THE HOUSEHOLD IN TRANSITION: SPATIAL ORGANIZATION OF
EARLY ANASAZI RESIDENTIAL-DOMESTIC UNITS,
SOUTHEASTERN UTAH.

Volume One

By
Karen M. Dohm

A dissertation submitted in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

WASHINGTON STATE UNIVERSITY
Department of Anthropology

DECEMBER 1988

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"It is very seldom that we can tell our friends exactly what we think of them"
Barbara Pym¹

Numerous individuals have contributed to this dissertation. Not all of them are named here and embarrassment at the possibility for becoming maudlin prevents me from writing exactly what I think of any of them.

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THE HOUSEHOLD IN TRANSITION: SPATIAL ORGANIZATION OF EARLY ANASAZI
RESIDENTIAL-DOMESTIC UNITS, SOUTHEASTERN UTAH

ABSTRACT

by Karen M. Dohm, Ph.D.
Washington State University

Chairperson: William D. Lipe

This study examines the spatial organization of residential-domestic units in two early periods (covering ca. A.D. 200-725) of the Anasazi tradition, in the American Southwest. It asks whether or not there is evidence that observed changes in the spatial organization of Basketmaker II and Basketmaker III period residential-domestic units can be explained by subsistence intensification and/or increased sedentariness. Architectural attributes, artifact assemblages, and spatial placement of artifacts and features from 24 residential-domestic units form the data base. The data base is principally from surface archaeological survey on Cedar Mesa, southeastern Utah.

The spatial organization of Basketmaker II residential-domestic areas is found to be similar to that of later Anasazi residential-domestic areas. Changes between the Basketmaker II and Basketmaker III periods in this traditional spatial organization support an inference that there was subsistence intensification between the two periods, but are inconclusive with regard to increased sedentariness.
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CHAPTER 1

INTRODUCTION

This study examines the spatial organization of residential-domestic units in two early periods of the Anasazi sequence in the Southwestern United States. The residential-domestic unit is defined here as the archaeological manifestation of the household. The main causes of predictable change in residential-domestic area (R-D area) spatial organization may be seen as the effect of changes in subsistence, scale of economy, sedentariness, local population density (or nucleation), and tradition. This study asks whether there is evidence for predictable change in the spatial organization of residential-domestic units of Basketmaker II (BM II) and Basketmaker III (BM III) period occupations on Cedar Mesa, southeastern Utah. And, in particular, this study asks whether change is explainable by subsistence intensification and/or increased sedentariness. While these are not the only factors which might affect residential-domestic area spatial organization, they are addressable as discrete questions with the data available from Cedar Mesa. Expected effects of increased intensification will be taken up first, followed by expectations for effects of increased sedentism.

It is clear that the subsistence system changes during the Anasazi periods. Presumably ancestral Archaic cultures have little agriculture compared to historic period Puebloans. Both BM II and BM III groups were horticulturalists. Change in the subsistence system of these groups is expected to be in degree, rather in than in the type of subsistence system.

It is also clear that there are changes in the settlement system
Figure 1. Cedar Mesa, Southeastern Utah, showing project area.
during the Anasazi periods and that some of these are related to aspects of sedentariness—degree of residency and duration of occupation. Southwestern Archaic period settlements seem briefly occupied in all senses of the word and historic period Pueblo sites seem relatively sedentary. Although Dean (1969) suggests that the great permanence of modern Pueblos is an accident of history, he also indicates that even prehistoric Pueblos show both seasonal stability and permanence which sometimes even extends across generations. As with the subsistence system, changes in the Basketmaker settlement system are expected to be changes only in degree. Both BM II and BM III groups maintain their RD units for most of the year and for several years.

In reviewing change in the Anasazi tradition, as a whole, the facile explanation is that change in the Anasazi periods was slow and gradual (Simmons 1986; Woodbury and Zubrow 1979) or at least unidirectional (M. Berry 1982, 1985). That unidirectional change is taken to have been towards increased agriculture and increased sedentariness, made necessary by regionally increased population (or by climatic deterioration that circumscribed groups, thus increasing population density). Either may have increased subsistence costs. If increased costs, increased agriculture, and increased sedentariness all occurred together and at the same rate (whether rapid or slow), our usual explanations are probably sufficient. However, it is not clear that increased costs, increased agricultural dependence, and increased sedentariness all occurred together; nor is it clear that any change in these occurred rapidly or even at all between the two Basketmaker periods. Changes in R-D areas that are consistent with changes in sedentariness and subsistence
intensification may therefore provide indirect evidence of changes in these factors.

Because the household area is the most basic space in which social behavior takes place, the residential-domestic unit should be the best place to study economically caused changes in the spatial organization of feature and artifact distributions. It is clear that along with other cultural changes, some attributes of R-D areas change between BM II and BM III, although these differences have never been subjected to systematic analysis. In this study, I document a number of differences (and similarities) between Cedar Mesa BM II and BM III R-D areas and ask if the differences can be related to change in patterns of subsistence intensification and sedentariness.

Data used in this study are principally from archaeological survey, and secondarily from test excavations. Most of the data come from the Cedar Mesa Project (Lipe and Matson 1971; Matson and Lipe 1978; Matson et al. 1988). Cedar Mesa is located just north of the San Juan River, in southeastern Utah. In the mesa top survey, a random sample of quadrats within five drainages were selected (Figure 1); chosen quadrats were intensively surveyed and mapped with all artifacts collected for subsequent analysis (Matson and Lipe 1975). Additional data come from excavations at judgmentally selected sites, conducted as part of the Cedar Mesa Project in 1972 and 1973, and more intensive excavations in 1984 at one of the tested sites. Further data are from excavations by William Lipe in 1969 and 1970, in the same area (Lipe 1978).
Intensification

It is curious to observe how differently these great men estimated the value of every kind of knowledge.

Thomas B. Macaulay

The first of two hypotheses addressed in this study is that the differences between Basketmaker II and III period residential-domestic areas (R-D areas) on Cedar Mesa, southeastern Utah reflect intensification of the subsistence economy. As stated above, it is clear that the subsistence system changes during the Anasazi periods from having little agriculture during the Archaic Period to having much more agriculture in the historic period Pueblos. Some archaeologists believe the Basketmaker II pattern is more similar to that of the Archaic (e.g., Irwin-Williams 1973; F. Plog 1974), others that it is more similar to the Pueblo pattern (e.g., Matson 1988).

To agree on whether or not there is evidence for intensification between the Basketmaker periods requires that we agree on the meaning of intensification. This study uses a cost-based definition. It is presented below.

While both BM II and BM III groups were clearly cultivating corn (as, indeed, were late Archaic groups), it is unclear what percent of their diet came from domesticates and what percent from wild foods. Wild foods certainly remained part of the Anasazi diet into the historic Pueblo periods. Since the importance of wild foods cannot be discounted, some aspects of hunter-gatherer intensification models may be important to understanding intensification within these low intensity horticultural

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1 Essay on Bacon and Plato.
systems. Therefore, both hunter-gatherer and horticultural intensification are discussed in this section.

**Intensification Defined.**

"Intensification" has various definitions. Its definition may be based on cost, on yield per unit of land, or on relative dependence on some sector of the economy. The cost-based definition says that to intensify is to expend more energy to produce a higher standard of living or to maintain the same standard of living. A production-based definition says that to intensify is to get a greater yield per unit land than was previously obtained. A dependence-based definition says that to intensify is to exploit relatively more of some resource than was utilized before.

Johnson and Earle define intensification of food production as trends which "increased the amount of labor devoted to procuring food" (Johnson and Earle 1987:59). Although their definition of intensification is specifically tied to population increase, it does not need to be. Theirs is a cost-based definition. A cost-based definition of intensification is used here because it is the broadest definition. Also, costs underlie the other definitions, although sometimes only implicitly. Finally, cost-based definitions are more accessible to archaeologists working in R-D areas than are measures based on yield per unit land or on estimates of relative dependence on any given resource.

The breadth of a cost-based definition of intensification is such that it can be applied either to change in hunter-gatherer subsistence systems or to change in agricultural subsistence systems. When hunter-gatherers intensify it usually means that the number of items collected increases relative to the calories procured. However, this implies
nothing about the yield per unit of land nor about the sector of the economy from which calories are derived. For instance, in a review of Mesolithic hunter-gatherers making the transition to farming in Europe, Zvelebil argues for specialization in resource rich environments and diversification in resource poor environments (Zvelebil 1986b:171). In either case, the labor expenditure of the hunter-gatherers is increasing while the yield per unit land or reliance on some particular resource may be unpredictable. In contrast to hunter-gatherers, farmers who intensify are usually increasing the yield per unit of land.\textsuperscript{2} However, when they attempt to increase yield, their costs may be expected to rise, regardless of whether or not they are successful in increasing production per unit land. They may attempt to increase yields per unit of land either by diversifying crops or by concentrating on fewer types of crops. For example, use of economic weeds, as well as of intercropped cultivars, represent types of diversification that may increase yields (e.g., see Ford 1981, 1985; Petersen et al. 1987). In sum, the cost-based definition of intensification is applicable to the broadest variety of subsistence systems.

The cost-based definition is not only broader than other definitions of intensification, it also underlies other definitions, including those based on productivity. Productivity refers to biomass or crop yield over the annual cycle or over some longer period of time. E. Odum differentiates this from standing biomass or the standing crop present at any given time, although he suggests that the differences may be minor "where organisms are large and living materials accumulate over a period

\textsuperscript{2} Farmers do not always attempt to increase yields per unit land. For instance, Hack describes the Hopi pattern as one in which farmers increase the number of garden plots, locating plots in several microenvironments to insure some acceptable harvest (Hack 1942).
of time without being utilized (as in cultivated crops...)" (E. Odum 1971:44-45). Still, there is a difference, and this is, perhaps, the basis of Boserup's (1965) definition of agricultural intensification which rests on the number of crops harvested per year. While Boserup is vague in her 1965 monograph (but see Boserup 1981), Odum makes a careful inclusion of "energy subsidies" in his discussion of productivity. Citing Bennett and Robinson (1967:397-398), Odum says that the "U.S. produces about three times as much food per hectare as Asia and Africa but at a cost of 10 times as much very expensive auxiliary energy" (1971:47). Similarly, Ellen says that total energy expenditure of a population varies by subsistence pattern and that, "There is a more marked increase in effort as subsistence techniques intensify if all energy inputs (including animal and mechanical traction) are considered. This is also the case if energy expenditure is calculated per food producer (M. Harris 1971:252-253)" (Ellen 1982:134). The concept of increased cost is central to all these studies of intensification.

There is one exception. Sometimes inventions may allow increased yields or increased productivity without increasing costs. While a productivity-based definition would include these rare phenomena as intensification, a cost-based definition does not. More frequently, good inventions increase productivity relative to costs, but costs still rise. The use of these latter inventions does represent intensification.

Besides being the broadest definition and underlying other definitions, a cost-based definition of intensification is most

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3 Ellen adds that energy expenditure per food producer "reflects social division of labour much more than technical necessity" (Ellen 1982:134). Social division of labor suggests not only social organization but also the importance of production to the group in question. To omit the time and energy that individuals and groups are willing to expend is to overlook their own estimation of the product's importance.
appropriate to this study. Increased energy investment in production may be expected to correlate with changing investment in processing and storage facilities in R-D areas (that is, with investment in more expensive technology or capital improvements). Therefore, attributes and spatial arrangements of processing and storage facilities and artifacts should reflect subsistence intensification. There is no similar correlation for increased yield per unit land. Use of a productivity definition of intensification would require additional information about actual plots of land cultivated and about regular catchment areas for collecting foods. Definition of intensification as increased dependence on some sector of the economy would require the ability to differentiate the exact functions of storage structures and processing paraphernalia. Identification of these functions is not available from survey data and probably would not be available from excavation data. Therefore, a cost-based definition of intensification is most useful to this study.

Intensification Among Hunter-Gatherers and Farmers

Both BM II and BM III groups are horticulturalists, so agricultural intensification models may seem most appropriate. However, reviewing hunter-gatherer as well as horticulturalist subsistence intensification studies has at least three benefits. First, it gives us more distant end points on the Anasazi subsistence continuum as checks for the comparison between Basketmaker periods. Second, we are provided with the separation of intensification from population increase. Third, comparison shows that energy expended in low intensity agricultural systems may not be much greater than energy expended in maintaining a hunting and gathering economy, even without much population pressure on the hunter-gatherers.
A Better Perspective on Change. It is easier to compare two low
intensity horticultural systems when they are viewed in the context of the
larger continuum of hunter-gatherers to moderate intensity
horticulturalists. Levels of intensity need to be considered on
continuous scales rather than on nominal scales. Groups from any segment
of the Anasazi tradition may be regarded as having practiced low to
moderate intensity horticulture and low to moderate intensity subsistence
systems in general. Anasazi groups may be more similar if they are
compared on levels of consumption of corn rather than on energy expended
in subsistence. Certainly this may be true for change between the
Basketmaker periods; change may not be great. Asking whether change
between the Basketmaker periods is significant (in a nonstatistical sense)
is to ask whether it is uniformly in the direction expected as part of the
longer continuum of an Archaic-to-Pueblo III and Pueblo IV subsistence
systems, in which the late Pueblo systems are presumed to have been more
energy expensive.

Removing Population From an Intensification Equation. Increased
local population density itself has considerable impact on R-D areas (see
Dohm 1987) and from this standpoint alone it is important to separate
population increase and intensification in the study of spatial
organization of R-D areas. However, it is also important to separate
population increase and intensification from a theoretical standpoint.

If population increases in all times and all places are part of the
natural order of things, then resource depletion is a certainty. If as
well, agriculture is everywhere and always more productive than hunting
and gathering, some conclusions may be drawn with certainty. For the
Southwest, if population increase is pan-regional from the PaleoIndian to
Historic Periods (as opposed to local increases with regional migrations—e.g., Cordell 1979; Berry 1982), then sometime during the Archaic period, hunter-gatherers approached carrying capacity. In this scenario, they must have turned first to simple horticulture and subsequently to intensified forms of agriculture in a mathematically predictable fashion. Then there is no reason to ask whether or not BM III groups had a more intensified subsistence system that did their BM II predecessors. They were later, therefore they did. While subsistence intensification would have been slow at first, it would have been inexorable and increasingly rapid to match geometrically expanding population. Although southwestern archaeologists generally find greater population late than early (e.g., Lipe 1983), population growth is neither steady nor regular (e.g., F. Plog 1979:113).

While there is evidence that the Cedar Mesa BM III population was greater than the BM II population, the estimated difference is small (Matson et al. 1988), and Cedar Mesa population densities remained quite low, at least relative to the estimated amount of arable land (Matson et al. 1988). Consequently, population increase from BM II to BM III cannot automatically be assumed to have been sufficient to promote subsistence intensification. It may have been.

The classic models of agricultural intensification suggest that it is tied to population increase (see Boserup 1965), and hunter-gatherers are widely thought to have turned to agriculture because of population pressure (e.g., Cohen 1977). However, other explanations are possible. For instance, recent data from New Guinea horticulturalists (Feil 1987) suggests population increase and subsistence intensification may occur separately, with intensification more directly associated with social and
ceremonial elaboration than with population density. Reduction of perceived risk may be an even more important causal factor in subsistence intensification.

Agricultural harvests are more readily manipulated than are harvests of wild foods. However, farming may require the expenditure of more hours per person per day than hunting and gathering, even when the hunter-gatherers live in marginal environments (e.g., Sahlins 1972; Lee 1968:37-40). As anthropologists have come to favor this idea, they have begun to explain the transition to agriculture as a forced response to population pressure and/or on perceived potential short-falls in wild food yields. Greater yield per unit area to feed an increased population has been the favored explanation whether applied to a world-wide pattern or to regional change. This explanation has faults, as well.

While Hayden (incorrectly citing Birdsell 1968:94 in Man the Hunter) suggests it is nearly impossible to accurately establish carrying capacity (Hayden 1975:12), others have been more sanguine. Cohen suggests that the world had become "saturated" with hunter-gatherers prior to sedentariness. His estimate is based partly on the presumption that preagricultural sites are largely temporary camp sites that are so infrequently preserved that population estimates are given a significantly low bias (Cohen 1975:472). For him, the transition to farming results everywhere from harsh necessity. His model is in direct conflict with that of Hassan (1975, 1981). Hassan says that small populations with a "short decision-making chain" and direct contact with the environment are likely to perceive any resource-population imbalance quickly--and take responsive action (Hassan 1981:174-175).
Not only do I find Hassan and Hayden's dismissal of population increase prior to cultivation appealing, I see there is recent evidence that intensification among horticulturalists may occur in areas of low population density. Feil's exposition on Highland Papua and New Guinea has particular significance. Especially reviewing works of Brookfield (Brookfield 1972; Brookfield and Hart 1971), he finds "there is often high intensity of production in areas lacking population pressure or high density, and vice versa" (Feil 1987:54). Citing Brookfield (1972:37-39), Feil indicates that agricultural production has been raised far beyond human subsistence needs. Much of the agricultural production is used in maintaining pigs which are necessary to social production (Feil 1987:58-59). Feil equates this with Sahlins' (1972) review of production for exchange as opposed to production for use, although that construct would imply that the "domestic mode of production" would be production for use, not for exchange. Sahlins wrote that production for use "is under no compulsion to proceed to the physical or gainful capacity, but inclined rather to break off for the time being when livelihood is assured for the time being" (Sahlins 1972:84). In contrast, "production for exchange (value) would constantly exceed itself: in the accumulation of a generalized 'wealth'" (Sahlins 1972:84).

More recent Marxist works apply production for exchange or social production even to hunter-gatherers. They suggest that while causes of subsistence change must be understood in terms of a specific historical trajectory (Friedman 1974), social requirements like those of alliance

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4 Whether prehistoric Southwestern farmers stored one year's crops or two year's crops need not discredit Sahlins's ideal. Bradfield writes regarding Hopi storage, "The fact that the household stores this year's crop and eats last year's does not, in the long run, affect the amount that has to be grown" (1971:21). Even if they must increase storage against a succession of poor harvests, some cut-off point may be expected for accumulation of storage to meet subsistence needs.
networks are sufficient to realize the potential surpluses of hunter-gatherer labor (B. Bender 1981:154). The important point for this study is that intensification without increased population pressure as a cause has been documented in some parts of the world. It is possible.

Removing the presumption of ever-increasing population pressure on resources (e.g., see Cowgill 1975; Hassan 1975; D. Harris 1978) frees us to consider a greater variety of conditions and scenarios under which intensification might occur. Population increase between BM II and BM III, though evidently slight on Cedar Mesa, may have promoted subsistence intensification. On the other hand, intensification may have occurred for other reasons, including attempts to reduce risk or to stabilize group membership by maintaining larger stores. The point of this review has not been to establish specific causes for intensification on Cedar Mesa, but to suggest that there are a variety of conditions under which it could have occurred. In the following chapters, then, changes in Cedar Mesa Project R-D areas are examined to determine if they are likely to have resulted from subsistence intensification.

Costs of Low Intensity Agriculture Relative to Costs of a Hunting-Gathering Economy. Comparison of costs for hunter-gatherers and horticulturalists makes two contributions. First, if we find that low intensity agriculture has little more expense than hunting and gathering, we may presume that hunter-gatherers may begin to cultivate crops even when they do not "need" to from a productivity standpoint. Second, if the differences in energy expenditure between hunting-gathering and simple farming are generally low, then the differences between two low-intensity

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5 However, Testart argues that unless the surplus is of small, lightweight items, they will be of little use even in this regard for mobile hunter-gatherers (Testart 1982:525-526).
horticultural systems will probably be even lower. Therefore, we may prepare ourselves for looking at equivocal results.

Incipient agriculture, or any low intensity agriculture, does not seem to have had energy requirements much greater than hunting and gathering. Boserup compares these investments by the number of operations required saying,

"For a population of hunter gatherers, who have gathered, processed, and consumed wild cereals or tubers, a shift to food production requires only one additional operation, that of sowing or planting, and no new tools if a simple long-fallow type of agriculture is adopted" (Boserup 1981:35).

Time/operations increase greatly when domestic animals are kept or when short fallow agriculture with plowing is practiced (Boserup 1981:Table 5.1). Therefore, while Boserup believes that the change to agricultural subsistence systems from hunting-and-gathering is a consequence of increased population, she also maintains that population stress at the point where hunter-gatherers shift to agriculture was probably not great and that the relief of such stress was not very costly (Boserup 1981:36).

**Intensification in the Upland Southwest**

The definition of intensification used in this study is based on costs. In the Upland Southwest, increasing costs commonly have been thought to result from increasing reliance on cultigens. However, broadening the subsistence resource mix is at least a theoretically possible form of intensification. Maintaining alternative strategies against the possibility of failure of cultivated crops would tend to mean that groups would continue some use of a relatively large number of resources, as well as investing effort on those resources whose harvests
they could manipulate (see Minnis 1985a; also Powell 1983). Even if Southwestern horticulturalists were largely dependent on their gardens for their subsistence we know that their gardens contained numerous ruderal as well as domesticated plant species (e.g., Ford 1981, 1985; Petersen et al. 1987). If the horticulturalists lived in areas with relatively low population densities, nearby areas of abandoned farmland and pristine or secondary growth woodlands would have offered additional resources (e.g., see Matson and Lipe 1978).

Models for early subsistence intensification in the Southwest, evidence for intensification, and evidence for subsistence mix change, are reviewed below as necessary background for this study. The focus remains on change in spatial organization of R-D areas. The question is whether the R-D areas of Cedar Mesa Basketmaker groups show evidence for intensification, especially in the form of concentration on a few plant foods, or evidence for any other change in subsistence resource mix that might have resulted in intensification.

Models for Subsistence Intensification in the Southwest. The underlying, implicit assumptions which have formed the archaeological basis for understanding subsistence change in Southwestern prehistory may be provided their best and most explicit theoretical framework by Earle (1980; also see Hastorf 1980). Earle’s model is driven by increasing population. For most strategies in a subsistence economy, Earle suggests that costs increase more rapidly than output, especially as the limit of resource availability is approached within a group’s territory. That is, hunter-gatherer economies suffer from diminishing returns. Since this seems less true for agriculture than for hunting and gathering strategies, Earle suggests that where movement was circumscribed by other groups,
there should be a tendency to increase agriculture (Earle 1980:15). Like the model of any cultural ecologist, Earle's model is sensitive to environment. Insofar as population density alters resource density of non-domesticated plants and animals, population alters environment (Earle 1980:19). In his model, population density can be inferred to alter cost curves (cf., Feil 1987).

Earle's model suggests that change in tools or production/organization is accepted if change reduces cost or increases maximum yield. For Earle, predictability is not at issue. Maximum yield as the definitive factor implies that population pressure is the prime mover (cf., Boserup 1965). This supposes that people increased the ratio of agriculture to hunting-gathering because of population pressure (or because they thought they risked approaching carrying capacity [Kaufman 1968]). And, Earle's population based model implies that there must be an inexorable pattern of increased subsistence intensification if population continues to increase. This is the implication most emphatically questioned by archaeologists seeing Anasazi subsistence adaptations as diverse responses to the subsistence risks imposed by temporal and spatial environmental diversity (e.g., Minnis 1985a; Elyea and Hogan 1983; Stuart and Gauthier 1983).

In the Southwest, evidence for increasing population during the Archaic is scant (but see Whalen 1973). While increasing population between BM II and BM III periods is commonly argued, even for Cedar Mesa groups (Matson et al. 1988), it is not clear that the increase is sufficient to support a stress based explanation for increasing use of

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6 Optimally, Earle suggested that groups shift labor allocations among alternative strategies, as each becomes less effective than another due to over-exploitation, in order to maintain an equilibrium in which the marginal costs of all strategies are equal (Earle 1980:15).
cultigens. On Cedar Mesa, for example, demand for cultivable land is far below that which is available, even under very conservative estimates of amounts of arable land. So, like Minnis (1985a), I would dismiss a population/resource stress model as inappropriate for explaining the adoption of early Anasazi agriculture, and by extension, I would dismiss it as the only source of intensification in the Basketmaker periods.

Between Basketmaker II and Pueblo III times, there is little solid evidence that corn increased as a proportion of the diet. Archaeologists are finding evidence for similar use of corn (and sometimes of other cultigens) in bones and coprolites of BM II or BM III and Pueblo II or Pueblo III Anasazi (e.g., Matson 1988). This does not preclude the possibility that more corn was grown in the later periods. While stable carbon isotopes in Mesa Verde skeletal samples between BM III and Pueblo III are unchanging, Decker and Tieszen (1988) suggest that maize production could have been increasing even if its consumption was not. The implications of this idea are that even in the absence of an increasing proportion of maize in the average daily diet, maize production could have increased in order to promote social alliances (e.g., through the hosting of feasts, etc.) or through increasing the average amount of stored maize as risk-buffering strategy. The latter would imply a shift away from a reliance on foraging if crops failed to an increased reliance on stored food. This might also be related to social factors, such as maintaining extended family or other local group aggregation even in times of difficulty. In the context of early farming in the Upland Southwest, these seem as likely explanations for increasing production as is

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7 In other North American areas, as in the Southwest, there is increasing evidence that cultigens had a steady level of importance throughout regional post-Archaic periods. Even in the eastern Woodlands, Fritz (1988) finds little change in maize consumption in the pre-Mississippian periods.
increased consumption demands from an enlarged (or even engorged) population. Both risk reduction models and models based on alliance networks offer alternative explanations for increasing production levels that are distinct from population pressure.

**Evidence for Intensification.** Evidence for agriculture may be either from botanical remains or chemical evidence from human bone (direct evidence) or from architecture, artifacts, or settlement pattern (indirect evidence). The presence of agriculture, and even the volume of agricultural production, is relatively easier to determine than its dietary or risk-buffering importance. A group may be "reliant" on agriculture for security, even when agricultural products provide a relatively small percentage of their total caloric intake (e.g., see Minnis 1985:316). Also, domesticates may represent only part of total garden produce—the rest being edible, perhaps encouraged, weeds (e.g., Petersen et al. 1987:154). Even when the importance of agriculture is addressed, the link between changing dependence on agriculture and social change or spatial and structural change within R-D areas may remain unclear since increasing investments in agriculture is only one form of subsistence intensification, albeit a likely one in this case.

**The Availability of Wild Foods on Cedar Mesa.** Reviewing wild plants recovered from nearby Natural Bridges National Monument (Table B.1, Appendix B) reveals a short list of plants ethnographically known to have been stored by various groups in the Southwest. These are the plants that could have contributed to intensification based on resource diversification and extensive land use. They include wild barley, two species of goosefoot, Sacaton grass, Indian rice grass, three species of amaranth, Rocky Mountain beeweed, berries of two species of juniper,
acorns of two species of oak, scurfpea, bulbs of a mariposa lily, yucca fruits, nuts from pinyon and ponderosa pines, Utah serviceberry fruits, and tomatilla fruits. Acorns, although they may be stored without preparation, must be kept very dry, effectively preventing storage in large surface or underground storage units. Ethnographically, in the intermontane West, they were stored in crooks of trees or hanging in bags (Buskirk 1986). Only the grasses, amaranth, possibly goosefoot, and two species of pine nuts can readily be stored in quantity without preparation, and pine nut harvests are highly variable.

Weedy annuals that grew up among domesticates as ruderal plants (cf., Petersen et al. 1985) in prehistoric Anasazi gardens or abandoned fields probably included amaranth, chenopods, mustard, portulaca, Physalis, and beeweed. These plants could have contributed either to a horticultural system or to a hunting-gathering economy (though the ground disturbance introduced by horticulture probably greatly increased their abundance in most parts of the Upland Southwest). In either case, storage of some probably occurred (as noted in the preceding paragraph) and while they are not presumed to have been the major subsistence resources, investment in collection and processing may have varied greatly by year. If their use increased greatly when agricultural harvests were low, it is appropriate to speak of horticulturalists still reliant on a kind of hunting and gathering.

The Potential Importance of New Cultigens to Production Costs and Total Yield. During the Basketmaker II and III periods, domesticates probably included only a subset of those indicated in Table B.1, Appendix B. Evidence of corn, squash, and in some areas, bottle gourds is common
in BM II sites. By the BM III period, common beans are common, as well (Ford 1985:351-353). All are recorded on Cedar Mesa sites.

Gardening generally produces a major harvest of one crop at a single point in time. It often also produces lesser harvests of other species at the same or several times. Among the Anasazi, many of the secondary harvests were probably of wild species but, even in BM II times, the domesticated species included at least squash in addition to corn. During the BM III period, beans became common as well. In comparing BM II and BM III period architecture the importance of beans, as well as maize, should be considered.

Beans are high in calories and can help to provide an important source of protein (they are only short one of the essential amino acids--see Carpenter 1981) and their production would not adversely affect a potentially important maize harvest. On the other hand, their storage requirements may be much more exacting than those of corn (see Expectation I.3 discussion).

Beans consumed with corn and lime offer to adults a protein complete in all amino acids. In general that protein is not digestible by infants or small children (Graham et al. 1979) and the digestibility to all individuals is low (Carpenter 1981); hence, beans are good for your heart. However, digestibility can be affected by the way in which beans are

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8 The literature review on beans presented here and in the chapter on expectations was a part of a flaccid attempt to translate differences in storage requirements into recognizable storage structure forms. None was found that was readily applicable to survey data and I have not updated the review since 1983. However, information on bean nutrients, intercropping, and storage requirements provide relevant background information in the consideration of new cultivars as a source of either intensification or increased residency at settlements.

9 Corn meal (whole, ground unbolted) has 1610 calories/pound. Common beans (mature, dry, raw) have 1542 calories per pound; pinto beans have 1556 calories. In comparison, all varieties of summer squash have 84 calories per pound; winter squash has 161 calories (Watt and Merrill 1963; also see Cordell 1984:Table 6.1). In terms of caloric yield beans closely approximate corn. By contrast, the thought of people intensifying by investing more heavily in squash production is appalling from a caloric standpoint.
prepared and cooked (Olson et al. 1982; Silva and Bragg 1982). So, beans can provide an important source of protein if properly prepared (also see Kaplan and Kaplan 1987 as referenced in Matson et al. 1988); under other circumstances they may offer little.

Intercropping beans with maize does not affect maize yields negatively (Serpa and Barreto 1981; Serpa et al. 1981), at least if the corn rows are widely spaced (Nadar and Rodewald 1979). In fact, beans probably increase maize yields. Among the general characteristics of arid and semi-arid zone soils is a low organic content, requiring nitrogen to improve crop yields (Grigg 1971:190). Where legumes are grown between cereal plants, cereal crop yields increase significantly even where the beans are harvested rather than left or used for in-field forage (Grigg 1982:76-77). So, planting beans among corn for the beans' potential protein (and flavor?) probably will not affect production of corn for its calories. In that regard, intercropping of corn and beans is not dysfunctional. The quantity of beans produced does tend to suffer, particularly where the bean-to-maize ratio is relatively low--perhaps because of decrease of light to bean plants as corn grows tall (see Gardiner and Craker 1981). Perhaps this lowered bean production in intercropped fields is more than offset by the increased resistance to disease possessed by beans grown in maize fields (see Rheenen et al. 1981).

The implications of the adoption of beans for subsistence intensification between BM II and BM III are as follows. A source of protein that is controllable through cultivation may have been attractive for risk reduction, given considerable unpredictability in the success of deer and bighorn sheep hunting, and cyclical fluctuations in abundance of
small game. The trade-off was increased costs in the horticultural part of the subsistence system, including increased costs from processing and storing, as well as cultivating, beans. If hunting became a less important strategy, this might have further promoted agricultural intensification by promoting increased sedentariness (especially increased residency). The following material reviews direct and indirect evidence which suggested that a search for change in intensification between Basketmaker periods might be fruitful, and then the evidence actually considered in this study.

Direct Evidence for Subsistence Change. At Cedar Mesa Basketmaker sites, direct evidence of foods has come from pollen and plant macrofossils in architectural features and natural deposits, from coprolites, and from stable carbon isotope ratios in bone. These studies have yielded a variety of findings.

West (1978) studied pollen from samples taken during the Cedar Mesa Project test excavations of 1972-73, and from some of Lipe's excavations in 1969 and 1970. Pollen of maize and of edible wild plants was identified in a number of samples from both BM II and BM III sites, but West concluded that the pollen evidence would not support quantitative estimates of the proportion of different foods used during the several periods sampled. He also noted that many of the wild food plants represented (such as chenopods, amaranths, Compositae, etc) were also those that would have invaded site areas due to human disturbance and would have been especially abundant shortly after abandonment. He felt that pollen from these species of wild or "ruderal" plants was likely to occur on the floors of structures and in features because of the local pollen rain as well as because plants of this sort were being brought to
the site as food. He was unable to separate these two sources of pollen in the floor and feature samples, but did conclude that the sequence of pollen frequencies in the fills of pitstructures was consistent with a pattern of local ground disturbance, abundant growth of weedy annuals and other "invaders," and gradual recovery of a mature pinyon-juniper woodland.

Lepofsky (1986) did a preliminary analysis of macrofloral materials from seven samples taken from a dry midden column at the Turkey Pen site, located in Grand Gulch on Cedar Mesa. The approximate 1.5 m high, 0.5 m square column was excavated in 1972 by the Cedar Mesa Project as part of its testing program. Aasen (1984) obtained several radiocarbon dates that indicated that this section of the midden was largely or entirely of BM II origin; this is consistent with the absence of ceramics in the column, and with Power's (1984) assessment of the date of for that section of the Turkey Pen midden column.

Lepofsky's analysis indicated little diversity of plant remains from one stratigraphic layer to another throughout the midden. Among the food plant remains, Zea mays was the species most abundant by weight, although not by frequency. Remains of squash (Cucurbita sp.) also were found in all levels analyzed. Seeds of various chenopods and amaranths were abundant and distributed throughout the column, although they did not contribute much by weight. Chenopods and amaranths were interpreted as ruderals whose growth was probably promoted in cultivated or recently abandoned fields. The abundant Indian rice grass (Oryzopsis hymenoides) seeds and pinyon seed hulls were interpreted as evidence of gathering of wild plant foods, probably away from anthropogenically disturbed areas, at least in the case of the pinyon remains. Less commonly found "wild food"
seeds included those from juniper, blazing star (*Mentzelia* sp.), prickly pear (*Opuntia* sp.), and banana yucca (*Yucca baccata*).

Coprolite analyses from Cedar Mesa and neighboring areas show a range of plants and plant pollen ingested during the Basketmaker periods (Table B.2, Appendix B). Coprolite analyses can indicate plants used as food, either by presence of significant weight of macrofossils of the given variety or by presence of pollen in larger amounts than would be found naturally (see Martin and Sharrock 1964:172ff; Aasen 1984:34ff). Aasen (1984) analyzed a sample of coprolites from the same midden column that Lepofsky (1986) later studied. After identifying both macrofloral remains and pollen from the coprolites, Aasen concluded:

> Analysis of the human coprolites indicated that Basketmaker II Anasazi ate both wild and domesticated plants. The feces showed a preponderance of corn macrofossils suggesting reliance on horticulture...Wild foods, such as pinyon nuts, ground Indian rice grass, and whole Rocky Mountain beeweed seeds, were often contained in the same coprolites. The most abundant pollen types in the feces, cheno-ams, Ambrosia-type, and grass probably resulted from the gathering of the leaves, flowers, or seeds of these plants for food. (Aasen 1984:v-vi)

Reinhard (1985; Reinhard and Jones 1988) has also worked with coprolites from the Turkey Pen midden, although his samples were collected from vandalized deposits by Peggy Powers (1984) as part of a study of "pothunter" damage that had taken place in 1979. Despite the disturbed contexts, Powers felt the midden was, in general, "horizontally stratified" and that she could give a general temporal assignment to particular areas of it. This was based on some sampling of the deposits exposed in the vandal’s pits, as well as on analysis of artifacts from the backdirt of these pits.

Reinhard’s early research on only ten feces from Turkey Pen Alcove classed the BM II coprolites as a "happy medium between hunter-gatherer
lifestyle and full time agriculture" based on a relative absence of worms and zoonoses (Reinhard 1985:2). His more recent work (with Jones) on sample of 25 coprolites from Basketmaker deposits at Turkey Pen shows not only a variety of wild and domesticated foods but a more substantial difference from Archaic remains at Dust Devil Cave near Navajo Mountain in the Glen Canyon area, than from Pueblo coprolites. The Turkey Pen samples show the establishment of a "corn dependent subsistence pattern typical for later Puebloan peoples." This finding is reinforced by a rise in helminth parasitism that the authors say was also a problem for local Pueblo groups (Reinhard and Jones 1988). The authors are careful to note that both squash and beans may be largely digested and therefore also underrepresented in macroscopic remains (Reinhard and Jones 1988; also see Stiger 1977, as referenced by Reinhard and Jones).

Matson and Chisholm (1986) have performed corroborative work with stable carbon isotope analysis of human bone from Cedar Mesa contexts. Matson writes, "The basis for this technique is that the two naturally occurring non-radioactive carbon isotopes, carbon 12 and carbon 13, are fractionated or concentrated differentially by different metabolic processes" (Matson 1988). Further, of plants that Matson and Chisholm regard as demonstrably important food resources on Cedar Mesa, only some chenopods have the same "C4" pathway as maize. These plants with a "C4" pathway have a higher "delta C13:C12 ratio" (that is about -12.5%) than do those with a "C3" pathway (about -26.5%). For three Pueblo samples they

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10 Matson infers that the following were dietary staples for the Anasazi: maize, pinyon pine nuts, chenopods, amaranths, and Indian Rice Grass. He reports lesser importance for prickly pear, banana yucca, squash, beeweed, and bur-sage. The listing is based on coprolite analysis by Assen (1984) and Reinhard and Jones (1988) and midden analysis by Lepofsky (1986).
obtain just slightly higher delta values than for four BM II samples\(^{11}\) and state, "This is in agreement with the idea that both periods are reliant on maize for the majority of their calories, but the Pueblo periods are slightly more reliant than the Basketmaker II" (Matson 1988; also see Matson and Chisholm 1986).

Overall, this recent work from Cedar Mesa suggest little appreciable dietary change during Anasazi periods (Matson 1988; Matson and Chisholm 1986). This is at considerable variance with many widely-circulated interpretation of early Anasazi subsistence patterns and change. Fred Plog (1974), for instance, argues that a dependence on cultigens was not well established in the northern Southwest until approximately A.D. 1000. Recent work by Decker and Tieszen (1988) on stable carbon isotopes from human skeletal material in the Mesa Verde region tends to support Matson (1988) and Matson and Chisholm (1986); however, Decker and Tieszen found that from the BM III through Pueblo III periods (ca. A.D. 600 to 1300), "stable carbon isotope ratios indicate that maize was an important and constant contributor to diet, averaging up to 80% during the entire period of occupation."

Stiger's (1977, 1979) coprolite data from a variety of BM III to Pueblo III contexts do indicate some dietary variability among Anasazi groups in the northern Southwest. After reviewing Stiger's data, Minnis (1988) concludes that there is greater similarity of food consumption patterns within the same study area through time than there is among contemporary assemblages from different study areas. Overall, both cultigens (especially corn) and garden weeds are common. The greatest

\(^{11}\) BM II delta values average -7.3 and Pueblo delta values average -7.7. Matson and Chisholm infer a 75-80% reliance on C4 foods. In comparison, for mountain sheep Matson and Chisholm found delta values averaging -17%, from which they estimated that about 30% of the sheep diet was from C4 plants.
variability is from naturally available resources which, he states, "argues for the importance of the local resource structure in determining the diet" (Minnis 1988).

In a recent study based on archaeological macrofloral samples from the Dolores Valley of southwestern Colorado, Floyd and Kohler (n.d.) find considerable variation in the abundance of pinyon remains relative to maize between about A.D. 650 and 950 (late BM III to early Pueblo II). Most of the variation appears explainable as the result of depletion of pinyon with rising Anasazi population, and its partial recovery when population declined. Thus, they argue that the density and structure of wild foods was affected by Anasazi exploitation, and cannot be considered an ecological variable entirely independent of cultural and demographic ones.

These same factors would operate on Cedar Mesa. However, while the Dolores Valley is thought to have been occupied continuously from A.D. 650 to 950, with a population maximum just after A.D. 850, occupation of Cedar Mesa is episodic. Furthermore, the maximum population density in the Dolores area was probably much higher (Schlanger 1985) than that estimated for Cedar Mesa. As discussed in Chapter 2, there is potential for partial recovery of pinyon and other natural resources during occupational hiatuses on Cedar Mesa. Therefore, while long-term degradation of the pinyon resource is expectable on Cedar Mesa, more variability may be expected in its use here than in the Dolores Valley.

**Indirect Evidence for Subsistence Change Used in Previous Research.**

In the Southwest, indirect evidence for subsistence change comes from settlement pattern analyses, change in architectural form and site layout, and artifact morphology. This last, because it is so familiar, is
reviewed only when presenting the expectations of changes associated with increased intensification.

In the Anasazi area considered in general, Lipe finds a broad regional shift in settlement pattern between BM II and BM III periods, with the later sites more uniformly near deep well-watered soils. He writes, "The obvious inference is that agriculture had become more important" (Lipe 1983:464). Data from Cedar Mesa show BM III sites were uniformly located on the best agricultural soils, but also show that BM II habitation sites were located in good agricultural soils (Matson et al. 1988; Matson et al. n.d.).

Other researchers have found change in architectural form and site layout throughout the Southwest, which they associate with increased reliance on maize. Plog suggests that agricultural intensification had organizational consequences in the Western Anasazi region, as well as to the east: "changes in village layout, especially in the location of storage facilities, and other changes in village organization..." (F. Plog 1979:129), but he is not specific about the nature of these changes. Cordell is specific. After about A.D. 900, when she believes domestic crops had become the principal food source, she sees considerable capital investments in devices to divert water to fields, to conserve water (e.g., mulch), and to slow soil erosion (Cordell 1984:182).

Gilman assembled cross-cultural evidence for a change from storage exterior to the dwelling unit to interior storage at the break between medium and high levels of agricultural dependence (see Gilman 1983:51-52). Where there is a medium level of agricultural dependence (35 to 66 percent dependence) and cool, dry climates, Anderson and Oaks suggest that agriculture may be used to buffer economic risks for single seasons (e.g.,
winter) even where population density is very low. In warmer climates, they find that population pressure, winter food storage, and combinations of length of growing season and population pressure affect agricultural dependence and intensification in a nonregular fashion (Anderson and Oaks 1980:32). Their data came from Murdock's (1967) *Ethnographic Atlas*; the measure of agricultural dependence (whether caloric, volumetric, or risk buffering) is unclear both in Murdock and in Anderson and Oaks.

Gross (1987) reviews possible causes for increased storage space in Dolores area BM III and Pueblo I sites in southwestern Colorado and finds these changes most likely associated with increased agricultural production (see review of some of Gilman's and Gross' work in Expectations I.2, I.3, I.4).

**Evidence for Intensification Used in This Study.** One may wonder not only what new evidence I may present but also why would I even bother given the new direct evidence showing similar levels of maize use throughout the Anasazi tradition from BM II through the Pueblo periods. My reasons are historical and theoretical.

First, the evidence wasn't in when I started work in 1981. Second, the intention is different. Researchers cited above are looking for change in diet more than they are looking for changing levels of economic intensity. Their data show *use*, while my investigation is aimed at differences in energy investment in subsistence related activities between periods. That is, my definition of intensification allows for investment in production for value and risk reduction as well as investment in production for consumption.

This study is designed to document changes between BM II and BM III in aspects of their R-D area units, including related artifacts,
architectural attributes, and the spatial distribution of those material remains. The study asks if these changes result, at least in part, from the effects of subsistence intensification. Thus, in a sense, this study relies almost wholly on indirect evidence of subsistence intensification. It is distinguished from other indirect estimates of subsistence intensification by including the possibility for increasing investment in foods other than maize (e.g., beans), by considering as a package the results from multiple lines of evidence, and by more systematic and specific treatment of spatial and architectural change.

Sedentariness

The second of two hypotheses addressed in this study is that there is evidence for increased sedentariness between Basketmaker period residential-domestic areas (R-D areas) on Cedar Mesa, southeastern Utah. As stated in the first section, it is clear that the settlement system changes sometime in the Anasazi tradition: Archaic cultures seem to have low levels of sedentariness and late Pueblo groups seem to have occupied their habitation sites for most or all of the year and sometimes for periods longer even than a single generation. It is not clear that the changes in sedentariness seen between either end of the Anasazi tradition occurred between the Basketmaker periods and it is change at this early end of the Anasazi tradition that this study addresses.

Sedentariness is conceived to included both residency and permanence (see below). Both aspects of sedentariness have been, and continue to be, of importance to archaeologists, and voluminous literature is present on the subject. This thesis offers little in the way of novel evidence for sedentariness, but makes is contribution first through use of multiple
lines of evidence and second through its application to this particular
data set. This section presents the definition of sedentariness used in
this study, and a review of the relationships of sedentariness to
intensification.

_Sedentariness Defined_

Sedentariness is defined here as having two aspects: residency and
permanence, and as being a continuous variable (rather a nominal
variable). This is somewhat more specific than its common meaning as the
opposite of mobility. Commonly, to be less mobile is to be more sedentary
and vice versa. However, groups that move a few times a year but maintain
permanent sites that they return to every year are sedentary in one sense.
For the definition of sedentariness used here, the important point is that
groups can have few or many residential sites that are used during the
course of a given year and they can use those sites, with the same
structures, for one or many years.

As noted above, these two aspects of sedentariness are residency and
permanence. Following Benson (1984), the degree of residency describes
the difference between year-round and temporary or seasonal occupation.
Both BM II and BM III groups on Cedar Mesa probably maintained their
residences for most if not all of the year (cf., data from Black Mesa
described by Powell 1983). Year-round residency may be interrupted by
episodic absence from R-D areas, sometimes for a few days, sometimes for a
season. Absences are expected to have economic causes. That is, the
whole resident group departs to obtain gathered or stored resources
available elsewhere. For example, if an agricultural harvest is poor, the

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12 Benson used "sedentariness" where I have used "residency".
resident group may move to an area where wild foods may be gathered or to a secondary storage location. In general, BM II households are expected to have been away from their R-D units more often and for longer periods of time than BM III households. Hence, residency at BM II R-D units is expected to be somewhat lower than at BM III units.

Degree of permanence marks the total duration of site occupation (Benson 1984:86). In this study, permanence refers to the total duration of occupation of a R-D area during single component occupations. That is, Pueblo reoccupation of Basketmaker R-D areas does not imply greater permanence of the Basketmaker R-D areas. Sometimes, structures may be replaced within a R-D area that is used for a long time during a single component occupation. Such rebuilding does imply greater permanence. More often, at least during the Basketmaker periods on Cedar Mesa, the actual use-life of a pithouse (without repair or rebuilding) is likely to approximate the permanence of a R-D area.

The Relation Between Sedentariness and Intensification

Most agriculturalists are sedentary in both meanings of the word, but data from hunter-gatherers shows that increased sedentariness and subsistence intensification are not fully correlated. Storage is central to hunter-gatherer subsistence intensification (e.g., Stuart 1982; Testart 1982), but sedentariness is not. Storage only requires that groups return to the storage location during that part of the year in which food availability is limited; it does not require that groups stay there and it does not require that they return to the same locations several years in succession. Similarly, if Basketmakers were "careless" farmers
(Kirkpatrick and Ford 1977:161) like the Western Apache (Minnis 1985) they need not be tending their crops during the full growing season.

Residency and permanence, like intensification, are best measured on a continuum rather than on a nominal scale. Groups may have varying degrees of residency and their R-D units may have any degree of permanence. Just as mobile hunter-gatherers can be foragers or collectors with settlement system differences that correspond to their organizational differences, there can also be different patterns of sedentariness among horticulturalists. They may fall anywhere between the extremes of being completely sedentary and being highly mobile. Therefore, it is sensible to ask about degrees of subsistence intensification and sedentariness separately.

Where archaeologists have argued for a functional relationship between sedentariness and intensification, it is usually based on underlying arguments for regular population increase (e.g., Testart 1983:525). The basic argument is that increasing regional population circumscribes the territory of the local group, thus limiting resource availability and forcing circumscribed groups to intensify their subsistence system to maintain the same standard of living as previously. Certainly, this is believed to have been true in Europe and the Middle East during the Mesolithic Period. There, remaining in one place would require the use of types of food which had not previously been gathered or hunted if stress on the usually utilized wild food resources was felt (e.g., Webster 1983). A related but converse argument is that lengthening the period of residency at a settlement for whatever reasons--e.g., for defense, to guard stored food or goods, to maintain group integration--
will promote intensification through depletion of the "best" food resources in the vicinity of the settlement.

Where food resources were seasonally available, sedentariness may have been made more possible by storage, and may in turn have promoted regional population growth and further intensification, rather than the other way around. While accepting Cohen's (1977) notion that the world had become saturated with hunter-gatherers prior to sedentism, Stuart (1982) addresses sedentism not as an evil that hunter-gatherers are powerless to stop but as a welcome possibility, specifically because of its association with storage, which reduces the risks of the most lean season. By reducing seasonal variance in food supply, storage creates the opening for enlarged population. For this argument, Stuart compares the Southwest to Mesopotamia, which also has a low-potential foraging season during which population might be expected to be dispersed over a larger area. In Mesopotamia, Stuart says that

any segment of the population consistently storing cereals for summer use would be regulated by food available during the next most limited season; in Iran's summer-dry regime the next worst season (midwinter) might have been only half as limiting (Stuart 1982:139).

One group staying off the land during the worst season would have substantial effects on neighboring groups since it would have made available new space for summer dispersal. This increase in dispersal space would have prevented the summer stress mechanism from activating "normal" population-regulating behavior and the neighboring population would expand (Stuart 1982:139). Stuart's discussion suggests a time lag between the beginning of technological proficiency in storage and increased population levels; during this time, the benefits of storage
could be realized without increased residency and without increased subsistence costs.

In summary, sedentariness is commonly associated with increasing regional population when local populations become circumscribed. On the other hand, increased seasonal residency as a result of food storage may precede regional population growth and increased intensification.

By systematically analyzing changes in attributes of BM II and BM III R-D units, this study will attempt to infer whether changes in residency or occupation duration took place between the two periods. Where possible, inferences on the systemic relationships of changes in sedentariness also will be attempted.

**Residential-Domestic Areas**

In societies characterized by a "domestic mode of production" (Sahlins 1972), the residential-domestic unit should be the best place to study economic causes behind changes in the spatial structures of feature and artifact distributions because it is the archaeological manifestation of the household. The household area is the most basic spatial unit in which social behavior takes place (Wilk and Rathje 1982; Sahlins 1972:78-79). Therefore, the R-D area is the most basic (smallest) areal unit in which a range of task-oriented economic behavior could be expected to be manifested.

Tying habitation sites or parts of sites to culturally meaningful divisions of past human populations has long been a concern of archaeologists. The manner of making such divisions has produced dramatic shifts in the interpretation of social organization and of the economic condition of groups that co-resided in some fraction of a site. Kinship
and descent have proved to be methodologically difficult to characterize (e.g., see Allen and Richardson 1971) and, perhaps because of their inaccessibility to archaeologists, the concept of household--distinct from family--became common early in archaeological literature (Rohn 1965). Donald Bender (1967) provided the ethnographic definition of "household" which differentiated it from "family" and aligned it with the co-residential group and, commonly, but not exclusively, with the group sharing domestic activities. Definitions of "household" in the archaeological literature continue to be directed at the ethnographic definition but operationally often assume equivalence with the residential-domestic complex.

Ethnoarchaeologically, the term "household" has been used variously, including both its implied or explicit identification with shared domestic activities. It is commonly associated with at least temporary propinquity (Wilk and Rathje 1982). Recently, corporate group "households" have been associated with shared status or wealth (Hayden and Cannon 1983), particularly through shared wealth of stored goods (Gilman 1983). The latter usage may be realigning the household with extended family or some other ideologically defined group, away from propinquity and shared activity that characterized Bender's (1967) definition. Certainly, for archaeologists, defining the basic residential-domestic unit by shared access to materials through shared storage (e.g., as indicated by the large architectural features which Winter [1976] found in his Mesoamerican sites) is the simplest case.

The household thus is identified with both a physical area and/or with architectural features. Ethnoarchaeological studies indicate a correlation between the extent of physical remains (refuse) and the
spatial area that the group used, especially in single household sites (e.g., Lange and Rydberg 1972; also Yellen 1977). This is so whether household boundaries are defined by coincident access to storerooms (e.g., Adams 1983:53-54; Gilman 1983) or by apparent, shared use of "site furniture." Site furniture is the term applied by Binford (1979) to "site-specific" artifacts (Binford 1978b) and is equivalent to Gould's (1978) site "appliances" meaning, in all cases, artifacts routinely left at a site with the intention of being reused at a later date.

For the Anasazi area, equivalence of households with specific architectural units, or parts of sites, has received some ethnographic support. Eggan states that the fundamental organization of the household in Western Pueblos is that it represents an extended family based on matrilineal residence. Women normally own the house, usually a series of adjoining rooms, and the house is the locus of both economic and ritual activities. Land is frequently associated with the household and the crops resulting are stored there in the keeping of the women, who cooperate in food processing. Sacred fetishes may be stored with food (Eggan 1950:298).

Southwestern archaeologists previously have defined some socially determined spatial organization within residential units of Pueblo period sites. Almost without exception, San Juan Anasazi sites have a central pitstructure, that is either a domestic pithouse or a kiva. To the south or southeast of this pitstructure are localized trash deposits; to the north or northwest of it is an open area which separates the pitstructure from a set of surface structures which may be for storage or for storage and habitation (see Prudden 1903). Reed (1956) labelled this arrangement "front-oriented" and identified it as characteristic only of the San Juan
Anasazi and not of other Southwestern traditions (also see Roberts 1939). Bullard (1962) called the arrangement simply, "habitation units." He believed the Northern San Juan area was central to the main Anasazi development of this type of site layout in the Pueblo I period (Bullard 1962:108). Spatial comparison of earlier sites is then likely to provide worthwhile information on the origins of this pattern of site layout. More recently, Ahlstrom pushes development of front-oriented habitation units back as early as A.D. 675-699 (Ahlstrom 1985:591).

Among the Anasazi, or at least groups within the BM II or BM III periods and the Pueblo I period of the Anasazi tradition, the combination of storage units, open activity areas, pithouse, and trash deposits delimit the basic residential area, and probably the basic household domestic area as well. In the later Pueblo periods, the basic residential-domestic unit may be reduced to a smaller part of the total site. For instance, Dean's "room cluster" is defined as a living room, plus one-to-six storage units and sometimes a grinding room, and commonly a courtyard (Dean 1969:34). Dean identifies this as the basic architectural unit with late Pueblo sites, and suggests it may belong to a social unit the size of a nuclear family (Dean 1969, 1970). His use of habitation unit, derived from Rohn's (1965) use, refers to a small number of contiguous surface rooms with a pitstructure, often in sites where several or many such units exist and where these units may be inferred to belong to social groups larger than a nuclear family, but perhaps only one household. Kane (1984), like others, presumes a single household per Pueblo I period living room/storage room unit, and two or three functionally related households associated with a single pithouse, the use of which is shared. Kane's household then is based on segmentary
propinquity and access to storage. If several of these households share activities and some storage in the pithouse or kiva and in the joint use open area between it and the rooms, they may represent what Hayden and Cannon called a corporate group. Hayden and Cannon suggested corporate groups are more likely to be the units that accumulate wealth than are individual households (Hayden and Cannon 1983). Changes within the archaeologically defined residential-domestic area (R-D area), as appear to have occurred between the Basketmaker periods and the late Pueblo periods, may reflect changes in household composition, in relationships among households, and in basic domestic activities.

Most problems in the definition of the household unit in ethnographic studies or in the definition of the habitation unit in the archaeological record seem to occur with relatively large settlements. In large settlements there may be unequal numbers of common domestic rooms, hearths, storerooms, and apparent task or activity loci, suggesting that spaces used by domestic groups, economic groups, and task groups (e.g., Kramer 1982a) may not be equivalent to spaces used by a particular residential group.

The early Anasazi sample used in this study is comprised of only small settlements, and hence this problem is avoided. In BM II sites, and even in BM III sites, on Cedar Mesa, the scarcity of sites with more than a single pithouse suggests that the basic R-D unit is commonly equivalent to the site unit.\textsuperscript{13}

\textsuperscript{13} Cf. Hayden and Cannon's (1982) ethnographically defined household versus corporate group.
Summary

Until recently, changes in prehistoric Southwestern subsistence largely have been seen as unidirectional changes toward greater dependence on agriculture. Only recently has subsistence change in the Southwest been seen as including some shifts towards less reliance on agriculture and greater reliance on a diversity of procurement strategies, often including an increased degree of mobility (e.g., Hastorf 1980; Upham 1982; Powell 1983; Nelson and LeBlanc 1986), although a few relatively early works proposed such diversity (e.g., Dean 1969:191; Gillespie 1976:205-206).

Definitions of intensification, sedentariness, and the residential-domestic area (R-D area) are central to this thesis. To intensify is defined as using more energy to produce more output per capita or to assure at least the same output as was previously produced. Sedentariness is defined as having two aspects: residency and permanence, and the definition requires that their measurement be by continuous scales. Finally, the residential-domestic area (R-D area) is defined as the archaeological manifestation of the household area.

As stated above, a cost-based definition of intensification is used here because of its breadth, because it underlies other definitions of intensification, and because it is most applicable to the study of change in the spatial organization of R-D units. In agricultural subsistence systems, greater production costs may be related to decreasing amounts of land or to increasing harvests on the same amount of land if the same cultigens are used. In contrast, if additional costs reflect the addition of new cultigens (such as beans in the BM III period), there is no reason to suppose that the collecting area was immediately decreased.
Particularly, this is true if the emic intent was to reduce stress or anxiety of fluctuating yields—rather than to feed a population at the limit of local carrying capacity. Given this underlying presumption, cutting forest for agricultural fields may be the result of adding to total cultivated area, rather than of replacing fields whose soil nutrients had been depleted. In the former case, more energy would be expended on more land. While this would not register as agricultural intensification based on production per unit land (e.g., Turner and Doolittle 1978), it is subsistence intensification in terms used here.

Determining the degree of intensification, especially through reliance on agriculture, is of interest because increased dependence on maize agriculture previously has been invoked to explain changes in architecture and artifact inventory—especially in storage and processing systems—even between BM II and BM III sites. Determining the degree of sedentariness and permanence of occupation is of interest in part because agriculture is commonly thought to require a high degree of residency (e.g., Flannery 1969) and to be associated with long duration of site occupation.

These problems are addressable in part because of overall continuity in spatial characteristics from Basketmaker periods through Pueblo periods. Certain characteristics of settlement spatial organization seem to be continuous throughout Pueblo periods in sites across the Southwest and Basketmaker II and III sites appear to have similar organization. At a gross scale, the spatial continuity is manifested at habitation sites by a north-south configuration, with a centrally located pithouse or kiva, flanked on the north or northwest by surface rooms or surface features

14 For instance, see Kidder 1924; Glassow 1972, 1977; Martin and Plog 1973; Rohn 1978; Plog 1979; Cordell 1984.
(especially storage), and on the south or southeast by trash deposits (e.g., see Prudden 1903; Reed 1956). This spatial formation, as well as other spatial attributes, also may characterize BM II period sites. This general spatial and architectural tradition extending back into the BM II period probably indicates cultural continuity, as do a number of similarities in artifact characteristics from period to period. This suggests that architectural spatial variations on this general (culturally defined) plan may have functional causes.

I have chosen to study change in architecture and spatial organization of residential-domestic units because I believe this is more likely to lead us into the meaningful study of social behavior than is any other manner of identifying economic change. For these early Anasazi periods, I have taken the residential-domestic unit as the physical manifestation of the household. I believe that change in architecture and spatial organization of residential-domestic units, as well as change in their artifact assemblages is more likely to show the impact of subsistence or settlement system change than will be seen in the physical remains of any other spatial archaeological division.

The following chapters examine a variety of architectural, artifactual, and spatial evidence from R-D units to determine if it is consistent with hypotheses of subsistence intensification and increased sedentariness between BM II and BM III periods on Cedar Mesa. I find first, evidence for intensification between the Basketmaker periods. This is not necessarily horticultural intensification, although it may be. Second, I find some evidence for increased sedentariness between the Basketmaker periods although Basketmaker R-D units are more similar than different, in regard to changes reflecting increased sedentariness. These
changes in Basketmaker R-D areas may be the result of refining low intensity agricultural systems while maintaining a tradition of accepting diversity in the resource base. Reducing subsistence risk by increasing storage and adding new cultigens appears to have been important to this refinement.
CHAPTER 2
ARCHAEOLOGICAL BACKGROUND

This research has well-defined areal and temporal boundaries. The hypotheses are tested against early Anasazi data. The Anasazi Tradition is one of several in the Southwest Culture Area. The periods used are Basketmaker II (BM II) and Basketmaker III (BM III). Boundaries of the macro area and the Basketmaker periods are described below. These descriptions are followed by a description of the environment of Cedar Mesa from the perspective of subsistence intensification based on agricultural reliance.

The Anasazi

The Anasazi represent one tradition of the Southwestern Culture Area. Anasazi sites were located in the upland Southwest, including the area today known as the Four Corners. Kroeber defined "Culture Area" as a regionally individualized type or specific growth of culture (Kroeber 1939). He believed that the whole assemblage of traits and complexes which defined a culture area corresponds in many ways with regional biotic units and his definition forms the basis of our present definition of the "Southwest." Archaeologically, the Southwestern Culture Area reached its major expansion around A.D. 1100. At that time it included most of the southern Colorado Plateau, all of the Mogollon Highlands, parts of the Southern Rocky Mountains, parts of the Basin and Range Province, and a small part of the Great Basin. Lipe defines the Southwest at A.D. 1100 culturally, on presence of corn agriculture, pottery making, and village or rancheria dwelling cultures. He notes that it is impossible to have the
boundaries coincide neatly with major geologic, biotic, or climatic units through time (Lipe 1983:421). Those proposing the importance of subsistence variability as an adaptive strategy and/or great cultural variability within or among regions still react strongly to the Culture Area concept (e.g., Cordell and Plog 1979; Hodder 1985). Instead of working within the regions of the Southwestern Culture Area they propose a locality-by-locality analysis for the Southwest (e.g., see Plog 1979), stressing the importance of the local area in prehistoric change.

**Basketmaker II**

Who were they and what were they up to?

*James Sackett*

The Basketmakers were named on the basis of their woven arts (McNitt 1957:65-6), shortly after their differences from later Puebloans were noted. These differences are their lower stratigraphic position, absence of artificial flattening of skulls, and a number of artifactual differences (Moseley 1966:144-148). The generally used dates for BM II are A.D. 1-450; the occupation on Cedar Mesa, southeastern Utah is probably somewhat shorter--perhaps A.D. 200-400 (Matson et al. 1988). The Anasazi Culture Area during the BM II Period was probably smaller than the Anasazi Culture Area at A.D. 1100. In the BM II period, the Anasazi core area may have been a relatively small one surrounding the Four Corners, with Cedar Mesa near its center, as suggested by Cummings (1910), or west of its A.D. 1100 center, as implied by M. Berry (1982:Figure 19). In the early 1940's,

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1 Sackett 1986:629.
2 While Berry (1982) has proposed two BM II phases (with one preceding A.D. 0), Smiley believes that Berry's early BM II sites may better be placed in the second or third century A.D. Smiley generalizes about dates in the Upland Southwest by saying, "any radiocarbon sample in this arid environmental setting is likely to overestimate the age of the event with which it is associated" (Smiley 1985:375).
McGregor accepted Cummings' suggestion that Grand Gulch, Utah (within the Cedar Mesa area) had the most characteristic Basketmaker material. McGregor offered Grand Gulch as a type area within a core area for BM II (McGregor 1965:173). Today, BM II cultures are most commonly thought to have developed out of local Archaic traditions (e.g., see Irwin-Williams 1973:11-12, 17-18); Michael Berry (1982) challenges this with an argument that population spread into the Four Corners area from the south, at this time.

Principal BM II domesticates were corn, squash, and bottle gourds (Ford 1985), and their diet now appears to have been more similar to that of later Puebloans rather than the prior Archaic groups. Domestic dogs were present. Turkeys were also present, but they may not have been domesticated (Lipe 1983:464).

BM II artifact assemblages are widely regarded as including more hunting equipment than do later assemblages. They include atlatls and compound darts, curved throwing sticks, rabbit nets, and a variety of snares. Milling equipment was often similar to Archaic style basin grinding slabs and cobble manos, but grinding slabs approaching troughed metates also occur (Lipe 1983:464). Pottery is generally absent, though some has been recovered, especially from BM II sites in the Petrified Forest National Monument, Arizona (Wendorf 1953:45) and from Los Pinos Phase sites in the Navajo Reservoir District of Northwestern New Mexico (Eddy 1966:384). BM II textiles are distinguished from later textiles by the general absence of loom weaves. Kent suggests that BM II plain weave textiles—that can be identical to loom-woven cottons—could have been wound on the same type of frame used in fur blanket manufacture.

\[3\] Matson's most recent work puts BM II reliance on corn agriculture quite high (75-80%), and maintains the idea of equivalence between Basketmaker and Pueblo dependence on corn agriculture (see Matson 1988).
Plant and animal fibers, human hair, feathers, and strips of fur were all used (Kent 1983:257), but the best known BM II textiles are, perhaps, large twined bags, plain weave cloth, and coiled baskets in a variety of styles. These were most often decorated with self patterns or simple painted geometric designs in red or black. During both Basketmaker periods, Kent suggests that clothing included tanned skins (especially deer and mountain sheep), calf-length fur yarn robes, a variety of woven sandals and moccasins, fringed aprons for women, and possibly yucca or apocynum fiber blankets, and breechclouts for men (Kent 1983:221-225).

By 1916 or 1917, Guernsey and Kidder surmised that Basketmakers lived mostly in the open, rather than in caves, where most Basketmaker evidence has come from storage cists (Guernsey and Kidder 1921:110; Kidder 1924:241; Morris 1939:29; Morris and Burgh 1954). The first definition of BM II houses in open sites was Morris' 1938 and 1940 excavations near Durango, although probable BM II pithouses were identified at two open sites on the Rainbow Bridge-Monument Valley Expedition of 1933 (sites N.A. 2542 and N.A. 2648 in Hargrave 1935:42-44). Early definitions of BM II sites in the open relied mostly on negative evidence--especially the general absence of arrow points and pottery. Therefore, these sites are often labelled as "campsites" or "aceramic" sites, as in the Glen Canyon area, west of Cedar Mesa (see Adams and Adams 1959:33, 36; Fowler 1959:503; Lipe 1960:3; Lister 1959:110).

Domestic structures are pithouses, and extramural features include a variety of hearths and small storage units. Differences in pithouse architecture and extramural features may be important markers of differences in mobility and storage requirements among Anasazi subregions.
Morris' descriptions of pithouses near Durango, Colorado (Morris 1941; Morris and Burgh 1954) vary from descriptions of pithouses in the Navajo Reservoir area (Eddy 1961), both sets of which differ from Glen Canyon area and Cedar Mesa area pithouses. Like the Cedar Mesa sites, each Durango area structure had a saucer-shaped floor with a hearth in the center. At the Durango sites, much of the remaining floor space was taken up by stone-lined storage cists topped with mud domes (see Morris 1941:23; Morris and Burgh 1954:21, 28). Glen Canyon and Cedar Mesa pithouses tend to be shallow with basin-shaped floors, to have few internal features, and to have slab-lined entryways (Sharrock et al. 1963; Lipe 1978). Variation in the locations of extramural features and artifact distributions at pithouse sites is poorly known because of limited excavation away from the pithouses. Eddy's excavations of BM II villages in New Mexico included early descriptions of extramural areas. He indicates that activity and work areas (identified by small pit features) were centered around habitation structures. Refuse was concentrated in the same areas although sheet trash was present throughout much of the villages (Eddy 1961, 1966). Site reports from Black Mesa do not include spatial analysis of features and artifacts, but maps published with preliminary reports show features concentrated around pithouses, especially north of the pithouses. Virtually all extramural features were interpreted as hearths or roasting pits (see Jobe and Whitecotton 1979; Whitecotton and Lebo 1980; Lebo and Warburton 1982). Examination of the data from several Cedar Mesa habitation sites shows remains of storage features located northwest of pithouses. Hearth features are also common at Cedar Mesa BM II sites.

Architectural differences in BM II pithouse architecture and site layout within the western Anasazi regions may have cultural or adaptational
significance. The comparatively small percentage of floor area taken up by internal features, especially unburned pits, in the southeastern Utah sample is consistent with their interpretation as habitation rather than storage structures. On Cedar Mesa, even at this early date, storage may have been sufficiently important to warrant specialized structures outside the pithouses, while processing materials which would require the use of extramural hearths of various types, as at Black Mesa, may have been less common.

In general, "settlements were in areas that had soil and water adequate for farming, but that also gave easy access to several different environmental zones for hunting and gathering" (Lipe 1983:463), but specifics of land use had considerable diversity. Elsewhere, pithouses may be clustered in flood plain oriented villages (e.g., Morris and Burgh 1954; Eddy 1961, 1966). Lipe suggests those may indicate more sedentary occupations than do the widely spaced pithouses in base camps or "villages" located near canyon springs in the Cedar Mesa area (Matson and Lipe 1978:5; Dohm 1981:87-88) and associated with numerous limited activity sites (Lipe 1983:463).

**Basketmaker III**

The generally accepted BM III dates are A.D. 450-750. The Cedar Mesa BM III occupations may have been much shorter: A.D. 650-725 (Matson et al. 1988). Traits distinguishing BM III period sites from the preceding BM II period sites are widely seen as representing an evolution from the earlier stage. Based on Berry's maps, BM III areas may be concentrated somewhat east of the most heavily used BM II areas (M. Berry 1982:Figure 19). Most
see the BM III period as characterized by a remarkable similarity across
the Anasazi area (e.g., McGregor 1965:206; M. Berry 1982:17).

BM III plant domesticates included the corn, squash, and bottle
gourds that were present earlier plus common beans (Ford 1985). Turkeys
were certainly kept (McGregor 1965:215; Lipe 1983:464) as well as dogs.
BM III groups are widely regarded to have been more reliant on agricultural
produce than their predecessors, but the use of common garden weeds and
wild plants and animals certainly continued.

Michael Berry (1982) argues that there is a standardization of BM III
artifact assemblages (compared to BM II) and that standardization results
from a period of close proximity of nearly all Upland Southwest groups in a
drought-induced refugium at the end of the BM II period. Berry argues a
full replacement of atlatls and darts with bows and arrows at BM III sites
and gray or black-on-gray ceramics at all sites as well as what he regards
as standard architectural characteristics at all BM III sites (M. Berry
1982:117). He may have overstated his case. For instance, Lipe describes
the replacement of atlatls and darts with bows and arrows as beginning near
the end of the period (Lipe 1983:464). Regardless, artifacts are
noticeably different from the preceding period. Not only are bows and
arrows (at least by the late end of the period) and ceramics common, but so
are trough metates, and split metatarsal awls appear (McGregor 1965:215).
Textiles remain important and their artistry may be greatest during this
period (Kent 1983:257). Principal textile changes are a decrease in weft-
twined bags, near replacement of fur-cord robes by feather-cord robes and,
by the end of the period, appearance of garments from traded cotton (Kent
1983:258). Kent suggests that loom weaving may have begun during this

4 Pithouses characterized by a four-post roof support system and large antechambers.
period, although there "is no firm evidence, in the form of loom parts, of
the presence of an historic type of Pueblo loom among the Anasazi until
about A.D. 1000" (Kent 1983:117).

Perhaps because of more durable pithouse construction elements, open
sites are well represented relative to cave sites, even in the early
archaeological literature. Domestic structures are pithouses, storage
units and, in late BM III sites, some surface rooms. Extramural features
include hearths and a variety of processing pits.

BM III pithouses and artifact assemblages may have no significant
inter-regional variation (M. Berry 1982). Investigations in southeastern
Utah, as elsewhere, have shown uniformly more substantial pithouses in
BM III sites than in BM II sites, with more visible storage units, and a
standard BM III site layout. Typically, BM III period habitation sites
have a circular to subrectangular pithouse with an antechamber (but see
Nusbaum 1981), or at the late end of the period, a large vent shaft.
Storage may be enclosed in this antechamber as well as in small surface
structures north or west of the pithouse (Hayes and Lancaster 1975; Plog
1979; Lipe 1983). The bases of these storage structures generally appear
similar to those of the slab-lined storage cists from BM II period sites,
but may have upper walls constructed of jacal (Brew 1946; Gooding 1980).
Birkedal (1976) believes that surface structures and other extramural
features should cluster close to the pithouse, presenting recognizable
household areas within any BM III period habitation site; he interprets
data from several excavations at Mesa Verde National Park as supporting his
thesis. BM III research in southeastern Utah (Schroeder 1965; Nickens
1977) supports an inference that site plans there may be similar to those
from the Mesa Verde or Dolores Valley areas (see Birkedal 1976; Dolores
area Tres Bobos Phase sites in Kane 1984; Breternitz 1982). Evidence for some community structures, including great kivas and village walls or stockades, is present during the BM III period (Lipe 1983).

Cedar Mesa differs from the generalized regional pattern in only a few particulars. Community structures have not been found on Cedar Mesa during the BM III period. And, extramural features at Cedar Mesa sites, at least, may be further removed from the pithouse than is true at sites in Colorado.

Lipe notes that Anasazi BM III sites tend to be near deep, well-watered soil regardless of access to other resources and suggests, "The obvious inference is that agriculture had become more important" (Lipe 1983:464). Certainly, villages were a more important settlement type and limited activity sites seem to be less commonly described (or recognized) everywhere during the BM III period than during the preceding BM II period.

Cedar Mesa from an Agricultural Perspective

Cedar Mesa is the eastern part of a triangle of highland east of the Colorado River, north of the San Juan, and west of Comb Wash. The natural area has been reviewed in a number of places. In brief, Cedar Mesa is a north-south trending plateau that is generally higher in the north and east and is cut by numerous deep canyons. On Cedar Mesa, elevation ranges between about 5600 feet (1707 m) and nearly 7000 feet (about 2100 m). The environment is not the same on all parts of the mesa. There is a noticeable difference in estimated number of growing days and in the amount of precipitation between the south end and the north end of Cedar Mesa.

This is approximately 144 frost free days in the south, with 10 inches (25

5 Lipe and Lindsay 1983; Lipe and Matson 1975; Lipe and Matson 1978; Matson et al. 1988; Matson et al. n.d.
cm) of precipitation, compared with 129 frost free days in the north, with 13 inches (33 cm) of precipitation (Matson and Lipe 1975:125-126). The dominant mesa top vegetation is pinyon-juniper interspersed with sagebrush flats. Five vegetation zones were recorded by the mesa top survey: pinyon-juniper; big sage and grasses; escarpment; blackbrush; and, of course, canyon bottom. Blackbrush is found at the lower elevations, where there is insufficient moisture for either pinyon-juniper or big sage and grass communities. West says that the distribution of vegetation on Cedar Mesa is determined mostly by climate as a function of elevation, but also by soil conditions, exposure, and other factors, including fire (West 1978:143).

Corn, rather than beans or squash, is widely regarded as the principal crop of the Anasazi. Therefore, only requirements for growing corn are considered here. Intercropping with beans probably does not affect maize harvests negatively (see Serpa and Barreto 1981; Serpa et al. 1981; Nadar and Rodewald 1979). Hopi corn (which may be related to Basketmaker corn) requires about 12 inches (31 cm) of precipitation for dry farming techniques and a approximately 130 days of growing season (Hack 1942:8, 20) with soil depth approaching one meter or more.

Cedar Mesa is marginal for dry farming. Haase extrapolated precipitation figures from nearby Natural Bridges National Monument to the Cedar Mesa study area (Haase 1983:14) and inferred that mean annual precipitation was 11.5 inches (33 cm), just short of the 12 inches (31 cm) estimated as the requirement for Hopi corn (Hack 1942:8). If we use Haase's figures rather than Matson and Lipe's estimates (1975:125-126)--which show greater precipitation near the higher, north end of the study area--we find that dry farming maize is only possible on Cedar Mesa during
years of above average moisture. Areas locally moister than the average and locations where runoff water augmented direct rainfall would probably have provided patches of arable land even in average or slightly below average years.

The ability to farm steppe regions depends on the rainfall pattern as much as on the actual precipitation. Like much of the Southwest, Cedar Mesa has a biseasonal rainfall pattern with rain in late winter, before the beginning of the growing season, and greater rains during August, September, and October. The spring planting times have the lowest precipitation: May and June are the driest months. Moreover, spring and early summer are the most windy. U.S.D.A. Soil Surveys suggest that the dry southwesterers of spring and early summer are a climatic factor that can adversely affect local farming (Olsen et al. 1962:3).

As noted, Hopi corn requires a growing season of about 130 days (Hack 1942:20). That length of growing season is probably not regularly available at the highest elevations in the north part of Cedar Mesa, although the actual number of frost-free days can be much greater in any given year. Moreover, growing season can vary greatly with local physiography. For instance, local canyons "improve air drainage and lengthen the frost-free period of the adjacent uplands" (Olsen et al. 1962:44). Adams notes that where the frost-free period is 150 days or less, Hopi farmers avoid narrow valleys in favor of open areas or higher locations in order to avoid cold air drainage that effectively shorten growing seasons by 10 to 30 days. And, he estimates that all areas with a 140 day growing season or less were probably avoided by prehistoric Hopi farmers (Adams 1979:293-294). The best Cedar Mesa farmland, in terms of
growing season, would be low enough to have at least a 140 day growing season and be set above or back from canyon and valley frost pockets.

Soils on Cedar Mesa are mostly sandy loams which Haase reports reach depths up to 2 m in some areas (Haase 1983:13). Today, even near watershed divides, where sediments are thickest, local drainages can cut to bedrock. Near the canyon rims, where sediments are thin, bedrock is often exposed, both in and between drainages. On the divide, soil depth may have decreased slightly as a result of recent wind and water erosion due to clearing pinyon, juniper, and sagebrush for rangeland and sometimes for cultivation. Elsewhere in the San Juan area, Olsen et al. report that such practices have led to increased wind erosion and have damaged more than half of the soils in the San Juan area (Olsen et al. 1962:6-7).

Sediments have developed into soils\textsuperscript{6} all across Cedar Mesa. Insofar as soils of all desert and steppe regions have low agricultural potential, the Cedar Mesa soils are poor. The U.S.D.A. Soil Survey for this part of San Juan County is not yet available but soil surveys for areas near Blanding and Monticello show that deep and moderately deep soils in wind-deposited materials are relatively good for farming (Olsen et al. 1962:4-5). This corresponds well with prior work by Hogan, indicating soil texture may be more important even than soil nutrients to growing Hopi corn because of the effect of soil texture on water absorption and retention values. Sandy loams have high water retention and high permeability values. Clays have lower permeability. Sands, unless they are thin and underlain by a less permeable material, tend to concentrate soil moisture below corn roots (Hogan 1987:35). Most of the soil in the Cedar Mesa study

\textsuperscript{6}Soils are defined as "the collection of natural bodies on the earth's surface,...containing living matter and supporting or capable of supporting plants out-of-doors" (Soil Survey Staff 1975:1).
area can be characterized as sandy loams. Therefore, relative to other
desert and steppe soils, most of the Cedar Mesa study area has good soil.

Because late spring and early summer have little rainfall, Haase says
both natural vegetation and domestic crops rely on stored groundwater. He
believes that the best farmland would be on relatively deep soils on
gentler north or northeastern facing slopes where winter snow may remain
longer (Haase 1983:15). In actuality, he finds field stations oriented on
south facing slopes as often as on north facing slopes. He suggests that
this may have minimized effects from early and late frosts (Haase

Site Location and Agricultural Potential

Site location on Cedar Mesa has been measured by proximity to canyons
and, more recently, by location relative to natural vegetation. By virtue
of the different plant communities in canyon bottoms and along canyon
sides, areas near canyons tend to have access to the greatest number of
plant communities. Early in the Cedar Mesa Project, when Matson and Lipe
perceived early Basketmakers as more dependent on wild foods than on
agricultural produce, they were not surprised to find that proportionately
more BM II sites were located near the canyon rims than were sites of later
periods (Matson and Lipe 1978). Moreover, like others they expected
evidence of farming in the more moist canyon bottoms (e.g., Fike and
Lindsay 1976:17).

More recent settlement pattern studies employing the entire BM II
site set have resulted in revisions of these earlier views. When
habitation sites are separated from camp sites (a new class of site type)
and limited activity sites sites, the habitation sites are not found to be
closer to canyon rims than are the centers of randomly-located quadrats. Matson et al. (n.d.) have also investigated site locations by proxy measures for soil depth and have found that BM III habitation sites are uniformly located in areas that are presumed to have deep soil, based on dense pinyon juniper woodland as a proxy, and that BM II habitations are also in good agricultural soil (Matson et al. 1988; Matson et al. n.d.). That soil arability may have been a determinant of residences for BM II horticulturalists is also inferred from substantial amounts of corn represented in BM II coprolites and sediments from cave sites (Aasen 1984; Lepofsky 1986).

Pinyon-juniper woodland is the most common plant community on Cedar Mesa. The pinyon-juniper is densest in the deep soil areas near watershed divides. It covers the areas of watershed divides and extends to lower elevations in the northeast part of the mesa than in the southwest. In the latter area, pinyon-juniper gives way to sage and blackbrush dominated shrublands at relatively higher elevations. Areas near the canyons tend to have thinner, or at least more dissected, soil cover. These areas tend to have more sparse pinyon-juniper woodland. Dense pinyon-juniper woodland does not appear in the canyon bottoms or escarpments and is not otherwise associated with proximity to the canyon (Haase 1983). In general, both BM II and BM III habitations seem to be more common in dense pinyon-juniper vegetation zones than elsewhere, but BM II habitation sites avoid the highest areas of dense pinyon-juniper at the north end of the mesa (Matson et al. n.d.).

In their most recent paper, Matson et al. conclude that the BM III settlement pattern concentrates both habitations and limited activity sites in dense pinyon-juniper woodland on watershed divides at the mesa's higher
elevations (Matson et al. 1988). The conclusion that BM III groups selected only the best agricultural land, marked by greater elevations and dense pinyon-juniper woodland, tends to be supported by the reoccupation of virtually all the BM III sites by Puebloans (Matson et al. 1988).

**Changing Agricultural Potential**

A review of climatic variation on Cedar Mesa has only recently been completed by Matson, Lipe, and Haase (Matson et al. 1988, n.d.). In summary, they infer episodes of relatively high effective moisture at A.D. 1-250 (just prior to the BM II occupation on Cedar Mesa), A.D. 500-700 (during the BM III occupation on Cedar Mesa) and A.D. 950-1250 (Matson et al. 1988:22). They write, "That the BM II, BM III, and Puebloan occupations of Cedar Mesa do not begin until late in episodes of high effective moisture indicates a lag in response to improved conditions" (Matson et al. 1988). And, "Abandonments, on the other hand, appear to occur at the outset of worsening moisture conditions, at least at the end of the BM III and Pueblo occupations" (Matson et al. 1988).

The specifics of climatic variability affect this study only insofar as conditions suggesting high agricultural potential during all periods of occupation on Cedar Mesa are consistent with primary dependence on agricultural systems, while occupation continuing during periods of low agricultural potential may suggest a greater importance of wild plant (or even animal) foods to Anasazi diet.

Dean et al. (1985) differentiate between low and high frequency environmental change. They define high frequency environmental change as occurring more than once per generation (or per 25 year period). Dean et al. suggest that during periods of low frequency environmental stress
related to population approaching carrying capacity, high frequency environmental variation is likely to determine adaptive success (Dean et al. 1985:538-539). Grigg believes that pre-industrial farmers were more vulnerable to increasing unpredictability than to slow, long-term change (Grigg 1982). Dean et al. find rapid environmental oscillations during the period A.D. 310-380 which includes the end of the BM II occupation on Cedar Mesa, and during the period A.D. 750-1000, following the BM III occupation on Cedar Mesa (see Dean et al. 1985:542).

Dean et al. define low frequency environmental change as less than once in a generation (occurring less than once in a 25 year period). They suggest that it is the low frequency change which is most likely to be severe and visible in the archaeological record (Dean et al. 1985:538-539). The A.D. 200-700 interval may be characterized by rising ground water levels following a hydrologic minimum. Increasing ground water levels are interrupted by a secondary pause at about A.D. 600. Because initial occupation occurred in this A.D. 200-700 year interval in most of the Four Corners areas for which population reconstruction is available, including the Cedar Mesa-Glen Canyon area, the period is described as favorable to colonization (Dean et al. 1985:544).

Low frequency environmental change includes alternating episodes of erosion and aggradation. The beginning of the Cedar Mesa BM II period is timed with the beginning of a period of predominant arroyo cutting on Black Mesa (Euler et al. 1979:Figure 4). Ultimately, these changes affect carrying capacity. When the change is gradual, a behavior response via demographic change may be appropriate. When change is rapid, appropriate behavioral change is likely to include change in the subsistence system, especially intensification. Importantly for the study of early
agriculturalists, Rindos suggests that they have a larger number of species in their gardens than do later agriculturalists and that any change in the environment is not apt to affect all species equally. Failure of one domesticated plant species may be compensated for by increased reliance on other plants—both wild and domestic (Rindos 1984:272-273). Both kinds of change probably occurred on Cedar Mesa.

The low frequency environmental change that caused, or helped to cause, abandonment of Cedar Mesa was probably not change in the availability of good farming soils. Slash-and-burn agriculture, like all types of agriculture, tends to deplete soil nutrients and long fallow seasons seem always associated with successful, many-generation systems of shifting agriculture. In southwestern Colorado and southeastern Utah (see Matson et al. 1983:26), as elsewhere, exceptional crop yields attributed to high nutrients available in burned forest lands are usually limited to the first several years after forest clearing. Using the upper range of the Basketmaker population estimates for the 800 km² (a momentary population of 1000), Matson et al. (1988) suggest that 1000 hectares would be in active fields at one time, and that during a 200 year occupation, this would more than exhaust the 18,000 hectares of dense pinyon-juniper woodland that they measure for the study area. While this would show eventual exhaustion of critical wood resources, it is not clear that it would show exhaustion of the soil. Moreover, even when population has exceeded the carrying capacity of the best soils, population does not seem to drop off rapidly, or at all (see Hogan 1987:254). To me, it seems more likely that total available moisture or warmth decreased enough to make risks on Cedar Mesa greater than were worthwhile.
CHAPTER 3

EXPECTATIONS

This chapter presents expectations for stated hypotheses. Hypothesis I, which relates to intensification, has a single set of expectations. Hypothesis II, which relates to sedentariness, has two sets, one for each aspect of sedentariness: residency and permanence. The full set of expectations for each hypothesis is important (Table 1); many alternative explanations for results of any single test are possible. Only the convergence of results from the several analyses is considered sufficient to support an hypothesis.

The general expectations for each hypothesis are stated in this chapter. Ten lines of evidence are investigated for Hypothesis I. Some are specific to agricultural intensification; most measure any kind of intensification on plant foods—regardless of whether those foods are domestic or wild. Seven lines of evidence are investigated for Hypothesis II. Five of these measure sedentariness and two measure duration of occupation. No line of evidence is used for more than one hypothesis and overlapping lines of evidence, along with alternative explanations, are discussed in a final section. Methodological and procedural concerns for individual test expectations and analyses appear in Chapter 6.

Hypothesis I

Hypothesis I states: on Cedar Mesa, change in some characteristics of artifact assemblage, architecture, and spatial attributes of R-D areas, between BM II and BM III periods, is a result of subsistence intensification.
**Table 1. Expectations for Hypotheses**

Hypothesis I: Intensification

1. Total Storage Volumes
2. Storage Unit Sizes
3. Surface Versus Subsurface Storage
4. Spatial Association of Storage with Pithouses
5. Spatial Association of Extramural Features with Storage
6a. Number of Features Types
6b. Variability of Artifact Assemblages
7a. Hearth Counts
7b. Hearth Type Variability
8a. Occurrence of Site Furniture
8b. Specialization of Site Furniture
9. Site Furniture Locations
10. Artifacts Associated with Vegetal Food Processing

Hypothesis IIA: Residency

1. Habitation Counts
2. Internal Structuring of Pithouses
3. Feature Variability Among Site Types
4. Curated Artifacts
5. Furniture/Expedient Tool Ratio

Hypothesis IIB: Permanence

1. Energy Investment in Pithouses
2. Secondary Refuse
If subsistence intensification occurred between the BM II and BM III periods on Cedar Mesa, its principal cause is likely to have been risk reduction. The reader may recall that the definition of intensification used here is based on energy expenditure. With intensification, greater energy input may be directed at increasing utilization of a few classes of foods, including domesticates, or at increasing the number of food resources used. I have presumed that Basketmaker intensification would be based on greater utilization of a few plant foods, including domesticates. Some expectations are directed specifically at energy invested in agricultural production and most presume intensification would be represented by greater energy invested in getting more production from one or a few plant species regardless of whether or not these are domesticates. However, in either case, the expectations are based on presence/absence of greater investments of energy to produce the same or greater return. Alternative meanings of intensification and tests appropriate to those, especially to studying changes in degree of reliance on various foods, as revealed through carbon isotope and coprolite studies, were reviewed in the Chapter 1.

1.1. Total Storage Volumes

Total storage volumes are expected to be greater with intensification on a few seasonally available plant foods (including domesticates). If BM III groups had a more intensified subsistence system than their BM II predecessors, total storage volumes in BM II R-D areas are expected to average less than totals for BM III R-D areas. Increasing storage volume requires construction investment and implies storage investment directed at maintaining a given subsistence level. While total
storage might be increased to support a larger residential group, there is no indication that BM III households were larger than BM II households (although the total BM III population on Cedar Mesa may have been somewhat greater [Matson et al. 1988]). Therefore, increased storage represents both increased per capita food storage and increased average per capita expenditure of energy to build and fill facilities.

Relative storage volumes are expected to be a proxy for relative agricultural storage volumes among Cedar Mesa Basketmakers. This is expected despite established presence of storage, and even large amounts of storage, among some hunter-gatherers (e.g., see Flannery 1969:78). Regardless of collection or processing technology, storage may be expected where groups rely on seasonal resources. Storage volume may be expected to be larger where most food becomes available during some short season of the year. This phenomenon tends to be associated with agricultural harvests although massive storage of wild food harvests is sometimes found (e.g., Testart 1982:524). Hassan (1981) relates increased storage with increased anxiety from relying on fewer resources. There is a theoretical expectation for increased anxiety among agriculturalists; expectably, they will maintain more storage than is necessary for purely caloric needs (Hassan 1981:216-218). This may relate to the manner in which our memories operate. Work with episodic memory (Saarinan 1969) and judgment under uncertainty (Tversky and Kahneman 1974) suggests humans have a tendency to compare the wrong things, especially by comparing the worst or best years in memory to the present year, rather than to an average of a longer period. In any case, agriculturalists may be expected to increase storage. For Anasazi in southwestern Colorado, this expectation is borne out: "Larger storage facilities were built both in periods when dependence
on agriculture increased and at times when larger storage margins were needed as a buffer" (Gross 1987:217; also see Lyneis 1986:70-72).

Offering the fullest heuristic explanation, Rindos suggests that when domesticates become very important, loss of information concerning the edibility and processing of alternative food supplies may create a perceived food shortage well below the actual, local carrying capacity (Rindos 1984:273).

The case for the expected increase in total storage volumes between the BM II and BM III periods representing increased agricultural storage volumes follows. I presume that Basketmakers were storing mostly agricultural foods and were more dependent on even wild plants than animals, although many early works suggest otherwise. For instance, McGregor suggests that the BM III economy was about equally reliant on hunting and agriculture--without mention of wild plants (McGregor 1965:216). Schiffer suggests that McGregor's statement "could not be far wrong" (1972:150). In reviewing Roberts' (1929) notes on BM III storage facilities at Shabik'eeschee Village in Chaco Canyon, New Mexico, he estimates that about 50% of each individual's daily calories could have come from stored agricultural goods (Schiffer 1972:155). Very recent works tend to place even greater emphasis on agricultural subsistence during the early Anasazi periods (e.g., Matson and Chisholm 1986; Decker 1988; Matson 1988; Minnis 1988; Matson et al. 1988).

Whether the goods stored in architectural facilities were only agricultural products or whether they included other cereals remains the major question. Certainly, the number of items that Basketmakers could have been storing in large quantities is nearly limited to cereals. In the unlikely event that Winter is correct that wild grasses were not used
in southern Utah before the introduction of maize (Winter 1976) we would not expect large storage units to become regular facilities before maize was used since grasses and cheno-ams are more amenable to storage than most other locally available wild plant foods (Table B.1). In such a case it would be difficult to imagine that increased storage represents anything other than increased agricultural storage. In slightly later periods, where intensive recovery of pollen and macrobotanical remains has been effected, there is general support for the idea that stored goods were agricultural. In the Dolores Valley, Southwestern Colorado, Gross found a correspondence between more agriculture and more total storage in all of his archaeological periods (Gross 1987:214-216), which begin at the BM III/Pueblo I boundary. Support is also derived from energy cost models. Across the Anasazi area, the BM II-BM III transition includes a shift from principally pit storage to principally surface feature storage. While maize can be stored in either pits or surface features, storage capacity is widely regarded as being greater in surface features. Glassow suggests this may reflect local scarcity of construction elements for large underground chambers as well as the greater protection from moisture and rodents offered by surface storage. Like Glennie (1983), he believes that pit construction has more rigid wood requirements than surface construction. Perhaps, he says, "as stored maize became increasingly more important in subsistence, the occasional loss of a bushel or two was less tolerated" (Glassow 1982:85).

Having considered these alternative explanations for increasing storage space in R-D areas, I will offer that I believe any increase in storage volume from BM II to BM III represents increased agricultural storage. While many grass seeds, nuts, and other plants were probably
stored in Basketmaker facilities of either period. An increase from BM II to BM III, would probably be agricultural produce because of the presence of a good subsistence food, like corn, whose harvest is readily manipulable.

If the stores are cultigens, their intended use--either as a buffer against bad harvests in the future or as foodstuffs intended only to last until the next harvest (which would mean that increased storage space would be highly correlated with evidence for increased consumption of some classes of storable foods in carbon isotope or coprolite studies)--has no effect on this test implication. As evidence for intensification, it is important only that increased total volume of storage units can represent increased storage of relatively few classes of foods. The intended use of the stores is irrelevant.

1.2. Storage Unit Sizes.

Generally, small to medium sized storage pits or storage units are expected in R-D areas of groups with extensified subsistence systems, especially those with little agriculture. If BM III groups had a more intensified subsistence system than their BM II predecessors, more large storage units may be expected in BM III R-D areas and more small to medium storage units in BM II R-D areas. Large storage facilities are more cost efficient to construct than small ones, if all of the storage space in large facilities is expected to be used. Farmers are likely to expect to fill their storage units, since they can manipulate harvests to some degree.
Gardens can produce a big harvest and a big harvest of several
different types of produce\(^1\). Often all garden produce may ripen at nearly
the same time. Given that garden multi-cropping is common and that
gardens provide not just agricultural produce, but many weedy annuals,
diversity of storage requirements and problems can multiply. Any garden
then may lead to a proliferation of small storage units or to a few larger
structures. If several types of produce are to be stored in a single
facility, regardless of its shape, Schiffer suggests that the size of the
facility will need to be larger than the sum of the storage space required
for each individual product. Increased diversity requires increased
"access volume". That is, when more types of things are present more
unfilled space is required to enable removal, monitoring, etc., of
specific materials (Schiffer 1973). Indeed, Hunter-Anderson suggests that
the advent of horticulture is correlated with the appearance of large
storage units, especially above ground (Hunter-Anderson 1986:117).
Previously, she has noted that increased investment in storage facilities
is based on predictable presence of large amounts of resources to be
sensible arguments on cost accounting of prehistoric structures may be
applied to size of facilities as well as expected volumes and use life.

Insofar as volume increases more rapidly than perimeter, it may be
seen that if requirements for larger amounts of storage are expected, it
is advantageous to meet those through a few facilities with large volumes
rather than many facilities with small volumes. For Anasazi in
southwestern Colorado, this expectation is borne out: "Larger storage

\(^1\) While "Agricultural subsistence is also accompanied by a growing specialization in diet" (Rindos
1984:273), gardens may still be producing a variety of produce. As Rindos notes, this may be
especially true at the early stages of domestication.
facilities were built both in periods when dependence on agriculture increased and at times when larger storage margins were needed as a buffer" (Gross 1987:217; also see Lyneis 1986:70-72).

1.3. Surface Versus Subsurface Storage

The ratio of surface to subsurface storage units is expected to be higher in R-D areas of groups having more intensified subsistence systems. If BM III groups had a more intensified subsistence system than their BM II predecessors, the ratio of surface to subsurface storage units is expected to be lower in BM II than in BM III sites. This is expected because of the storage requirements for maize—especially the requirement for humidity control and for increasing storage area (Gross 1987). And, it may be more efficient to build large surface storage units than large underground storage chambers (see Expectation II).

Storage Requirements. The requirements for storing maize are not the same as the requirements for storing beans, much less squash. These also may differ from the requirements for storing various wild plants (see Table B.1). Hence, the finding of McGuire and Schiffer (1983) that maize stores better above ground than below need not translate to all other food stores. And, presence of relatively more above ground storage may be expected to coincide with increased intensification on cereals.

Corn. Like other cereals, corn does best with dry storage. This often translates to surface storage, as opposed to underground storage. Surface storage may be more rodent proof, as well (Glassow 1982:85; McGuire and Schiffer 1983). Specific requirements for storage previously have been reviewed by Gross (1987).
Beans. Storage requirements for beans are somewhat different than for corn. In some regards, requirements for bean storage are more exacting. Length of storage, temperature, moisture content of beans and humidity of storage unit, and relative carbon dioxide to oxygen levels strongly affect bean hardness (which refers to the bean coat) and cooking time as well as long-term ability to germinate. While beans can be stored in cool, dry, carbon-dioxide rich environments and still be expected to germinate after three years (Grange 1980); under other conditions, storage terms as short as three months can effect differences in bean hardness and cooking times (Valle de Mejia 1981). The effect of storage term, and other factors, on bean hardness and cooking time is strongly influenced by variety (Grullon and Jimenez 1982) but for all varieties high storage temperature increases bean hardness and cooking time (Gonzalez de Mejia 1982; Mora C. 1980; Rozo 1982). While ventilation is today considered useful in keeping beans, ventilation must include little exposure to oxygen (Gonzalez de Mejia 1982; Valle de Mejia 1981)--a condition more difficult to meet prehistorically. However, BM III and later practices of storing beans in capped ceramic jars probably helped reduce oxidation.

Beans store better in cool temperatures than in warm temperatures. Pithouses or their antechambers may provide sufficiently cool storage. Glennie conducted a series of temperature experiments in a replicated BM III pithouse and found a considerably more stable environment in the pithouse (without a hearth fire) than outside. In August, with an outside temperature of 103 °F (39.4 °C), the temperature was only 57 °F (13.9 °C) inside the pithouse (Glennie and Lipe 1984). This is an important difference, since "high temperature" is placed at about 25 °C. for bean storage (Mora C. 1980; Rozo 1982). A fire changes these values. Glennie
and Lipe state, "With outside air temperatures in the mid-30s F, a
moderate sized fire in the hearth caused the pithouse interior temperature
to rise 29 °F in 2.5 hours" (Glennie and Lipe 1984). With an ambient
temperature in the mid-30s this would not create "high temperature"
conditions for storage; however, if outside temperatures were at, or above
50 °F, a hearth fire would create high temperature storage conditions in
the main chamber. Glennie and Lipe do not offer corresponding
temperatures for an antechamber under any of the several conditions of
hearth fires or passageway closure. With the access between the main
chamber and the antechamber closed, I suspect that the antechamber offered
the necessary temperature values for bean storage.

It is not clear that surface storage would have offered the same
temperature advantages for bean storage as did pithouses until surface
storage was in multiple, contiguous rooms (e.g., see Knowles 1974:29-30)
in Pueblo I and later periods.

Like corn, beans do best in dry storage. Moisture, beginning at
about 18.5-22 percent, is highly favorable to development of fungi (Lopez
and Lopez 1971; Valle de Mejia 1981). Certainly, surface storage would be
expected to be better here than pithouses, antechambers, or especially
exterior pits. However, antechamber floors are often slightly elevated
relative to the main chamber in Cedar Mesa BM III structures, so the
antechamber may have offered substantially lower humidity compared to the
main chamber of a pithouse. In short, given the requirement for low
temperature storage, pithouse antechambers may have offered an adequate
bean storage environment prior to the development of multiple room storage
facilities in the Pueblo I period. The increased mass of the surface
structures tends to reduce diurnal fluctuations in interior temperature.
Squash. Modern storage of pumpkins (*Cucurbita pepo*) is possible for two years or more, often with chemically controlled air. However, good results are obtained even of whole fruits by partial drying in circulating warm air, followed by cool, dry storage. Gorini and Testoni (1978) report five month storage periods by placing pumpkins in circulating air at 79 °F (26 °C) for 10-12 days prior to storage at 50-54 °F (10-12 °C). From this, I presume that sun drying strips of squash, followed by storage in a dry environment--perhaps best as hanging storage--would be adequate. This method is reported for the Zuni by Cushing (Cushing 1979:58) and for the Tepehuan by Pennington (1969:79). For this food, the importance of low humidity probably supercedes the importance of cool or stable temperatures and surface storage would be preferable.

**Increasing Storage Size.** Increasing size for the storage of multiple types of things may be more possible with surface units than with subsurface pits. In any event, larger storage units, especially above ground, are commonly correlated with increased amounts and variety of horticultural stores (Glassow 1982:85; Hunter Anderson 1986:107, 116).

I.4. **Spatial Association of Storage with Pithouses**

Among groups with a more intensified economic system, storage units are expected to be closer to pithouses. If BM III groups had a more intensified subsistence system than their BM II predecessors, then

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2 Similarly, the Hopi are reported to have dried and preserved squash (Kennard 1979:557). In contrast, however, the Maricopa--living in a more arid area--built knee-deep gabled structures for keeping melons and pumpkins (Harwell and Kelley 1983:77).

3 I have personal experience pertaining to this, as well. I live in a semi-subterranean dwelling set in a hollow. The house has concrete floors that perhaps are only arguably superior to sand carpeted earth floors for moisture depression and, like a pithouse, the sole source of heat and humidity control in my house is a wood fire. And yet, there is no problem storing whole pumpkins from October to April or May, depending on the year. I leave them on the living-room bookshelves where the uneaten reside, firmly, until I fail to light the daily fire--then they begin to rot.
storage-to-pithouse distances are expected to be less than in BM II R-D areas. Keeping storage near the pithouse may provide differential access to social others and it may be more expedient for conducting domestic-processing activities.

Differential access. Evidence that differential access is an important consideration in the location of storage units relative to habitation rooms comes primarily from historic period pueblos and may be most applicable to storage in aggregated--or even nucleated villages. E.C. Adams (1983) and Patricia Gilman (1983, 1987) have been most specific in showing differential access to storage in modern pueblos.

In intact portions of old Walpi, access to storage rooms was through the floor of the habitation rooms. Adams suggests that the manner of this access continued the association of storage with both the household and the matrilineal lineage boundaries (E.C. Adams 1983:54). Elsewhere, architecture and village patterning have also been found to be good measures of corporate group presence, wealth, and cohesiveness. Especially under periods of stress, these groups may be at the supra-household level or even cross-cut households (Hayden and Cannon 1982:152). Still, for most of the Anasazi tradition, much storage may be conducted at the household level and many researchers have found storage rooms associated with particular habitation rooms (Dean 1969; Rohn 1965, 1971; Roberts and Gregor 1971:200).

Both Gilman (1983) and Gross (1987) have discussed the differences between storage that is contiguous and isolated storage units as these affect access to storage. Both suggest that difference between free-standing storage and storage units that are contiguous to habitation structures is more important than the distance between free-standing
storage structures and habitations for managing access to stores. Gilman suggests that storage rooms separate from other structures "are associated with groups having medium to large population densities and a medium to major dependence on agriculture" (Gilman 1983:132), such as the Pima and Papago. Gross specifically suggests that the difference between isolated and adjoining storage units represents a difference in the amount of actual control that groups exercised over storage facilities (Gross 1987:69). Researchers dealing with the symbolic use of space (e.g., Sommer 1969; Newman 1974) might argue that visual cues can effectively set off some extramural areas as private to all but the most obdurate visitor. Still, those measures are not easily accessed here.

Functionality of Use. Gilman regards the use of outside storage as indicative of low to moderate dependence on agriculture with an apparent absence of intent on storing materials for more than one year and, possibly, with the intent of storing them only for a season or less. I will take this section of her argument and expand it to say that drawing storage features closer to the pithouse may indicate increasing importance of stored food. I ignore her arguments equating distant granaries, as those in rockshelters, with outside storage in a habitation site.

Gilman has previously written that granaries in distant rockshelters or outside the habitation rooms in noncontiguous units are functionally equivalent (Gilman 1983:131-133). Unprotected granaries are not equivalent to freestanding, sometimes discontiguous storage structures within a R-D area. While recent work with stable carbon isotopes suggests similar consumption of corn for both Basketmaker and late Anasazi populations (Matson and Chisholm 1986; Matson 1988; Decker 1988), it is clear that the same Pueblo II and III groups with corn stored in distant
granaries also had corn stored in surface rooms attached to their habitation units. Some of those distant granaries did provide differential access—as at Moon House (see Bloomer 1988). Others seem no more protected than the storage Gilman cites for the Havasupai (Spier 1933; Forde 1934). Gilman has elsewhere suggested these later Pueblo groups have more than "low to moderate" reliance on agriculture. For the Havasupai, Gilman notes that the granaries are on their owners' seasonal migration line (Gilman 1983:133) implying that presence and location of distant storage may indicate seasonality. Indeed, this might be a sensible inference for Pueblo storage sites. Storage in such limited activity sites differs from storage in free standing storage units within the R-D area itself.

Distance between free-standing storage structures and the habitation structure, within the confines of the R-D area, may indicate breadth of use of the area. Speth and Johnson note that in "agglomerated storage areas" items may represent either a single function or a wide range of activities (Speth and Johnson 1976:51-52), which could certainly include food preparation. Data from a modern urban housing project indicates that residents prefer food preparation areas near entry and access areas or with a view of these, if individuals need not actually pass through those activity areas to get to other areas (Saile et al. 1972:18). Even relatively minor distances can be important if the need for access to storage units is frequent and especially if other activities are carried out at the storage units. If the stored foods supply a large proportion of the diet, access to storage will need to be more frequent, and minimizing distance to storage—even within the R-D area—may be energy efficient.
Really, this is a correlate to intensification, rather than a line of evidence for showing intensification of any sort and, particularly, intensification on domesticates (e.g. see Salmon 1975:451). There are two problems with storage-pithouse distance as a line of evidence rather than as a correlate to intensification. The first and most obvious is that the effect of differences in distance between pithouse and storage within R-D areas cannot be great. The areas themselves are not that large.

The second problem in using pithouse to storage distances as a measure of subsistence intensification occurs even if we considered the entire settlement pattern for this analysis. Within the larger settlement system, location of storage units may be more strongly affected by degree of sedentariness and population density than by intensification on any resource.

Within R-D areas, change in distance between a pithouse and free-standing storage units is more likely to represent definition of residential territory (Sommer 1969) or definition of household holdings (Newman 1974) than to measure actual limitations on storage access. Moreover, if storage is considered not as wealth, but simply as a resource, change in distance is more likely to represent part of the more general, possibly functional, reduction in size of the R-D area than to represent attempts to limit access. However, decreased storage-to-pithouse distance is consistent with subsistence intensification and, therefore, is not out-of-place among the other expectations.

I.5. Spatial Association of Extramural Features with Storage

Fewer nonstorage features are expected in the main storage complex areas of groups with a more intensified subsistence system. If the BM III
period is marked by a more intensified economic system than the BM II period, then extramural features are expected to be associated with storage features less frequently than in BM II R-D areas.

If the safety of storage becomes more important (e.g., Gilman 1983; Glassow 1980) and if storage was—for one reason or another—difficult to protect from vermin, perhaps because it was earth-covered (see Ahrens et al. 1981 in McGuire and Schiffer 1983:291), increasing exclusivity of that area may be expected. Its protection may warrant greater investments in energy, just as those features and structures intended to be used longer can warrant greater investments in energy in their construction. That is, if storage becomes more important in the BM III period, one associated investment may be the effort required to conduct extraneous activities a few meters away from storage.

This may be part of a separation of storage from an "agglomerated activity area" (Speth and Johnson 1976:52). Formalization of spatial organization in extramural areas may follow the same pattern as within structures. Within structures, Gilman (1983:35) suggests that special loci avoid interference with other activities and provide a specialization of material remains within certain (activity/use) areas. Outside, repetitively used areas are expected to be marked by features and/or artifact concentrations. This expectation only looks at features. While it is possible to have storage areas with multiple activities embedded, when storage is very important, sorting of activities may be increasingly expected and fewer non-storage features may be expected in storage areas.
I.6. Variability of Feature Types and Artifact Assemblages

Number of feature types and number of artifact assemblages will be relatively greater at BM II R-D units than at BM III R-D unit. That is, number of feature types and number of kinds of artifact assemblages from R-D units are expected to decrease with subsistence intensification. The idea that intensification leads to fewer classes of features and less artifact assemblage variability among habitation sites stems from a logical sequence that first, intensification means fewer major subsistence resources; second, reducing subsistence resources leads to less diversity in subsistence activity; and third, diversity of subsistence activities is tied to diversity of material remains.

There is general agreement with the first part of this sequence—that intensification among horticulturalists is generally based on more labor put into a few resources or types of resources. Intensification may decrease subsistence resources through decreasing the absolute number of taxa in a society's subsistence base (Rindos 1984:271). However, arguments of Hayden (1981:519) and Zvelebil (1986b:171) together suggest that a group may have multiple strategies with specialization only in resource-rich areas. Agriculture would, of course, be intended to provide a local, resource-rich area.

Argument does occur over whether or not fewer major subsistence resources lead to fewer subsistence activities and over the nature of the relationship between activities and material remains. Regardless of whether fewer major subsistence resources lead to fewer subsistence activities, the same number of subsistence activities should be expected in sites having equivalent functions. For instance, if all of habitation sites in this study reflected complete dependence on corn and squash
agriculture, we might expect that artifact and feature assemblages on all habitation sites would be equivalent, and the number of feature types and the number of kinds of artifact assemblages would be low. In contrast, if groups at some habitations were relying mostly on pinyon harvests and stored pinyon seeds, the addition of those habitation sites to the sample would be expected to add a different feature assemblage. This test implication is directed at the relationship between activities and material remains at this site level. That is, assemblages are compared. Number of kinds of assemblages of artifacts and number of feature types at habitation sites are expected to be smaller with intensification on a few plant species.

I suggest that change in feature and artifact assemblage richness (defined here as number of types) with intensification is consistent with the more well accepted implication for artifact diversity at the site type level (that sites of a particular type, e.g., butchering, would have artifact assemblages more similar to each other than to sites of some other type, e.g., hunting stands). Richness of artifact types in a site assemblage is more directly and consistently a function of the presence or absence of specialized activities in the unit of analysis (e.g., the R-D area) than are either proportional measures or actual frequencies (Cannon 1983:790-791), at least for comparing across a range of sample size (Kintigh 1984:44). In studying Pueblo site types, Schlanger and Orcutt found that the number of tool types present in an surface artifact assemblage is one measure of richness and that habitation loci have greater artifact class richness than assemblages from more specialized sites like seasonal loci and limited activity sites (Schlanger and Orcutt 1986:300).
Therefore, number of kinds of features are expected to be greater at BM II R-D units than at BM III R-D units, if BM III groups have a more intensified subsistence system. This is so because BM II groups would then have been performing more types of activities in their R-D areas. Also, more kinds of artifact assemblages are expected at BM II R-D areas. Site artifact assemblages previously have been clustered by Matson et al. (n.d.) and I infer that the assemblages of R-D areas will not differ much from the assemblages of habitation sites of which the R-D areas are part. Hence, if BM II sites (corresponding to R-D areas) used in this study fall into more artifact assemblage clusters than is true for the BM III period sample, this portion of the expectation is supported.

1.7. Hearth

Fewer hearths and fewer types of hearths are expected at R-D areas of groups with more intensified subsistence systems. If BM III groups had a more intensified subsistence system than their BM II predecessors, then there generally will be fewer hearths and fewer types of hearths in BM III R-D areas than in the less intensified BM II R-D areas. This is expected because intensification on a few resources is consistent with a reduced variety of procurement and processing systems. Increased investment in fewer resources (with predictable harvests) should result in less ad hoc construction of processing facilities. If material remains have a positive relation to activities, fewer hearths and less variety of hearths should be associated with little variety in the resource base.

In the Basketmaker sample, seven classes of extramural hearths are considered: large ashy areas, ash hearths, unlined burned pits, rock-filled hearths, slab-lined hearths, indeterminate types of hearths, and
limestone dumps. Only extramural hearths are compared. Intramural hearths of all types are considered as one class— and that class is excluded from the study.

While hearths of all these types are theoretically possible in sites of either Basketmaker period, I believe that burned limestone features belong only to BM II or earlier occupations. Deposits of heat-broken limestone are most consistent with stone boiling. I believe that most limestone dumps represent a palimpsest problem on BM III and Pueblo sites on Cedar Mesa. As Matson (Matson et al. n.d.) has argued, it is unlikely that pottery-making people would return to more labor-intensive stone-boiling for cooking under any circumstance. At habitation sites, where remains of ceramic vessels are common, it seems inconceivable. Of course, limestone also could be refuse from roasting pits, functioning in the same manner as fire-broken rocks of other material types among root (camas) processors in the Columbia Plateau (see Thoms 1986; for roasting *Agave* spp. see Ebeling 1986:364). However, I find this very unlikely. The Cedar Mesa limestone features are comprised of quite small rock. Small rock is good for stone boiling—it heats quickly and releases its heat quickly (and not so violently as large rock—Thoms, personal communication). On the other hand, because it releases heat quickly, small rock is not so good for ovens. The functional characteristic of an oven is that the heating element maintains its temperature for a relatively long time. Large rocks maintain heat best. Roasting pits for pinyon seeds (see Powell 1983) might be larger than most of these; limestone dumps on Cedar Mesa are generally the size of other hearths.

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4 McKenna has previously hypothesized differentiation of intramural "firepits" into functionally specific features in Puebloan period Chacoan rooms and suggests that differentiation reflects differentiation of room functions. He specifically mentions small, unlined, oval "heating pits" as separate and specialized features (McKenna 1986:32-33).
Considering first expected changes in variety of hearths at R-D areas, it is useful to review expectations for hunter-gatherers. Among hunter-gatherers, environmental richness and diversity of resources is important to predicting feature and artifact variability. For understanding hunter-gatherer strategies, Binford discusses the advantages to archaeological studies of land use patterns as opposed to studies focused on individual site locations. He suggests that residential sites are located in places prejudged to have "an optimal congruence among foods, fuels, and water obtainable from the chosen location" (Binford 1982:10; also see Jones 1985:108). In discussing residential moves among logistically organized hunter-gatherers Binford states, "The locations preferred for residential camps can be expected to yield a most complex mix of archaeological remains since they were commonly also utilized logistically when the residential camps were elsewhere" (Binford 1982:15). Therefore, we might assume a greater number and variety of hearths would be found at residential sites than at any other class of site. In this regard, BM II and BM III residential sites should be comparable. Among Mesolithic hunter-gatherers in Europe making the transition to farming communities, a similar differentiation of land use is noted. There, Zvelebil (1986b:171) argues for hunter-gatherer specialization in resource rich environments and diversification in resource poor environments. Therefore, we might expect the greatest variety of hearths to occur in resource poor environments. If agriculture provides a local, resource rich area (see Expectation I.6) and if agriculture is more important during the BM III period we should find a lesser variety of hearths in BM III R-D areas.
As with variety of hearths, total number of hearths in each R-D area is expected to be less during the Cedar Mesa BM III period than during the BM II period. From the standpoint of intensification, the total number of hearths at a R-D area should be the number of types of hearths in that R-D area. That is, if every R-D area requires one hearth of each type, the R-D area of the less intensified system will have more hearths just because of the greater variety. However, in contrast to change in hearth variety, which is best explained by change in the economic system, decreased number of hearths may be derived from changes in sedentism as much as from changes in intensification. With short term occupation and repeated reoccupation, hearths might be rebuilt, and the number of reoccupations could have a greater effect on hearth count than does variety of activities at a R-D area. In either case, BM II R-D areas are expected to have more hearths and greater variety of hearths than are expected at BM III R-D areas.

1.8. Occurrence and Specialization of Site Furniture

Site furniture is expected to be more specialized and more common at R-D areas of groups with more intensified plant resource subsistence. If BM III groups have more intensified subsistence, their site furniture is expected to be more specialized and relatively more common than furniture at BM II R-D areas. Furniture includes those items routinely left at a site with the expectation that they will be used there again; commonly these are items that are too heavy or awkward to regularly carry long distances (see Binford 1978; Gould 1978).

With intensification on a few plants, the furniture assemblage would be expected to shift to more of certain types of furniture classes and
fewer of other types of classes (e.g., Westfall 1985) and, particularly, increase in more specialized forms might be expected, that is a shift from forms that are suitable for a wide range of activities to forms which are suitable to only a narrower range of activities. In BM III R-D units, the ratio of two-hand manos to one-hand manos and the ratio of trough metates to basin metates should increase. If BM III subsistence is more intensified, use of particular specialized classes of furniture should increase and we might expect to find a few worn items, as well as useable items—as is found in the late Pueblo periods. This same expectation could result from greater sedentariness as well as greater duration of occupation. For instance, Hayden and Cannon (1983) argue that all sedentary people tend to accumulate material remains.

Since agricultural intensification is the most commonly represented type of subsistence intensification in the Southwest, it is the most studied. In the Dolores collection, Phagan finds that the proportion of one-hand manos is a constant, small, percent of the nonflaked lithic assemblages during all Anasazi occupations, representing "a consistent pattern of generalized plant processing throughout the entire sequence" of Anasazi occupation (Phagan 1986:579), which starts about A.D. 1, with permanent settlement beginning in the A.D. 600s (Kane 1986:361). In contrast, two hand manos are always more common and more variable, increasing noticeably during temporal periods that Phagan suggests had greater reliance on corn, greater population, and greater environmental stress (Phagan 1986:579). Dolores analysts have previously suggested that with increasing reliance on one or a few plant foods, dietary variety may have been maintained by increased variety of preparation techniques including a variety of utensils (Orth and Phagan 1984:151).
While this seems contradictory to the expectation for decreasing variety in types of hearths associated with greater specialization on a few plant foods (Expectation 1.7), the expectations are not necessarily contradictory. Here, the increased variety refers to different types of preparation, potentially within the same processing system. This, I suspect, is the same rationale as McKenna (McKenna 1986:32-33) used in arguing that small, unlined, oval heating pits should be considered separately from differentiation of other classes of hearths (which he called "firepits") in Chacoan structures. Evidence from furniture assemblages for variety in preparation techniques should be taken to include different raw materials (such as may be used to produce cornmeal with different grades of fineness) as well as different morphological forms, although form and material type may sometimes be correlated and best suited to certain tasks (see Lancaster 1986:177-178,183).

It is generally inferred that a high proportion of two hand manos and troughed or flat metates in a ground stone assemblage represents a subsistence system based on corn agriculture (e.g., Woodbury 1954:50-51; Martin and Plog 1973:215-217; Phagan 1986:579). Westfall, however, does not find this strong association of two hand manos with botanical evidence (pollen) for maize on White Mesa (Westfall 1985:380-387). In fact, in her comparison of BM III to Pueblo II ground stone assemblages with pollen from archaeological features, she finds that there is evidence for an apparent decrease in corn production, and increased intensification of foraging activities. At the same time, she suggests such alternative explanations as different plant harvesting methods, storage emphases, processing methods, and redistribution methods could affect the botanical data against which the ground stone was compared (Westfall 1985:402-403).
In general, it remains that one-hand manos and basin metates can be interpreted as representing a generalized plant processing complex, while a high proportion of two hand manos and trough metates in a ground stone assemblage may represent intensive preparation of some few plant foods especially, but not necessarily exclusive to, maize.

Because I do not have similar data on choppers, core-scrapers, or hammerstones, these classes of furniture are used only for comparative counts between BM II and BM III R-D units.

I.9. Site Furniture Locations

Site furniture is expected to have more restricted locations in R-D areas of groups with more intensified economic systems. Site furniture is expected to have less restricted locations in BM II R-D areas than in BM III R-D areas. The rationale for this is the same as for the expectation on feature locations because furnishings are inferred to have a low degree of portability.

With subsistence intensification, site furniture is expected to become economically important and to have strong spatial association with particular subsistence activity areas. As those areas become spatially discrete, locations of site furniture are also expected to become more restricted. Although more definite spatial structure of activity areas might result (and probably would result) in unused items being stored apart from areas of intended use, I expect that such storage locations would be within structures and, hence, not available to this study.\textsuperscript{5}

\textsuperscript{5} Of course, if BM III groups are storing furniture within structures and BM II groups are not then furniture will appear less common on BM III R-D areas, and the preceding Expectation I.8 will be found to be at least partly false.
I.10. Artifacts Associated with Vegetal Food Processing

Artifacts associated with vegetal food processing are expected to be relatively more specialized and more common with greater intensification. If BM III groups had a more intensified subsistence system than their BM II predecessors, artifacts associated with vegetal food processing are expected to be less specialized and less common at BM II R-D areas than at BM III R-D areas. These artifacts include the previously discussed manos and metates (see Expectation I.8), numbers of hammerstones, ratios of hammerstones to flaked lithic artifacts, and the relative proportion of projectile points in the flaked stone tool assemblage.

Arguments both for this expectation and for its reverse have been presented in the archaeological literature. Some archaeologists have suggested that when food diversity is reduced, increased numbers of feature and artifact classes associated with cooking will be found, representing the desire for diversity in taste (e.g., Gilman 1983:33). Others have argued that a reduction to a few specialized forms of artifacts represents a selective emphasis on processing a few specific resources (Martin and Plog 1973; Kane 1983b, 1983c; Westfall 1985:402). I favor increasing specialization and frequency of artifacts associated with vegetal food processing under subsistence intensification in the early Anasazi agricultural periods based only partly on the desire for diversity in taste. I will argue it more strongly because I believe that secondary subsistence systems (perhaps best regarded as farmers' insurance) would continue, and that artifacts and furniture associated with those possibly less specialized systems would remain in addition to the newer, more specialized forms. Together, these would result in a greater total number of items and greater apparent specialization of the assemblage.
For the Basketmaker artifact assemblages, ground stone artifacts may provide the most well-accepted evidence regarding subsistence change. Therefore, increasing numbers of two-hand manos either with or without continued presence of one-hand manos would provide strong support for this expectation. Two-hand manos are widely regarded as more specialized grinding stones (than one-hand manos) because one-hand manos could be used for pounding as well as for grinding. Change in metate forms also would provide strong support for this expectation. Explanations for the apparent long-term shift from basin metates (Archaic) to troughed and then flat slab metates (late Pueblo) are similar to explanations for change in mano forms. And, the intervening forms of metates may show increasing specialization. Hammerstones may provide indirect evidence for the regular use of metates because of their function in "sharpening metates" (Lipe et al. 1985), but provide this evidence only in the presence of metates and, in any event, do not provide even the same level of indirect evidence for subsistence as do groundstone artifacts.

While groundstone may provide the most well-accepted evidence for subsistence change, the most common artifacts on Basketmaker sites are flaked lithic artifacts. They have previously been used for subsistence discussions, as well. Especially through the use of projectile point frequencies, flaked lithic tools tend to be most associated with establishing the importance of hunting, rather than plant harvests, to the economy (e.g., Brisbin and Varien 1986). Other flaked lithic tools are associated with unspecified cutting or scraping tasks or with woodworking
versus hideworking. Therefore, this expectation must rely most on evidence from groundstone.

The appearance and proliferation of ceramics also is taken as a general measure of reliance on plant foods and especially on agricultural produce but, for the periods included, the first appearance of ceramics might best be considered in light of additional data from basketry. Such data is not available from open sites on Cedar Mesa.

**Hypothesis II**

Hypothesis II states: On Cedar Mesa, BM III groups were more sedentary than their BM II predecessors.

Sedentarity has two aspects: residency and permanence. Following Benson, degree of residency describes the difference between year-round and temporary or seasonal occupation. Permanence is the total duration of site use (Benson 1984:86). In the testing of this hypothesis it is presumed that both BM II and BM III groups on Cedar Mesa are semi-sedentary in both residency and permanence.

To test Hypothesis II, it is broken into two parts: a) On Cedar Mesa, BM III groups maintained individual residential-domestic units in a single location for a greater part of the year than did BM II groups; b) On Cedar Mesa, BM III groups maintained individual residential-domestic

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6 A review of functional classifications of flaked lithic tools is provided by Simmons (1982) and the following is principally from his discussion. Whittling and adzing are variously listed as accomplished with scrapers (Clark 1958; Gould 1968; Gould et al. 1971, Wilmsen 1970:68-74) or choppers (Prison and Bradley 1980:129) and shaft manufacture with notched tools (Bordaz 1970:19; Servello 1976:362), which Prison and Bradley list as a general tool for removing sharp edges, bark, etc. (Prison and Bradley 1980:109). The only lithic tools listed for hideworking are scrapers (Isaac 1967:146-147; Wilmsen 1970:68-74). Similar functional overlap is seen in the nondifferentiation of butchering and other cutting activities using bifaces (Prison and Bradley 1980; P. Jones 1980) or other retouched flakes (Prison and Bradley 1980:85, Wilmsen 1970:73-74; Simmons 1982:249-251).
units in the same location for longer periods of time than did their BM II predecessors.

IIA.1. Habitation Counts

At a given level of population, residential sites are expected to be less common with increasing residency. If BM III groups have a higher degree of residency than their BM II predecessors, their residential sites are expected to be less common.

Only residency is considered here. Duration of occupation is not considered. It is the possible difference in degree of residency that affects this expectation for a between-period difference in frequency of residential sites.

Groups that move even once during the year, have at least twice the number of residential sites of groups with year-round residency. Groups that move during the course of the year are often doing so to exploit resources not available in the location of the immediately previous residential site. Since the resources may differ (especially if they are horticulturalists who spend some part of the year, or some part of some years, exploiting wild resources), various residential sites may have different task orientations. Because these sites have an important residential component they may be tallied as residential sites, whether they are long-term habitations or shorter term camps. Groups that move several times during the year may have little need for task specific sites because those tasks are incorporated in residential sites. For these groups, residential sites will not only be more numerous but will comprise a larger proportion of the total number of sites than do residential sites of groups with greater sedentariness.
Groups that do not move during the year, but only send off members to collect or harvest different resources that are not locally available will have task-specific sites that are readily recognizable as distinct from the residential class of sites. Their residential sites will not only be fewer in number, but will also comprise a smaller proportion of the total number of sites than do residential sites of groups with a lower degree of sedentariness.

With complete sedentariness, there is at least a theoretical possibility for a group to have only a single site that includes both the residential-domestic area and the sum of all processing and procurement loci. I believe that this single site residency is most likely to be found where resource distribution is homogeneous and stable (whether the resources are wild or domesticated). In a homogeneous, stable environment, horticulturalists with complete sedentariness might exploit only land around their R-D areas and might move only because of exhaustion of resources including exhaustion of soil nutrients. However, resource distribution approaches homogeneity and stability only in tropical and subtropical regions and, even there, the reality of a stable, homogeneous resource base is highly questionable (see Posey 1985:157).

This expectation supposes that stable, homogeneous resource distribution is not met in the upland Southwest, even with agriculture, and that Basketmakers, or at least BM II groups were unlikely to have had a complete degree of sedentariness during all years.

In the Cedar Mesa area, a stable, homogeneous resource base is most likely to be approached by horticulturalists. Among horticulturalists, old cleared fields could add productive variety to the local environment, if group size was kept small (so that the sustaining area would not have
to be kept large) and if resource instability was countered by low permanence of settlements. Moreover, as the contribution of farming rises, the need for quantities of various gathered resources is reduced; therefore, the site-making potential of wild resource procurement activities is also reduced.

I am assuming that these groups need enough non-local, non-agricultural resources to establish sites while they are procuring the resources. If so, limited activity sites and, perhaps, limited activity site types would proliferate with increasing sedentariness. Of course, there is a cut-off point. In heterogeneous, unstable environments, a reduction in site types occurs when the task specific groups sent off become, or are replaced by, traders. However, a reduction in limited activity sites is not expected during the Basketmaker periods. And, in the Upper Little Colorado region limited activity sites are found to increase in importance during Pueblo periods (see F. Plog 1974). In terms of site assemblage, this means that there should be relatively more special activity sites in the late Pueblo periods and relatively fewer long-term "campsites" or habitations. If the same trend holds between BM II and BM III periods on Cedar Mesa, we should expect to find a lower proportion of residential sites (which may include the category of long-term campsites) in the BM III settlement system than in the BM II settlement system.

IIA.2. Internal Structuring of Pithouses

Increased internal structuring of habitation units is expected with increased residency. If BM III groups have a higher degree of residency than their BM II predecessors, their pithouses are expected to have more
internal structuring of space. At the most theoretical level, this expectation results from studies on perception of individual spatial requirements. The theoretical justification for this expectation is also supported by extrapolation from expectations for storage facilities and by empirical data comparing housing of mobile and sedentary groups. The perceptions of space necessary for long-term interactions, such as in living arrangements, have been found to be different from those for short-term personal interactions, such as at parties or conferences. Individuals require more space in long-term interactions (Hall 1966:16). That is, they require more privacy. Increasing size of rooms or partitioning rooms provides the same effect. Either lowers the perception of crowding (Desor 1972:82-83). In comparing architecture among aggregated and dispersed Pueblo villages, both number of rooms and space per person are found to be good measures of privacy. More aggregated Pueblo villages tend to have more rooms or more space per person (Dohm 1987). Therefore, if partitioning of a same-size room is equivalent to increased space, other factors remaining equal, partitioned rooms would be more expected among dwellings that will be occupied continuously for longer periods of time.

In this instance, expected use-life—a measure of duration of occupation—may be the best proxy measure of residency. Expected use-life may determine the amount of energy that groups are willing to invest in construction (see McGuire and Schiffer 1983). The expectation is also empirically derived from ethnographic descriptions of housing. Subjectively, the houses of groups with a low degree of residency tend to have little internal division within "family" areas of structures (cf., Rapoport 1969:37-40), perhaps because a change of activity is associated
with a change of place. Again subjectively, housing of groups with a high degree of residency tend to have more internal divisions within structures.

Although architectural types have been compared by technology and by social organization, there is little comparison by residency. Four categories of divisions may enter into such a comparison of space differentiation: subfloor pits, other bins, and either entryway bins in BM II pithouses or a partition wall at the south end of the main chamber of BM III (and later) pithouses. Presence of antechambers in BM III structures (absent in BM II pithouses) needs to be considered also.

I would suggest that partitioning walls perceptually expand space by partially hiding activities from view elsewhere in the structure. Subfloor pits and bins offer the perception of expanded space by hiding stored goods. Because floor pits can be covered, they leave more useable floor space than is available with storage bins or stacked storage. Where Gilman sees a movement to indoor pits to hide stores from social others (Gilman 1987:557-558), I see a movement of indoor storage to out-of-sight locations to keep stores from cluttering limited living space. While I believe this would be only marginally important to short-term camp arrangements, I believe that a sense of spaciousness becomes quite important for long-term living arrangements. Spaciousness is more important with increasing residency and while a sense of spaciousness can be achieved by increasing living space it can also be approached by segregating activities with partitions.
IIA.3. Feature Variability Among Site Types

For groups with a low degree of residency, the sum of feature types from the sum of all R-D areas should approach the total number of feature types. For groups with a high degree of residency, special task sites are expected to have features not found at the R-D unit. The sum of feature types in R-D areas is expected to be less among groups with a higher degree of residency. Because both BM II and BM III groups on Cedar Mesa are presumed to have a high degree of residency, the differences between them are not expected to be great. To the extent that BM III groups are expected to have a higher degree of residency, features at their R-D areas are expected to be a smaller subset of all feature types in the site sample.

If site types are considered on a dichotomy of residential sites and limited activity sites, two derivatives of this expectation are apparent. With increased residency, variability of features for a given site type will decrease and variability of features between site types will increase. Groups with a higher degree of residency are likely to leave their R-D unit only for specific activities rather than for a seasonal residential move. The case of historic period Pueblos provides a useful discussion, albeit only as a heuristic example. Despite our preference for considering historic period Pueblos as fully sedentary, in this analysis they would be seen to have an impressive degree of permanence in their villages, but only a moderate degree of residency. That is, among historic period Pueblos, seasonally occupied farmsteads are common (Bodine 1972) and probably help to alleviate any stress that may accumulate from close winter quartering within a Pueblo. Farmsteads virtually replicate the Pueblo apartments, except that they are made of
less durable materials and are commonly more open to cooling summer
breezes (e.g., see Marriott 1948). Insofar as these farmsteads are
residential sites in their own right, albeit often with a lower degree of
permanence and shorter residency than the village habitations, they cannot
be considered limited activity sites. Late Pueblo limited activity sites
are special task sites, especially for the procurement of distant goods,
such as salt among the Hopi (e.g., L. Simmons 1942) or for religious
reasons (e.g., Marriott 1948) and are readily differentiated from
residential sites. In summary, if the BM II groups have a lower degree of
residency than BM III groups, we may expect BM III limited activity sites
to be task specific sites rather than seasonal residential sites. Hence,
the kinds of features recognized at residential-domestic units will be
more numerous than the kinds of features recognized among limited activity
sites.

IIA.4. Curated Artifacts

Where any habitation site represents only one of several used during
the whole seasonal round, curated artifacts are expected to be carried
with their owners, rather than curated at a given habitation site. Where
individuals move frequently, curated items—those that will be kept and
considered for transport to another site—will tend to be small because
they may be carried often. The corollary is that relatively few items are
expected to be curated among groups that move frequently—at least if the
only means of moving possessions is for individuals to carry them,
themselves. Many more artifacts and larger artifacts can be curated among
groups with a high degree of residency. Hayden and Cannon write,

"Since almost all implements in sedentary communities are
curated and represent some significant investment of time,
labor, or money, broken artifacts of all kinds tend to be kept around for varying lengths of time in the event that fragments might still be useful for something. The greater the potential future value, the longer it is kept" (Hayden and Cannon 1983:131).

Hayden and Cannon's curated artifacts differ both from those that Binford labelled as curated artifacts (Binford 1979:279) and from those he labelled as site furniture (Binford 1978; 1979; also see Gould 1978). They differ from Binford's "curated" artifacts because these may not be maintained. They differ from furniture because there is no expectation that a set of these items should be manufactured and kept at each regularly used site. However, while Hayden and Cannon's definition of curated artifacts differs from Binford's original construction of curation, it elucidates the idea that curation is a simpler matter for sedentary groups than it is for mobile groups.7 Where mobility is relatively high, curated items are expected to be a low percentage of total tools not only because their total number is relatively small but also because the R-D areas of semi-sedentary groups (the "base camps") where those items would be refurbished but not discarded or lost (see Binford 1979:263) may be relatively numerous.

If BM III groups have a higher degree of residency than their BM II predecessors, curated artifacts are expected to be more common and less portable in BM III R-D areas than in BM II R-D areas. If BM II groups are more mobile than BM III groups, curated items are expected to be less common and more portable in their sites than in BM III R-D areas. If BM II groups used several residential sites per year, fewer curated items would be discarded or lost at any one site. If BM II groups were more mobile, their tool kits would be more likely to belong to individuals

7 Leonard (1973:96-97) presents the same basic argument as Hayden and Cannon, with acknowledgments to K. Flannery.
(rather than households, for instance) and to be portable. That is, where people move often, high energy investment would logically be limited to manufacture of items that move with the individuals that have to carry them.

All pottery may be regarded as curated. Some ceramic vessels are too large to be moved regularly and many anthropologists regard all pottery as difficult to move among occupation locations. To this extent, the presence of pottery on BM III sites argues for lower mobility than is recognized for BM II period groups. However, because of the absence of comparable material during the BM II period (which would be best represented by basketry), ceramics are not included in the expectations for curated artifacts.

Only curated lithic artifacts are used in between period comparisons because they are present on both BM II and BM III sites (Table A.5, Appendix A ;). Curated lithic artifacts are expected to be more common and more abundant in BM III R-D areas than in BM II R-D areas because of expected differences in the settlement pattern, rather than because of expected differences in number of curated lithic artifacts manufactured.

IIA.5. Furniture/Expedient Tool Ratio

Considering all sites of a momentary population, less total furniture is expected where equivalent furnishings need not be left at each site. If BM III groups have a higher degree of residency than their BM II predecessors, the ratio of flaked lithic artifacts to site furniture is expected to be lower in BM II R-D areas than in BM III R-D areas. Assuming that BM II and BM III groups use the same furnishings, the rationale for this expectation can be simply stated. If BM III groups
have a greater degree of residency, the smaller number of residential sites expected for any group should have enabled them to use relatively fewer pieces of site furniture. Therefore, a smaller actual number of furnishings should provide a higher flaked lithic artifact to site furniture ratio. Because post-occupational site formation processes should act the same on all artifact classes, measuring ratios of furniture-to-flaked lithic items has some benefits over measurement based on simple frequencies of any single artifact class.

The Heuristic Case. In the simplest case, useful only as a heuristic device, we would presume exactly the same types of tools used among two periods and the same total duration of site occupation for sites in either period. Then, we would be in an ideal position to study degree of residency based on artifact assemblages. In this most simple case, we would expect that if each residence is one of several base camps more total pieces of site furniture would be present in the residential sites of groups with a lower degree of residency. This is because the more mobile group has more residential sites and each residential site is expected to have the full complement of site furniture.

Since the total number of curated tools is expected to be the same for a group in either period (given that they would replace these when they became worn or otherwise damaged, but only upon return to some residential site), the ratio of furniture/curated tools would be higher in residential sites of the more mobile group.

Since expedient tools are likely to be freshly made at least with each move, the same reasoning as above suggests that there would be many more expedient tools at sites showing a lower degree of residency. Increased abundance of expedient tools would be most noticeable in
relation to site furniture, but might be expected even in relation to curated tools. That is, the ratio of furniture to expedient tools would be lower at residential sites of more mobile groups.

Adding Complexity. Reality is not so simple. Two divergences from the most simple case present immediate problems to this study.

1. There is no indication that total duration of occupation is the same for both periods. The expectation that BM II sites had a shorter total duration of occupation in fact, comprises Hypotheses IIB. And, according to those test implications directed specifically at duration of occupation (as opposed to degree of residency)--that is, investment of labor in pithouses and distribution of secondary refuse, it seems likely that BM II sites did have shorter total occupations than BM III R-D areas.

2. The types of artifacts present are not the same. This is true both for furniture and tools. While both BM II and BM III assemblages have furniture, curated tools, expedient tools, and debitage, the types of artifacts included in each of these classes vary and their frequencies vary (see Matson et al. n.d.). Since the rate at which furniture would be replaced depends on the type of furnishing (e.g., Hildebrand 1978), variability in the types of furniture present can be expected to alter the ratio of furniture[curated tools or furniture/expedient tools.

Weighting. For analysis of this test implication, weighted data rather than raw data are used. The weighting is derived from a comparison of the expected case and an idealization of the actual case of the way artifact assemblages may have been created. In the first case--that permanence differs between the Basketmaker periods--we can make the comparison more suitable by weighting to overcome the effects of a longer total duration of occupation (as opposed to the duration of a single
occupation). In the second case—that artifact classes are not comparable—no simple alteration is available. There is insufficient furniture present in the artifact assemblages of individual sites in either period to limit the ratio comparisons to furniture of specific types against curated or expedient artifacts.

Hypothesis IIB

The first half of Hypothesis II referred to residency. This second half refers to permanence. The second half can be stated as: On Cedar Mesa, BM III groups maintained individual residential-domestic units for longer periods of time than did their BM II predecessors.

IIB.1. Energy Investment in Pithouses

Greater energy investment in construction is expected for structures with a longer expected use-life. Where people build their own homes of materials equally available to all, construction may be expected to reflect their perceived needs. If residential sites of BM III groups may be expected to have longer duration of occupation than those of their BM II predecessors, BM II pithouses are expected to show less investment of labor than are BM III pithouses on Cedar Mesa.

Residents of more permanent settlements may be expected to require larger structures than residents of temporary settlements. If BM II people are indeed more mobile and less likely to return periodically to the same housing, their houses may be expected to be less durable. If BM II people are more mobile, they can be expected to perceive less need than would BM III people to expend the greater energy required to build large
or durable houses. Bigger structures cost more than smaller structures; more durable structures cost more to build than more flimsy structures.

Mobility and architectural form, per se, have received little scholarly treatment in architectural journals. However, they have given rise to time and cost studies that have contributed to archaeological perceptions of trade-offs between need for shelter and for minimizing energy input in shelter construction which has gained increasing importance over the last two decades. For instance, Ammerman et al. suggest that there is a maximum floor space that subsistence level farmers are willing to construct and maintain for each individual (Ammerman et al. 1976:60). Also, in a study of changing land-use patterns, Kelley found increased house size associated with permanence of occupation (Kelley 1986:142). Finally, circular structures are more often associated with less sedentary groups than are square-to-rectangular structures (Gilman 1983:63; Hunter-Anderson 1977:291; Robbins 1966:21; Whiting and Ayres 1968).

Some archaeologists have generalized the observed pattern to one in which builders have a trade-off between energy costs in construction and energy costs in repair; these authors suggest construction costs may be

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8 Of course, duration of occupation is only one variable, perhaps a minor one, affecting house size. Through a study of historic period Pueblo housing, I have come to believe that the major variable affecting house size within a given environment and a given subsistence and technological system is proximity of households to each other. Proximity can have a greater effect than even number of residents (Dohm 1987).

9 Gilman falls into this group for different reasons than the others. While Robbins (1966) and Whiting and Ayres (1968) suggest that round structures simply cost less than rectangular structures cost, Gilman suggests that round structures are less easy to attach to each other and therefore less functional in hiding contents from other households. She believes that the need to hide stored goods, particularly food, increases among more sedentary, more agricultural groups (Gilman 1983:63). She suggests that presence of pithouses is always accompanied by at least some degree of bi-seasonal settlement pattern, dictated by reliance on stored food during a cold season with no plant production (Gilman 1987:543).

10 None of these authors has carefully separated the effects of increased agriculture from increased sedentariness, although Robbins (1966) lists the results empirically with degree of mobility and degree of agricultural dependence.
inversely proportional to repair/remodeling costs, noting builders must choose limiting costs of one or the other, possibly based on the expected duration of structure use (McGuire and Schiffer 1983:278-279; Wilk and Rathje 1982:635-636). Modern construction of Anasazi Pueblo I type pithouses and surface structures (e.g., Glennie 1983; Varien 1984) seems to indicate that construction of pithouses is as energy expensive as building surface structures, but that surface structures might be easier to maintain and repair.

Construction costs of Basketmaker pithouses may be judged by size, materials, and durability. To meet the expectations of this test implication, BM II pithouses should be smaller and/or require less "expensive" materials but be built in such a way that the period of use before repair is necessary is shorter than implied for BM III pithouses. Size measurements are straightforward and not elaborated here.\footnote{In discussing Pueblo architecture, Wilshusen has proposed that size of Pueblo I pitstructures is dependent on the amount of dirt needed to construct associated surface dwellings (1984), thus effectively amortizing the cost of larger, deeper structures. However, in the Basketmaker periods deeper pithouses are best seen as costing more than shallower structures; the amount of surface construction is relatively small in these periods and does not seem to be sufficient to use the dirt excavated from at least the BM III pithouses.} Cost of materials is partly dependent on the amount of enclosed space. Cost is also dependent on the overall architectural form. Glennie has suggested that the wood requirements for surface structures (or very shallow pitstructures) is not as critical as those for pitstructures (Glennie 1983). Simpler wood requirements may actually apply to any dome or conically-roofed structure compared with any flat-roofed structure (see Jett and Spencer 1981). Domed dwellings with oval floors are most common with highly mobile groups. These tend to be less substantial and have less stringent requirements for building materials than are the rectangular structures that usually typify long-lived settlements. Cost
in construction that will provide greater durability includes any buttressing to the pit or roof. Glennie found the major problem with his pithouse was slump at the base of the wall due to water damage (Glennie 1983) - any construction which provided additional strength for the base of the pithouse wall would help to make it more durable. Lipe and Breternitz suggest that structurally, the strongest form of pitstructure is probably circular with a bench or slope at the base of the wall (Lipe and Breternitz 1980:28)

Previous work has been conducted on the use-life of BM II and BM III pithouses, both on Cedar Mesa and elsewhere. Estimates vary. For example, Schlanger differentiates between archaeological estimation and estimation through analogy. Just for archaeological estimation, she considers five data sources: tree-rings, archaeomagnetic dating, ceramics, pithouse morphology, and stratigraphy (Schlanger 1985:104). More important than variation from the technique used to estimate permanence is the definition of use-life or permanence. Specifically, the use-life of a structure measured only to the point of repair may be very different than its total duration of occupation, including one or more episodes of repair or remodeling.

Ahlstrom points out that repair dates provide imperfect estimates of use-life first, because they provide a minimum estimate of the interval between construction and repair; second, because they do not account for the period of use following repair; and third, because many pithouses were probably abandoned before their time (Ahlstrom 1985:634). This last has considerable ethnographic support. Sometimes, people probably just moved away. Among the Navajo, factors including death or vermin infestation can cause early abandonment (Kluckhohn and Leighton 1974:89; also see McGuire
and Schiffer 1983:291). Among the Pawnee, in the Missouri River area, vermin infestations (especially fleas) required maintenance that included seasonal burning of brush in the pithouses (Weltfish 1965:238, 252). Surely this implies the occasional loss of pithouses through a mechanism that would archaeologically appear as the intentional burning of structures. It is unclear to me whether durability of construction for expected use-life includes these phenomena, or whether Anasazi may often have built more durable structures than they needed for the number of years that the structure would be used. That is, while some overbuilding may be expected--in an attempt to reduce maintenance and repair costs--it is not clear how much actual and expected duration of occupation differ.

Schlanger suggests that "a reasonable uselife for an earth covered, wood post supported pitstructure lies between 2 and 15 years, with a likely average falling between 6 and 12 years" (Schlanger 1985:126). Basing their estimate partly on Schlanger's, Matson et al. suggest Cedar Mesa pithouses last 5-10 years during either Basketmaker period (Matson et al. 1988:). Based principally on tree ring analyses and secondarily on ethnographic analogy, Ahlstrom estimates maximum common pithouse use-life at 15-20 years, much shorter than the expected uselife for kivas (Ahlstrom 1985:638). These estimates are somewhat longer than the ethnographic earthlodge samples Ahlstrom shows from the Navajo, the Hidatsa, and the Pawnee. His pithouse estimates are a combination of BM III, Pueblo I, and later pithouses. His sample (Ahlstrom 1985:Table 30) suggests a somewhat shorter BM III uselife (9 sites/structures: range 4-24 years,

12 Six to 10 years is the estimate provided for Navajo hogans by Ahlstrom (1985:84) and McGuire and Schiffer (1983:291)—both based on personal communication from Jeffrey Dean.
13 Hidatsa earthlodge use-life estimates from Wilson are 10-12 years or 7-10 years (Wilson 1934:358, 372).
14 Pawnee earthlodge use-life estimates from Weltfish average 12 years, with a maximum of 15 years (Weltfish 1965:86, 88).
median 7 years, average 8.6 years) than Pueblo I uselife (15 sites/structures: range 2-86 years, median 20 years, average 14.1 years). Kiva uselives are longer (median 8 years; average more than 25 years). Still the difference between tree-ring dated use intervals in BM III and Pueblo I show that relatively minor architectural changes may be associated with different expected use-life estimates.

Berry (1982) found considerable regional variation in BM II period pithouses in his review of virtually all of the well-dated BM II pithouse sites. BM II period pithouses on Cedar Mesa and the nearby Red Rock Plateau (Sharrock et al. 1963; Lipe 1978) may show less effort in construction than Durango area pithouses (Morris 1941; Morris and Burgh 1954) or even Navajo Reservoir area pithouses (Eddy 1961; Eddy 1966) and such differences in construction cost might have been correlated prehistorically with differing expectations for length of residency in those areas. In contrast to the variability of pithouses in the BM II period, Berry found a wider distribution of architectural and assemblage attributes in BM III period sites, but this does not seem to be divided into eastern and western regional types, as may be true for the BM II pithouses. Berry believes the similarities in BM III sites are based on "climatically induced coexistence of previously distinct BM II populations..." (Berry 1982:117). The conclusions which Berry draws are not of major importance to this study except for the indication that we might expect all BM III pithouses to have the same expected use-life, while expected use-life figures for BM II pithouses might be expected to have greater between region variation. Between periods, investigators on Cedar Mesa, as elsewhere, indicate they have uniformly more substantial pithouses in BM III sites than in BM II sites.
IIB.3. Secondary Refuse

Disposal of refuse is more important with long-term occupation. If residential sites of BM II groups have shorter durations of occupation than those of the later BM III groups, secondary refuse is expected to be more scattered in BM II than in BM III R-D areas.

Schiffer defined primary refuse as "material discarded at its location of use" and secondary refuse as having a location of final discard different from the location of use (Schiffer 1972b:161). He stated the general principle that secondary refuse becomes more important with increased intensity of site use, particularly because of the need for access between activity areas, for sanitation, and for use of scarce activity area space (Schiffer 1972b:161-162).

In my masters thesis, I suggested that structured trash deposition may be a function of perceived congestion (Dohm 1981:23), and accepted the notion of Speth and Johnson that there is a real difference in the formation processes and distributional remains of agglomerated activity areas and agglomerated disposal areas. They defined agglomerated activity areas as locations where many activities were performed and agglomerated disposal areas as the locations where refuse or sweepings from many activities were dumped, that is, as secondary refuse areas (Speth and Johnson 1976:51).

On Cedar Mesa BM II sites, I expected secondary refuse to be deposited near the original locations of use (Dohm 1981:23) for three reasons. First, I expected it because previous investigators had found indications that BM II settlements represented short-term occupations (e.g., Lipe and Matson 1975:68; Sneed 1974:5; Camilli 1975:85). Second, BM II pithouse sites elsewhere had multiple deposits of trash, especially
with trash surrounding pithouses (Eddy 1961; Wendorf 1953). Finally, BM II pithouse sites made use of the unbounded space of mesa top locations where perceived congestion would not be expected to develop so rapidly as in bounded areas, such as rockshelter or cave sites. Starting from this initial work with my masters research, I think that trash disposal patterns would be a simple measure of difference in expected or actual duration of site occupation for BM II and BM III residences on Cedar Mesa.

Therefore, if BM III R-D areas have a longer duration of occupation we should expect to find more structured trash deposition that at BM II R-D areas. The structuring should be apparent both in a relative decrease of primary refuse areas (in favor of secondary refuse disposal patterns) and in movement of agglomerated refuse areas away from important activity areas.

Many archaeologists have implicitly noted an uneven distribution of refuse in archaeological sites (e.g., David 1971:Figure 1; Yellen 1977). While Lawrence suggests that "the meaning and use of spaces and objects are context dependent and evolve through time (Lawrence 1980:168; also see Douglas 1966), he has also noted that a four-part division of public/private and clean/dirty provides the basis of a cross-cultural system of spatial organization (Lawrence 1980:166; also see Portnoy 1981).

Boone writes,

"If midden accumulation was synchronous over an entire settlement, if occupation density and refuse-producing activities were uniform over the settlement, and if people adhered to the least effort principle with regard to disposal of their refuse, we could expect a pattern of middens of equal size dispersed evenly throughout the settlement" (Boone 1987:337).

In an ethnoarchaeological investigation of secondary refuse disposal in the Mayan highlands, Hayden and Cannon conclude that placement is based
on economy of effort, potential value, and potential hindrance of the refuse (Hayden and Cannon 1983:119). Rathje computed potential hindrance by size, and indicated artifacts less than 9 cm in size tend to be casually discarded (Rathje 1979:9-10); he did not consider potential recycling value of discarded items in his analysis of patterning. Hayden and Cannon similarly find that little, if any, refuse is left at primary locations of use within villages, including the areas within houses (Hayden and Cannon 1983:125, 133-134; also see Boone 1987; Samuels 1983:172-173 for a Northwest Coast example; cf., Flannery and Winter 1976:41-44). Hayden and Cannon noted that there was usually a conscious effort to put structures on top of any slope so that all organic refuse could be thrown downhill (Hayden and Cannon 1983:126; also see Damp 1984:580, 582; a pattern possibly present in Basketmaker sites on Cedar Mesa as well), contributing to a pattern in which disposal of refuse items could be done with minimum effort and minimum consideration. Within houses, this often meant sweeping up organic refuse and small inorganic items; where space was greater and other activities less frequent, materials might accumulate (Hayden and Cannon 1983:130).

Within houses, with their cramped spaces, any refuse might simply be regarded as a hindrance. In extramural areas, trash is expected to be excluded from activity areas, such as those used for storage, that are very important to subsistence. I would expect extramural storage areas to be treated in much the same way as Hayden and Cannon found "patio" areas treated in their highland Maya sample. That is, storage areas are not expected to be so well swept as house interiors, but are expected to be discrete from trash locations. If the storage complex represents a more important activity area in BM III than in BM II R-D areas, there should be
less evidence of secondary refuse near storage in BM III R-D areas. There is both a structural argument for refuse disposal following a clean/dirty dichotomy (Lawrence 1980) and a functional argument (Schiffer 1972b, 1976; Hayden and Cannon 1983). In either case, the more important activity areas are, the more we may expect those areas to be kept clear of secondary refuse. And, where areas are used for long periods of time, we may expect hindrance from trash to be less tolerated. That is, we may expect trash disposal to be more structured.

**Overlapping Lines of Evidence**

Each of the expectations presented above is really a line of evidence. For any expectation, that evidence can be used to support other hypotheses, in addition to intensification and increased sedentism. For instance, increased total storage (Expectation I.1) might indicate intensification, with costs principally related to procurement and storage of a few predictable resources; to increased variability in the annual food supply (which is a variation on the above), to extensification (in which case requirements of access space might make a significant contribution to increased total volume), or increased population. However, the latter two causes for increased total storage in R-D areas would be associated with additional expectations that differ, as least in part, from the preferred assemblage of R-D area expectations associated with increased intensification on a few plant foods, as indicated below.

If total storage increased not because of intensification on a few plant foods, possibly associated with risk reduction, a different assemblage of R-D area expectations would be indicated. Some of these are the reverse of those expected with the hypothesis of intensification. If
total storage increased because more plant foods are used, we might expect
increased types of processing features, increased spatial association
between processing features and storage features, increased variability in
artifact assemblages, increased numbers feature types, more hearths and
types of hearths, etc. If total R-D area storage increased because the
coresidential groups is larger, we might expect bigger pithouses, bigger
hearth, and more refuse in the BM III R-D units.

The sum of results from expectations is considered in determining
whether or not the hypotheses are useful in explaining change. That is, a
positive result on any one expectation can only provide weak and ambiguous
support for a hypothesis, since they concern only circumstantial evidence.
However, convergence among results of multiple expectations provides
strong support for an hypothesis. The strength is from multiple lines of
evidence.

In this study, I suggest that an increase in total storage unit
volume at a R-D area tends to support an hypothesis of increased reliance
on agricultural foods. Similarly, I also suggest that an increase in the
size of individual storage units tends to support an hypothesis of
increased reliance on agricultural foods. However, neither an increase in
total storage unit volume nor an increase in individual storage unit sizes
at R-D areas should be taken as prima facie evidence for increased
reliance on agriculture. Like other expectations in this study,
differences in storage can have many different causes. It is only the sum
of evidence, from all of the lines of evidence, that should be viewed as
indicating subsistence intensification—or an absence of intensification.

For example, in a recent dissertation, Gross considers seven
hypotheses for the cause of change in storage unit size through four
Dolores Archaeological Project Modeling Periods. His seven hypotheses are
that increase in size was

1. "caused by an increase in the proportional contribution of agriculture to the diet",
2. "caused by an increase in the volume of material relative to nutrient content",
3. "caused by an increase in the access volume necessitated by increases in content diversity",
4. "caused by an increase in the amount of material stored to buffer variation in food availability",
5. "caused by an increase in the amount of ceremonial activity involving the feeding of many outside individuals",
6. "caused by the accumulation of individual surpluses for use in developing leadership positions",
7. "caused by an increase in household size" (Gross 1987:Table 5).

Although each of these hypotheses has been considered as a sole cause by some author, none are mutually exclusive. Gilman suggests that increased storage is associated with increased dependence on agriculture (Gilman 1983; 1987). So does Glassow, by suggesting that increased storage reflects increase in "activities associated with tending fields" (Glassow 1972:298). However, partial causation from increased storage requirements associated with agricultural produce does not affect possible contributions by content diversity, fluctuation in resource availability, increased ceremonial activity or individual aggrandizement, or requirements from population increase. Indeed, more recently, Glassow proposed that increased storage may be a function of increased content diversity. He suggested not only that storage facilities are built to trade off energy costs in construction and repair (e.g., see McGuire and Schiffer 1983:50), but also to minimize costs for access of stored materials (Glassow 1982:79-80). Even if the increase in storage reflects greater dependence on agriculture, providing room not only for the major agricultural crop but also for the pioneer species that could be expected to proliferate in plowed fields (e.g., Ford 1984:130; Petersen et al.
1987:154) in an energy efficient manner, it does not, by itself, preclude the possibility that increase in storage also reflects an increase in the amount of material stored to buffer against variation in food availability (e.g., Burns 1983). For Chaco Canyon town sites, these factors, with increased storage, have all been tied to ritual intensification and/or regional integration (especially as reviewed in Cordell 1984; or see Judge 1984). Certainly, some individual aggrandizement can be expected to accompany such changes. While the relation between increased storage and accumulation for individual aggrandizement is overwhelming in relatively few areas, as in the Trobriand Islands (e.g., Malinowski 1922:64, 96-98), especially for increasing a woman's status (Weiner 1976:91-92), arguments for its appearance in the specific context of ceremonialism are not inconsistent. In any of these contexts, the contribution of increased local population density can only be expected to accelerate the swelling of storage unit size (see Hassan 1975:32).

So, multiple hypotheses for the cause of increased storage unit size are not mutually exclusive or necessarily independent. Nor are the factors used to explain increased storage suitable only to this purpose. For example, the need to buffer variation in food availability does not necessarily lead to increased storage. Among agriculturalists, storage may be represented by social organization rather than by facilities (e.g., O'Shea 1981:169). Alternatively, response to the resource fluctuation may be emigration (e.g., Berry 1982; Hassan 1981:171) or mobility (e.g., Benson 1984).

In summary, the suite of expectations and results presented in this study that argue, in the first case, the relative degree of agricultural
dependence and, in the second case, the relative degree of mobility, must be considered together.

I think that these overlapping lines of evidence from functional or economic causes of change can be dealt with rather neatly. Change that does not have a functional cause is more difficult. This is the spatial or architectural correlate of style. In the long term, of course, this is part of what we have called "tradition". Anasazi R-D areas have a demonstrated spatial alignment. Southwestern archaeologists have long been convinced that Anasazi set storage and trash in particular directions from pithouses, at least from the BM III through Pueblo III periods. That is, we have accepted Reed's (1956) front facing town sites as a legitimate concept. Therefore, it is legitimate to ask questions about spatial patterning beyond those that have purely functional correlates. Orientation of doorways, of storage units relative to the habitation structure, perhaps of hearths relative to the habitation structure, and possibly even of total R-D area size are among those patterns of spatial organization that relate to tradition rather than functional causes. There are functional reasons for associating or segregating some activities; but the spatial pattern of those activities may have additional emic meaning that lacks any functional correlate. These are addressed only in passing, in the context that they define the pattern of spatial organization in which functional changes take place.
CHAPTER 4

PROCEDURE

Sometimes, if you put things off long enough, you may find you really didn’t need to do them at all. William D. Lipe

This chapter presents the manner in which the sample was chosen, how attributes of the sample are defined and how measurements are made on these attributes. My method, the analyses of multiple expectations for each hypothesis, was incorporated in Chapter 3.

Sampling

The study sample is twenty-four R-D areas. Fourteen date securely to the BM II period and ten components are dated to the BM III period. All contain good evidence for habitations, and most have been tested. The reliability of the sample on various points is addressed. Principal among these points are chronological concerns, the problem of invisibility, and the potential problems of relating survey and excavation data. Finally, the manner in which these were selected from approximately 250 sites with an indefinite number of R-D areas is presented below.

Sources of the Data

Most of the data used in this study come from the Cedar Mesa Project (see Figure 1 in Chapter 1). The Cedar Mesa Project ran from 1972 through 1974. It was directed at understanding the adaptive strategies of all prehistoric groups on Cedar Mesa and the environmental limitations to

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1 Personal communication.
these strategies (Matson and Lipe 1975:124). Only the Cedar Mesa Project
mesa top quadrat survey and test excavations are used in this study.² In
the mesa top survey, a seven per cent random sample of 400 m quadrats
within five drainages was selected (Matson and Lipe 1975:135). Chosen
quadrats were intensively surveyed and mapped with all artifacts collected
for subsequent analysis. In D. Thomas’ terms (1975:62-63), this was a
non-site survey: every artifact and every feature identified within the
selected quadrats was mapped with about two-meter accuracy. However, this
was not explicitly a non-site survey. Sites were defined as conveniently
mappable units, distinct from thinly scattered artifacts and isolated
finds. Some sites were tested by Joseph Winter in 1972 and 1973. Test
excavations were intended to collect samples, including prehistoric
pollen, tree-ring samples, and archeomagnetic samples from hearths, to
expose certain classes of features to determine their characteristics in
more detail and test the assumption that similar features underlie similar
surface manifestations, to test for possible cultural stratification, and
to measure depths of midden for volume estimates (Lipe and Matson
1971:52).

Excavations conducted in 1984 at two R-D areas of site West Johns
12-6 are best seen as an extension of Cedar Mesa Project testing program
with a shift in emphasis to investigation of the smaller, extramural
features, as opposed to identification of habitation structures. The
excavations were aimed first at searching for rare features, especially
storage features, second at determining whether these rare features were

² A canyon survey also was conducted, as well as a canyon architectural survey. Additionally, separate
surveys in the Comb Wash area and on Sheiks Flat and Horse Flats were conducted. Data from those
surveys have not been used in this study, although results are referenced here and there.
clustered, and third at gaining a personal understanding of the vagaries of surface and subsurface remains of features on the Cedar Mesa Project.

The second principal source of data was results of 1969 and 1970 excavations at Basketmaker sites in the upper part of the Grand Gulch drainage between Kane and Bullet Canyons. These were intended specifically to characterize Basketmaker dwellings on open sites (Lipe 1978). A few (e.g., Grand Gulch 69-1) were described on an extensive survey in 1969. However, most were found during an intensive survey on the palteau in 1969. That survey recorded 83 nonceramic sites and 57 sites with ceramic materials—some of which may contain BM II or earlier components. On the plateau survey, crews made notes and photographs of sites and usually made intensive surface collections from standard size plots—20 foot diameter circles (Lipe 1978:391-392). Additional sites were recorded in the canyons, but none of those are included in this study.

All three periods of excavation (1969-1970; 1973-1974; 1984) were intended to augment survey data rather than to stand alone. Because the principal intent was, in each instance, study of relatively rare features, probabilistic sampling was neither appropriate (see Nance 1981:152-155; Redman 1987:251; Shott 1987:361) nor desired. In each case, location of excavation units was judgmentally determined.

Assigning Components to Basketmaker Periods

Cedar Mesa Project crews identified BM II sites by the presence of burned limestone as well as by various architectural characteristics, lithic tools (especially certain kinds of metates and flaked points) and absence of pottery. Similarly, BM III sites were identified by various
pithouse and storage characteristics, styles of metates and projectile points, and characteristics of the ceramic assemblage.

_Basketmaker II:_ In considering survey data, Matson et al. state, "If a site, or large areas of it, had limestone present, no ceramics, and abundant lithic artifacts, a Basketmaker II component was inferred to be present" (Matson et al. n.d.). For the mesa top occupations, Matson et al. (n.d.) name the BM II component the Grand Gulch Phase.

"San Pedro" and corner-notched points are believed consistent with BM II sites (Matson et al. n.d.). Snapped denticulates or "Don's saws" seem limited to this period. Overall, the frequencies of lithic artifact classes at BM II sites differ from frequencies at sites of later periods (cf., Matson et al. n.d.). Additionally, Keller (1982) found that material types of BM II lithic assemblages differed from later periods.

Metates, where present, are mostly basin-shaped, although some deep trough-shaped metate fragments are associated with BM II occupations. Most, or perhaps all, of the manos recovered from BM II contexts are one-hand manos (Matson et al. n.d.)

Several types of hearths and cists are found, some not distinguishable from those of later periods by surface evidence. However, honeycomb cists, as shown with West Johns 19-3, seem to be limited to BM II sites. "Ash hearths" (small ashy soil areas which Matson et al. [n.d.] suggest were probably less formally constructed than slab or rock hearths) are rare on any but BM II sites. This is also true of burned limestone concentrations, and I would suggest that the presence of burned limestone may usually be taken to indicate some BM II use of a site area.

The presence of ceramics was universally taken to show later use.
**Basketmaker III**: In considering the survey data, "The chief diagnostic was ceramics;" sites were considered to be Mossbacks if they had substantial amounts of plain gray pottery and no other kinds" (Matson et al. n.d.). "Mossbacks" is the phase name that Matson et al. use for the BM III occupation on Cedar Mesa.

Of 65 ceramic types considered in the seriation of the Cedar Mesa assemblages (Matson and Lipe 1977), only six are consistent with a BM III date. These are Lino Black-on-Gray, Chapin Black-on-White, Lino Gray Rims, Lino Gray Body Sherds, Chapin Gray Rims, Chapin Gray Body Sherds and, possibly, Undecorated, Unidentified Gray Ware. Because there is no overlap in ceramic assemblage of BM III and late Pueblo II or early Pueblo III occupations, Matson et al. suggest Lino B/G, Chapin B/W and Gray ware rim sherds may be considered diagnostic of a BM III component. Also, plain gray body sherds are rare in the Pueblo II and Pueblo III assemblages, so abundance of plain gray pottery is a good indicator of BM III period occupations (Matson et al. n.d.).

Lithic artifact classes are not so well separated from those of other periods as in the BM II collections, but Keller was again able to show differences in material type. In the BM III period, use of the local brown quartz decreased. The local brown quartz was partly replaced by Morrison Formation types from areas east of Cedar Mesa (nearer to Aneth, Utah) that were common in later components, as well, and partly by a "greenish quartzitic chert" found infrequently in later components. Moreover, "a smooth creamy white chert" that is common in the Pueblo occupations is virtually absent here (Keller 1982:167).

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3 In Table A.1, Appendix A, Pueblo phase assignments (1p, 2p, 3p, 4p0 are based on ceramic seriation. 3p is Wingate Phase (Pueblo II), the other are Pueblo III phases (see Haase 1983, Matson et al. n.d.).
Most of the BM III components identified by ceramics are habitations. These typically have multiple, discrete slab-lined features present north or northwest of a pithouse depression, and an absence of masonry or masonry and jacal surface rooms that characterize the later Pueblo components.

The Problem of Invisibility

Not all sites on Cedar Mesa are visible. Much less are all parts of sites visible. Some sites and parts of sites have been eroded away. Some sites are obscured by overlying sediments. Others are obscured by more recent sites. Many are simply too small to be noticed, even with non-site survey techniques. Burial by sediments and later sites are discussed below as they pertain to habitation sites. Invisibility because of small size is not discussed because habitation sites, with their architecture, are not likely to be invisible due to an absence of remains.

Natural Deposition and Invisibility. Data on the depositional environment of Cedar Mesa during the Basketmaker periods are inferential. They are based on archaeological excavations on the mesa top and geological investigations in the Grand Gulch area (Arrhenius and Bonatti 1965; Agenbroad 1975; Salkin 1975). Their data are in general agreement with other studies of the Four Corners area sedimentary environment and pollen record (see Euler et al. 1979; Petersen 1981; Petersen 1983; Dean et al. 1985). They suggest the presence of some local depositional environments on mesa tops within the larger, erosional environment. Although erosion and deflation are common, some local areas may have accumulated deposits sufficient to bury sites. The case for variability

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* See "Changing Agricultural Potential" in Chapter 2.
in the sedimentary record is critical to explaining the presence of buried features and the possible presence of buried sites on mesa tops of the Grand Gulch Plateau.

The archaeological data show evidence of both significant erosion and significant aggradation on Cedar Mesa. Much of the evidence for erosion is along drainages. Erosion is particularly active at the edges of major drainages—whole areas of some sites have crumbled with headward erosion of canyons. West Johns 2-3, one of the BM III habitation sites used in this study, today appears as a narrow linear alignment of features running parallel to a nearby arm of Johns Canyon. Of course, West Johns 2-3 may always have had a linear configuration, but erosion approaching the level of mass wasting is indicated by scatters of architectural debris down-slope from the main site area. Erosion is less dramatic, but still noticeable, along the minor drainages within sites. These intrasite drainages are shown on all site maps; most are wide and shallow—less than half a meter deep with a width three-or-four times as great—but some, including a few at West Johns 19-3, are over two meters deep.

Subjectively, most architectural remains seem to have been discovered outside tree-shaded areas and within the "watersheds" of these intrasite drainages.

The 1984 excavations at West Johns 12-6, a multicomponent Basketmaker site, clearly show local aggradation as well as the small scale erosion near site drainages. This aggradation, however, may be associated less with eolian events than with local pinyon and juniper growth. Pinyon and juniper trees probably took root on abandoned sites during some humid period favorable to seedlings. Growing trees protected the soil from subsequent erosion during later, drier episodes and, because
the site has little slope, their roots protected micro-areas from erosion. In 1984, BM II (or earlier) features were discovered more than one meter deep under tree berms. Elsewhere, BM II remains are commonly less than 30 cm below the modern ground surface. Protected by tree roots or hidden because of other phenomena, some BM II features are invisible to surface surveys. More BM II sites are probably present than are represented by Cedar Mesa Project tallies. And, more features are probably present in R-D areas of BM II and BM III sites than those tallied in this study. In no case has archaeological testing of a surface scatter of materials revealed less substantial remains than those anticipated from the Cedar Mesa surface collection.

**Palimpsests and Pentimento.** Palimpsests are parchment, or the like, from which writing has been partially or completely erased to make room for another text. Pentimento is a reappearance in a painting of a design which has been painted over. In archaeology, both represent obfuscation of some prehistoric occupation. The term "palimpsest" has been made known to archaeologists through the work of Binford (1980; 1982). Binford calls palimpsests "aggregates of artifacts...that commonly lack internal structure and would be characterized by accretional histories" (Binford 1980:9). In a later statement, he notes that items comprising assemblages may never have occurred together as an organized body of material during any given occupation (Binford 1982:17). An archaeological palimpsest results from reuse of sites where natural accumulation of sediments is not sufficient to stratigraphically separate every use of a site and especially where reuse is for a different function, so that assemblage composition as well as placement of items is modified. Binford's basic solution to the palimpsest problem is fourfold: 1) excavate wide,
contiguous areas, 2) excavate as many different forms of sites as possible, 3) including sites in different environmental zones and, 4) observe correlation of attributes not normally studied, especially between raw materials and artifacts, between activities and faunal or floral assemblage, and between activities and the physical characteristics of sites (Binford and Binford 1966). This solution seems equally applicable to the problem of pentimento.

Pentimento also is applicable to the study of archaeological remains and, in some instances, creates the greater problem. Insofar as the features and artifacts of the past remain in use, their appearance in a later context is not always recognized as anachronistic—much less recognized as phenomena out-of-context rather than as some curiously curated item or style.

Both the problem of palimpsests and the problem of pentimento occur on Cedar Mesa Basketmaker sites, as they occur elsewhere. On BM III sites, palimpsests may easily be recognized where Puebloans built over earlier architecture. On BM III sites, the problem of pentimento should be considered with every occurrence of limestone or limestone-sandstone scatters, which may be associated with stone boiling—an anachronistic activity in BM III R-D areas. Of course, each problem is seen elsewhere, as well.

Along with intensification this study looks for a difference in degree of sedentariness between BM II and BM III periods on Cedar Mesa. The BM II groups and, to some degree, the BM III groups, might have been only partially sedentary (cf., Matson and Lipe 1978). That is, the entire resident group of a pithouse site may have had more than one pithouse site or may have lived away from the pithouse site during some parts of the
year. Even where only a few years are accounted, many groups following some pattern of seasonal transhumance could be expected to reuse their base camps (or habitation sites) as limited activity sites (e.g., Binford 1982). It is likely that such reuse would not be separable from an original occupation on Cedar Mesa because naturally deposited strata here are mostly thin.

Such reuse has, in fact, been recognized on many Cedar Mesa BM II sites (Camilli 1983; Dohm 1981). There is general agreement that the assemblage is more important to understanding occupation dates and characteristics than are individual artifact classes, even taken together (Binford and Binford 1966). Also, there is general agreement that one spatial attribute of single occupations is a discontinuous scatter of artifacts (e.g., see P. Thomas 1986), which means that there are activity areas or use areas recognized by clusters of artifacts. Multiple occupations tend to "smear" these artifact clusters and, hence, produce a more homogeneous spatial distribution of artifacts. Therefore, most archaeologists seem to agree that separating multiple occupations will require both prior knowledge of assemblages and study of spatial attributes of a given site. As an intermediate solution to separating occupations, recognition that any artifact type which is both ubiquitous and clustered is a palimpsest may be of more assistance. Given that all assemblages are polythetic, Carr suggests dimensions of polythetic sets can be partitioned by techniques of spatial filtering or Fourier analysis (Carr 1984:201). I have not done this. Instead, I have assumed that some overlapping occupations will go unrecognized. Especially within the same period, later features are not identifiable as indicative of reoccupation except where they intrude into earlier features or structures (e.g., a
late hearth [HS 2] above the pithouse in site Grand Gulch 69-18). In short, late materials add "noise" to the spatial patterning of the habitation sites. Such overlays can be seen as essentially random, and they are apt to make spatial patterns less visible, but they will not confute spatial patterns that are discovered.

Certainly, during some part of the approximate 200 year BM II period or the 100 year BM III period on Cedar Mesa, reuse of a site location in the same, or in a different manner, should be expected. In the longer BM II period, such reuse could have produced aggregates of habitation sites that have been described previously as "villages" (Dohm 1981). Moreover, if occupation of sites in the BM II period were sufficiently brief (that is, if pithouse residences do not represent long-term farmsteads), destruction of the pinyon-juniper might have been much less than is associated with long term farmsteads and reoccupation of an area as a habitation site might have been possible several times during the temporal equivalent of one Pueblo occupation, or possibly, one BM II occupation. Such an overlay of habitation sites would not be expected from the BM III period because the BM III period itself is so much shorter and because pithouse construction techniques suggest that individual pithouses were expected to be occupied for relatively long periods of time.

All of the Basketmaker III habitations on Cedar Mesa appear as components of multiple occupation sites. Matson and Lipe (1978:5) recognized that many BM III sites are obscured by Pueblo II occupations. Still, remnants of the BM III occupations are clearly visible. The BM III architecture and ceramics are noticeably different from the late P II or P III materials that represent the next occupations on Cedar Mesa.
following the BM III period. In general, Matson et al. have tried to separate BM III and Pueblo components by plotting the density of Basketmaker and Pueblo ceramics on sites (Matson et al. n.d.).

Matson et al. are not concerned with description of BM III R-D areas in the manner of this study. Each of the Cedar Mesa BM III R-D areas probably includes more features and more artifacts than are shown on R-D area maps in this study. Pueblo reoccupation of BM III R-D areas obscures Basketmaker storage areas, other small features, and clusters of artifacts just by presence of late artifacts. Here, Pueblo reoccupation creates special problems. Underrepresentation is, after all, only a special case of misrepresentation. And, to that extent, BM III R-D areas are misrepresented in this study.

On BM III sites with little Pueblo noise, the ceramic/lithic ratio is quite low (Table 2). Pueblo sites differ from BM III sites not only in the greater variety of ceramics, but also in the relatively greater number of ceramics. At the Basketmaker Pueblo division, there is a noticeable shift in ceramic/lithic ratios. This may be partly a function of increased numbers of ceramic vessels and partly a decrease in certain types of lithic tools that had previously been used in processing raw materials for basketry. Surface collections from Cedar Mesa Pueblo sites show a much higher ceramic/lithic ratio than their Basketmaker predecessors and commonly even have more sherds than lithic items (Table 3).

In all three tables of ceramic/lithic ratios, considerable variation may be noted. This is particularly true in ceramic/lithic ratios for sites with both Basketmaker and Pueblo components (Table 4). Variability may reflect differences in the type of use or in duration of use during
Table 2. Ceramic/Lithic Ratios in BM III Sites\(^a\)

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>BM Cer</th>
<th>Pueblo Cer</th>
<th>Lithics</th>
<th>BM Cer/Lithics</th>
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</thead>
<tbody>
<tr>
<td>B 5-7</td>
<td>BM III</td>
<td>17</td>
<td>0</td>
<td>43</td>
<td>0.39</td>
</tr>
<tr>
<td>B 6-6</td>
<td>BM III</td>
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<td>2</td>
<td>54</td>
<td>0.51</td>
</tr>
<tr>
<td>WJ 2-3</td>
<td>BM III</td>
<td>44</td>
<td>17</td>
<td>410</td>
<td>0.10</td>
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<td>WJ 12-6</td>
<td>BM III</td>
<td>14</td>
<td>2</td>
<td>89</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Table 3. Ceramic/Lithic Ratios in Pueblo Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Date</th>
<th>Cer/Lith</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ugg 4-1</td>
<td>PIII</td>
<td>6.56</td>
</tr>
<tr>
<td>WJ 2-7</td>
<td>PII-PIII</td>
<td>infinity</td>
</tr>
<tr>
<td>WJ 2-8</td>
<td>PII</td>
<td>2.46</td>
</tr>
<tr>
<td>WJ 4-3</td>
<td>PII-PIII</td>
<td>3.71</td>
</tr>
<tr>
<td>WJ 12-7</td>
<td>PII</td>
<td>0.98</td>
</tr>
<tr>
<td>WJ 16-1</td>
<td>PII-PIII</td>
<td>1.63</td>
</tr>
<tr>
<td>WJ 16-3</td>
<td>PII</td>
<td>0.79</td>
</tr>
<tr>
<td>WJ 2-1</td>
<td>PIII</td>
<td>0.59</td>
</tr>
<tr>
<td>WJ 6-4</td>
<td>PIII</td>
<td>1.42</td>
</tr>
</tbody>
</table>

\(^a\) Ceramic/Lithic ratios are derived from figures shown in Table A.3, Appendix A. These may differ slightly from artifact tallies shown in Matson et al. (n.d.) because of ongoing artifact analysis.

\(^b\) WJ 2-3 is suspected on including a BM II component. Because BM II components should have no ceramics, presence of a BM II component may be expected to lower the ceramic/lithic ratio.

\(^c\) WJ 12-6 is known to have both a BM II and a BM III component. Only artifact summaries from the BM III area are included here.
Table 4. Ceramic/Lithic Ratios in Sites with Both BM III and Pueblo Components.

<table>
<thead>
<tr>
<th>Site</th>
<th>Dates</th>
<th>Cer/Lith</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS 14-2</td>
<td>BM III/PII</td>
<td>0.46</td>
</tr>
<tr>
<td>NR 4-2</td>
<td>BM III/PII</td>
<td>2.29</td>
</tr>
<tr>
<td>NR 4-3</td>
<td>BM III/PII</td>
<td>0.50</td>
</tr>
<tr>
<td>NR 4-5</td>
<td>BM III/PII</td>
<td>1.99</td>
</tr>
<tr>
<td>NR 11-2</td>
<td>BM III/PII</td>
<td>1.26</td>
</tr>
<tr>
<td>NR 11-4</td>
<td>BM III/PII</td>
<td>1.19</td>
</tr>
<tr>
<td>UGG 2-2</td>
<td>BM III/PII</td>
<td>0.90</td>
</tr>
<tr>
<td>UGG 6-1</td>
<td>BM III/PII</td>
<td>3.01</td>
</tr>
<tr>
<td>W 11-3</td>
<td>BM III/PII</td>
<td>0.74</td>
</tr>
<tr>
<td>WJ 12-1</td>
<td>BM III/PII</td>
<td>1.20</td>
</tr>
<tr>
<td>WJ 12-4</td>
<td>BM III/PII</td>
<td>0.47</td>
</tr>
<tr>
<td>NR 9-1</td>
<td>BM III/PII</td>
<td>1.98</td>
</tr>
<tr>
<td>NR 10-2</td>
<td>BM III/PII</td>
<td>2.83</td>
</tr>
<tr>
<td>UGG 4-3</td>
<td>BM III/PII</td>
<td>1.52</td>
</tr>
<tr>
<td>UGG 6-3</td>
<td>BM III/PII</td>
<td>2.02</td>
</tr>
</tbody>
</table>
the different periods. Elsewhere, however, such differences have been
associated with variability in artifact inventory.

Kohler and Blinman (1987) have tried to separate proportional
contribution of different site components to total ceramic population
using multiple linear regression analysis. This required that they
estimate sherd deposition rates. They found quite different results
depending on whether they divided sherds by households or by pitstructures
(they believe that the number of households represented by a single
pitstructure was variable by period in their study area, the Dolores
Valley of southwestern Colorado). In part, they believe this results from
changes in ceramic inventories over time and that these are positively
associated with increasing reliance on agricultural products affect
ceramic populations (Kohler and Blinman 1987:8). Additionally, they
suggest that changes in ceramic populations result from different
occupation patterns: both expected duration of occupation and the
proportion of the year that households were resident at the site (Kohler
and Blinman 1987:10). It is clear that short term and limited activity
occupations will not make the same contribution to refuse as long term and
full activity occupations make. These aspects of sedentariness are also
expected to be variable on Cedar Mesa, and may account for some of the
variability shown in Tables 2, 3, and 4.

Matson et al. (n.d.) have shown that separation of Basketmaker and
Pueblo areas on Cedar Mesa sites is possible where the components have
only partial spatial overlap. My technique of choice was to exclude from
study all areas where Pueblo ceramics were recovered. This was not
possible on all sites. On sites with Basketmaker and Pueblo components
that partially overlapped in space, I attempted separation of
predominantly Basketmaker areas from the rest of the site by analyzing the relative amount of Basketmaker and Pueblo ceramics, as well as by limiting Basketmaker R-D areas to those without Pueblo architecture or obvious Pueblo furniture (e.g., slab metates). On these sites, areas found to be predominantly Basketmaker were then included in analysis of features and structures but excluded from spatial analysis of Basketmaker artifact distributions. This is true of North Road 11-4, North Road 4-5, and Upper Grand Gulch 4-3. The North Road 4-5 maps showing first, the spatial distribution of ceramic sherd counts relative to lithic artifacts (Figure 2) and second, the spatial distribution of Pueblo ceramic densities alone (Figure 3), show that even areas which may be recognized as Basketmaker III by low ceramic/lithic ratios have such high Pueblo ceramic counts that a Basketmaker association for any artifact is questionable. The confusion on North Road 4-5 was such that it was excluded from all artifact analyses (not just those directed at spatial distributions). The two other large sites with considerable Pueblo noise, North Road 11-4 and Upper Grand Gulch 4-3, would have been excluded from spatial analysis of secondary refuse locations, had the anticipated analysis been conducted (Expectation IIB.2). Both were included in analyses for Expectation I.10, Expectation IIA.4, and Expectation IIA.5 which used only counts, rather than spatial distributions. Because one might assume that Pueblo occupations would show evidence for greater subsistence intensification and residency, the negative results of those analyses are particularly interesting to me, and are discussed in Chapter 6.
Figure 2. Assigning R-D areas to Basketmaker components: North Road 4-5 density distribution of ceramic/lithic ratio.
Figure 3. Assigning R-D areas to Basketmaker components: North Road 4-5 density distribution of Pueblo ceramics.
Relating Survey and Excavation Data

Previous work with spatial patterning of artifact distributions in BM II sites on Cedar Mesa indicated that functionally different site types showed different spatial distributions of materials, with habitation sites having their own distinctive patterns (Dohm 1981), a conclusion generally supported by later research (Camilli 1983). As a result, there is every reason to expect a general similarity in the layouts of R-D areas in Cedar Mesa BM II or Cedar Mesa BM III sites. However, neither survey nor excavation data are complete in themselves. Data from excavated sites are quite exact, but not very extensive. Relatively few sites have even been tested (8 BM II and 7 BM III), and no site is completely excavated. Instead, these excavations offered tests of feature identifications made from survey data and some control on metric sizes of features and distances among features and artifact clusters. In contrast, data from survey are far more extensive. Many sites are recorded from survey (182 BM II and 52 BM III), and the full horizontal extent of those sites was recorded. Collections are complete horizontally. In summary, survey and excavation data are complementary.

In this study, feature and structure descriptions from excavation are used whenever available. That is, a survey feature labelled as an ash area during survey, but found to include two processing pits and a posthole during excavation, is given three labels: two processing pits and a posthole. The ashy area, under which the excavation features were identified, is not listed again, as a discrete feature.

All three periods of excavation (1969-1970; 1973-1974; 1984) were intended to augment survey data rather than to stand alone. Because the principal intent was, in each instance, study of relatively rare features,
probabilistic sampling was neither appropriate (see Redman 1987:251) nor desired. In each case, locations of excavation units were judgmentally determined. As implied above, cultural material at the surface seems universally to indicate presence of underlying material. Some regard this as uncommon (e.g., see Redman 1987:251; Lewarch and O'Brien 1981), while others suggest that even plowing does not move artifacts very far (e.g., S. Plog, et al. 1978:416). Excavations on Cedar Mesa have always been directed at the buried features, whether these were artifact features (including trash middens) or structural features.

In contrast, all artifact data are derived from survey. No artifact data from the excavations are included in the study. Originally, this decision was made because I believed that Cedar Mesa sediments were deflating today, and had been deflating since before Basketmakers had lived there. Therefore, a large proportion of the artifacts present at the site would be on the surface. Even though I now believe (based on the excavation results) that there may be a number of cases where deflation has not occurred, I have stuck by the decision to use artifact data from survey only. The survey artifacts represent full site collections from a random sample of sites. The excavated artifacts are from judgmentally selected locations within judgmentally chosen sites. While it is reasonable to use the excavations to clarify feature description and function, thus strengthening the interpretation of features observed during survey, it does not seem reasonable to use excavations to add new, nonrandom artifactual data.
Choosing Sites

The study sample of 24 R-D areas is taken from the 1972-75 Cedar Mesa Project sites and from sites studied during Lipe’s 1969-1970 survey and excavation. The Cedar Mesa Project sample includes 340 sites (Matson and Lipe 1978:2)⁵. Ten of these were tested by Joseph Winter in 1972, 1973, and 1974, and I conducted further excavations on one of Winter’s tested sites (West Johns 12-6) in 1984. Of these, 47 sites were potential candidates for this study, and 17 were actually selected. The 1969-1970 project recorded over 100 sites. Only the six tested sites from the 1969-1970 project were considered potential candidates for this study, because this survey produced less substantial records than the subsequent Cedar Mesa Project survey, and artifact collections were made only from judgmentally selected locations.

Identification as a probable habitation made a site a potential candidate for this study. Tested sites were preferred. Candidates were excluded on the basis of inadequate or conflicting information in field records. Because of the greater number of BM II sites, rules for BM II R-D area inclusion were more rigid. For the BM II sample, only well-dated single component sites were considered. For the BM III sample, only well-dated components which Matson and Haase had believed to be spatially separable from later Pueblo components on the basis of ceramic assemblage were included in the study sample. Absence of maps or problems with map records were the most common reasons for exclusion. For instance, while a pithouse might be identified in notes, if it was not shown and labelled on field maps, the site was excluded from the study sample. Conflicting

⁵ Sites may include multiple components and/or multiple R-D areas; see Table A.1, Appendix A.
scales or north arrows on field map segments also were sufficient reason for excluding a site from the study sample.

Only sites identified as residential units are part of this study. Previously, Basketmaker period habitation sites on Cedar Mesa have been identified in several manners. At least among BM II period sites, identification of residential sites by the presence of certain artifacts and features produces results similar to the more accurate results produced by sorting sites based on spatial similarities among the feature and artifact distributions (see Dohm 1981). The latter method placed all BM II sites which test excavations had showed to contain a pithouse within the category of residential sites. However, this method was very time consuming. Identification of residential sites based on the presence of certain artifacts and features seems to be accurate except that it is very conservative. Presence of diagnostic artifacts and features does not place all tested pithouse sites with residential units. Despite its shortcomings, this was the method used to determine sites useful to this study.

For the purpose of this study, any characteristic commonly associated with a habitation site was sufficient to categorize a site as a probable habitation (see Table A.6, Appendix A). This included the presence of a pithouse, or the inferred presence of a pithouse based on survey records or excavation; for BM II sites, spatial characteristics of the artifact distribution previously associated with habitation sites (see Dohm 1981); or, for either Basketmaker period, Matson et al.'s (n.d.) identification of the site as a habitation based on artifact assemblage.

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Defining and Measuring Attributes

Analysis of the site sample has two basic components: definition of attributes and measuring the differences in occurrence and distribution of those attributes. Discussion of the definition of attributes is broken down into architectural attributes and artifact attributes. Similarly, discussion of measurement procedures is divided between measuring differences in occurrence between BM II and BM III, and measuring differences in spatial association.

Among feature classes, dwellings are certainly the most important because site spatial organization was measured principally in relation to the pithouse. All of the R-D areas in this study are at least inferred to have a pithouse. Research for my Master's thesis suggested that the BM II pithouse was generally near the center of the artifact distribution (Dohm 1981). Since it has been shown that the spatial organization of BM II sites is not random, comparison of BM II and BM III site spatial structure based on distance between pithouses and various classes of architectural features and other remains is logical. Site spatial organization is secondarily measured in relation to storage units, because of the roles they are expected to play both in sedentariness and in resource intensification.

Because of the emphasis on site organization, as opposed to architectural form, features within pithouses and other structures are excluded. Emphasis is on describing continuity and change in the spatial relationship among economic features, most easily identified as classes of pithouses, hearths, storage units, and trash units (Table 5). Less common and less easily identified features receive less emphasis.
<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
<th>Surface Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>Ash Spot</td>
<td>Discrete concentration of ash, without artifacts or sandstone, but larger than the 1 m diameter defined for ash hearth features.</td>
</tr>
<tr>
<td>HA</td>
<td>Hearth: Ash</td>
<td>Discrete concentration of ash less with diameter 1 m or less.</td>
</tr>
<tr>
<td>HN</td>
<td>Hearth: Not Further Defined</td>
<td>Identified as present in field notes, but no characteristics recorded.</td>
</tr>
<tr>
<td>HP</td>
<td>Hearth: Pit</td>
<td>No surface characteristics; excavation only.</td>
</tr>
<tr>
<td>HR</td>
<td>Hearth: Rock</td>
<td>Burned, fire-cracked rock in a burned pit with diameter 1 m or less.</td>
</tr>
<tr>
<td>HS</td>
<td>Hearth: Slab-lined</td>
<td>Discrete concentration of ash within an area outlined by upright sandstone slabs, having a diameter of 1 m or less.</td>
</tr>
<tr>
<td>LD</td>
<td>Sandstone</td>
<td>Scatters or concentrations of sandstone rock or rubble with a general absence or artifacts or ash.</td>
</tr>
<tr>
<td>LM</td>
<td>Mixed Sandstone-Limestone</td>
<td>Scatters or concentrations of sandstone rubble and heat-broken limestone with a general absence of artifacts, although ash may be present.</td>
</tr>
<tr>
<td>LS</td>
<td>Limestone</td>
<td>Scatters or concentrations of heat broken limestone with a general absence of artifacts.</td>
</tr>
<tr>
<td>PH</td>
<td>Posthole</td>
<td>No surface characteristics; excavation only.</td>
</tr>
<tr>
<td>PP</td>
<td>Pit: Processing</td>
<td>Presence of mano and metate described as 'in situ'; excavation.</td>
</tr>
<tr>
<td>PU</td>
<td>Pit: Not Further Defined</td>
<td>No surface characteristics; excavation only.</td>
</tr>
<tr>
<td>RA</td>
<td>Pithouse; Antechamber</td>
<td>For BM III, upright slabs and more than 2 m diameter hollow immediately south of pithouse main chamber.</td>
</tr>
<tr>
<td>Type</td>
<td>Definition</td>
<td>Surface Characteristics</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>RP</td>
<td>Pithouse: Main Chamber</td>
<td>Roughly circular hollow greater than 3 m diameter; for RM II, parallel lines of slabs about 1 m apart (marking an entry).</td>
</tr>
<tr>
<td>RU</td>
<td>Room: Not Further Defined</td>
<td>No surface characteristics; excavation only.</td>
</tr>
<tr>
<td>SF</td>
<td>Possible Architectural Feature</td>
<td>Discrete concentrations of rock (as opposed to rubble) or slabs, but with a general absence of jacal.</td>
</tr>
<tr>
<td>SH</td>
<td>Storage: Honeycomb</td>
<td>Contiguous cluster of small (less than 2 m diameter) areas enclosed by rock—often including at least some slab-lined units.</td>
</tr>
<tr>
<td>SL</td>
<td>Storage: Slab-lined</td>
<td>Small area (less than 2 m diameter) enclosed by upright sandstone slabs.</td>
</tr>
<tr>
<td>SP</td>
<td>Storage: Pit</td>
<td>No surface characteristics; excavation only.</td>
</tr>
<tr>
<td>SR</td>
<td>Storage: Jacal and Rock</td>
<td>Small area (less than 2 m diameter) enclosed by rock or slabs with relatively large amounts of adobe present.</td>
</tr>
<tr>
<td>SU</td>
<td>Storage: Not Further Defined</td>
<td>Discrete concentration of upright slabs or rock, ash and, especially, jacal that does not fully enclose a small area (less than 2 m diameter).</td>
</tr>
<tr>
<td>TR</td>
<td>Trash</td>
<td>Scatters of sandstone and artifacts in an ashy matrix, sometimes including heat-broken limestone.</td>
</tr>
<tr>
<td>UN</td>
<td>Unknown</td>
<td>Materials especially including ash or shaped sandstone scattered along bedrock in a drainage.</td>
</tr>
</tbody>
</table>
Attribute Definitions

Attributes used to define various classes of features and artifacts are identified below.

Features. Among feature classes, architectural units are given the most attention. Functionally identified architectural units are dwellings, storage units, and hearths. Feature classes are derived empirically from field maps and notes (Table 5).

Rooms: All types of rooms have been reduced to four categories: pithouse main chambers, pithouse antechambers, surface rooms, and room-like structures about which nothing more could be stated (some of these are probably ramadas). Antechamber, surface room, and room-like structure categories seem to apply solely to the BM III sample.

Pithouses are inferred from excavation results or from survey notes showing a circular depression, with a diameter of three meters, or more. For BM II pithouses, notes also may show parallel lines of slabs leading off from the depression, which excavation has showed to correspond with BM II pithouse entryways, and these are also used to infer the presence of a pithouse.

Other categories of rooms (antechambers, surface rooms, and room-like structures) have been identified only through excavation. Perhaps because the BM III antechambers excavated on Cedar Mesa sites tend to be more shallow than the main chambers they do not leave a substantial depression from which they can be identified without excavation. Surface rooms and room-like structures (ramadas) have been identified only from posthole patterns and use-compacted surfaces. These attributes are discovered only in excavation. If any slab-walled rooms were present,
they probably have been mistakenly identified as slab-lined storage structures.

Storage Units: Five categories of storage units have been recognized: honeycomb, jacal, slab-lined, pit (not further defined), and surface storage (not further defined). Some of these categories overlap. For example, honeycomb storage structures are defined as contiguous storage units (Matson et al. n.d.). They also are likely to be either jacal construction or slab-lined features and may be either surface or pit features. Still, because their appearance is so striking and because they seem limited to BM II R-D areas, honeycomb storage units are given their own designation. Other storage unit categories are found on both BM II and BM III sites. Identification of storage features, except slab-lined honeycomb storage units, was limited to circular outlines of rock and jacal or to excavation and to features located near excavated storage units that had morphologically similar surface expression.

Hearth: Through analysis, the hearth category has come to incorporate not only well defined hearths, but also the few burnt pits identified in excavation, ash spots (which also are recognized to represent other features) and burnt limestone dumps. Well-defined hearth features include ash hearths, adobe-lined hearths, burnt pits filled with rock (rock middens\(^7\)), slab-lined hearths, and unlined hearths or features identified as hearths in survey records, about which nothing more is known. Burnt limestone dumps are inferred to be associated only with BM II or earlier occupations. Other hearth types seem to appear in both BM II and BM III contexts (see Expectation I.7). Where not specifically

\(^7\) These differ from the large burned rock middens or burned rock mounds identified on the Plains (see Suhm 1958). Cedar Mesa Project rock middens are the size of other hearths. That is, they are less than 1 m in diameter.
identified as hearths in notes, definition as a hearth for this study required some evidence of burning, most commonly the presence of domestic ash in a small, well-defined area. Larger, ashy soil areas are often found with other materials and were identified as trash middens.

Trash Middens: Trash middens are identified in excavation or inferred through presence of a mixture of rock and artifacts in an ashy soil matrix over a relatively large area (more than about two m diameter).

Other Feature Classes: Other feature classes include postholes, pits, discrete sandstone deposits, amorphous sandstone deposits (with or without artifacts), mixed sandstone and limestone deposits. These are considered individually for understanding variability of R-D area feature assemblages (see Expectation I.6).

Cedar Mesa Project Artifact Classes: While some bone and a few bits of perishable items have been recovered, most of the artifacts collected on the Cedar Mesa Project are ceramic or lithic. Ceramic artifacts are described by Matson and Lipe (1977). Lithic artifacts were categorized by Sneed and Matson (1972). The description of the lithic artifacts was included in Dohm (1981:Table 9) and Matson et al. (n.d.). This detailed classification is used for Expectation I.6, but otherwise lithic artifacts are classed by apparent energy expended in their manufacture and maintenance. This general lithic classification used furniture, curated tools, expedient tools, and lithic debris. These are discussed below.

Ceramics: Ceramics are found only on BM III and later sites in the northern Southwest. They are not used in BM II-BM III comparisons because I believe that they replace perishable items, particularly bags and baskets, of which we obtain no regular record in either BM II or BM III open sites.
Lithic Debris: This includes all unmodified flakes and lithic shatter. Often, this class of artifact has the individually smallest pieces. If Rathje is correct that artifacts will be removed to secondary refuse locations on the basis of their size (Rathje 1979:9-10), lithic debitage and shatter—if it is small enough—can provide the best evidence of primary refuse locations (also see Schiffer 1976:32-34).

Lithic Tools: Lithic tools are recognized as three types: expedient tools, curated tools, and site furniture (Table A.5, Appendix A). Expedient tools and furniture are expected to remain on the sites where they were made and used, albeit for different reasons. Expedient tools are defined as those which can be rapidly made. Insofar as good knappers can turn out a biface in well under 30 minutes, often under 10 minutes, designation of "expedient" may have a great deal to do not only with the labor invested in manufacturing the lithic component of the tool but also with the labor invested in hafting the tool. Many expedient tools are inferred to have been unhafted. In this study, all utilized flakes are classified as "expedient" tools.

Curated tools, as used here, are equivalent to those Binford (1979) identified as personal gear among the Nunamiut; these tools are likely to be carried as part of an individual tool kit. According to Binford, "the discard of personal gear related to the normal wearing out of an item was generally done inside a residential camp, not in the field where the activity in which the item was used occurred" (Binford 1979:263). They are also the most likely lithic items at a site to have been collected (and kept) as curiosities either prehistorically or by modern collectors. Particularly at sites with easy access, or at reoccupied sites, these are
likely to be under-represented. In this study, most tools except utilized flakes are identified as "curated" (Table A.5, Appendix A).

*Site Furniture:* Site furniture is defined as items likely to be left at a site with the intention of reuse. Commonly, these are items that are too heavy or too awkward to be easily moved long distances.\(^8\) Furnishings are not limited to lithic artifacts, but only lithic site furniture is included in the study. Ceramics are excluded although it is clear that some vessels are furniture: the largest jars are too unwieldy and fragile-if not too heavy-to have been moved often or far. Although site furniture may be collected, even prehistorically, when a furnishing remains on a site (and is treated as an artifact rather than incorporated into construction), it is expected either to be found in a storage location—ready for reuse—or in the area where it was used. In this regard furniture is important in studying prehistoric use areas. Because, by definition, furniture is heavy, horizontal movement by natural agents is unlikely and, therefore, furniture can be treated in the same way as features for analysis of spatial relationships.

On both BM II and BM III sites, lithic furniture includes core-scrapers, choppers, hammerstones of all types, manos, metates, and other ground stone fragments. On BM III sites, many large knives or knife fragments may also function as site furniture, since Matson et al (n.d.) found these items clustered with other site furniture in assemblage analyses of BM III sites (but not on BM II sites).

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\(^8\) For example, among the Western Apache, Buskirk notes that on migrations, "The equipment carried included one mano...but no metate" (Buskirk 1986:163).
Measurement

Measurement is central to this study. Presence/absence of certain attributes are compared; counts of items are made; distance and direction between features or features and artifacts are considered. These measurements are the ultimate basis for comparing BM II and BM III R-D areas. The measurements are the data for the expectations. As noted below, frequency and presence/absence data were each used. Similarly, several methods of describing spatial attributes were employed. This section provides the general rules that I followed for taking measurements and for comparing measurements. The specific techniques used in analysis of each expectation are incorporated in Chapter 6.

Measurement of Frequency Attributes. Two types of measurement were used: nominal and numeric. Comparisons based on simple presence of an attribute (feature type or artifact class) were limited to those without a spatial component. All other comparisons required the use of numeric data, albeit often transformed in some manner.

On the one hand, nominal data may be preferred because its use will be appropriate with nonparametric methods of analysis. Further, it is the better choice when the number of categories is more important than the number of items in any given category. For example, presence/absence states are more appropriate than numerical data in comparing diversity of hearth types on R-D areas. The preference stands because, first, some features are assumed to be undiscovered or represented only by descriptive (rather than functional) labels. Second, and more importantly, presence of any (functional) category of feature, regardless of its frequency, shows presence of some class of activity. Except for a few very common
feature classes (that is, sandstone deposits), all feature comparisons are based on nominal data.

On the other hand, use of nominal data may be problematic where absence is weighted as strongly as presence (see Doran and Hodson 1975:103-104). Particularly where recognition is partly a function of site size, results may be skewed by the use of presence/absence data. Also, where comparison is based on a single attribute, numeric data are appropriate. Often, this comparison is presented not as a count of items, but instead as a comparison of means or medians. Sometimes, comparison is based on a ratio of attributes, or some transformation of numeric values representing attribute states.

Matson et al. distinguish between measures of commoness (medians) and measures of abundance (means) in artifact profile comparisons among classes of sites (Matson et al. n.d.). Comparing medians provides the more conservative measure of difference between samples. In all numeric comparisons, medians as well as means are provided.

Measurement of Spatial Attributes. Three spatial attributes were considered: distance, direction, and density. Distance was always a metric measurement. Only feature and artifact distances to the pithouse and to storage units were considered. Distances were measured between the closest edge of the pithouse, or storage unit, to the closest edge of any given feature.

Direction was a qualitative measure (N, NE, E, SE, S, SW, W, NW). It was made by centering a mylar overlay, marked with eight radiating lines separating directions (e.g., NE from both N and E), on the pithouse shown on each field map. Labelling the direction from the pithouse to each feature was then systematic.
Density measures were limited to artifact classes. Deriving density measures was a multi-stage effort. It is outlined below. Density measurement first required deriving coordinates for each collection location, with the aid of a Numonics 1224 digitizer. Second, these coordinates were re-associated with field labels. The digitizer associates coordinates only with their entry order; field designations of collection locations were by collection order within a grid and any site might have one or many grids--often at different scales. Third, coordinates and field labels were entered on a computer and sorted by the Cartesian coordinates. For each location, number of artifacts was tallied by both Cedar Mesa Project types for subsequent error searches (so that I would be able to check my artifact totals against other Cedar Mesa Project results and would be able to leave a data record in previously used Cedar Mesa Project terms), and by "energy class" (debitage, expedient tool, curated tool, furniture, ceramic, other) used in this study. Fourth, coordinates within two meters of each other were combined, and centroid coordinates used for the new combined location. Artifact counts were also combined, with much reverification. Because relatively more collection locations are present in high density areas of these Cedar Mesa sites, failure to precombine artifact tallies can make a substantial difference in the appearance of density maps. The short lists of combined collection locations and combined artifact tallies constituted the raw data for trend surface analyses (density plots). Precombining was necessary because the best computer software available to me for this density mapping, SYMAP\textsuperscript{10}, does not combine values within the search radius of any mapping point.

\textsuperscript{9} Artifact collection locations had diameters approaching 3 m; collection locations with center coordinates less than 2 m apart have overlapping areas.

\textsuperscript{10} SYMAP is short for Synagraphic Mapping System (see manual by Dougenik and Sheehan 1975).
That is, artifact counts from a second collection location within SYMAP's search radius are not automatically combined. I had to add counts by hand to show actual artifact densities where two or several collection locations occurred within a three meter area. Fifth, then, three density levels were established for each artifact class used on each site in the study. No attempt was made to use the same levels on different sites or among different categories of artifacts because site size (measured as total number of artifacts or average number of artifacts per square meter) is highly variable. The levels were chosen empirically for each site, usually from bar charts of the data.

The steps involved in production of this data set have been outlined because they imply the tremendous time commitment that this form of analysis requires.\textsuperscript{11} While the advantages of point-located data are numerous, since these can always be converted into grid data, the time commitment for comparing multiple sites in this manner is much greater than it would be for artifacts collected from grid locations. Other analyses using point pattern data are limited to the analysis of a single site.\textsuperscript{12}

Depending on the definition used, simple density plotting of one variable may be regarded as trend surface analysis if densities are interpolated over areas larger than their collection units (see Hodder and Orton 1976:155-156). My SYMAP maps fall in this category. However, trend

\textsuperscript{11} Data production, excluding time for computer entry of cartesian coordinates and artifact sums by location required more than 10 hours for an average size site. The time requirements for large sites, such as Upper Grand Gulch 4-3, are multiples of this basic time requirement. Having made that time commitment, the ultimate unsuitability of most large BM III sites' artifact data to this study (because of noise from Pueblo reoccupations) nearly brings tears to my eyes.

\textsuperscript{12} For instance, the following archaeologists use point pattern analysis of intrasite assemblages only for discussion of a single site (or for sites treated as points within a region): Ferring 1984; Hietala and Stevens 1977; Howes 1982; Kintigh and Ammerman 1982; Price 1974; Whallon 1974. I have found none that uses point pattern analysis to compare intrasite spatial patterning, and I would suggest this is because of the prohibitive time commitment.
surface analysis more commonly refers to mapping residuals to show a changing relationship between two (or more) attributes across space; that is, the mapping will show a spatial trend in their relationship (see Clarke 1968:449-454). Insofar as the intention here is to relate density peaks to architectural features (measuring between high density areas and architectural features as with other distance and direction computations), use of the density plots produced with SYMAP may be regarded as part of a trend surface analysis, but the SYMAP maps actually only provide the data for these analyses.

Comparing Measurements Between Periods. Comparison of BM II and BM III data for each expectation was by simple comparison of frequency, comparison of histograms, or by regression plots.\textsuperscript{13} This comparison was systematic, but judgment of similarities and differences did not employ statistical tests, because of unsuitability of inferential statistics.

While the reader might suppose that some statistic would be appropriate, all statistics have sampling requirements. All require a representative sample. The sample for this study is judgmentally chosen. While the Cedar Mesa Project survey sample was random, the sample used here is partly a judgmentally chosen subset of that sample and partly other judgmentally chosen sites. Selection was based on presence of sufficient surficial evidence of R-D area attributes to be useful to this study. Each site had to have either strong evidence of a pithouse or of storage structures. And, I suspect that this evidence is partly the result of environmental factors. More R-D areas seem to have been defined by the survey where erosion was active than elsewhere on Cedar Mesa.

\textsuperscript{13} These were performed on an IBM 3090 mainframe computer, using SAS software (see SAS 1985a, 1985b).
Hence, this sample may not be representative. No matter what statistic is used, the assumption of a representative sample may be violated.

In practice, some assumption often is violated in statistical analyses. So, this violation does not, in itself, preclude the use of inferential statistics. However, to sensibly test this data, a powerful statistic is necessary because the sample is so small that the ability of any statistical test to find significance is greatly impinged (e.g., see Henkel 1976:82-83). Rarely are data on more than 20 sites from both periods available for any one expectation. Parametric statistics, including the readily accessible Pearson's r, are relatively powerful. However, these presume a normal distribution and there is no indication that the total population of any attribute in this study is normally distributed, although some sample populations appear to be. While statistics each have many assumptions, and often several are violated, to violate the two basic assumptions of a representative sample and a normal distribution would make a finding of statistical significance meaningless to me. While use of nonparametric statistics would violate one less major assumption, their use is similarly problematic. They are more robust, but because they are less powerful (e.g. see Steel and Torrie 1960:400-401), their chances of showing no difference between samples that truly differ is much greater. That possible error is as important as a possible false statement of significance. In sum, I do not believe that my present data set meets the conditions necessary to sensibly run statistical tests on the hypotheses.

Instead, my procedure is to discuss each expectation and to make my decision as to its outcome in the same informed-intuitive manner in which
we make decisions to call a sherd grayware or whiteware. Those calls are then used as qualitative attributes for hypothesis "testing".

This procedure lacks the rigor that traditional statistical testing may aspire to. However, such an intuitive basis for the analysis of spatial patterning has often shown valuable results and, recently, Kintigh and Ammerman (1982) have defended it, albeit their use is both more elegant and more reliant on subsequent statistical analyses than is this one.

Evaluating Hypotheses

With the sample at hand, it is important to recall not only that no tests have shown the sample population of any attribute to represent a normal distribution, but that the sample was not derived randomly. The sample used in this study is taken from a random sample, but this second level sample uses all available data. It is essentially a judgmentally derived subset. Of course, so are most archaeological samples.

The results of this study will show an indication of whether or not the hypotheses can hold. They will show, in a common-sense manner, whether or not individual expectations were met. When multiple analyses show the same direction or trend with regard to the expectations, the resulting inferences can be argued as sounder than if results are equivocal. They will not show the results of analyses for expectations as results to expectations. The results will provide an empirical basis for discussion of the hypotheses. They will show whether or not it is worthwhile to pursue the investigation with the intent of formal hypotheses testing.
CHAPTER 5

CHARACTERISTICS OF SELECTED SITES

But what would I do with all my notes if I didn’t write them up?

Barbara Pym as Professor Alaric Lydgate

The sample is 24 R-D areas from 22 Basketmaker sites. Five of these were investigated during Lipe’s 1969 and 1970 excavations on Cedar Mesa. The other 19 R-D areas are from habitation sites\(^1\) investigated as part of Cedar Mesa Project mesa top quadrat survey (Figure 1, Chapter 1; Table A.1, Appendix A). A brief description of the project and of Lipe’s earlier excavations are included in “Sources of the Data” in Chapter 4. Nine of the R-D areas included in the study were tested by Joseph Winter in 1972 and 1973 and, in 1984, I conducted further excavations at two R-D areas that Winter had tested.

Identification of pure or separable BM II or BM III components, as shown in Table A.1, provided the first level of screening for sites used in this study. Ability to identify discrete BM II or BM III R-D areas provided the second level of screening. Only those R-D areas in which a pithouse was excavated or in which outlines for a pithouse or surface features could be inferred from surface remains were used in the analysis of any test implication.


\(^2\) My definition of habitation differs somewhat from that of Matson et al. (n.d.). Theirs is based on artifact assemblage attributes, mine is based on structural and spatial attributes with the presence of a pithouse taken as sufficient evidence for labeling a site as a “habitation.” Therefore, some BM II sites labeled “campsites” by Matson et al. (n.d.) are included within this study.
Because "R-D areas" rather than "habitation sites" are used as the basis of analysis, the correlation between my study units and the Cedar Mesa Project study units is not exact. Some of the habitation sites have evidence for more than one R-D area, so that the potential number of R-D areas for comparison is slightly greater than the number of BM II or BM III sites with pithouses. While analysis is by R-D areas, the descriptions that follow are mostly by the larger site units. This avoids redundancy. For example, multiple R-D areas in a single site are described in the same section if they are dated to the same period.

The description of each site includes notes on its natural setting, previous research, feature characteristics, and the use of the site in the present study. The natural setting offers information both on resources available to the site's departed owners and on natural processes that may have affected recognition and distribution of materials (also see Table A.1, Appendix A).

Description of previous research at each site includes the extent of field investigation and identification of analytic studies of which the site was part.

The section on feature characteristics includes descriptive labeling of features (Table 5) and their inferred functional type (Table A.2, Appendix A) as well as their location within the site. More specifics are sometimes given here than were used in analyses for the expectations. That is, some sandstone concentrations may be remains of storage units or other architectural features and those possibilities are discussed with site descriptions. However, the label "sandstone concentration" (feature type LD) indicates that it was not included among the functionally labeled features (e.g., pithouse, storage unit, hearth) in analyses. For
instance, feature LD 4 on Bullet 20-1 is discussed as a possible pithouse, but is excluded from formal analyses (Bullet 20-1 is excluded from all analyses that require information about pithouses, including pithouse location).

The section on the use of the site in the present study states the rationale for excluding particular R-D areas from particular analyses. An analysis is equivalent to the trial of a particular expectation (Table 1). The final comparison is between 14 BM II R-D areas and 10 BM III R-D areas\(^3\). Some of these R-D areas are used only in particular analyses. As few as seven BM II and seven BM III R-D areas were used for the analysis of a single test implication.

**Definitions Used in this Study**

"Site", "Residential-Domestic area" (R-D area), and "component" are each used differently. R-D area is the principal unit in this study. It includes a dwelling and associated extramural features such as storage units, hearths, and trash areas. R-D areas are equal to, or smaller than, sites, which contain R-D areas. Matson and Lipe (1975) referred to sites spatially, as conveniently mappable units within the quadrats, and that use is continued here. Components refer to temporal associations. For instance, a site may have both BM III and Pueblo components.

Determination of the boundaries of R-D areas is subjective, based on some decrease in the number of features or in artifact density. In general, maps in this chapter represent the whole site rather than individual R-D areas so that proximity of areas within a single "site" may

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\(^3\) Ten of the BM II R-D areas and 8 of the BM III R-D areas are from the Cedar Mesa Project Quadrat Survey sites; the others are from Lipe’s 1969-1970 excavations.
be recognized. Plan maps of sites presented with R-D area descriptions use standardized symbols (Tables 5, 6).

"Analyses" refer to method and technique of investigating expectations for Hypotheses I and II. While those hypotheses refer to intensification and sedentariness, any given analysis is performed on characteristics of various classes of artifacts or features or on the distances among those archaeological remains. Insofar as survey and excavation data on some R-D areas do not include the relevant data, a given R-D area may be excluded from some analyses. The basis for exclusion of R-D areas from particular analyses is noted with the R-D area descriptions. A summary of analyses in which any R-D area is used appears in Table A.5, Appendix A).

Definitions of features and artifact classes are presented in "Attribute Definitions" in Chapter 4. Definitions of features are summarized in Table 5 (in Chapter 4).

Basketmaker II Sites

A total of 14 BM II R-D areas were used, from 14 distinct sites. One of these, West Johns 12-6, also has a BM III R-D area used in the analyses; the description of the West Johns 12-6 BM III R-D area appears with those later components while the description of the BM II component and information on the West Johns 12-6 site location appears here.

Bullet 4-2 (42SA4094)

The Bullet 4 Quadrat is located about 1600 m east of where Bullet Canyon begins to entrench. The entire quadrat is within pinyon-juniper woodland at about 6400 feet elevation. The site map (Figure 4) may under-
<table>
<thead>
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<th>Mapping Category</th>
<th>Symbol</th>
</tr>
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<td>RP</td>
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<tr>
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</tr>
<tr>
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<td>Room: Nothing More Stated</td>
<td></td>
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</tr>
<tr>
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<td>Storage: Honeycomb Units</td>
<td></td>
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</tr>
<tr>
<td>SJ</td>
<td>Storage: Jacal Units</td>
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</tr>
<tr>
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<td>Storage: Slab-lined</td>
<td></td>
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</tr>
<tr>
<td>SP</td>
<td>Storage: Pit</td>
<td></td>
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</tr>
<tr>
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<td>Storage: Surface</td>
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<td>Hearth</td>
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<tr>
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<td>Hearth: Adobe lined</td>
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<tr>
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<td>Hearth: Nothing More Stated</td>
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<td>Hearth: Rock</td>
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<td>Hearth: Slab-lined</td>
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<td>PP</td>
<td>Pit: Processing?</td>
<td></td>
<td><img src="image23" alt="Symbol" /></td>
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<tr>
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Figure 4. Bullet 4-2, site area.
represent vegetation\(^4\).

A pithouse lies atop one of the many hillocks. With possible storage features to the northwest, the pithouse defines the R-D area. It covers about 3000 sq m (70 m north-south by 50 m east-west). To the southeast, across a drainage, nine well-defined rock features and scatters of sandstone and limestone fragments are recorded as outliers to the R-D area, rather than as part of a separate domestic area. Their addition to the R-D area increases its size to about 6600 sq m (60 m north-south 110 m east-west).

One other BM II site (Bullet 4-1) is present within the quadrat as well. Like the southeastern part of Bullet 4-2, it does not contain clear evidence of a pithouse.

**Research History.** Bullet 4-2 was surveyed in 1972 by a crew of four or five individuals. Mapping and collection required one day. Except for three soil samples, no excavations were conducted. Matson et al. (n.d.) call Bullet 4-2 a habitation.

**Features.** The pithouse (RP 1) was identified by a semi-circle of upright slabs partially enclosing a 7.5 m diameter area. There is no depression and no ash (perhaps because the feature is disturbed by a drainage). The functional inference that this is a pithouse is based on feature size.

Evidence for storage structures is much weaker than the evidence for the pithouse; no feature on Bullet 4-2 is labeled as a storage unit. Jacal, elsewhere used in the identification of storage features, was not regularly included in the 1972 survey notes. SF 10 is a discrete cluster

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\(^4\) Buffalo berry, sage, rabbit brush, prickly pear, and yucca are noted as present, but not shown on the field maps. Further, soil cover on the site is continuous, although moderately dissected, a condition common with more abundant plant cover than shown.
of sandstone enclosing a small, circular area. It is labeled as a possible architectural feature because of its size and shape. No functional determination of any sandstone feature (LD 4, LD 6, LD 12, LD 13, LD 16, LD 17, LD 18, LD 19, LD 20, LD 23) is attempted. Two of these, LD 4 and LM 12, are in the approximate location that storage features have been found on other BM II sites.

Several apparent trash areas are present, defined by artifacts and scatters of sandstone and limestone. A few of these (LS 7, LM 14, LS 15) are principally burned limestone dumps.

**Use in the Present Study.** Bullet 4-2 is used only in architectural analyses that do not require identification of definite storage features. It was excluded from analyses of storage attributes and from all artifact analyses (see Table A.4, Appendix A) because location numbers in the artifact catalog and collection location numbers on field maps were not reconcilable.

**Bullet 5-1 (42SA4099)**

The Bullet 5 quadrat is located less than 100 m north of the deeply entrenched Bullet Canyon. It is within the pinyon-juniper zone at about 6240 feet elevation.

Bullet 5-1 (Figure 5) is in the southwest corner of the quadrat and the R-D area used in this study lies in the southwest corner of the Bullet 5-1 site. The R-D area covers a 50-by-50 m area; additional features and artifacts are scattered more than 75 m north and east, forming a continuum with another BM II pithouse site, Bullet 5-2 (not included in this study).

The Bullet 5-1 R-D area is defined by an apparent pithouse depression and several unidentified sandstone features just north of the
Figure 5. Bullet 5-1, BM II residential-domestic area.
depression (Figure 5). Additional ash and sandstone features are located to the east, from well north of the apparent pithouse to well south of it. The probable pithouse and associated features are located on relatively thick soil. Moderately deep drainages lead away from this area in all directions; drainages empty onto bedrock in the southeast part of the R-D area.

This quadrat contains a BM II site cluster, or possibly a "village". Four BM II sites are located nearby. Bullet 5-2, which is partially contiguous with Bullet 5-1; Bullet 5-8 about 300 m to the northeast; and Bullet 14-1 and Bullet 14-3, each about 400 m north of the study site. Three additional sites, which were not dated on survey because they lacked artifacts, also may be Basketmaker remains and additional BM II sites are probably located in the unsurveyed area between Bullet quadrats 5 and 14.

Research History. Bullet 5-1 was mapped and surface artifacts collected over a two day period in 1972. The site is at the extreme southwest corner of the survey quadrat but entirely contained within it. No further work has been conducted at the site since it was surveyed. Matson et al. (n.d.) call Bullet 5-1 a habitation.

Features. A 4 m hollow with sandstone rubble and ashy sediment is probably a pithouse (RP 1). A soil test at its south edge exposed ashy soil to a depth of 40 cm. This does not necessarily indicate the use of fire--ashy soil in the Cedar Mesa sites often appears only to be remnants of an occupational stratum that once covered a larger area and remains only in protected places, e.g., in and around dwellings and extramural features. The diameter and depth of ashy soil here are consistent with a pithouse.
A small trash deposit (TR 3) and a larger concentration of ash (AS 5) lie immediately east of the pithouse.

No definite storage units or hearths could be identified but any of five sandstone features located north of the mid-line of the pithouse could be remains of storage features. Three of these (SF 2, SF 9, and SF 10) are discrete concentrations of sandstone. Two others (LD 4 and LD 7) have more poorly defined boundaries.

Another discrete sandstone feature (SF 6) is located 17 m east of the pithouse. SF 6 contains a single large upright slab within a tight cluster of sandstone; it may have been either a hearth or an outlying storage unit. A final sandstone concentration (LD 11) is 25 m south of the pithouse, only a few meters from a large scatter of sandstone, limestone, and ash (UN 8) eroding onto bedrock. No function is inferred for either UN 8 or LD 11.

Artifacts. Four site furnishings were recovered during survey. Two are metates: one was directly above the pithouse, the other was 21 m southwest, near a hammerstone fragment and several other artifacts. The fourth furnishing is a mano, about 6 m southwest of the pithouse.

Other artifacts were limited to 11 curated flaked lithic items, 7 expedient tools, and 98 pieces of lithic debitage. Most of these were southwest of the pithouse. There were no ceramics.

Use in the Present Study. Bullet 5-1 is excluded from analyses in which measurements to storage features are required. It was similarly excluded from analysis of internal characteristics of pithouses (see Table A.4, Appendix A).
**Bullet 7-2 (42SA4112)**

The Bullet 7 Quadrat is about 5700 m east and 400 m north of Bullet Canyon on the mesa top divide between Bullet and Road Canyons. Bullet 7-2 is in Pinyon-Juniper woodland, at about 6600 feet, although the site has more big sage and grasses than pinyon or juniper. Twenty meters north, and across a shallow ravine, are remains of Basketmaker III and Pueblo occupations. This close proximity creates a minor palimpsest problem--sixteen sherds were collected along with the 167 lithic artifacts during survey. The 50-by-50 m Bullet 7-2 R-D area is the only identified BM II occupation in the Bullet 7 Quadrat, but three other Basketmaker II sites, and five other BM III sites are located within 400 m, in other survey quadrats.

**Research History.** Bullet 7-2 was mapped and surface artifacts collected over a two-day period in 1972. No excavation conducted. Matson et al (n.d.) class the BM II component as a habitation.

**Features.** The pithouse (RP 1) lies near the center of the site (Figure 6). It is identified by several upright slabs, sandstone rubble, and artifacts lying in an ashy soil matrix. Ashy soil covering a seven-by-five m area is the basis for estimating pithouse size.

Two probable storage units (SU 2, SL 3) located northwest of the pithouse are identified by upright slabs, ash, and rubble. Additional features may be storage, but lacked some of the characteristics (especially presence of jacal) used for identification of storage units. A discrete concentration of sandstone (SF 4) near SU 2 and SL 3 may be storage. Three other discrete sandstone concentrations (SF 6, SF 7, SF 8), each with ash, located 12-to-15 m southwest of the pithouse also may represent storage.
Figure 6. Bullet 7-2, BM II residential-domestic unit.
The only evidence for hearths in this R-D area is the presence of two limestone dumps (LS 11, LS 15) northwest of the pithouse. Probable trash (TR 5, TR 12), defined by long, linear scatters of sandstone, limestone, and artifacts is found both east and southeast of the pithouse.

Other features are rock concentrations. Five sandstone deposits (LD 9, LD 10, LD 14, LD 16, LD 17) line the west edge of the site. Another sandstone scatter (UN 13) is northeast of the pithouse, associated with an artifact scatter. It is classified as an unknown feature type because of the associated artifacts.

**Artifacts.** Three possible mano fragments were recovered from the BM II R-D area. Two were found in the storage area northwest of the pithouse (associated with SU 2), the third was recovered from above the pithouse. Only two appear in artifact summaries (see results to Expectation I.8). Sixteen sherds, already noted, and 166 flaked lithic items, including 64 tools, 18 of which are classified as curated, were collected also.

**Use in the Present Study.** The BM II R-D area of Bullet 7-2 is included in all aspects of the analysis, except those characterizing pithouses (see Table A.4, Appendix A) because those required excavation data.

**Bullet 10-1 (42SA4127)**

The Bullet 10 Quadrat lies between Bullet and Johns Canyons, some 3200 m southeast of where Bullet Canyon begins to entrench. Here, in pinyon-juniper woodland at about 6560 feet elevation, the soil is generally continuous. However, within the site, soil is highly dissected, exposing bedrock in some areas.

Bullet 10-1 (Figure 7) is located at the extreme southeast edge of
Figure 7. Bullet 10-1, DM II residential-domestic area within Bullet 10 Quadrat boundaries.
the quadrat. Not all of the site falls within Bullet 10 Quadrat and part was collected as Bullet 8-1. The eight fragments of lithic debris collected from Bullet 8-1 were inadvertently excluded from the descriptions of the R-D area. Only the 30-by-30 m area in the Bullet 10 Quadrat is included.

The Bullet 10 Quadrat is contiguous not only with Bullet 8 but also with the Bullet 21 Quadrat. Within these three quadrats, 13 discrete BM II sites are present (Table A1, Appendix A), including seven probable R-D areas.

Research History. Bullet 10-1 was mapped and surface artifacts collected in 1972. No excavation (beyond a soil test) has been conducted. Materials from the site may have been included in the lithic debitage analysis by Eileen Camilli (see Camilli 1983:Table 41, p. 369). Matson et al. (n.d.) call Bullet 10-1 a habitation.

Features. A four-by-two m depression, with sandstone, limestone, ash, and artifacts defines the location of a probable pithouse (RP 1). A soil test within the depression revealed ashy soil to a depth of 20 cm; the ashy soil is presumed to show the depth of the pithouse.

Only five other features were identified. Three meters north of the pithouse, an ashy area outlined by sandstone slabs is probably a storage cist (SH 2). A few pieces of limestone mark a feature (LS 3) south of the pithouse. A sandstone feature (LD 4), loosely associated with artifacts, lies between the pithouse and the limestone feature. A trash deposit (TR 5), defined by artifacts and ashy soil, is nearby.

Artifacts. Bullet 10-1 is unusual because of the presence of a large number of site furnishings. Thirteen furniture items were recorded in field inventories (but see results to Expectation I.8). Five of these
(two manos and three core scrapers) lay above the pithouse. Four more furnishings (two hammerstones, a chopper, and a mano) were recovered above SH 2. Another hammerstone was among the artifacts associated with LD 4. Only three of the 13 furnishings (all hammerstones) were not directly associated with any feature--but all are near the pithouse--two were only three meters south of the pithouse and one is immediately northwest of it.

Other artifacts included 9 curated tools and 21 flaked lithic tools best regarded as expedient. The remaining 63 artifacts are lithic debris.

Use in this study. Bullet 10-1 is included in all analyses except comparisons of surface to subsurface storage (no storage features were excavated) and analyses of hearth counts and diversity (see Table A.4, Appendix A).

**Bullet 20-1 (42SA4184)**

The Bullet 20 Quadrat is less than 100 m south of Bullet Canyon. It lies between 6080 and 6300 feet elevation, entirely within the pinyon-juniper vegetation zone. Soil cover is continuous, but with numerous, shallow drainages.

Bullet 20-1 (Figure 8) has well-defined storage cists, and a hearth. The scatter of 257 artifacts and 16 features covers approximately 90 m east-west by 50 m north-south. The actual R-D area may be somewhat smaller.

Bullet 20-1 is the only BM II habitation in the quadrat. Its nearest contemporary R-D area neighbors are 400 m east, in Bullet Quadrat 22.

Research History. Bullet 20-1 was mapped and surface artifacts collected over a two day period in 1972, by a crew of three individuals.
The site is at the south edge of the quadrat, but wholly within it. Excavation was limited to two soil tests made during survey. Analysis of Bullet 20-1 lithic debitage may have been conducted by Camilli (see Camilli 1983:369). Matson et al. (n.d.) call Bullet 20-1 a habitation.

**Features.** A pithouse is inferred but not identified. Its most likely location is between LD 4, a scatter of sandstone distributed linearly along a drainage, and HS 7, a slab-lined feature identified in the field as a hearth. The depression between these two features, inferred to be the pithouse location, is at least partly formed by erosion. If this is a pithouse, then the "hearth" (HS 7) is mislabeled and actually represents part of that larger architectural unit. On other Cedar Mesa BM II sites, slab-lined features sometimes have been found to represent either a later, intrusive feature or part of a larger Basketmaker feature.

If this depression is accepted as a pithouse, the distribution of features could be described in a few words: probable storage features are located north of the pithouse, limestone dumps are west of the pithouse, and sandstone features lie principally east and especially southeast of the pithouse.

The field identification of upright slabs some seven meters north of LD 4 was storage cists. Surveyors noted that the slabs might instead be part of a pithouse entryway. Presuming that the slabs are walls of storage features, as indicated here (SL 1, SL 2, SL 3), they are morphologically similar to the excavated honeycomb cists on West Johns 19-3.

Two hearths and four limestone features were defined. One is an isolated slab-lined hearth (HS 7) noted above as a possible pithouse
element. Ash fill is visible at its surface. The second hearth (HA 12) is ash; it is exposed in a well-developed drainage at the extreme southeast edge of the site. None of four limestone dumps (LS 8, LS 9, LS 14, LS 15) was near an identifiable hearth. Each is west of the pithouse and central R-D area. LS 9 was excluded from all analyses because it is very close to a caliche-and-limestone outcrop.

Ten sandstone features were identified (LD 4, LD 5, LD 6, LD 10, LD 11, LD 13, LD 17, LD 18, LD 19). LD 6 is at the west edge of the site; the others lie southeast of the storage units and of the inferred pithouse.

Artifacts. A mano recovered above the central storage unit is the only site furnishing. Of the 256 other artifacts, 10 are classed as curated and 28 as expedient tools. There are no ceramics.

Use in This Study. Because identification of the pithouse is uncertain, Bullet 20-1 was excluded from analyses of pithouses. It is also excluded from comparison of surface to pit storage unit counts, as no storage units were excavated (Table A.4, Appendix A).

Grand Gulch 69-1 (Veres Site)

Grand Gulch 69-1 is located 300 m north of the point where Sheiks Wash begins to entrench, dropping towards Bullet Canyon. The site lies on a relatively flat part of a sandy ridge, surrounded by a maze of shallow drainages, between about 6280 and 6320 feet elevation. Although it is within the pinyon-juniper vegetation zone, ground cover is sparse—there are scattered pinyon and a few older juniper trees along with a few shrubs.
Research History. The Grand Gulch 69 and Grand Gulch 70 series sites are not part of the Cedar Mesa quadrat survey. They were part of a judgmental survey and testing program aimed at understanding Basketmaker occupations (Lipe 1978:389, 391). In 1967, large judgmentally chosen mesa top areas were extensively searched for BM II sites. In 1969 and 1970 intensive survey and some excavation were conducted in the same area (see "Sources of the Data" in Chapter 4).

Grand Gulch 69-1 was among the BM II sites discovered in 1967. It was then labeled 67CM15. In 1969, four individuals mapped and made collections from circular plots having 20 foot diameters (Lipe 1978:391). Plane-table mapping and excavations were conducted over 12 days in 1969 by an eight-person crew, followed by 26 days of excavation in 1970 with a crew of nine individuals. Excavation was limited to the pithouse and a 9 m trench through the midden area south of the pithouse.

Eileen Camilli did the lithic analysis in 1981.

The site was assigned a BM II date by absence of ceramics and by architectural characteristics of the pithouse. The pithouse also was dated by six tree ring samples, with dates from 256vv to 309vv and a \(^{14}\)C date at about A.D. 295 (see Matson et al. n.d.).

The Grand Gulch 69-1 pithouse has appeared in two publications. First, a photograph of the pithouse appears in Lipe's article (Lipe 1978). Second, this is among several "well-dated" pithouses included in Berry's monograph on Anasazi prehistory. He suggests it was occupied shortly after A.D. 300 (Berry 1982:57).

Features. The pithouse (RP 1) is a large oval structure with a long, slab-lined entryway and a probable southeast corner bin marked by an upright slab and posthole. The pithouse has a probable four post roof
support pattern. The presence of two hearths may be an oddity or may indicate remodeling (Figure 9).

The midden (TR 2) is located about 5 m south of the pithouse. A limestone dump is approximately 27 m southwest of the pithouse.

**Use in the Present Study.** Grand Gulch 69-1 was used primarily in analyses of pithouse characteristics, but was also included in feature analyses where appropriate (Table A.4, Appendix A). No maps of extramural features are presented.

**Grand Gulch 69-18 (Pittman Site)**

Grand Gulch 69-18 is about 200 m south of the entrenched part of Sheiks Wash, at about 6060 feet elevation. It lies on a gentle slope dropping off to the southwest and is cut by numerous, shallow drainages. Parts of the site are quite eroded, including the refuse area south of the pithouse. Juniper is the dominant vegetation, but pinyon, rabbit brush, Mormon tea and prickly pear are also present.

This site is the only one in the study sample in which reoccupation can be shown by architectural stratigraphy: the presence of a later hearth over one edge of the pithouse. Seven other features are present as well, distributed along a northwest-southeast axis having about the same elevation along the gentle slope.

**Research History.** Grand Gulch 69-18 was surveyed in 1969 by a crew of four in the same manner described for Grand Gulch 69-1. Sixteen days of excavation were undertaken that summer by a crew of seven and continued in the summer of 1970 by a six person crew working six days. Excavation was limited to the pithouse and two trenches, each about five meters long. One trench was cut southeast of the pithouse in trash deposits, the other
Figure 9. Grand Gulch 69-1, BM II pithouse plan.
was placed northwest of the pithouse (Figure 10). Eileen Camilli did the lithic analysis in 1981.

The pithouse (Figure 11) is among several included in Berry's monograph on Anasazi prehistory. He suggests that the 14 tree ring dates from the site, ranging between A.D. 106 and A.D. 253 represent occupation just after A.D. 250 (Berry 1982:57). ¹⁴C dates from the pithouse, HS 2, and HS 9 are consistent with the tree ring dates (see Matson et al. n.d.).

Features. Nine features were identified. The pithouse (RP 1) was wholly excavated. It is an oval chamber (6.7 m east-west by 6.1 m north-south) with a 1 m wide slab-lined entryway off of the south edge. The entryway continues into the main chamber and is partially connected to other series of slabs that may demarcate corner use-areas (Figure 11). The single central firepit has a slab and rock deflector. Several other pits are present and postholes line part of the chamber's walls.

Four hearths are identified. Three are slab-lined. The hearth from a later occupation (HS 2) lies on the southwest edge of the pithouse, but did not use any of the standing wall remains for its construction. A second slab-lined hearth is 64 m east of the pithouse (HS 9) and the third (HS 5) is 91 m southwest of the pithouse; neither is shown on Figure 10. The fourth possible hearth (HR 8) is defined by a small concentration of burnt rock 6 m east of the pithouse. Excavation revealed blackened earth and small amounts of charcoal within the rock-enclosed area of HR 8.

Some 13 m east of the pithouse is a small sandstone-enclosed area (SF 4). No function is inferred.

A sandstone concentration (LD 3) is 22 m northwest of the pithouse. Remains in a trench excavated at the edge of the concentration include a few standing slabs, some of which showed evidence of burning. No function
Figure 10. Grand Gulch 69-18, BM II site area.
Figure 11. Grand Gulch 69-18, BM II pithouse plan.
is inferred.

Two trash deposits (TR 6, TR 7) complete the feature inventory. TR 6 is just south of the pithouse. A trench revealed an unpatterned deposit of sandstone with limestone and artifact inclusions, but without ash. The second trash deposit, TR 7, is associated with HS 5; it is 91 m southwest of the pithouse and omitted from Figure 10.

Use in the Present Study. Grand Gulch 69-18 was used in analyses of pithouse characteristics and in distribution of features (Table A.4, Appendix A). While HS 2 clearly dates to a later occupation than the pithouse, it was included both in test implications involving feature classes and in those involving distance and direction from the pithouse. It can only serve to weaken, rather than to strengthen arguments presented in this study. The Grand Gulch 69-18 site, as a whole, was omitted from artifact analyses because of the incomplete surface collection of artifacts from the 1969-1970 surveys.

Grand Gulch 69-20 (Leicht Site)

Grand Gulch 69-20 is located about 100 m south of Sheiks Wash, less than 600 m south of where Sheiks drops into Grand Gulch. The site lies on a sandy ridge in pinyon-juniper woodland. Vegetation also includes some sage, buffalo-berry, and rabbit brush. While the site location is relatively flat and undissected, small hummocks have formed around trees and numerous small unvegetated areas are present, presumably from wind erosion.

Only the R-D area in the east half of this large site is considered in this study and shown on Figure 12. That area revealed 12 features and 331 artifacts in the surface collection. The feature locations are
Figure 12. Grand Gulch 69-20, BM II site area.
identified only to the artifact collection locations because of the nature of the survey approach (see below).

**Research History.** Grand Gulch 69-20 was surveyed and excavated over a 20 day period in 1969 by a 7 person crew. Collection locations were twenty foot diameter areas established where relatively large numbers of artifacts had been noted. All artifacts from such areas were collected. Features were recorded only from these areas.

In the R-D area, excavation was limited to a single, long trench and expansion off the trench to define the remnants of a pithouse. A single $^{14}C$ date from the pithouse is near the end of the third century (Matson et al. n.d.). The pithouse was in one of the numerous unvegetated areas thought to be the result of wind erosion. Evidence found here for deflation and erosion provided empirical support for an argument that Cedar Mesa is in an erosional environment.

The lithic analysis was undertaken by Eileen Camilli in 1981.

**Features.** Twelve features are identified. Two were partly excavated: the pithouse (RP 1) and a sandstone feature (LD 2). The pithouse (RP 1) is eroded and only the central portion, with the hearth and part of a slab-lined area that may have been the entryway, remains (Figure 13). The sandstone feature (LD 2), excavated in 1969, is just 2 m south of the pithouse, and was discovered in the trench extension.

A trash midden (TR 12) defined by sandstone, limestone, and artifacts is immediately south of the pithouse, just outside the limits of the trench excavation.

A small concentration of rock and jacal (SU 3) is about 3 m northwest of the pithouse, in a scatter of artifacts including two bifaces. Although only a few shaped slabs and large rocks are present,
Figure 13. Grand Gulch 69-20, BM II pithouse plan.
this is classed as a possible storage feature because of its location and
because the eroded condition of this part of the site suggests that good
surficial evidence for feature characteristics would be unlikely.

Three hearths are recognized. A slab-lined hearth (HS 6) and
another hearth (HN 7) defined by sandstone chunks and ash are both about
44 m west of the pithouse. These may be associated with an ash
concentration (AS 8) of undefined size. The third hearth (HS 9) is a
slab-lined feature about 46 m southeast of the pithouse.

Three features of unknown type are present. One (UN 4) is a large
concentration of slabs, sandstone, and limestone with artifacts, including
two bifaces, about 14 m west of the pithouse. Another (UN 5) with the
same characteristics, but only a single slab, is nearly 30 m northwest of
the pithouse. The third (UN 10) has no limestone, but does contain ashy
fill; it is about 49 m southeast of the pithouse.

Use in the Present Study. Grand Gulch 69-20 is used in all analyses
of features and structures although additional, unrecognized features may
well be present between the areas in which artifacts were collected. No
artifactual data is included (Table A.4, Appendix A).

Grand Gulch 70-193

Grand Gulch 70-193 is about 800 m northeast of entrenched Bullet
Canyon, on a gentle, sandy slope not far from a ridge. The south wall of
Bullet Canyon can be seen from the site. Its elevation is about 6370 feet
and it is in pinyon-juniper woodland.

Research History. Grand Gulch 70-193 was surveyed and tested over a
six day period in 1970, by a crew of three. Survey included collection
from five 20 foot diameter locations. Excavation was limited to a single
5 foot by 35 foot trench that was oriented northwest/southeast. It
longitudinally bisected the slab-lined entryway of the pithouse and caught
part of a central hearth and perhaps an eroded section of the north wall
of the pithouse.

Lithic analysis was conducted by Eileen Camilli in 1981.

Features. Nine features are identified. The pithouse (RP 2) is at
least 6.1 m in diameter. It has a long slab-lined entryway and a central
hearth. The hearth has a slab deflector. Based on rubble at the north
end of the trench and large sandstone slabs found in a 5 foot extension of
the south end of the trench, lower pithouse walls may have been lined with
rocks and slabs (Figure 14).

Aside from the pithouse, the only excavated feature was a small pit
(PU 9) south of the pithouse, discovered in the trench profile (not shown
in Figure 14). No function is inferred for the pit.

Four trash areas were defined (TR 3, TR 5, TR 6, TR 7) based on
presence of sandstone, ash, artifacts, and surveyors’ label of "midden."
TR 6 has a scatter of limestone, as well.

Two possible architectural features were identified. One is a stone
cluster some 25 m southwest of the pithouse (SF 4). The other is a
concentration of sandstone rock and slabs with a scatter of lithic
artifacts (SF 8) some 37 m south of the pithouse.

A mano and metate described as in situ, lying about 18 m northeast
of the pithouse, are included in feature analyses as PP 183. A feature
defined by a single upright slab (feature type UN) and a vandalized hearth

3 While numbering these furnishings as a feature requires a tremendous leap of faith, omitting them
from the feature data seemed equally onerous. Processing features do not appear in most analyses.
They are used in measuring distance and direction of total features from storage and pithouses, and PP
18 was included in both of these analyses.
Figure 14. Grand Gulch 70-193, BM II site area.
(feature type HN) southwest of the pithouse were (inadvertently) omitted from the analyses.

**Use in the Present Study.** Grand Gulch 70-193 is excluded from analyses of storage features and artifactual data (Table A.4, Appendix A).

**North Road 6-2 (42SA4013)**

North Road Quadrat 6 falls across part of the old Mormon Trail. Quadrat 6 is on the mesa top between a north tributary of Road Canyon and a south tributary of Owl Canyon. Although elevations within the quadrat vary little from a 6400 foot average, several plant communities are represented. All three of these—cliff-side, big sage and grass, and pinyon-juniper—are represented on North Road 6-2.

North Road 6-2 has a clear pithouse entryway and several rock features somewhat east of the pithouse. Seven features and 284 artifacts are exposed in deep gullies dissecting the 50 m north-south by 60 m east-west site area. North Road 6-2 is one of five BM II sites with some architectural remains discovered in the North Road 6 Quadrat. A rare identification of a possible Archaic site was also made in this quadrat.

**Research History.** North Road 6-2 (Figure 15) was mapped and surface artifacts collected over a one day period in 1973 by a crew of three individuals. The pithouse entryway was identified just outside the quadrat. Because no other features or artifacts are recorded outside the quadrat boundaries it seems likely that the actual R-D area boundaries lie beyond those shown here.

Matson et al. (n.d.) class North Road 6-2 as a habitation.

**Features.** The pithouse (RP 1) is identified as a five-by-five meter area within a slight erosional hollow in which sandstone, limestone, and
Artifacts are exposed. Upright slabs at the southeast edge of the depression mark its entryway. A small sandstone and limestone feature with a few artifacts (LM 2) lies just beyond. Two limestone concentrations (LS 4, LS 5) and a sandstone concentration (LD 3) are located between 5 and 10 m east of the pithouse. Two other limestone dumps (LS 6, LS 7) are located about 50 m northeast of the pithouse.

Artifacts. Two site furnishings were recovered, both from near the pithouse: a mano was among artifacts recovered between LM 2 and the pithouse entryway and a hammerstone was recovered six m southeast of the pithouse. In addition to the site furniture, 14 flaked lithic tools characterized as curated artifacts, 14 expedient tools, and 253 pieces of lithic debris were collected.

Use in the Present Study. North Road 6-2 was used in all analyses except those characterizing pithouses or storage (see Table A.4, Appendix A).

Upper Grand Gulch 7-4 (42SA4063)

Upper Grand Gulch Quadrat 7 lies on a triangle of mesa overlooking the confluence of Kane Gulch and Grand Gulch. The promontory is just above 6520 feet elevation and covered with pinyon and juniper trees. Upper Grand Gulch 7-4 is one of 10 sites in this quadrat. Nine of those sites, including Upper Grand Gulch 7-4, are probably BM II sites but only Upper Grand Gulch 7-4 has a well-defined pithouse. Only two other survey quadrats have a similar topographic situation to that of Upper Grand Gulch 7 (West Johns 19 and Hardscrabble 11) and, like Upper Grand Gulch 7, both have multiple BM II sites but relatively few BM II pithouses.
On Upper Grand Gulch 7-4, deep channels draining east and west have exposed 17 features. As well as the features, 345 artifacts were located on the 50-by-50 m area.

**Research History.** Upper Grand Gulch 7-4 was mapped and surface artifacts collected over a two day period in 1974 by a crew of four individuals. While it seems likely that trees and shrubs are present in the north part of the site, none are mapped there. There was no formal excavation, but a few shovel tests were made in the pithouse area, and these have been used to indicate pithouse depth for the purposes of this study (Table A.2, Appendix A). Upper Grand Gulch 7-4 has previously been described as a conglomerate of several sites including an habitation (Dohm 1981:49-50, 57ff) or as a habitation (Matson et al. n.d.).

**Features.** Most of the features on Upper Grand Gulch 7-4 lie within 15 m of the pithouse (Figure 16). Near the north end of the site, probable ash hearths (HA 15 and HA 16), a limestone dump (LS 20), and a slab-lined hearth (HS 17) may represent a discrete processing area. At the extreme northeast edge of the site, a small scatter of sandstone (LD 19) has not been given any functional interpretation.

A cluster of probable and possible storage features (SL 10, LD 11, SS 12, and LD 21) are located five to ten meters north of the pithouse (RP 1). As elsewhere, features labeled "LD‘ are not included in analyses of storage units. Two ashy areas (AS 13 and AS 14) lie just north of the storage complex. Closer in, just northeast of the pithouse, an ashy area (AS 6) and three limestone features (LS 4, LS 9, LS 18) are identified.

All of the features south and southeast of the pithouse could be identified as either primary or secondary trash. Only one, an elongated scatter of ash with common artifacts (TR 5) is labeled as trash. It is
Figure 16. Upper Grand Gulch 7-4, BM II site area.
separated from two ashy areas, AS 2 and HA 3 (labeled a possible hearth because of the presence of limestone and some jacal), by less than two m. Three limestone features (LS 7, LS 8, LS 20) are located five meters east of TR 5.

Artifacts. Only three of the 345 lithic artifacts on Upper Grand Gulch 7-4 class as site furniture; all are hammerstones. Two are northeast of the pithouse in a cluster of features and artifacts; the third lay about 8 m west of the pithouse. In addition to the site furniture, there were nine lithic tools classified as curated artifacts and 55 classified as expedient tools. A single sherd was recovered from the R-D area.

Use in the Present Study. Upper Grand Gulch 7-4 is included in all analyses except those requiring excavation of the pithouse (Table A.4, Appendix A).

West Johns 12-6 (42SA4248)

The West Johns 12 Quadrat is about 700 m northwest of a major branch of John's Canyon, at about 6400 feet elevation. The site is in an area of deep, undissected soil with pinyon-juniper woodland. Vegetation includes various species of cacti, grass (including Indian rice grass), sagebrush, Mormon tea, several species of chenopods, and various annuals.

West Johns 12-6 is one of nine sites in the quadrat. Survey did not show the presence of the buried BM II component described here. The only BM II component identified on survey was West Johns 12-9, in a bulldozed area at the north end of the quadrat. Three of the quadrat sites have recognized BM III components; two, including West Johns 12-6, have evidence for pithouses.
The BM II pithouse is southwest of the BM III R-D area (Figure 17). Because it is recognizable at the modern ground surface only by the upright slabs in an internal storage cist, the pithouse was not identified until a north-south trench was excavated through it in 1984. Thirty-two extramural features are known from the BM II R-D area. These features were marked only by a few sandstone fragments and grayish sediment. The low visibility of the BM II part of the site may be attributed to little erosion.

Research History. West Johns 12-6 was mapped and surface artifacts collected over a two day period in 1973 by a five person crew. Test excavations were conducted over a thirteen day period that same year, supervised by J. Winter. More extensive excavations were conducted over a thirty-eight day period in 1984 by a five person crew. Effort in 1984 approached an even division between the BM II and BM III components (Dohm 1984).

The 1973 test excavations were directed at identifying the BM III pithouse and associated architectural features. The 1984 excavations were aimed at identifying extramural features. After discovery of the BM II pithouse, the 1984 sampling plan was one in which both BM II and BM III R-D areas would be tested in the same way. The plan was to open a large horizontal unit north and west of each pithouse, where the major concentration of storage units was expected, and to trench south and east of each pithouse, where only refuse was expected. Block excavations were taken only to a depth below the modern ground surface at which features could be identified.

Fine screening samples from the 1984 excavations provided little new data—preservation is poor. Some cheno-ams, corn cupules and cob
Figure 17. West Johns 12-6, site plan showing BM II and BM III residential-domestic areas.
fragments, one mustard seed, and a juniper leaf were found in features in
the BM II area. In the burned pithouse, charred beams provided five tree-
ing dates between 211vv and 292++vv, consistent with a BM II date.

West Johns 12-6 provided the empirical evidence for aggradation on
Cedar Mesa through burial of BM II features. Evidence for aggradation
here is equivalent to evidence for erosion and deflation on Grand Gulch
69-20, which was used as support for an argument that Cedar Mesa is in an
erosional environment.

**Features.** The BM II pithouse (RP 1) was tested in 1984, with a
north-south trench in the west half of the chamber and and east-west
trench near the north end of the chamber. RP 1 is a shallow, oval
structure. Although it is burned, no postholes were identified and the
manner of roof construction could not be inferred from the charred beams
and burned adobe which directly overlie the floor in the excavated
section. These produced five tree-ring dates of 211vv, 238+vv, 268vv,
281++b, 292++vv. The floor is flat to slightly basin-shaped. Five floor
pits may all be storage cists. None has been fully excavated. The slab-
lined feature at the southwest end of the pithouse (Figure 17) is probably
also a storage unit. It was tested in 1973. Neither a definite
antechamber nor an entryway was discovered.

A partially slab-lined feature south of the pithouse (SF 1) could be
contemporaneous with the use of the BM II pithouse but seems distant to be
part of that structure. It is probably a storage cist rather than (part
of) a precocious antechamber.

Seven storage features were identified. Two units (SL 24, SL 26)
and an unnumbered possible feature may be part of a honeycomb-shaped

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6 These are Laboratory of Tree Ring Research Numbers CML-433, CML-431, CML-442, CML-439, and CML-437.
storage structure. Both (numbered) units have small (0.75 m) diameters and partial adobe linings. Walls are a combination of rock and adobe; the manner of covering is unknown.

Four overlapping pits (SL 17, SL 19, SP 27, SL 38) four meters north of SL 24 and SL 26 may represent additional storage space. The three slab-lined pits are together covered with massive silty-sand fill that appeared to be "melted" adobe. SL 17 and SL 26 share one wall. SL 19 may be intrusive into these features although it is covered with the same massive adobe fill as the other slab-lined features here. The fourth feature (SP 27) is an unlined pit which clearly postdates the others. The date of these pits is called into question because a single sherd was recovered from fill above the depth at which these storage features were recognized. The sherd may be assignable to the collapsed walls of any one of the pits or to rodent activity (there was evidence for considerable rodent activity throughout the site).

A small storage pit (SP 12) immediately north of the pithouse contained remains from corn, chenopods, and Descurainia.

A slab-lined feature (SL 21) is present just southeast of the pithouse, identified in a deep (1.5 m) trench. While this is labeled as a discrete storage unit, it may instead represent part of the pithouse, producing a symmetrical arrangement with the slab-lined feature (not numbered) near the southwest edge of the pithouse.

Nine pit features (PP 9, PH 13, PU 14, PU 15, PU 18, PU 20, PU 22, PU 23, PU 25) are identified. PH 13, one meter northwest of the pithouse, is clearly a posthole. Two small pits nearby (PU 14 and PU 15) may be storage units. Similarly, a large basin-shaped pit (PU 22) southeast of the pithouse and immediately east of SL 21 also may be a storage unit.
Other pits are adjacent to hearths, and no storage function is inferred. For instance, an adobe-lined pit (PU 23) approximately 7 m south of the pithouse is immediately adjacent to a small burned pit (HP 16). Another pit (PP 9) is just west of a rock hearth (HR 37).

The final pit feature (PU 20) is 7 m north of the pithouse, near the north end of the BM II R-D area. Based on the partial outline recognized at the base of excavations, PU 20 is a large feature cut by later storage pit construction.

Four hearths (HR 10, HP 16, HR 28, HR 37) and one limestone dump (LS 29) are recorded in the BM II R-D area. The three rock hearths are north and east of the pithouse. Fine sieved samples from one of these (HR 10), yielded large amounts of microscopic, burned bone as well as cheno-am, juniper, and corn remains. This hearth and HR 37 may postdate the BM II period because sherds were recovered from excavated sediments in their vicinity. HR 28, east of the pithouse, contained a possible fragment of a burnt corn cob. The fourth hearth, a burned pit (HP 15), is associated with an adobe lined pit (PU 23) south of the pithouse. The limestone dump (LS 29) is northwest of the pithouse.

Additionally, five possible architectural features are present (SF 32, SF 33, SF 34, SF 35, SF 36). All are defined by sandstone. Only SF 34 has upright slabs.

Three trash areas (TR 11, TR 20, TR 31) are identified south and east of the pithouse.

Artifacts. Surface collections from the whole site produced 64 ceramic sherds and 588 lithic artifacts. In the BM II R-D area, a total of 14 sherds including 4 Puebloan sherds were recovered, which must represent some mixing of temporal components. The 208 lithic artifacts
from the BM II R-D area surface collection include one hammerstone, 6 
curated artifacts, 44 items that would class as expedient tools, and 153 
pieces of lithic debitage (Table A.3, Appendix A).

Use in the Present Study. West Johns 12-6 is used in all analyses 
(Table A.4, Appendix A).

West Johns 19-3 (42SA4270)

The West Johns 19 Quadrat is located less than 0.5 km from the north 
end of Johns Canyon. It is within pinyon-juniper forest at about 6500 
feet elevation. The quadrat slopes toward the canyon and drainage on all 
sites in West Johns 19 Quadrat is toward the canyon.

West Johns 19-3 is near the center of the quadrat. It is one of 
eight sites in the quadrat (Figure 18); all are BM II and several probably 
contain residential structures. Test excavations at West Johns 19-3 and 
West Johns 19-7 (also included in this study) provided positive evidence 
of pithouses. This quadrat contains part of a BM II site cluster or 
"village" and other BM II architectural remains are located in the West 
Johns 10 Quadrat, to the southeast.

Only the south fraction of West Johns 19-3 is included in the R-D 
area used in this study. This R-D area covers a 50-by-50 m area. Its 
pithouse is near the south end of the feature and artifact distribution of 
materials and a well-preserved set of honeycomb storage features lies 
north of the pithouse (Figure 19).

Research History. West Johns 19-3 was surveyed and surface 
artifacts collected over a two day period in 1973 by a crew of five 
individuals. Test excavations, supervised by J. Winter, were conducted 
that same summer over a thirteen day period.
Figure 18. West Johns 19 Quadrat, site areas.
Figure 19. West Johns 19-3, BM II residential-domestic area.
West Johns 19-3 has been included in several analyses. West (1978) ran pollen diagrams on the site. The site also was used in Dohm's (1981) analysis of spatial attributes of BM II sites on Cedar Mesa. It was one of several sites providing evidence that all large BM II sites on Cedar Mesa are conglomerates of smaller sites (Dohm 1981:52, 84, 89; also see Camilli 1983); hence, the division of north and south fractions of the site in this study. West Johns 19-3 also provided evidence that the spatial distribution of artifacts in some types of habitation sites, including West Johns 19-3, approaches a U-shape with a pithouse near the center of the artifact distribution (Dohm 1981:84, 90-92). Further, Camilli included this site in her lithic analyses of tested BM II sites in 1981. Finally, Matson et al. (n.d.) class West Johns 19-3 as a habitation site on the basis of its artifact assemblage.

Features. The pithouse (RP 1) is located near the center of the R-D area. A north-south test trench was cut across the slab-lined entryway and one edge of the pithouse. The trench showed this shallow pithouse to be oriented northwest-southeast. The floor is a flat unprepared surface with a low shelf at the north edge of the excavated area. Burned roof materials directly overlay the floor; beam samples provided tree ring dates after A.D. 300: 293+vv, 302+vv, 311vv, 329+vv, reviewed in Matson et al. (n.d.).

A cluster of six honeycomb storage units (SH 2, SH 3, SH 4, SH 5, SH 6, SH 7) and three additional storage units (SU 8, SU 9, SU 10) which may be part of the honeycomb structure are seven meters north of the pithouse. A trench revealed the six honeycomb units to be slab-walled cists. Most of these (SH 2, SH 3, SH 4, SH 6) had hard-packed floors sloping up to meet the walls or surrounding the bottom of the slabs. Four
post holes were exposed along cist walls. Burned wood from these structures provided dates in the early A.D. 300s: 313+rv, 329+rvv (see Matson et al. n.d.), as did beams from the pithouse. In one cist (SH 4), a large slab scabbled to an oval was found in contact with the floor and leaning against one wall. Based on comparison with doors found in cliff-side granaries, the excavator suggested this would represent either a door or hatch cover.

East of the storage structures, sandstone and limestone (UN 13) is scattered along a drainage; it may be the eroded remains several features, rather than being a discrete feature.

No formal hearths were discovered. Two ash areas (AS 14, AS 25) are identified north and northeast of the pithouse. Also, six limestone concentrations (LS 20, LS 22, LS 23, LS 27, LS 28, LS 30) are present.

The ten sandstone concentrations (LD 11, LD 12, LS 15, LD 16, LD 17, LD 24, LD 26, LD 29, LD 31, LD 33) are distributed in all directions from the pithouse. The few mixed sandstone-limestone concentrations (LM 19, LM 21, LM 32) are, as well.

A single trash area (TR 18) was identified south of the pithouse.

**Artifacts.** A site total of 415 lithic artifacts was recovered from West Johns 19-3 in survey collections. Two hundred forty-five of these came from the R-D area used in this study, including 52 items classified as curated tools, 44 expedient tools, and 144 pieces of lithic debitage. Six furniture items were recovered: a metate, two manos and three hammerstones (Table A.3 Appendix A).

**Use in the Present Study.** West Johns 19-3 is used in all analyses except that for Expectation IIA.2, which required nearly complete excavation of the pithouse (Table A.4, Appendix A).
West Johns 19-7 (42SA4274)

West Johns 19-7 is at the center of this quadrat (Figure 18), just
northeast of West Johns 19-3 (described above). The site is not so deeply
dissected as West Johns 19-3 and, perhaps as a result, fewer features and
artifacts are found at the modern ground surface.

The entire site is included in the R-D area (Figure 20). The
pithouse is at the southwest end of the distribution of nineteen features.

Research History. West Johns 19-7 was mapped and surface artifacts
collected over a one day period in 1973 by a crew of four; following this,
there were three days of test excavations, supervised by J. Winter. The
site was subsequently included in West's (1978) study of Cedar Mesa
pollen samples and in Camilli's 1981 analysis of BM II lithics from Cedar
Mesa. It was also included in Dohm's analysis of spatial attributes of
BM II sites on Cedar Mesa, and a photo of the pithouse appears there (Dohm
1981:Figure 3). Matson et al. (n.d.) class West Johns 19-7 as a
habitation.

Features. The pithouse (RP 1) is in the southwest part of the R-D
area. An east-west trench was excavated through the structure in 1973.
The trench caught the hearth and part of a slab-lined bin to the east; it
showed RP 1 to be a shallow, circular-to-subrectangular structure. A
deflector at the south edge of the hearth is constructed of a double row
of upright slabs. A scabbled sandstone hatch cover leaned against these.
The cist or bin area is defined by a further series of slabs and a
slightly raised floor. Excavators thought this to be a corner bin, and
suggested that the slabs and several posts represented part of a U-shaped
Figure 20. West Johns 19-7, BM II site area.
wing-wall that connected this corner bin to a second (unexcavated) bin in
the southwest corner of the pithouse. They thought the pithouse might
approach rectangular and that remains on the modern ground surface
provided some evidence for an antechamber. In short, the appearance is of
an early (and very shallow) BM III pithouse as much as a late BM II
structure. Posts from wall and bin construction failed to provide tree-
ing dates. Based on the complete absence of ceramics from the site, West
Johns 19-7 continues to be regarded as late BM II.

Five storage features (SL 2, SU 4, SU 5, SU 6, SU 8) are identified
from surface evidence. SL 2 was trenched in 1973. A double row of slabs
which form cist walls are set 30 cm into the ground. The floor of the
cist was hard-packed earth over which both a layer of ash and a layer of
charcoal were deposited. Excavators suggested that this could be a deep
cooking pit or a storage cist. None of the other four features labeled as
storage units has such well-defined walls and none was tested. All are in
the immediate area of SL 2, six to eight meters north of the pithouse.

A possible architectural feature (SF 7) is identified 10 m northeast
of the pithouse, just beyond the storage feature area.

Eight sandstone concentrations (LD 8, LD 11, LD 12, LD 13, LD 14,
LD 16, LD 17, LD 19) and four mixed sandstone and limestone concentrations
(LM 3, LM 9, LM 10, LM 15) are present, all north and east of the
pithouse. No limestone concentrations were identified, although these are
common on other Cedar Mesa BM II R-D areas in the study sample.

Artifacts. The surface collection total is 49 artifacts, all flaked
lithic items. There are seven artifacts classified as curated tools, 13
items classified as expedient tools and 29 pieces of lithic debitage.
Use in the Present Study. West Johns 19-7 is used in all analyses except those directed at site furniture (none was found) or requiring complete excavation of the pithouse (Table A.4, Appendix A).

Basketmaker III Sites

A total of 10 BM III R-D areas were used, from 9 sites. One of these, West Johns 12-6, also has a BM II R-D area used in this analysis. Most of these sites have Pueblo components; however, as far as possible only the Basketmaker components are considered.

Bullet 3-7 (42SA4089)

The Bullet 3 Quadrat is about 5200 m east and 2000 m south of Bullet Canyon on the mesa top divide between Bullet and Road Canyons. Bullet 3-7 is located at the edge of the pinyon-juniper zone just above 6640 feet elevation. Numerous juniper and some pinyon trees, as well as sage and ephedra grow on parts of the site with thick soil.

Bullet 3-7 is a multiple occupation site with components dating to the BM III and Pueblo II periods. The site covers 23,750 square m. Multiple occupations confuse definition of the BM III R-D area; definite BM III R-D area remains, without Puebloan admixture are found only in the southwestern part of the site, an area 75 m north-south by 100 m east-west (Figure 21). Numerous shallow drainages lead away from the undissected pithouse area, emptying onto exposed bedrock in other parts of the site.

The Bullet 3-7 R-D area may form part of a cluster of Basketmaker III residences. Two, or even three, R-D areas may be present in Bullet 3-7 itself and two other R-D areas may be present in nearby sites, Bullet 6-5 and Bullet 3-1. Within the R-D area of Bullet 3-7, a large
Figure 21. Bullet 3-7, BM III residential-domestic area.
shallow feature (RU 12) may represent one R-D area, and features some 75 m
to the south of the identified pithouse (RP 1) may represent yet another
R-D area obscured by sediment accumulation and later Anasazi use.

Research History. Bullet 3-7 was mapped and surface artifacts
collected over a three day period in 1972 by a crew of eight individuals.
The site is at the extreme northeast edge of the survey quadrat but
entirely contained within it.

Test excavations were conducted in 1973 by a five person crew
working 12 days, supervised by J. Winter. Excavation was aimed at dating
the several components through investigating burned structures that could
contain wood suitable for dendrochronology and excavating trash areas from
which stratigraphic relations and ceramic assemblages could be compiled.
Separate excavations were conducted in the Pueblo II and BM III areas. In
the BM III R-D area, three one-m wide trenches were excavated through
burned features and segments of these trenches were expanded to identify
features. With one exception, tree-ring dates show this area to have
BM III period construction. The single exception was a pinyon beam
fragment in pithouse fill (see discussion of RP 1, below). Some sediments
were screened and pollen samples were routinely collected from ashy fill.
Excavation resulted in the definition of a pithouse with a cluster of
probable (small) storage pits to the northwest, and three larger
structures southwest of the pithouse. A pollen sample at a bell-shaped
cist (SP 6) in the inferred storage cluster about six m from the pithouse
is reported in West (West 1978:112, Figure 28). Two of the three larger
structures southwest of the pithouse are slab-lined storage cists, the
third (RU 12) may be a habitation structure.

Matson et al. (n.d.) class Bullet 3-7 as a habitation.
Features. A pithouse (RP 1) was identified in a trench oriented east-west. Its surface manifestation was ashy soil in a shallow depression of about four meters diameter. Excavation shows the pithouse to be circular with a flat earth floor excavated less than 45 cm below the modern ground surface. The trench intersected the pithouse hearth and two slab-lined bins. The hearth is an oval adobe-rimmed pit less than 10 cm deep and measuring 80 cm east-west. A distinct adobe rim at the north edge of the hearth may be evidence of remodeling. A small, shallow pit was exposed just northeast of the hearth near two metate fragments. Each of the bins is marked by an upright slab and a deep (more than 60 cm) posthole. Behind these bins, remaining walls are vertical and may have been plastered with adobe, as was the east wall of the pithouse. Upright posts are evenly spaced along the exposed portions of the east and west walls. None yielded a tree-ring date; however, tree ring dates were recovered from beams in fill. Pithouse fill was mostly roofing remains: fragments of burned beams, earth, adobe, and sandstone fragments. Three of four tree ring dates are consistent with a BM III occupation (557+ vv, 559 vv, 670 vv), but one has a date of 905 vv (Matson et al. n.d.). One corrugated sherd also was recovered from this fill; others were graywares consistent with a BM III date. Although the Pueblo II occupation of Bullet 3-7 was extensive, I have no specific explanation for the occurrence of late wood or a late sherd in this shallow BM III structure.

Three storage pits (SP 6, SP 7, SP 8) were identified by surface remains of ash and a single upright slab about six meters northwest of the pithouse trench. Excavation showed that two are bell-shaped cists and the third is a basin-shaped pit with two upright slabs marking its south edge; one of the slabs was visible at the surface.
Three large architectural features (SL 9, SL 10, RU 12) and a posthole (PH 11) were identified in a long trench south of the pithouse. Prior to excavation, this ashy area was identified as having the main concentration of upright and horizontal slabs in the BM III site area. Some of the slabs were aligned and the remains extended nearly 5 m east-west. A shallow slab-lined cist (SL 9) has a circular, flat base, lined with upright slabs and adobe. Sandstone blocks and burnt remnants of pinyon beams suggest additional construction elements. Two of these provided dates: 548+vv and 636+vv (see Matson et al. n.d.). Another slab-lined cist (SL 10) uses the same construction elements. The third feature here, RU 12, is probably a surface structure or shallow pithouse based on the presence of a hearth and other internal features. Interior space is effectively divided by a broken alignment of four upright slabs and several lumps of adobe marking a change in floor level. The west part of the floor (near the hearth) is about 10 cm lower than the floor area southeast of the slabs. These slabs, set into grooves, may have helped stabilize a superstructure; evidence for a roof is burned beams and ash found only in this section of RU 12. Two beams produced tree ring dates at 674vv and 600vv (Matson et al. n.d.). The ash filled hearth is circular, outlined by a raised adobe ring. Northwest of the upright slabs, the higher floor defines an adobe-shaped area with two shallow pits. Excavators suggested this area might represent an antechamber, a later structure, or something else.

Three sandstone features (LD 14, LD 19, LD 20) are located nearby. LD 14 and LD 20 may have associated artifacts. No function is inferred for any of these sandstone concentrations.
Nine other untested features are located well to the west and southwest of this main part of the R-D area. One of these is an ashy area (AS 2), the others are sandstone (LD 3, LD 5, LD 13, LD 17) or sandstone and artifact scatters (LD 4, LD 15, LD 16, LD 18). No function is suggested for any of them.

Artifacts. Only the surface artifacts in the excavated area were summed—those to the west of the test excavations (i.e., Figure 21;) were omitted (a sampling error). Of 565 lithic artifacts collected in this area, only six pieces of site furniture were recorded. All are hammerstones. Additionally, 36 items classed as curated tools and 92 classed as expedient tools were recovered. Even in this area, only 167 of 421 ceramic sherds in the surface collection were Basketmaker; more than half of the 421 sherds are characteristic of Pueblo assemblages.

Use in the Present Study. Much of the area north of the excavated features is dominated by Pueblo reoccupation and was not included in this survey. However, areas south and west of the excavated features reflect mostly BM III use, based on spatial analysis of ceramic distributions performed by Matson and Haase. The areas are included in the feature-structure analyses and site furniture analysis but not in other artifact comparisons (i.e., Table A.4, Appendix A;).

**Bullet 5-7 (42SA4104)**

Bullet 5-7 is the only BM III site in this BM II dominated quadrat. Like the rest of the Bullet 5 Quadrat (described with the BM II period sites), Bullet 5-7 is within the pinyon-juniper vegetation zone at about 6240 feet elevation. Bullet 5-7 has continuous, undissected soil cover.

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7 A total of 2394 artifacts were recovered from Bullet 3-7, including 15 pieces of site furniture.
It is flat, which is unusual. It lacks a Pueblo reoccupation, which is more unusual for a Cedar Mesa BM III period site. Bullet 5-7 is the only BM III site in the sample that has no Pueblo sherd in its collections.

The remains of a pithouse are apparent but only two other features are visible and these are more than 15 m to the southeast (Figure 22). Five features and 60 artifacts are scattered over an area 20 m north-south by 25 m east-west. No other BM III remains are located nearby.

Research History. Bullet 5-7 was mapped and surface artifacts collected over a two day period in 1972 by a crew of three individuals. Shovel tests to define the pithouse were the only excavation.

Features. The pithouse (RP 1) is marked by a number of small slabs, rubble, and ash at the modern ground surface. Based on 14 shovel tests, the pithouse diameter is conservatively estimated at just over 5 m and its depth at 0.25 m. Slabs and sandstone rubble (SF 2, SF 3) to either side of the pithouse are identified as discrete features because shovel tests showed that the areas between them and the pithouse lacked ashy soil. No functional identification of either SF 2 or SF 3 has been made.

Two additional rock features are present. One of these (LD 4) is a small area containing sandstone rubble and artifacts. The other (LD 5) is defined only by sandstone rubble.

Artifacts. Three furniture items were collected: a metate and two knives. The metate was found on the surface above the pithouse. One of two large knives was found three meters southwest of the pithouse; the other was associated with LD 4 and five Basketmaker sherds. All other artifacts found—five expedient tools, 28 pieces of lithic debitage, and 17 Basketmaker ceramics—were recovered above or near a feature.
Figure 22. Bulletin 5-7, BM III residential-domestic area.
Use in the Present Study. Bullet 5-7 is included in all aspects of the analysis except comparisons of pithouse architecture (Table A.4, Appendix A).

Bullet 6-6 (42SA4110)

The Bullet 6 Quadrat is about 5200 m east and 1600 m south of Bullet Canyon on the mesa top divide between Bullet and Road Canyons. It is entirely within the pinyon-juniper vegetation zone at about 6640 feet elevation. Bullet 6-6 is covered by a dense stand of pinyon and juniper trees; it sits on very flat ground with continuous and undissected soil cover. The sediment probably covers additional features.

Bullet 6-6 is a nearly pure BM III site with an apparent pithouse and several sandstone features. The 84 surface artifacts were scattered over a 50 m north-south by 90 m east-west area (4500 sq m). One of three other BM III sites in this quadrat, Bullet 6-5, is continuous with Bullet 3-7 (previously described). Each of these BM III sites has at least one possible pithouse.

Research History. Bullet 6-6 (Figure 23) was mapped and surface artifacts collected over a two day period in 1972. Bullet 6-6 is near the southern boundary of the quadrat but entirely contained within it. Except for a shovel pit emplaced during survey, no excavation has been conducted.

Matson et al. (n.d.) call Bullet 6-6 a habitation.

Features. A probable pithouse, RP 1, has a 4.5 m diameter and 0.4 m depth based on fill described in a survey shovel pit. That fill includes a thick layer of ashy soil with numerous charcoal fragments that may be remains of roof materials.

A single slab-lined storage pit (SL 3) is identified 12 m north of
Figure 23. Bullet 6-6, BM III residential-domestic area.
the pithouse. Five other sandstone features are present (LD 2, LD 4, LD 5, LD 6, LD 7). Two of these have furniture associated with them. LD 2, a sandstone scatter west of the pithouse is associated with a mano. The small sandstone scatter northeast of the pithouse, LD 7, includes a pebble hammerstone, four Basketmaker sherds, and two pieces of lithic debris. No functional identification is made for any of these rock concentrations.

Artifacts. A total of 84 artifacts was discovered on the surface of Bullet 6-6. Artifacts include two pieces of furniture, three curated items, seven expedient tools and 41 pieces of lithic debris, as well as 28 Basketmaker III sherds and 2 Pueblo sherds. The Pueblo sherds may be associated with Pueblo occupations on Bullet 6-4 or Bullet 6-5, either less than 100 m distant.

Use in the Present Study. Bullet 6-6 is included in all aspects of analysis except comparisons involving internal pithouse features (Table A.4, Appendix A).

Grand Gulch 70-187 (CM #3)

Grand Gulch 70-187 consists of two small occupation areas located on sandy ridges overlooking the southwest part of Sheiks Flat. The site lies between pinyon-juniper woodland and open grass and sage parks. It is a large site. The R-D area used in this study is defined by a number of storage units. No definite pithouse could be identified here. If present, the pithouse may lie between storage structures in the eastern excavation units and midden deposits in the trench. Based on field notes, a pithouse may be present some 35 m west of the R-D area used in this study.
Research History. Grand Gulch 70-187 was identified on a 1967 survey. It was mapped and tested over a 20 day period in 1970 by a crew of eleven persons. About half of that time was spent on the R-D area used in this study.

Features. Ten storage features are identified from this Grand Gulch 70-187 R-D area. Six are in two sets of honeycomb storage units (SH 3, SH 4, SH 5, SH 6, SH 7, SH 8). One of these units (SH 4) had a slab-lined floor. All are excavated into calcified soil. Four are slab-lined storage units (SL 1, SL 2, SL 10, SL 11). SL 1 had a partially slab-lined floor as well as a fully articulated dog skeleton, in an apparently intrusive pit. SL 2 is notable for a metate resting on a prepared section of floor. Four additional possible architectural features (SF 9, SF 12, SF 13, SF 14) identified by upright slabs, may also be storage units.

A single hearth (HR 16) is present in the main storage unit area. Trash deposits (TR 15) discovered in trench excavation, lie to the southeast.

Artifacts. A total of 453 lithic artifacts were recovered in surface collections from the R-D area, including two site furnishings, five tools that are classed as curated, 314 worked flakes, and 131 pieces of lithic debitage.

Use in the Present Study. Grand Gulch 70-187 is used in analyses of hearths and storage units (Table A.4, Appendix A).

North Road 4-5 (42SA4002)

North Road Quadrat 4 is approximately 6 km west of where the north branch of Road Canyon begins to be entrenched. Although elevation within the quadrat varies from less than 6240 feet at the northwest corner of the
quadrat to more than 6480 feet in the southeast edge of the quadrat, most of the quadrat lies within the pinyon-juniper vegetation zone. Part is dominated by cliff-side vegetation. The site is located about 300 m north of the ephemeral stream that, further east, becomes North Road Canyon. The site is tree-covered, with juniper the most common. Pinyon and buffaloberry also grow on the sandy hummocks contoured by numerous, moderately deep drainages.

North Road 4-5 is a multiple occupation site. A Pueblo II Prudden Unit overlies Basketmaker materials. The Basketmaker occupation is composed of several elements. There may be two or more BM III occupations and a BM II occupation, as well, based on the presence of several concentrations of burnt limestone and occasional pieces of limestone found in other rock features.

A possible BM III residential-domestic unit at the north end of the site has such a dense overlay of Pueblo artifacts and features that it is not useful to this study. A definite BM III R-D area occupies the southeast quadrant of the site (Figure 24). This R-D area covers an area 42 m north-south by 45 m east-west. The number of artifacts is problematic because of float from the nearby Prudden Unit, but probably approaches 230 of 372 total lithics and 250 of the 659 total North Road 4-5 ceramics.

The intensity of occupation apparent on North Road 4-5 is apparent throughout the quadrat. There are at least two other BM III R-D areas within the quadrat and perhaps two BM II occupations, as well as additional Pueblo period remains.

Research History. North Road 4-5 was mapped and surface artifacts collected over a six day period in 1973 by a crew of seven individuals.
Figure 24. North Road 4-5, BM III residential-domestic area.
In some areas, artifacts were so dense that collection was by three meter units within a gridded area (Figure 24). Test excavation at the site (including Pueblo II areas) were conducted over a three day period in 1973, perhaps one-third of this devoted to the BM III remains. Excavation was supervised by J. Winter.

The chosen BM III R-D area is not fully separate from the Prudden Unit immediately to the northwest. Only the pithouse (RP 2), from which fill was screened in arbitrary levels without yielding any Pueblo sherds, is known to be BM III in origin. The larger pitstructure between RP 2 and several masonry rooms was not tested. Features west of the pithouse (RI 1, AS 3, UN 16, UN 17, UN 18) are described here because they are well within the expected distance from the pithouse for Basketmaker features. Other features, especially including several storage units, may be BM III as well.

Matson and Haase previously separated the contribution of Basketmaker and Pueblo occupations to the total artifact assemblage and distinguished BM III and Pueblo areas of individual sites on the basis of ceramics. Their efforts were the principal source of the R-D area definition used here and their efforts are in general agreement with definition of a discrete BM III area on the basis of characteristic BM III ceramic-to-lithic ratios (as in Tables 2, 3, and 4, in Chapter 4; also see Matson et al. n.d.). As noted in Chapter 4, high ceramic-to-lithic ratios are consistent with Pueblo occupations. Figure 2 (in Chapter 4) shows that the highest ceramic-to-lithic ratios tend to occur north of the R-D area defined here. However, all parts of North Road 4-5 include collection locations showing a higher ceramic-to-lithic ratio than expected with a purely BM III occupation.
Matson et al. (n.d.) call North Road 4-5 a habitation.

**Features.** The BM III pithouse (RP 2) is a small, circular, slab-lined chamber with a flat floor. A 1.1 m wide trench was excavated to a length of 4.5 m east-west through the center of the pithouse. The pithouse is very shallow. The construction sequence appears to have been that the shallow excavation was made, then wall slabs placed into this and rubble shims and dirt packed behind the out-sloping slabs, as necessary. The floor may have been either native earth or adobe clay as found in the thick adobe collar of the central firepit. The inner dimension of this hearth is 0.51 m in diameter. The adobe collar is just over 0.15 m wide. On the west, the collar connects to a narrow adobe-and-slab wingwall. A posthole in the wingwall may be part of a four post roof support system. East of the firepit two postholes and rubble suggest some form of architectural division--either a wingwall or a more formal storage enclosure.

No extramural storage features were discovered. If storage was part of the R-D area plan, the features may be buried by juniper hummocks north of RP 2 or obscured by Pueblo trash or the late pitstructure to the northwest.

RI 1 is a prehistoric surface defined by the presence of two postholes cut into native earth. Because of the postholes, Feature 1 is interpreted as a room but it seems likely that it was no more substantial than a ramada. It was identified and assigned to the BM III occupation through results of excavation. RI 1 lies within a larger area of sandstone rubble and artifacts (UN 17).

UN 17 is one of three surface scatters between RI 1 and pithouse RP 2. Most of the associated artifacts in UN 17, UN 18, and AS 19 appear
to date to the BM III occupation because they have relatively few Pueblo ceramics. UN 18 is a scatter of sandstone and artifacts in an ashy matrix. AS 3 is a large ashy area immediately west of RP 2; it could have been formed by erosion of the pithouse.

Other features identified as BM III because of the relative absence of Puebloan pottery are scattered from southwest of RP 2 to well east of it. Three of these features are listed as unknown types (UN 8, UN 9, UN 16). UN 8 is a scatter of sandstone and artifacts; UN 9 and UN 16 are scatter of sandstone with discrete ash deposits. Three areas with more numerous artifacts have been listed as possible trash deposits (TR 4, TR 7, TR 11). The boundaries of TR 4 are defined by ash and artifacts; the boundaries of TR 11 by a diffuse scatter of sandstone and artifact.

The remaining features are two ash deposits (AS 5, AS 10), a mixed sandstone-limestone scatter (LM 13), and four sandstone features (LD 6, LD 12, LD 14, LD 15), some including burnt rock.

Artifacts. BM III artifact counts are indeterminate because of admixture from Pueblo occupations but a summary of artifact counts from the R-D area are shown in Table A.3 (Appendix A).

Use in the Present Study. North Road 4-5 is limited to architectural analyses. Although they cannot be certainly assigned to the BM III occupation, six site furnishings were used in the analyses for Expectation I.8 (occurrence and specialization of site furniture), because they lay within, or near, BM III features.

North Road 11-4 (42SA4034)

The North Road 11 Quadrat is about 600 m north of North Road Canyon at about 6000 feet elevation. The quadrat lies within the pinyon-juniper
vegetation zone. Soil cover of North Road 11-4 is sufficiently deep to support sage in places. Numerous drainages cut deeply into the soil, leaving hillocks on which rock features were discovered.

The BM III R-D area includes only a fraction of the total 35,000 sq m North Road 11-4 site with its total 8997 artifacts (Figure 25).

Research History. The whole North Road 11-4 site was mapped and surface artifacts collected over an eight day period in 1973 by a crew of 18 individuals. The BM III R-D area took 11 individuals four days to record. The site was tested later in the summer of 1973 over a four day period. The testing crew excavated seven trenches, all but one apparently within the BM III area. The excavators' objective was to get tree ring dates and they closed those units that did not provide tree ring samples. Excavation was conducted in the pithouse and its antechamber, a slab-lined hearth, a trash unit, and an apparent surface room.

Features. The pithouse (RP 2) was discovered unexpectedly in a small, ashy area with two upright slabs and a few bits of rubble (Figure 25). The trench caught the pithouse near one edge. Remains in the much extended trench suggest that RP 2 is deep and just over 7 m in diameter with a shallow, 2.3 m long antechamber (RA 1). The full north-south length of the pithouse was not excavated and only the floor south of a post and adobe wingwall was cleared. Two postholes set very close together at the south edge of the antechamber may be part of a series set next to the wall where there is also at least one slab bin. Pithouse and antechamber may have been separated by a wall defined with postholes, as well as by a difference in floor height (the antechamber floor is more than one half meter higher than the floor of the main chamber).

Just over 15 m north of the pithouse are two possible BM III
Figure 25. North Road 11-4, BM III residential-domestic area.
structures (RS 10, LD 11), identified by several upright slabs and sandstone rubble. RS 10 was tested. At its south edge, excavators discovered a line of upright slabs with one posthole but still could not identify the floor. Although there is no definite floor nor any floor features, RS 10 is identified as a surface room because of its 3.5 m north-south length. The few Pueblo sherds in fill may be either contamination or evidence of later use (a large Pueblo surface room is only 14 m to the west).

LD 11 is located just northwest of this room. It is identified only as a rock feature although it is defined by several upright slabs which probably indicate that it was an architectural unit of some sort. A single jacal and rock storage unit (SL 9) is located only 12 m northwest of the pithouse.

A slab-lined hearth (HS 3) and two ash spots (AS 4, AS 5) are located northwest of the BM III surface remains.

An extensive trash midden (TR 6) lies southeast of the pithouse. It is almost 0.5 m deep in places, and predominantly BM III in origin, but with a few San Juan redware sherds. Remaining features are rock deposits of unknown function. LD 7, defined by two upright slabs protruding from a hillock, may be a structural feature. Functions of discrete sandstone features recognizable even within the thin sheet trash extending away from midden (TR 6) are unknowable.

Artifacts. The separation of BM III and Pueblo artifacts is uncertain.

Use in the Present Study. Use of North Road 11-4 is limited to feature-structure analyses that did not require positive identification of storage units (Table A.4, Appendix A).
Upper Grand Gulch 4-3 (42SA4047)

The mesa rim along the east edge of Grand Gulch, north of its confluence with Kane, was densely occupied during the Anasazi periods. Upper Grand Gulch Quadrat 4 covers one segment of this well-used landform. The quadrat elevation varies between about 6580 and 6640 feet. Although the pinyon-juniper vegetation on the mesa top is not much different from elsewhere, there are numerous springs and seeps along this upper part of Grand Gulch, some quite near the mesa rim. Perhaps the many springs were an attraction to the farm families.

Upper Grand Gulch 4-3 is a very large multiple occupation site. There is clear evidence for at least one and probably several Pueblo III period Prudden Units and at least three BM III R-D areas. Additional BM III remains are probably present but hidden by Puebloan construction and Puebloan trash. The total site approaches 67,600 sq m. Two of the three identified BM III R-D areas are included in this study. Together they cover an area less than 75 m north-south by 45 m east-west, including a central area obscured by Puebloan remains (Figure 26). This is a small fraction of the total Upper Grand Gulch 4-3 site.\(^8\)

Besides remains within this large site, there are six known BM III sites nearby. Three of these are in the Upper Grand Gulch 4 quadrat and three are in the contiguous Upper Grand Gulch 2 quadrat. None has a definite dwelling mapped although surely some contains a dwelling.

Each of the Basketmaker R-D areas used in this study was identified by a pithouse and a scatter of extramural features and artifacts. The northern R-D area includes 15 features and 4480 artifacts. The southern R-D area recognizes only four features and 412 artifacts.

\(^8\) R-D areas shown here are within survey Grids E6 and E7.
Figure 26. Upper Grand Gulch 4-3, BM III residential-domestic areas A-E, with intervening Pueblo remains.
Research History. Upper Grand Gulch 4-3 (Figure 26) was mapped and surface artifacts collected in 1972 by a crew of 12 over 10 days, including 15 person days on the BM III R-D areas of interest here. Later in the summer a crew of five, supervised by J. Winter, returned for 11 days to excavate RP 1 in R-D Area E. They found this small pithouse and antechamber to have a burned floor with numerous sherds and some bone. The walls, however, were poorly preserved, and no dates were obtained from the pinyon and juniper beams.

Matson et al. (n.d.) call Upper Grand Gulch 4-3 a definite habitation site.

Features: R-D Area A. This is the north R-D area. A possible pithouse (RP 6) is located near the southwest edge of the defined R-D area. It was identified on the basis of upright slabs and sandstone around the perimeter of a 3.6 m diameter depression. A cluster of sandstone rubble (LD 7) immediately south of the pithouse may represent remains of an antechamber (absence of artifacts and ashy soil suggests it is not refuse).

Three slab-lined storage units (SL 8, SL 9, SL 10) form an alignment three to eight meters north-to-northeast of the pithouse. Several additional sandstone clusters (UN 12, SF 14, LD 18) may be functionally, as well as spatially, associated. An ashy deposit with a sandstone outline (UN 5) is immediately north of SL 10. UN 5 may represent collapsed structural elements of SL 10, or it may be a discrete feature.

Sandstone, ash, and artifacts define UN 13, east of the main storage complex, with a dense scatter of sandstone (UN 11) eroding from its south edge. Three other sandstone scatters are present in R-D Area A (LD 15,

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9 This corresponds to Feature E in Grid E7 in 1972 survey and excavation notes.
LD 17, and LD 19). One of these, LD 17, is outside the quadrat boundaries, near a possible room (RU 16). Feature 16 is defined as an architectural unit because of the presence of burned jacal and its relatively large size (RU 16 is 8.5 m sq).

Features: R-D Area E. The south R-D area is defined by the tested pithouse (RP 1). The pithouse appears to be circular and antechamber and main-chamber are separated by upright slabs, without a change in floor level. Its only internal feature is a hearth, which appears to have been set off-center. Although tree-ring samples did not yield dates, ceramic sherds from pithouse fill were graywares consistent with a BM III date.

Two sandstone scatters (LD 3, LD 4) are northeast of the pithouse and sandstone is exposed in a drainage north of the pithouse (UN 2).

Artifacts. Lithic artifacts from surface collections of R-D Area A were 7 furniture items, 18 curated tools, 71 expedient tools and 409 pieces of debitage. About one third of the total 3963 ceramics were Basketmaker (Table A.3, Appendix A). A considerable amount of ceramic (and other) material may have "floated" from nearby Pueblo occupation areas, including the one shown on Figure 26.

Surface collections from the smaller R-D Area E, to the south, include three furniture items, 10 curated tools, 22 expedient tools, and 157 pieces of debitage. Fifty-nine of 217 ceramics are Basketmaker (Table A.3, Appendix A), again indicating considerable Pueblo noise.

Use in the Present Study. Although a Pueblo structure lies between the two R-D areas, and trash from that occupation is scattered widely, artifacts from Upper Grand Gulch 4-3 R-D areas were used in artifact analyses (Table A.4, Appendix A).
West Johns 2-3

West Johns Quadrat 2 lies within 50 m of one of the tributary canyons that lead south into Johns Canyon. Most of the quadrat lies above 6400 feet elevation but, along the east edge of the quadrat, the ground slopes abruptly down towards the canyon. Along this edge, Puebloans built houses at several different times, each with the blue green view of the tops of juniper trees descending down to the main canyon walls. West Johns 2-3 is at the north end of the quadrat. Another Basketmaker III site lies north of it, outside the quadrat, and several BM II (as well as Puebloan sites) lie to the south and east.

West Johns 2-3 has a clear BM III R-D area and apparent BM II remains underlying this. The other BM III pithouse sites in the area may be contemporaneous. West Johns 2-3 itself is quite large: while it covers an area only 90 m north-south by 50 m east-west it has a dense scatter of 4600 artifacts, virtually all lithics.

Research History. West Johns 2-3 was mapped and surface artifacts collected in 1973. Test excavations were conducted over an 8 day period in 1973, supervised by J. Winter. Excavations were intended to verify the presence of a pithouse, understand the nature of the slab features north of the pithouse--found to be storage facilities--and excavate in trash areas because these were deemed likely to provide tree ring dates. They tested the pithouse, storage units, and trash deposits. Tree ring dates were obtained from the pithouse (see description of RP 1 and RA 2, below) and all are within the BM III date range.

Features. The map (Figure 27) reveals 27 features, including a pithouse (RP 1) with antechamber (RA 2) and separate grinding bin (PP 3), five storage units (SL 4, SL 12, SR 13, SL 14, and SR 21), 16 rock
Figure 27. West Johns 2-3, BM III residential-domestic area.
features (see Table A.2, Appendix A), one ashy area (AS 16), and a well-developed trash midden southeast of the pithouse (TR 5).

The pithouse was tested in 1973. A 1.1 m wide trench was excavated north-south through the pithouse and antechamber, near the east edge of the structure. The pithouse is circular, with a flat floor that is excavated more deeply north of the U-shaped wingwall than south of it. All of this main chamber floor is deeper than the antechamber floor. There are numerous floor pits within the structure; most are probably for storage.

Six tree ring dates were obtained from samples in the main chamber. Three from the north end of the chamber are 611+vv, 648+vv, 655+vv. Two at the wingwall are 655vv and 681vv. A sample south of the wingwall produced a date of 652+vv. All are consistent with assignment to the BM III occupation (see Matson et al. n.d.).

The antechamber (RA 2) is separated from the main chamber by upright slabs and the difference in the floor elevation. Upright posts line the inner wall of the antechamber. One of these provided a tree ring date of 572+vv (Matson et al. n.d.).

The processing pits at the east edge of the pithouse (PP 3) are apparently mealng bins. Two small pits (9 cm diameter and 15 cm diameter), identified immediately north of the pithouse, were inadvertently excluded from this study. Their function is unknown.

Four slab-lined features and a rock feature north of the pithouse are inferred to be storage units (SL 4, SL 12, SR 13, SL 14). SL 4 was tested in 1973. It proved to be a slightly excavated pit with a floor of native earth and lower walls lined with outward-leaning slabs. Broken remains of a hatch cover were found in fill near the base of the feature.
Heavy clay fill throughout the feature was inferred to be the remains of a wattle-and-daub superstructure.

Excavation in trash (TR 5) southeast of the pithouse was as much as 0.3 m deep. Another excavation unit was placed in a depression with sandstone rubble visible at the modern ground surface (UN 11), without conclusive results.

Artifacts. Six pieces of site furniture were identified at the modern ground surface. These were three hammers, a knife, a core scraper, and a single mano. The isolated mano was found 3 m south of the pithouse antechamber. The other furniture items were either in or near features: the knife in trash, the core scraper in an ash feature west of the pithouse and two hammerstones in or near limestone features east of the pithouse. The final hammerstone was found at the extreme north edge of the site, not associated with any feature. Additionally, 17 curated tools, 50 expedient tools, and 337 pieces of debitage were recovered in surface collections. Virtually all of the small ceramic sample (14 of 16 sherds) were Basketmaker (Table A.3, Appendix A), making the temporal assignment of this R-D area quite secure.

Use in the Present Study. West Johns 2-3 was used in all aspects of the analyses (Table A.4, Appendix A).

West Johns 12-6 (42SA4248)

West Johns 12-6 is one of nine sites in the West Johns Quadrat. Three of these sites have recognized BM III components; two, including West Johns 12-6 have evidence for pithouses. West Johns 12-6 also has a BM II component, which also is included in the study sample. The West Johns 12 Quadrat setting is described with the BM II sites.
Research History. Because of the numerous grayware sherds found on survey and the near absence of later ceramics West Johns 12-6 was identified as representing a BM III occupation. Results of J. Winter's excavation in the BM III pithouse and storage units confirmed the presence of a BM III occupation. In 1973, the south half of the pithouse antechamber and a 1 m wide trench running north-south through the pithouse were cleared. Tree ring dates were obtained, including a final date of 698++v (see descriptions of RP 14 and RA 17, following). A trench was excavated through a large slab-lined cist northwest of the pithouse. Another trench was excavated southeast of the pithouse and intersected a storage pit (SP 31) and a processing pit (PP 30). In 1984, this area had become part of a local erosional pocket and numerous ceramics were visible at the surface, including a number of redwares. Therefore, it is not certain that this area should be included in the BM III R-D area.

In 1984, further excavation was conducted (Dohm 1984). This excavation removed post-occupational deposits from above features in the storage complex area, but did not remove feature fill, and included a series of (deeper) north-south and east-west trenches away from the pithouse (Figure 17).

Matson et al. (n.d.) class this BM III component of West Johns 12-6 as a habitation.

Features. The pithouse (RP 14) is a circular structure with a circular antechamber (RA 17). Both chambers were partially excavated in 1973. Burned roof materials comprised most of the lower pithouse fill. Lithic flakes and many sherds (all Lino Gray) were recovered from this stratum, and are consistent with the BM III date. Four tree ring samples
collected in 1973 and two collected in 1984 are also consistent with a BM III date.

The pithouse main chamber is approximately 5.0 m diameter; the smaller antechamber is approximately 3.5 m diameter. Upright posts set into the floor ring the walls of the antechamber and, apparently, the main chamber as well. Two large central postholes in the south half of the antechamber suggest a four-post roof-support pattern for the antechamber. Tree ring samples from the antechamber provided dates of 597+vV, 698++vV and 652vV (see Matson et al. n.d.). The antechamber is separated from the main chamber by a double wall of upright slabs, posts, and redeposited earth.

The north-south trench through the main chamber uncovered a central hearth with an adobe coping. A possible slab-and-post wing-wall stood one half meter south of the hearth. Several additional pits were identified in the floor. In 1984, a trench excavated away from the northwest edge of the pithouse intersected a wall bin. Two juniper posts in the bin provided tree ring dates of 657vV and 669r.10 A tree ring sample from fill in the main chamber provided a date of 613+vV (see Matson et al. n.d.).

Remains of five storage features are located northwest of the pithouse (SL 2, SS 3, SL 9, SL 11, SL 15). These are large, circular, earth and rock features, each 2-to-3 m in diameter. They were not all visible at the modern ground surface (in 1984, post-occupational fill was removed from above them, and a long east-west trench intersected two: SL 11 and SL 15), but the storage complex area was marked by sandstone slabs and small sandstone fragments. One of the storage units, SL 9, was

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10 These are Laboratory of Tree Ring Research catalog number CML-444, and CML-445.
partially excavated in 1973. It had a flagstone floor and lower walls were slab-lined. Based on stratigraphic relationships among the storage units, they may not have all been in use at the same time.

Numerous other features were intersected in the storage complex area. Most of these are pits (PU 18, PU 19, PU 20, PU 21, PU 22); others are sandstone concentrations that may be masking pit features (LD 10, LD 25, LD 26). Any of these, could have been used for storage. However, at least one may be a hearth (HP 1).

Additionally, the remains of a feature which may have been ephemeral surface structure were found directly north of the pithouse (RU 16). RU 16 was identified by lines of sandstone rubble on a stratum which defined the base of cultural materials elsewhere in the BM III R-D area. A posthole southwest of the pithouse (PH 6) may represent some other ephemeral shade or structure. PH 6 had a base stone and small rock spalls resting mostly against its walls.

Several other pits were identified (PU 5, PU 13, PP 30, and SP 31). Most contained some cultural material, but only one, TR 7 was a pit filled with refuse. Two other refuse deposits are also identified: TR 23 and TR 24. TR 23 is a trash lens identified in a trench excavation. TR 24, west of the pithouse and storage complex area, is known only from surface survey.

**Artifacts.** Only surface collections made in 1973 are included in this tally. Lithic artifact collections included one furniture item, three curated tools, seven expedient tools, and 78 pieces of lithic debris. Additionally, 16 sherds were collected, including only two Pueblo items.
Use in the Present Study. West Johns 12-6 is used in all analyses (Table A.3, Appendix A). The area of Features 30 and 31, with redware sherds, is included in the R-D area data.