan or Mesa Verde Corrugated, but this is not its most important typological attribute. I believe that the assignment of specimens to this type could have been improved somewhat, but I did not have the time for the intensive re-examination this would have required.

**Kiet Siel Gray.** This type grades into Moenkopi Corrugated, from which it is distinguished by the fact that traces of its coils have been obliterated. I reclassified as Kiet Siel Gray a number of sherds originally placed in Chapin Gray, an early Mesa Verde branch type. These sherds, mostly from the 1961 excavations (Sharrock et al. 1963) are sand tempered and differ in no important way from other Red Rock Plateau material classified as Kiet Siel Gray. Chapin Gray, as originally defined (Abel 1955), is tempered with crushed igneous rock and has vessel and rim forms that contrast strongly with those
of Kiet Siel Gray. The sand tempered plain gray sherds in question here were apparently classified as Chapin Gray because 1) some of the decorated and corrugated pottery with which they were associated clearly belonged to the Mesa Verde tradition, 2) it already seemed clear that much of the sand-tempered corrugated pottery (what is herein called the Loper variety of Mesa Verde Corrugated) was identical in other respects to the crushed rock-tempered Mesa Verde Corrugated, and 3) it was therefore postulated that the same relationship (differently tempered variants of the same type) would be present in the plain gray pottery.

I decided to reject this last conclusion for the following reasons. First, the rock-tempered plain gray occurred in much smaller quantities than the sand-tempered variety. Second, the sand-tempered plain gray was very rare in "pure" Mesa Verde sites such as Loper Ruin, while being abundant in sites having a mixture of Kayenta and Mesa Verde pottery, or where Kayenta pottery was heavily predominant. Hence, it did not seem to be a part of the Mesa Verde element in the Horsefly Hollow phase ceramics. Third, as previously noted, the sand-tempered sherds in question did not seem to differ in tempering, rim form, vessel form, or any other characteristics from material classed as Kiet Siel Gray, so that their inclusion in Chapin Gray would be only on the
basis of association with other types, a procedure that does violence to any kind of systematic comparison of collections by type frequency and pattern of occurrence (see Dempsey and Baumhoff 1963: 499 for further discussion of this point.)

Tusayan White Ware, Kayenta Series

Black Mesa Black-on-white.

Sosi and Dogoszhi Black-on-white. These were combined for purposes of economy in preparing Fig. 7. They seemed consistently to occur together in the Red Rock Plateau, as they are reported to do elsewhere. Sosi was nearly always much more abundant than Dogoszhi. Few changes were made in the original assignment of specimens to these categories.

Flagstaff Black-on-white.

Tusayan and Betatakin Black-on-white. These types were combined following the suggestion of Ambler et al. (1964: 70-1) that Betatakin Black-on-white is most usefully viewed as a normal late variant of Tusayan Black-on-white, which was in any case the much more common of the two in the Red Rock Plateau sites.

Kayenta Black-on-white, Kayenta Polychrome, and Kiet Siel Polychrome. The two Tsegi Orange Ware types were combined with Kayenta Black-on-white because outside the Red Rock Plateau, all three usually occur together in sites of the late Tsegi phase; that is, they appear to be
equivalent to one another as temporal horizon markers. In the Red Rock Plateau, all three types were seldom present at a single site, but this probably reflects only difficulties of sampling (all three are quite rare in the region) rather than a different pattern of association. These types are very distinctive and difficult to confuse with others; the assumption that their dates and cultural associations are the same in the Red Rock Plateau as in northeastern Arizona seems warranted because specimens from both areas seem typologically identical.

Unidentified Tusayan White Ware. This category principally includes unpainted sherds, as well as a few painted specimens in which the design was too fragmentary or indeterminate to allow typological assignment.

Tsegi Orange Ware.

Medicine Black-on-red and Tusayan Black-on-red. Medicine Black-on-red, which in general has its highest frequency in the Black Mesa rather than the Klethla phase, was very rare in the Red Rock Plateau sites, occurring principally in sites where Tusayan Black-on-red was abundant. Since the two types occur together and are obviously closely related, they were combined for economy of presentation. A small number of sherds originally classed as Tusayan Black-on-red were reclassified as Dogoszhi Black-on-red by applying Colton's definition of the
latter type rigidly. (Basically, Dogoszhi differs from Tusayan in having a partial rather than an all-over red slip. Ambler et al. 1964: 76-7 treat it as a late variety of Tusayan Black-on-red.)

Cameron and Citadel Polychrome. Citadel was uncommon, and Cameron extremely rare in the collections studied. I combined the two types because they are rather closely related, and to simplify the presentation. (This was probably a mistake, in view of their nearly complementary distribution in time - see Fig. 8 and Table 4.) In looking over the sherds that originally had been assigned to Citadel Polychrome, I felt that some should have gone into other categories, mostly Tusayan Polychrome, so I reclassified them. Here I applied Colton's definition quite rigidly, excluding from Citadel Polychrome any bowl sherd that did not have all-over red exterior slip (unless the sherd was obviously from the bowl bottom) and the appropriate style of design.

Tsegi Black-on-orange, Tsegi Red-on-orange, and Tsegi Orange, rim sherds. The first two types have minimal amounts of decoration, and thus seem quite closely related to Tsegi Orange. All three types tended to occur together in the Red Rock Plateau sites, so it did not seem improper to lump them for the purposes of the graphical presentation (Fig. 7).

I confined the label Tsegi Orange to rim sherds
only, because body sherds of this type cannot conclusively be distinguished from sherds originating in the unslipped, unpainted areas of other types. This is a departure from the original classification, in which undecorated body sherds were sometimes included in this category.

**Tusayan Polychrome.** See Discussion of Citadel Polychrome.

**Dogozhí Polychrome.** See discussion of Tusayan Black-on-red.

**Unidentified undecorated Tsegi Orange Ware.** Despite the typological indeterminacy of these unslipped and unpainted sherds, I felt it would be useful, in a quantitative study such as this, to tabulate them separately from the equally unidentifiable but decorated specimens of this ware. I expected the frequencies of these two categories to differ in the two phases, because of the general trend of ceramic change in Tsegi Orange Ware. The earlier types made great use of red slip and overall painted decoration; the later popularity of polychromes and skimpily decorated types such as Tsegi Black-on-orange or entirely plain types such as Tsegi Orange left large areas of many vessels unslipped and without painted designs. Hence, in the Klethla phase, most of the typologically unidentified Tsegi Orange Ware sherds should bear red slip or perhaps part of a painted design; in the Horsefly Hollow phase, unpainted and unslipped sherds should be much more common in the "unidentified"
category. In general, these expectations were borne out, as shown by Fig. 7.

**Unidentified decorated Tsegi Orange Ware.** See above.

**Mesa Verde Gray Ware.**

Crushed rock tempered plain gray. Most of this material was originally classified as Chapin Gray, and essentially it is what was left in that category after the sand-tempered sherds were taken out (see discussion of Kiet Siel Gray). The rim and vessel forms and modes of finishing displayed by these remaining rock-tempered specimens do not conform to Abel's (1955) description of Chapin Gray, so their classification under this label seems unwarranted. Abel (*ibid.*.) points out that a small number of plain gray vessels of unnamed type continued to be made on the Mesa Verde during Pueblo II and III times, and that their shaped were generally those of the associated corrugated types. Morris (1939: 193) noted similar vessels in the La Plata area, and considered them as "variants of corrugated ware." The specimens I am dealing with here probably represent material like that observed by Abel and Morris.

**Mesa Verde Corrugated, Mesa Verde variety.** Nearly all the material in this category was originally called Mancos Corrugated, on the grounds that much of it was deeply indented, with a few pieces showing patterned corrugation, such as alternating bands of plain and pinched
coils. These are attributes listed by Abel (1955) as characteristic of Mancos Corrugated, but they are by no means uncommon in the later Mesa Verde Corrugated. In general, the modes of corrugation shown by the specimens here being considered fall well within the range of variation in Mesa Verde Corrugated (Arthur Rohn, personal communication), while "diagonal ridged" corruga-
tion, typical of Mancos Corrugated only (Hayes 1964: 49) does not appear.

Furthermore, the shift from the earlier Mancos to the later Mesa Verde type was marked by a diagnostic shift in vessel and rim form (Morris 1939: 196; Abel 1955 Hayes 1964: 48-50). Mancos Corrugated has a bell-shaped mouth nearly as wide as the vessel's maximum diameter, no clearly pronounced neck constriction, and gently curving sides that meet in a rounded to conical bottom. Mesa Verde Corrugated, on the other hand, has a relatively narrow mouth, a definite flaring (though not horizontal) rim, and a definite change in curvature at the point of maximum diameter, which lies somewhat below the midpoint of the vessel's altitude. Morris (1939: 196) likened this form (his "late Pueblo III Corrugated") to a "plump egg stood on the blunter end, truncated near the tip."

All the whole vessels and virtually all the rim sherdsof crushed rock tempered corrugated pottery from
the Red Rock Plateau showed forms typical of Mesa Verde rather than Mancos Corrugated. Hence, it seemed reasonable to change the label on this material to Mesa Verde Corrugated. The appended "Mesa Verde variety" is necessary to distinguish it from the sand tempered Loper variety described below.

**Mesa Verde Corrugated, Loper variety.** The taxonomic status of the Mesa Verde branch corrugated pottery is not entirely clear. Provisionally, I have distinguished between Mesa Verde and Loper varieties of Mesa Verde Corrugated. The former has the standard crushed igneous rock temper, while the latter is tempered with coarse sand or (perhaps) crushed sandstone. Otherwise both varieties are quite similar, sharing the distinctive vessel form and the deeply and regularly indented pattern of corrugation noted above in the discussion of the Mesa Verde variety of this type.

Because Tusayan Corrugated is also sand-tempered, there is the possibility of confusing it with the Loper variety of Mesa Verde Corrugated. This is one reason I used a rather narrow definition of Tusayan Corrugated, emphasizing attributes other than tempering (see relevant section above). The Loper variety contrasts with the Red Rock Plateau Tusayan Corrugated in generally having more deeply indented corrugation, thicker vessel walls, a much dirtier, more roughly-fracturing paste,
and the "egg-shaped" form with a flaring rim. Also, the backs of Loper variety sherds often are crackled so that the grains of sand temper show through, but the grains seldom protrude above the level of the surface. The "pimpled" appearance common on Tusayan sherds is rare on Loper variety specimens.

The Loper variety corrugated was assigned to Mesa Verde Corrugated not only because it is formally very similar to it, but because it consistently appeared in sizable amounts in components where virtually all the other specimens were in the Mesa Verde tradition (as, for example, at Loper Ruin and the Horsefly Hollow components of Steer Palace). Further evidence of its branch affiliation comes from the Beef Basin sites about 40 miles northeast of the Red Rock Plateau; these sites yielded Mesa Verde pottery to the virtual exclusion of other traditions (Rudy 1955). When I examined samples of corrugated pottery from two of these sites (227 sherds from Sa37 and 363 sherds from Sa45), I found that the sand-tempered Loper variety made up 51 percent of the first sample and 61 percent of the second. The remainder of the sherds were of the rock-tempered Mesa Verde variety of Mesa Verde Corrugated. In general, the ceramic complex at these sites is very similar to that of the Mesa Verde-dominant sites from the Red Rock Plateau.
In a few of the southern Red Rock Plateau sites, such as Rogers House (Sa554) and Fence Ruin (Sa377), the Loper variety of Mesa Verde Corrugated occurred in pottery assemblages that were heavily Kayenta dominated, with few other specimens of the Mesa Verde tradition. Also, at the Museum of Northern Arizona in Flagstaff, I saw a few vessels classified as late Tusayan Corrugated that in form and mode of corrugation closely resembled my Loper variety of Mesa Verde Corrugated. These vessels were from sites at which there was virtually no Mesa Verde tradition painted pottery or crushed igneous rock tempered corrugated (Lindsay, personal communication). It therefore seems probable that in the late Pueblo III period, along with the more popular Moenkopi and Kiet Siel types of gray ware, Kayenta potters were producing a few deeply-indented, egg-shaped vessels quite similar to the sand-tempered variety of Mesa Verde Corrugated I have recognized.

One might conclude, after a thorough survey of a larger area than I have taken up, that these kinds of pottery are indistinguishable except by context and should therefore be given a single label, but one that does not imply branch affiliation. Whatever the future decision on this, the evidence from the Red Rock Plateau leads me to the conclusions I have indicated above, to wit: 1) The Loper variety of corrugated gray ware,
although sand tempered, has a close formal resemblance in other attributes to Mesa Verde Corrugated, appears on a late time horizon, and is generally in association with other ceramics of the Mesa Verde tradition. 2) This variety contrasts formally in a number of attributes with the local Tusayan Corrugated, which is more common on an earlier horizon and generally is closely associated with Kayenta branch types.

San Juan White Ware

Mancos Black-on-white. Relatively few specimens were assigned to this type, and the assignments often were not made with great confidence, since most of the sherds dealt with were small, making it difficult to reconstruct mentally the overall design pattern. The principal attribute which these specimens share and in which they contrast to the other Mesa Verde pottery is the presence of mineral (iron) rather than organic paint. Since mineral paint was occasionally used in later types (Abel 1955; Hayes 1964: 70), some of the specimens here classed as Mancos may instead be aberrant examples of McElmo or Mesa Verde Black-on-white.

Mesa Verde White Ware

Mesa Verde Black-on-white, Loper variety. Most of this material originally was classified as McElmo Black-on-white. It clearly does not conform to Abel's (1955) description of Mesa Verde Black-on-white, but neither,
in my opinion, does it closely resemble McElmo Black-on-white as described by either Abel (1955) or Hayes (1964: 65-9). Because the general design layout and choice of motifs seemed to me closer to the Mesa Verde than to the McElmo type, I decided provisionally to consider this material a local variety of Mesa Verde Black-on-white.

The Loper variety of Mesa Verde Black-on-white differs from the Mesa Verde variety of this type in the following ways: 1) It usually has a thin, uneven, soft, chalky white slip, instead of a thick, smooth or crackled, hard, polished one. 2) It seldom has painted designs on the outsides of bowls. 3) Rims are not so often either squared or "ticked." 4) Some of the design modes used are uncommon in the Mesa Verde area proper (Rohn, personal communication). 5) The paste is generally of a darker gray. 6) The variety of forms is smaller, with mugs, ladles, and kiva jars being rather rare.

The two varieties resemble one another in having 1) paste tempered with crushed sherds, occasionally with additional small amounts of crushed igneous rock; 2) black designs executed predominantly in organic paint; 3) a number of shared design motifs, and 4) a predominance of encircling band design layouts on bowls, many of which include one thick and several thin encircling stripes just below the rim.
Although the Loper variety seemed to be heavily predominant in all the Red Rock Plateau collections where Mesa Verde Black-on-white appeared, it probably would have been possible to identify a small proportion of specimens as belonging to the Mesa Verde variety. I have no doubt that some items should also have been classed as McElmo. I did not have time for the systematic restudy of all the collections that would have been required to do this on a consistent basis, and I do not think the information gained would have contributed a great deal to this study. Hence, all specimens of organic-painted Mesa Verde tradition black-on-white pottery were assigned to the Loper variety of Mesa Verde Black-on-white.

This variety also seemed to be dominant in the painted pottery from the Beef Basin collections I examined. Rudy (1955), writing before Abel's study had appeared, classified the bulk of his painted pottery as Mancos Black-on-white (although recognizing that most of it had mineral paint) and the rest as Early Mesa Verde Black-on-white. He considered classifying the bulk of the collection as McElmo Black-on-white, but rejected this alternative because there was at that time no adequate published description of the type (ibid.: 84).

Unidentified Mesa Verde White Ware. This category includes sherds from the unpainted portions of black-on-white
vessels. The few San Juan White Ware specimens that were encountered were lumped together with Mesa Verde White Ware for economy in tabulation.
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