THE ARCHAEOLOGY OF MONITOR VALLEY 1. EPISTEMOLOGY

DAVID HURST THOMAS

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THE ARCHAEOLOGY OF MONITOR VALLEY
1. EPISTEMOLOGY

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ABSTRACT

This is the first of a five Part monograph series analyzing the archaeology of Monitor Valley, Nevada. This volume establishes a theoretical and epistemological framework within which the archaeological fieldwork was conducted. The structure of inquiry begins with selected issues of general and mid-range theory of hunter-gatherers, with special emphasis on seasonal and long-term mobility patterning as an organizational principle. Although recent studies of hunter-gatherer mobility have emphasized a global, cross-cultural perspective, certain normative procedural assumptions restrict the utility of that approach. Another mode of analysis, emphasizing variability rather than uniformity is more relevant to the present study. The protohistoric period in the Great Basin manifests a wide range of adaptive strategies that can be conveniently scaled along Binford's (1980) forager-collector continuum. To emphasize this high degree of synchronic diversity, we explore subsistence, settlement, political, social, and territorial variability in three protohistoric case studies: the Kawich Mountain Shoshone, the Reese River Shoshone, and the Owens Valley Paiute. To explain the evolution and dynamics of this variability, it is necessary to develop a body of mid-range theory to link protohistoric behavior with the specific archaeological record. Three independent axes of mid-range theory are synthesized into a series of specific, strategic models that anticipate the archaeological record of Monitor Valley. The first model employs a residentially mobile foraging strategy, as monitored archaeologically from within the annual foraging radius. Alternative exploitative strategies are possible, such as a fusion-fission settlement strategy. One archaeological model monitors this behavior from within the foraging radius, while another (contrasting) model monitors it from within the logistic radius. Although these models derive from the same behavioral strategy, the archaeological expectations for a particular landscape contrast radically. Two additional models derive from a collector strategy, monitored from within both foraging and logistic radii. These five models not only examine strategic options for protohistoric Great Basin hunter-gatherer populations, they also provide an operational vehicle for anticipating the archaeological record of the Monitor Valley. The archaeological fieldwork exploring the empirical evidence for these mid-range theoretical models is described in subsequent volumes of this series.

INTRODUCTION

This is the first part of a series, presenting the results of fieldwork that began in June 1970 and ended in August 1981. The inquiry ranged from stratigraphic and living floor excavations at the 11 m. deep Gatecliff Shelter (Thomas, 1981a) to work at Alta Toquima Village, a multicomponent task group and habitation site located at an elevation of 3300 m. (11,000 ft.). Both probabilistic and opportunistic site surveys were implemented, resulting in the recording and collection of hundreds of additional sites and non-sites. A dozen rock art localities were located and recorded. Numerous additional satellite sites—game drive fences, hunting blinds, rock ambushes, and soldier cairns—were also mapped and collected. Approximately 300 people participated in this fieldwork spanning nine summer field sessions.

The archaeological research in Monitor Valley necessarily has a general and mid-range theoretical orientation, and the present monograph discusses epistemological issues. At the conclusion of this volume, we present five strategic models designed to anticipate the archaeological record of Monitor Valley.

Subsequent volumes present and interpret the empirical data generated in the Monitor Valley fieldwork, arrayed against the theoretical framework developed in this Part. The second volume deals strictly with the archaeology, geomorphology, paleontology, and paleobotany of Gatecliff Shelter. The third presents empirical data and interpretations from additional excavations and surveys in the Monitor Valley area. The fourth details the high elevation archaeology of Monitor Valley. The final volume discusses these findings against a regional and theoretical background.

Although each monograph can be considered independently, each is designed as a single link in a linear argument, beginning and ending with theoretical considerations. All parts of this series will be indexed cumulatively at the end of the final monograph.

ACKNOWLEDGMENTS

It is customary at this point to thank all of those who assisted in various ways. In the case of the Monitor Valley research, which spanned a dozen years, the task is staggering. In subsequent volumes I make specific acknowledgment for assistance in fieldwork and laboratory analysis. Here, my thanks is directed to those fundamentally responsible for making the entire project go, as well as to those who assisted in the preparation of this first volume in the Monitor Valley series.

I acknowledge first the role of the American Museum of Natural History in making the research possible. I am grateful not only for personal and project support, but particularly for the institutional commitment to long-range research. A continuing theme in this series is the importance of a long-range approach to research. The Monitor Valley project would have been impossible had it not been for the support provided by the American Museum of Natural History, specifically Dr. Thomas D. Nicholson (Director), Dr. Jerome G. Rozen, Jr. (Deputy Director for Research), and Dr. Stanley A. Freed (Chairman of the Department of Anthropology during the first four years of the American Museum research effort in Monitor Valley). I appreciate the patience and understanding displayed by my numerous colleagues in the Department of Anthropology throughout the last decade.

I warmly thank the late Dr. Junius B. Bird who not only provided dozens of suggestions regarding our laboratory analysis, but also spent three weeks with us at Gatecliff Shelter, helping out with both interpretive and logistic matters.

I thank members of the Department of Anthropology at the University of California (Davis) for their support and encouragement in the first phase of the Monitor Valley project. Had it not been for the encouragement and tangible support provided by Drs. M. A. Baumhoff and D. L. True, the Monitor Valley project literally would never have begun. Although the American Museum of Natural History assumed formal responsibility for the Monitor Valley research in 1973, the University of California (Davis) continued to provide storage space, vehicles, and field equipment to assist in our work. I also thank Mr. Leonard R. Williams, then of the University of California (Davis), for helping to make the various Monitor Valley excavations run smoothly. Throughout the mid-1970s, Williams functioned as our West Coast representative.

The financial aspects of the project were complex and multifarious. The major financial burden was borne by the American Museum of Natural History. In addition to general fund support, I acknowledge specific support from the Frederick G. Voss Fund for Anthropology, the James Ruel Smith Fund, and also from the Council of the Scientific Staff of the Museum.

The first couple of years of fieldwork in Monitor Valley were conducted as a summer field school by the University of California (Davis). I also received two Chancellor grants from that institution.

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mous donor provided much-needed funding near the end of the Monitor Valley fieldwork.

Finally, I acknowledge financial support from an unusual source: the collaborators themselves. The Monitor Valley series contains reports from dozens of scientists who assisted in both fieldwork and analysis. Almost without exception, this research was unfunded, the collaborators contributing their own time and in many cases paying for their own expenses. Despite the generous financial support acknowledged above, the Monitor Valley project was, in truth, underfunded, and without the unselfish dedication of my colleagues, the project could not have been completed.

The artwork in the monographs to follow also involves the collaboration of several individuals. Mr. Dennis O'Brien, in many ways my right-hand man, is responsible for the overall graphic framework of these monographs. O'Brien prepared nearly all the field art, as well as planning and executing the final graphic material. Mr. Nicholas Amorosi drew all the artifact illustrations from the Monitor Valley fieldwork—itself a staggering task. We also acknowledge the assistance of several others in preparing the final artwork: Ms. Stacy Goodman, Ms. Lisa Sherman, Ms. Louise Fishman, and Ms. Kristina Jacobsen.

A hearty thanks to the members of my Museum staff who throughout the years helped me in a wide variety of matters directly related to our Monitor Valley research: Ms. Susan L. Bierwirth, Ms. Lisa Cook, Ms. Deborah Mayer, Ms. Debra Peter, Ms. Lorann Pendleton, Mr. Robert Rowan, and Ms. Lisa Sherman.

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I particularly acknowledge the assistance of those who helped me in preparing this manuscript. Ms. Jane Epstein, my research assistant for several years, began the editorial process on the project. Ms. Margot Dembo assumed editorial responsibility in 1980 and has followed all the Monitor Valley monographs from rough draft through finished product. Her editorial skill and touch is evident on every page of each volume. I also thank Ms. Joan Buttner for typing the numerous drafts of the manuscript, a task which consumed years, and in which she was aided by Ms. Pat Bramwell and Ms. Clarissa Wilford. Ms. Florence Brauner of the Scientific Publications Department at the American Museum of Natural History deserves a word of thanks. Additional editorial assistance was provided by Mr. Fred Wayne and Ms. Liza Miller.

The present volume is respectfully dedicated to Congressman James Santini, an ardent devotee of Great Basin archaeology. In addition to Mr. Santini's personal encouragement and enrichment, I publicly acknowledge his fund-raising efforts on behalf of the Monitor Valley project. Congressman Santini came to our assistance at a time when the future of the Monitor Valley archaeological project was in jeopardy. The image of a national political figure campaigning on behalf of an archaeological site, without regard for political considerations, is one I will not soon forget.

CHAPTER 1. THE DILEMMA IN CONTEMPORARY ARCHAEOLOGY

> We face the challenge of science itself—how to keep our feet on the "empirical" ground and our heads in the "theoretical" sky.
>
> L. R. Binford (1981, p. 21)

The conventional archaeological site report usually begins by considering why a particular site was chosen for excavation, sketching the natural and cultural setting, proceeding to describe the geology, the artifacts, and ecofacts recovered, then concluding with a series of inferences drawn from these observations.

The volumes to follow do not adhere to that conventional site report format. We are not discussing the archaeology of a single site but rather the archaeology of a single region. Therefore, we must begin this discussion with a consideration of relevant theoretical issues before turning to the empirical data and interpretation.

To do both in a series is not without difficulty. Most of my colleagues agree that archaeological theory and archaeological fieldwork should proceed hand in hand. But a quick examination of the archaeological literature indicates otherwise. In practice, archaeologists either conduct fieldwork or they theorize—rarely both (see Flannery, 1982). Although a certain degree of specialization is unavoidable and desirable, it is a sad commentary on contemporary archaeology that such a deep split has developed between the archaeological theoretician and the archaeological practitioner. "This is the familiar quandary of choosing between a significant pursuit based on faulty method or one which is methodologically sound but trivial in purpose" (DeBoer and Lathrap, 1979, p. 103).

This dilemma in American archaeology is not a fussy point concocted by skeptics and doomsayers. The problem is real and has practical significance for all archaeologists, but particularly for today's generation of graduate students. The better educated of them see the dilemma in clear focus because they are commonly forced to align themselves inextricably with one or the other posture.

There is a compelling force at work, drawing bright young archaeologists into the complex and self-feeding world of archaeological theory: everyone wants "to be like Binford." Unraveling the fascinating and fashionable issues of mid-range theory and ethnoarchaeology has assumed glamor status within archaeology.

But on the other hand, as Dunnell (1979, p. 439) has noted, "in trying to become scientific, the new archaeologists themselves contributed to the ambiguity." Many of these same young archaeologists—particularly those with sound grounding in fieldwork—also feel drawn to the pressing empirical issues of contemporary archaeology. The ongoing destruction of sites and the oppressive magnitude of contract archaeology have caused the more perceptive students to realize the folly of archaeologists turning their backs on their own database. How can any thinking archaeologist assume the absurd posture of declaring the archaeological record to be irrelevant for today's objectives? Not only is this position untenable from the standpoint of the conscientious archaeologist, but the public—that ultimately supports every bit of modern archaeology—would laugh us out of our jobs. If the archaeological record were to be ruled irrelevant to modern inquiry, why should the bureaucrats, the town planners, the industrialists, the philanthropists, and the politicians care about preserving the archaeological record?

The dilemma between the empirical and the theoretical is a curious turn of events, considering the recent history of our discipline. The *new archaeology* actually began as both a theoretical and a methodological revolution. Describing the summer of 1958—"the first field season of the 'New Archaeology'"—Binford (1972) extolled the advances in sampling, field excavation and data-recording. When the standard University of Michigan forms proved to be inadequate, Binford and his colleagues devised new ways of recording their empirical data; when they could find no screens for small-scale

excavation, Binford constructed the first sifter himself; when traditionalists pressured him for higher artifact yields, Binford retorted that "the archaeological record has information to yield beyond the recovery of 'goodies.'" According to Binford, the new archaeologists organized "the largest, best-trained crews ever fielded in Michigan . . . . The field notes were the finest I had seen." The purpose of field archaeology was perceived as "the search for relationships between things . . . . We acted like knowledgeable dictators demanding that everything be saved and recorded" (1972, pp. 127–131).

But now, 25 years later, one cannot help wonder why the theoretical elite seem to have lost interest in archaeological fieldwork. Even factoring out an ample measure of graduate student enthusiasm, it is clear that the new archaeology began as both a theoretical and an empirical revolution. Over the years, the new archaeologists have placed great emphasis on "methodological cleverness," but American archaeologists have tired of innovative methods that seem incapable of articulating with the new theory to produce substantive results (Schiffer, 1978; Dunnell, 1979).

Contemporary archaeology needs to establish a more rational balance between programmatic assertions and substantive utility (Flannery, 1973, 1982; Schiffer, 1976; Meltzer, 1979). This imperative is taken as a primary objective of the present study.

Yet the archaeology of Monitor Valley will not provide the final word on anything. We are still woefully ignorant regarding both general and mid-range theory relevant to hunter-gatherers. In truth, there is no clear-cut body of theory to guide us in this substantive direction.

Unless the archaeological gains of the recent two decades are put to practical use, their significance will be lost. The Monitor Valley series attempts to integrate contemporary archaeological field techniques with contemporary archaeological theory. But the field methods and the theory will continue to evolve in decades to come, and I sincerely hope that much of what is said here will be obsolete a decade from now.

Today's challenge is clear: to put into practice the theory that we think we now know. Although one cannot practice good archaeological fieldwork without solid theory, one can ill afford to wait for the final theoretical word. The archaeological record is a contemporary phenomenon, and today's archaeology is only as healthy as the substantive efforts it begets.

CHAPTER 2. THE STRUCTURE OF THE MONITOR VALLEY INQUIRY

Inquiry into Monitor Valley archaeology begins with a brief consideration of the relevant general theory of hunter-gatherers; we then pause for a more lengthy examination of relevant mid-range theoretical models; finally we proceed to an empirical encounter with the archaeological record of Monitor Valley. This inferential sequence is reversed once the archaeological objects have been recovered, requiring one to work from the objects, through mid-range theoretical warranting arguments, and finally to consider once again the issue of general theoretical relevance for hunter-gatherer studies. This chapter provides a brief flow-chart of the structure of that inquiry.

TOWARD A GENERAL THEORY OF HUNTER-GATHERER ECOLOGY

A great deal of attention has been paid in the last few decades to the transition from a collector lifeway to the so-called settled village lifeway. Food production involves a reciprocal relationship with domestic organisms, which are obligately dependent on man (Wagner, 1960, p. 157). Domestic specialization applies to a relatively small number of food organisms, and societies of cultivators generally command an effective technical order with a potential for great comfort, security, and sophistication (at least for a segment of that society). The environmental impact of the cultivator is extreme and warfare is often accelerated in the agricultural matrix. The transition from food consumption to food production is considered to be a landmark event in the evolutionary history of mankind.

Non-cultivators also exist in an obligate dependence on plants and animals, but these organisms are not obligately dependent on people. The relationship between human and other organisms is non-reciprocal and complex because most available resources can be exploited by either a forager or a collector strategy (or a combination of the two). These different strategies have rather different mobility and ecological implications.

The articulation between the nearly nomadic lifeway and the nearly sedentary lifeway is poorly understood (Lee, 1972; Hayden, 1981a). It has been suggested, for instance, that ceasing to be a forager and beginning to be a collector changes the rhythm of life, permitting residential groups to be less responsive to seasonal or momentary states of nature (Wagner, 1960, p. 170). In this perspective, collectors are less subject to the whims of nature, because consumption is equalized over longer periods of time (but see comments by Hunn and Williams, 1982). Methods of preservation and storage are developed, as are elaborate preparatory techniques. Wagner (1960) has argued that the life of the collector is less rigorous and less accident prone than that of the forager, and this lessened risk is reflected in the religion, social organization, art, and warfare of the collector.

But collectors are hardly immune to crisis and catastrophe, due in part to the sometimes substantial modification of their ecosystem stemming from the continuous inroads on non-obligate plant and animal communities (see Bettinger, 1980, p. 189; Lewis, 1982).

It is tempting, following Wagner (1960) and others, to think of an overall global evolution from a foraging to a collecting lifeway. Such a transition, whenever it occurred, held the additional evolutionary potential for traditions of writing, evolution of class distinctions and evolving traditions of warfare, and highly developed arts.

But this evolutionary perspective obscures the adaptive significance of the foraging and collecting options. Although only in the formative stage, there is a growing body of general theory that attempts to explain the articulation between the nearly nomadic lifeway and the nearly sedentary one. Lewis Binford has argued that the forager and collector options merely represent extreme positions along a strategic continuum, along which various hunter-gatherer mobility and subsistence patterns can be scaled (Binford and Binford, 1966; Schalk, 1978, 1981; Binford, 1980, 1982a, n.d.; see also Kelly, 1980; Gould, 1982). The forager-collector continuum

attempts to transcend the empirical, probabilistic generalization, and approaches instead the processes by which non-agricultural peoples cope with specific habitat mosaics.

Foragers employ a series of residential moves among a sequence of resource patches—a strategy most effectively applied to a set of largely undifferentiated habitats, such as occur in the tropical rain forest and other equatorial settings (Binford, 1980). Foragers typically gather food on an encounter basis, rarely storing their food, and usually returning to their residential base daily. Foraging strategies generally employ a high degree of residential mobility exploiting low-bulk food inputs; this strategy is often termed *mapping-on.*

Collectors, on the other hand, are characterized by a reliance on food storage (during at least part of the year) and a logistic food procurement strategy. Collectors restrict residential mobility in favor of movement by task-specific groups who often stay away from the base camps for considerable intervals.

At this level, the forager-collector continuum is little more than a typological exercise. In fact, Binford's (1980) terminology was rather fully anticipated in an earlier work, as partially acknowledged by Binford and Binford (1966).[1]

The importance of the forager-collector continuum is that it stresses the strategies behind the observed patterns, rather than the empirical patterns themselves. The general objective is to explain hunter-gatherer variability, rather than to create another set of normative generalizations about hunter-gatherer behavior. The emphasis on mobility and storage as an adaptive mechanism suggests a number of archaeologically observable implications; specific site patterning in geographic space; degree of microstratigraphic integrity of specific site types; long-term positioning and land use strategies; approaches to economic zonation; patterns of faunal transport and discard; staging, damage, and discard of lithics; long-term implications for sedentism; implications for population growth and intensification of resource exploitation; long-term potential of given strategies across varying landscapes.

The forager-collector concept by no means provides a polished general theory of hunter-gatherer dynamics. In fact, we have at present only the barest notion of what *forager* means. As Binford (1982a, p. 181) has pointed out, the San Bushmen—the classic forager case—are predominantly foragers, yet their hunting activities are organized logistically. The challenge now is to determine what conditions the extremes of foraging and collecting.

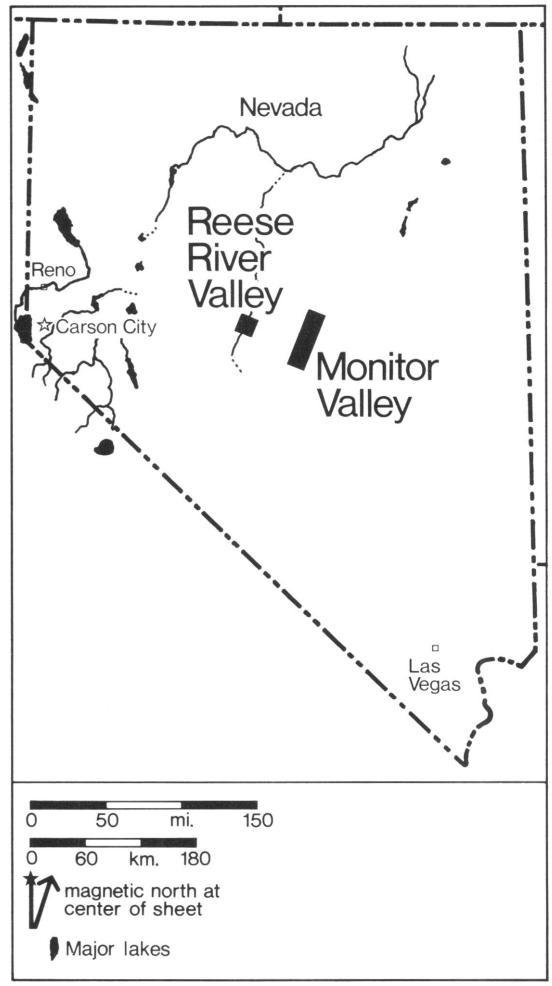

FIG. 1. Locations of Monitor and Reese River valleys, Nevada.

Little theory and virtually no empirical evidence is available to reflect the long-term trajectories of various non-agriculturalists (McFeat, 1969; Rogers and Black, 1976). *Is foraging strategy, for instance, inherently more stable (less risky) than a logistical mode? Does ecological intensification necessarily*

trigger sociocultural evolution? Can there be progressive waves of intensification, followed by episodes of arrested intensification—or perhaps even devolution?

Bettinger (1978, 1980) stresses the importance of exploring alternative adaptive strategies among hunter-gatherers (see also Damas, 1969; Rogers, 1969; Ackerman and Ackerman, 1973; Martin, 1974; Binford, 1980; Smith and Winterhalder, 1981). Because of their internal mechanics, some general models assume that not only the existence of a single optimal adaptive solution but also the adaptive process among hunter-gatherers must be sufficiently constrained so that local groups will closely approximate this optimal solution (Bettinger, 1980, p. 237). This notion of the optimal adaptive solution is enshrined in the technoenvironmental deterministic literature (e.g., Murphy, 1970; Harris, 1971; Jochim, 1976, pp. 77–79) and demonstrates the surviving importance of a steady-state approach to hunter-gatherer dynamics.

One must question this assumption, and examine the importance of alternative subsistence strategies (Damas, 1969; Rogers and Black, 1976; Bettinger, 1978, 1980, p. 237; Colson, 1979; O'Connell, Jones, and Simms, 1982; Wiessner, 1982, p. 176). A more realistic approach is to recognize that hunter-gatherer situations can readily contain more than a single adaptive peak or solution.

Rather than assuming an optimal solution, it is heuristically more productive to seek out adaptive variability. Such an approach recognizes that alternative adaptive strategies can, and sometimes do, exist in all primates (Tattersall, 1977). "Even when faced with the same technoenvironmental circumstances not all hunter-gatherer groups will evolve toward a single optimum adaptation" (Bettinger, 1980, p. 240). Such a research strategy seeks not a single, absolute, optimal projection but rather a rank-ordered set of subsistence alternatives.

The search for optimal solutions also runs the risk of reverting to a functional premise (Vayda and Rappaport, 1968; Anderson, 1973, pp. 203–207; Meltzer, 1979; Bettinger, 1980; Orlove, 1980; Smith and Winterhalder, 1981). Functionalism (and its neo-functional offspring) has proven to be a difficult perspective for evolutionary ecology, rarely leading to crisp formulation of models, often failing to develop realistic alternative hypotheses, and nearly always failing to deal adequately with systemic change (Radcliffe-Brown, 1958; Collins, 1965; Orans, 1975). "Functional understandings can never serve as the explanations of evolutionary changes" (Binford, 1982b, p. 181).

Ecological system change results from historical processes operative on ecosystems which are themselves variable across space and through time. Too little attention has been given to the spatially variable and historically changing qualities of natural microenvironments (Winterhalder, 1980, p. 136). We need to explore the nature of this variability rather than pretend it does not exist (Ember, 1978; Smith and Winterhalder, 1981, p. 4; Durham, 1981; Brooks, 1982).

THE PARTICULARIST-GENERALIST PARADOX

Up to this point the discussion outlined the flow of argumentation for this study. But before proceeding to consider the mid-range theory research necessary for Monitor Valley, we must touch briefly on a lingering issue, namely: the particular perspective to be adopted in this study.

We now have the beginnings of a general theory of human adaptation (Binford, 1980, p. 4), a working framework within which to channel inquiry about hunter-gatherer dynamics and evolution. Much recent research has attempted to provide explanations of hunter-gatherer behavior at the global, *hologeistic* level.[2] Binford's hypothesis relating residential mobility to effective temperature (ET) demonstrates how testable hypotheses can be derived from general theory, as well as how hunter-gatherer behavior can be approached from a hologeistic perspective. This effort is hardly new, but recently a number of studies have employed such an approach to hunter-gatherer ecology (e.g., Bicchieri, 1966; Murdock, 1967; Lee, 1968; Murdock and Morrow, 1970; Ember, 1978; Kelly, 1980).

The hologeistic perspective has great

potential, but it also has limitations. To explore the structure of global inquiry, consider Binford's hypothesis: *dependence on stored food should increase as growing season decreases* (Binford, 1980, p. 15). Binford presents empirical support for this generalization by recourse to a worldwide sample of 31 ethnographically documented hunter-gatherer societies (drawn from Murdock and Morrow, 1970). That relationship is reproduced as figure 2.

In this scattergram, dependence on stored food is scored along an ordinal scale ranging from one to six; the greater the index, the higher the dependence on food storage.

Binford (1980, p. 16) interprets the graphic results to indicate that, even in such a small sample, there is "a clear curvilinear relationship between increased dependence on storage and decreasing ET values . . . it is notable that storage is practiced only among hunters and gatherers in environments with ET values less than 15."

This is an example of how hologeistic approaches contribute to testing general hunting-gathering theory. But as in most cross-cultural studies, there are exceptions. Köbben (1967, p. 4) has noted: "[many] anthropologists who have succeeded in establishing the existence of a statistically significant relationship between two . . . phenomena are quite satisfied with their achievement and consider their task to be completed. In this belief, however, they are wrong. *Exceptions must be explained.*" Hologeistic exceptions arise from a number of factors (Köbben, 1967): defective classification by ethnologists, defective classification by ethnographers, multicausality, parallel causality, functional equivalents, intervening variables, diffusion, external contacts, cultural and social lag, coincidence and personality.

Binford also recognizes the importance of exceptions in his correlation study of ET and storage dependence: "exceptions to the general trend are interesting and perhaps instructive" (1980, p. 16). Two exceptions occurred in the warmer environments, the Andamanese and the Chenchu (fig. 2). Binford believes that the Andamanese were miscoded (defective classification by ethnologists), whereas the Chenchu are apparently in the process of adopting agriculture (intervening variables). Exceptions at the cold end of the ET spectrum are the Yukaghir, Yahgan, Slave, Copper Eskimo, and the Ingalik. The Yukaghir are presumed to be miscoded, while the other cases are considered by Binford to be "truly exceptional" in that they are mobile people, who do not put up stores for the winter: "these groups might be technically foragers with relatively high residential mobility, nevertheless they are foragers of a different type than most equatorial foragers" (1980, p. 16).[3]

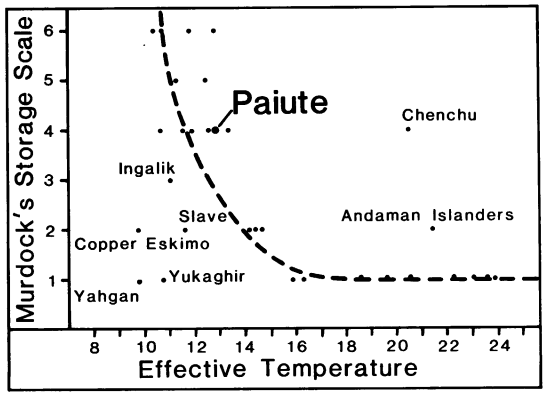

FIG. 2. Scattergram relating dependence on storage and effective temperature (after Binford, 1980, fig. 4).

The 31 hunter-gatherer societies arrayed on figure 2 are a subsample of a larger global study assembled by Murdock and Morrow (1970). The objective of that study was to present "a set of codes and a body of coded cultural data pertaining to the . . . preservation, and storage of food in a typical (or focal) community in each of the 186 societies selected by Murdock and White [1969] as a representative sample of the world's known cultures" (Murdock and Morrow, 1970, p. 302).

Archaeologists have been urged to stop seeking the comfortable empirical generalization and to begin explaining the variability observable in the anthropology of hunter-gatherers (e.g., Binford, 1978b, p. 360; 1980, p. 4; 1981, p. 179). Despite its articulation with general theory, figure 2 stands as another empirical generalization that itself glosses over a tremendous amount of variability.

A number of investigators have recently emphasized the problem with such a global approach to variability (Cohen and Naroll, 1973; Naroll, 1973b; Smith and Winterhalder, 1980, p. 4). Winterhalder (1980, pp. 136–142) goes so far as to accuse most worldwide ecological studies of being little more than "normative descriptions of non-dynamic ecology."

Normative is a decidedly pejorative term, particularly in the literature of current archaeological theory (Binford, 1965, 1981, pp. 167, 179; Flannery, 1967; Cordell and Plog, 1979). But there is no escaping the fact that figure 2 has a normative flavor. There is the inevitable normative assumption in all such hologeistic studies: the "typical" environment, the "typical" year, the single local community that can be selected as "typical." Figure 2 arrays 31 such "typical" groups.

Murdock and Morrow (1970, p. 302) warn about the danger of taking any particular group at a particular date as representative of an entire culture, especially in the case of diversified and complex societies such as those of Burma, China, Japan, Russia, and Vietnam (specifically with regard to hunter-gatherers, see also Hunn and Williams, 1982; Myers, 1982).

But what about the dangers of a normative approach to the primitive, hunter-gatherer end of the global spectrum? To what extent do the 31 datum points on figure 2 represent the societies of which they are "typical"?

This monograph deals with Great Basin peoples, so let us focus on the single datum point on figure 2 that relates to a Great Basin case. Figure 2 is based on the sample by Murdock and Morrow who selected the Wadadika Paiute of 1870, living in Harney Valley, Oregon, as "typical" of Paiute society in general (1970, p. 325). The Paiute case falls almost exactly on the curvilinear model describing the posited relationship between global patterns of storage and ET. The Paiute do not appear to be an exception to Binford's generalization.

But it is my impression that the Wadadika Paiute of 1870 may not be so "typical" of Paiute society after all (see also Fowler, 1982, pp. 115–117). Murdock and Morrow (1970) rely on two ethnographic accounts for the Wadadika Paiute (Stewart, 1941; Whiting, 1950). But these sources, for instance, indicate that the ethnographic population density of the Wadadika Paiute is only about one person per 78 sq. km. By comparison, the average aboriginal population density for the Great Basin is conventionally estimated to be about one person per 40 sq. km. (Kroeber, 1934, p. 3; Steward, 1938, pp. 48–49); some Paiute groups, such as those in Owens Valley and in the Humboldt Sink area may have approached a density of one person for every 5 to 8 sq. km. If Whiting's (1950) figure is correct, this means that the Wadadika Paiute of 1870 had a very sparse population, even by Great Basin standards, comparable to that estimated for extremely arid and environmentally difficult areas like Death Valley and Las Vegas.

Despite this low population density, Murdock and Morrow (1970, pp. 312–313) score the Wadadika Paiute relatively high in terms of dependence on stored and preserved food (fig. 2). It puzzles me why such a sparse population should store so much food. Perhaps this could be due to the dependence of this group on communal salmon fishing. We do not know the importance of salmon in overall Wadadika Paiute subsistence; yet the traps and weirs are known to have served as aggregation spots in the spring (Whiting, 1950, p. 20). Although salmon is hardly a "typical" Paiute resource, other cases of salmon exploitation by Great Basin groups seem to have led to territorial systems protecting this highly predictable and localized resource (Steward, 1938, pp. 42, 234; 1970, p. 123). The data are sketchy, but it seems possible that the exploitation of salmon might have created a somewhat disproportionate reliance on techniques of preservation and storage, at least relative to other Paiute groups. Thus the Wadadika Paiute may be more aberrant than typical.

It turns out that the Paiute are extremely variable in terms of their storage and preservation patterns. At one extreme are groups such as the Kamödökadö Paiute (Steward, 1939, p. 137), who lived in a zone of relatively low productivity and probably low microenvironmental diversity. Storage by the ethnohistoric Kamödökadö Paiute was drastically limited, certainly no higher than two on the Murdock storage scale.

But other Paiute groups—particularly those in Owens Valley and Deep Spring Valley of southeastern California—amassed and stored rather large quantities of native plant foods (Steward, 1933, 1938, pp. 50–61). According to the Murdock-Morrow criteria, storage for the Owens and Deep Spring Valley Paiute would probably rate as high as five.

This surprising amount of variability—ranging between two and five on this scale—should be of concern and interest to those attempting to explain ecological diversity among hunter-gatherers. After all, such wide variability in storage patterns (and presumably also attendant mobility patterning) was occurring contemporaneously, within a narrow range of ET values, and within a radius of less than 170 km.

Global generalizations, like figure 2, cannot cope with such local diversity; patterning can be perceived only in terms of "typical," "modal," "focal" datum points. Yet variability and diversity should not be a source of embarrassment just because they conflict with neat, elegant generalizations, for such variability is another ecological phenomenon in need of explanation.

However, my point concerns neither the variability in the Paiute case nor the appropriateness of hologeistic generalization. As scientists, students of hunter-gatherer existence face an unappealing choice: "either to achieve generalizations that fail to explain much of the observed variation, or to give up the task of constructing general models and deal only with the specific societies or regions. The first option is normative: diversity explained away. The second option is particularist: diversity is accounted for in the aggregate but is not explained in a theoretically cohesive fashion" (Smith and Winterhalder, 1981, p. 4). The particularist-generalist dilemma is a thread that runs through most ecological and anthropological inquiry, and a problem that will not go away.

On the one hand, archaeologists can hardly retreat to an individual case study mentality if they wish to understand human ecology. Ethnologists who have tried this option have run into a dead end (see Köbben, 1970). In a classic case, Holmberg (1950) once concluded—based on his study of the Siriono of Bolivia—that hunting and gathering tribes tend to be underfed and obsessed by food. But based on equally valid field data from the Punun of Borneo, Needham (1954) concluded precisely the opposite: hunting and gathering tribes are usually well fed and unobsessed by food.

Argumentation based on impressionistic analysis of the single case—or a small sample of related cases—is insufficient because it precludes the possibility for testing the supposed processual relationships between variables.

It is only in large samples of societies which differ widely from each other in most respects that such linkages emerge and that we can expect the irrelevant attributes to cancel more or less randomly (Naroll, 1973a, p. 314).

But the cross-cultural, hologeistic approach cannot shoulder the total burden either. Naroll (1973a, pp. 311–312), a leading proponent of the global research technique, has made the following pertinent comment: "To many, such [cross-cultural] studies seem crude, clumsy, blunt, and awkward tools for the understanding of human affairs. And so do they seem to me." Hologeistic analyses run the risk of matching observed behavior with the wrong causes because of the cultural and ecological generality involved (Winterhalder, 1980, pp. 138–142); the Paiute case study amply demonstrates this problem. Such studies necessarily view both human and environmental systems in typological terms, tending to match abstract environmental factors with generalized aspects of the human sociocultural system. At its extreme, global analysis of ecological and cultural systems proceeds more by classification than by analysis of process.

Holding time (and systemic change) constant is an acceptable procedure in some contexts, but it relies heavily on the concept of the *optimal adaptation* as a mechanism for explaining observational sets. Like its cousin, neofunctionalism, the adaptive assumption can create a false sense of stasis, giving each society the appearance of being generally well-adapted to a generally unchanging ecological setting (Leacock, 1969; Colson, 1979; Orlove, 1980; Winterhalder, 1980, p. 142; Carneiro, 1982, p. 111; Hamilton, 1982, pp. 229–230; Hunn, 1982, p. 35).

The issue of systemic change goes to the heart of the question, and brings up another

normative difficulty with the cross-cultural approach. Lee has criticized many contemporary ethnographic studies of human ecology for their failure to take into account both short-term and long-term systemic change: "when an investigator reports an environment which is without significant regional or temporal variation . . . we may suspect that he has not looked into the matter carefully enough or long enough" (Lee, 1976, p. 96; see also Yellen, 1976, pp. 30–33; Winterhalder, 1980, p. 137; Binford, 1982a, n.d.). By holding temporal and regional variability constant, we remain ignorant about one of the best inputs for understanding hunter-gatherer dynamics (see also Hunn and Williams, 1982, p. 7; Hamilton, 1982; Richardson, 1982).

Global, cross-cultural inquiry cannot proceed in isolation; it requires integration into a more diversified approach to theory building: "hologeistic studies are the second-best method known to science for testing insights to see whether they are right insights or wrong insights. The best method, of course, for that purpose is controlled experiment" (Naroll, 1973a, p. 312). But social scientists have traditionally had difficulty in providing experimental control, especially when attempting to explain cultural change and evolution. As Naroll points out, "Controlled experiments on whole societies or cultures . . . often cost too much money for anyone to be able to do them. Such experiments often would take too long—key changes may need hundreds of years to take effect" (Naroll, 1973a, p. 312). Money, of course, may be the least of the impediments that would prevent such experimental control.

The archaeological record contains the physical record of thousands of such controlled experiments, if only that record can be adequately monitored. Adequate testing of theories regarding systemic evolution (morphogenesis) requires a number of rather specific empirical components (after Hill, 1977, p. 91):

1. A functional description of the system and its homeostatic processes prior to change.
2. Isolation of the extrasystemic inputs promoting change, and a demonstration that extant homeostatic mechanisms failed to cope with the inputs.
3. Demonstration that "new" variables and homeostatic mechanisms were selected for in order to stabilize the system at a different level.

Evolution involves change from relatively indefinite, incoherent homogeneity to relatively definite, coherent heterogeneity (Carneiro, 1973, pp. 90–91). Evolution is hence movement toward increasing complexity. Although adaptive change may well lead to evolutionary change, the relationship is not one to one. There are cases when local social or ecological conditions can foster adaptive changes that are *devolutionary,* in the sense that they lead to systemic simplification and increased homogeneity (see also Hamilton, 1982, p. 236).

Any general theory of hunter-gatherer adaptation must address short-term adaptive change as well as full-blown systemic evolution. But hard data on the microevolutionary process are difficult to come by. Leacock (1969), for instance, projected her study of Montagnais-Naskapi mobility and social change back into the seventeenth century through judicious use of historical sources; Rogers and Black (1976) combined 17 years of fieldwork among the Weagamow Lake Objibwa with archival data to project the degree of adaptive flexibility in the 1880–1920 Objibwa demographic and subsistence pattern; Binford and Chasko (1976) marshaled an impressive body of demographic information to extend Nunamiut population parameters back as far as 1884 in some cases.

But ethnographic ethnohistorical studies cannot stand alone. Although such data exhibit a sharp degree of resolution about ecological and population change, the time depth is necessarily limited to the availability of external documentary evidence. As Leacock (1969, p. 2) notes:

> Now the historical perspective of the New World takes . . . account of very early European-aboriginal contacts, and, as the archaeological record has unfolded, a fuller sense of pre-contact complexities has developed. Previously there was a vague notion that the aboriginal societies which we [ethnographers] painfully attempt to

> reconstruct had existed for untold generations as more or less stable entities. Scholars now take a second look at the possible pre-European influences of more complex cultures on simpler ones, and there is a greater sensitivity to the ebb and flow of culture histories as changing ecological conditions affected subsistence patterns, population density, and movement.

The archaeological record is blessed with nearly unlimited time depth, but the level of resolution of these data are presently distressingly low.

We may have a general picture, but rarely can we document the "ebb and flow" of adaptive and evolutionary change in hunter-gatherer societies. Speaking specifically of archaeology in the middle western United States, Ford (1977, p. 166) has reminded us that "no substantiated [archaeological] settlement system incorporating seasonal and functional variability in occupations, despite decades of labor, has been published." Unfortunately, this statement is true for most of the archaeological record of hunting-gathering societies.

The challenge for archaeology is quite clear. Adequate theory cannot rest merely on a global, hologeistic approach. We will argue in this monograph series that in order to develop robust theory, we must supplement the global, hologeistic approach to explanation with solid, empirical case studies of adaptive change and cultural evolution.

Assuming that the objective of scientific inquiry is to explain—not explain away—variability, we must develop alternative research approaches to emphasize the range of coping behavior, rather than merely isolating the modal, focal tendencies in hunter-gatherer exploitative strategies.

MID-RANGE THEORY AND HUNTER-GATHERER ECOLOGY

Properly formulated, mid-range theory links our ideas about the world to the world itself, and mid-range theory attributes meaning to our empirical observations (Clarke, 1973, p. 8; Schiffer, 1976; Binford, 1977, pp. 2–10; 1981, pp. 21–30; Sullivan, 1978; Thomas, Winterhalder, and MacRae, 1979; Smith and Winterhalder, 1981, p. 7).

Although progress has been made in fleshing out the warranting arguments necessary to bridge the gap between behavioral and archaeological contexts, mid-range theory remains imperfect. Some archaeologists have complained about the lack of progress in developing usable, relevant theory at a mid-range level (Schiffer, 1978; Dunnell, 1979), and Gould (1978) cautions that many of the behavioral inferences so far available are not nearly so sophisticated as one might think. There is also growing conflict regarding the degree to which uniformitarian principles can be said to have operated in the past (Binford, 1977, p. 8; 1981, pp. 26–29; Gould, 1978, p. 255; 1980, pp. 32–34). This dialogue indicates, if nothing else, that mid-range theory building remains in a formative stage.

A couple of points deserve mention at the outset. Mid-range theory is a way to build our knowledge of the past, an intellectually independent exercise from building general theory to explain that past (Binford, 1981, p. 29). Adequate mid-range theory requires a wide range of inputs from the behaviorally observable world. Ethnoarchaeology and experimental archaeology have to date been most heavily involved in mid-range theory building, but there are compelling reasons for looking beyond these rather restricted sources of data. In order to provide a more balanced, diachronic picture, it is useful to comb ethnohistoric records, consult older ethnographic descriptions, and especially to integrate natural science data in order to detail the spatial and temporal structure of the resource base (e.g., Jochim, 1976, 1981; Schalk, 1978, 1981; Kelly, 1980; Keene, 1981; Smith and Winterhalder, 1981). While information regarding contemporary biota will hardly allow deterministic statements about the past, these data will permit investigators to flesh out the parameters of resource structure: patch density, spatial and temporal incongruity, bulk considerations, expenses of processing, and transport costs. These data have already proven useful to those exploring optimal foraging approaches among ethnographic and contemporary societies (e.g., Wilmsen, 1973; Smith, 1979; Earle, 1980; Hespenheide, 1980; Hawkes and O'Connell, 1981; Jones, 1981).

But optimal foraging tenets have yet to provide compelling explanations for the archaeological record. Archaeological studies suffer from imprecise data on both environmental and adaptive structuring, but ordinal-level projections from optimal foraging theory seem quite possible for the archaeological record as well (Jones, 1981, provides a useful example of one such preliminary study).

Because of the attention attracted by mid-range theory over the past few years, it would be easy to mistakenly assume that such theory eventually will evolve into a grand edifice, erected on lofty principles and generalizations. Actually, the most useful mid-range theory may turn out to be quite prosaic in nature. After all, mid-range theory is merely a way of making sense out of empirical chaos, and such a "body of theory" can easily take on a rather mundane cast.

Consider the case of Tel Yin'am, a late Roman-Byzantine site in Israel (Liebowitz and Folk, 1980). The excavators came upon a paved surface of uniformly sized and closely fit basalt cobbles. Locally occurring basalt had been employed in 99 percent of all construction at this site, and has, in fact, been used in construction throughout the eastern lower Galilee area for millennia.

The Tel Yin'am cobbles were slightly worn on the upper surfaces, but nobody had any idea what this wear patterning meant. Although the excavators could obtain endless empirical data from the paved floor cobbles, they lacked the mid-range theory necessary to breathe behavioral meaning into the archaeological facts.

Not far away, in the modern kibbutz of Yavne-el, Moshe Lipschitz and his family regularly have walked out of their front door and across the street for the past 18 years. This modern street is paved, like many in the area, with the same kind of squared basalt cobbles that turned up in the Tel Yin'am excavations. Over nearly two decades the pavement in front of the Lipschitz house had begun to wear in some places but not in others.

This is when Moshe Lipschitz and his paved street became involved in mid-range theory building. Liebowitz and Folk (1980) studied the modern evidence and came up with an "official unit of scuffle," which they called a LIPSCHITZ: one LIPSCHITZ is defined as the wear produced on the central portion of a basalt pavement by one family in two decades. One LIPSCHITZ of wear produces distinctive rounded corners on basalt cobbles, with an apparent radius of curvature of about two meters.

In adopting the LIPSCHITZ, the investigators cautioned that the constant works only on basalt pavements; limestone, used occasionally for construction material, wears more rapidly. There are also differential, but unknown, effects of abrasion caused by animal feet, naked human feet, mocassins, sandals, and leather shoes: "this information awaits further research and volunteer scufflers with patience" (Liebowitz and Folk, 1980, p. 33).

But once the LIPSCHITZ had been established, they returned to the archaeological pavement. Because the basalt cobbles at Tel Yin'am had only about one-half LIPSCHITZ of wear, the excavators concluded that "the Tel Yin'am pavement was probably made for a private room; obviously it could not have been for a street or public building" (Liebowitz and Folk, 1980, p. 32).

One should not make light of this study because, the humorous aspect aside, it illustrates how mid-range theory can be derived to deal with everyday empirical and definitional problems of archaeology. Although much remains to be synthesized, mid-range theory has been formulated for many years in American archaeology. Mid-range theory is, after all, where you find it.

MID-RANGE THEORY AS OPERATIONAL DEFINITION

In establishing linkages between behavioral and archaeological worlds, it is important to recognize the difference between definitions and hypotheses. *Hypotheses* assert a relationship between two or more independently monitored variables said to be operative in the empirical world (Binford, 1977, pp. 2–9). *Operational definitions,* on the other hand, specify relationships between a set of concepts, words, or phrases and a class of empirical or observational phenomena

(Thomas, 1970, 1972c; Campbell, 1973; Binford, 1977). The LIPSCHITZ is an operational definition, not a result of hypothesis testing. Without operational definitions of the variables involved in hypothesis testing, one cannot relate to the empirical world.

To illustrate how these concepts apply to actual inquiry, consider one recently articulated hypothesis: *residential mobility should decrease as length of growing season decreases* (after Binford, 1980, pp. 14–15). Directly deduced from general theory, this hypothesis suggests a relationship between two specific variables. But before one can examine this hypothesis against real data, both concepts must be operationally defined in empirically observable terms.

Growing season can be defined in a number of ways. Lee (1968, p. 42) employs gross latitude as an indicator of growing season; other investigators use "the number of frost-free days" to indicate duration of growing season. Recently Binford (1980) has proposed *effective temperature* (ET) as a third operational definition of growing season. Originally developed by Bailey (1960), ET monitors both the amount and the annual distribution of incoming solar radiation available over a given region of the earth's surface (see also Kelly, 1980): "in a very simplistic sense we might expect 'food rich' environments when ET is high and 'food poor' environments when ET is low" (Binford, 1980, p. 14).

All three definitions of growing season are operational, but they produce rather different rank-orderings of potential ecosystem productivity, in turn producing somewhat different analytical results. This is why it is critical to define things in an operational manner.

Binford's hypothesis contains a second undefined concept—*residential mobility.* This is a more difficult notion to pin down, since it itself comprises several lower-level concepts. *Residence* is behaviorally defined as "the locus out of which foraging parties originate and where most processing, manufacturing, and maintenance activities take place" (Binford, 1980, p. 9). Although the behavioral concept is clear, it is inadequately expressed relative to the archaeological record since we still have three unspecified terms: *processing, manufacturing,* and *maintenance.* To link the behavioral to the archaeological, one must define what these three processes are and how they will impact the archaeological record.

This second concept also implies something about *mobility,* another term in need of operational definition. *How long must a group be absent from its base camp for the event to qualify as "movement": Two days? A week or so? More than a month?* Even assuming agreement on duration, this is still only a behavioral construct, not yet operationally defined relative to the archaeological record.

Much of what is now considered as mid-range theory can also be characterized as operational definition. Under either guise, such theory building has only begun.

But archaeologists cannot simply suspend fieldwork, waiting for the final word on mid-range theory. Theory is not built this way. Archaeologists have made a fair amount of substantive and methodological progress in the past decade. But if we fail to test and amplify the theoretical framework as it now stands, the gap between theory and practice may soon become insurmountable.

MID-RANGE THEORY AND MONITOR VALLEY PREHISTORY

Perhaps the most difficult mid-range theoretical issue facing contemporary archaeology is a disarmingly simple question: *how do we recognize an exploitative strategy in the archaeological record?* To solve this problem it is necessary to bridge the gap between a behaviorally relevant strategy and its material outcomes (some of which can be expected to survive in the archaeological record). This section outlines such a sequential series of steps.

We begin initially by examining the resource structure of the landscape in question. In chapter 4, we consider the natural resources that have a significant potential for human exploitation in the protohistoric western and central Great Basin. But rather than focus on mere abundance of a few key resources, it is necessary to examine the specifics of resource structure: spatial and temporal variability, costs of capture and pro-

cessing, storage possibilities, as well as the bulk requirements that condition transport costs from area of procurement to areas of consumption.

At this level of inquiry, there is a body of relevant theory stemming from evolutionary ecology (e.g., Winterhalder, 1980; O'Connell and Hawkes, 1981; Smith and Winterhalder, 1981). Unfortunately, at this stage data for the protohistoric period in the central Great Basin are insufficiently precise to allow for accurate computations of cost/benefit ratios. Quantitative model-building is a fruitful goal, but we must be cautious about over-quantification (Thomas, 1978). For instance, mathematical systems theory has been developed to the point that its conventions have too often emphasized "holistic, single-level descriptions, avoidance of instabilities, optimization under fixed constraints and artificial isolation of adjacent levels" (Pattee, 1973, p. 149). Such conventions, sometimes unrealistic, can be involved in any mode of explanation attempted at a single level, regardless of whether the system being examined is physical, chemical, biological, social, or artificial (Simon, 1973; Perlman, 1977, p. 326). In addition to creating sophisticated mathematical approximations of human systems, it is necessary to develop explanations at a rank-ordering, qualitative level. In fact, "some archaeologists and others may find the real challenge at the present time, paradoxically, in the use of *qualitative* models" (Perlman, 1977, p. 326).

Rather than proceeding with spuriously concrete computations, it is preferable to keep inquiry at the ordinal level in developing a sequence of qualitative evaluations regarding the relative resource ranking. Perhaps future research can pin down these relationships more precisely, but ordinal scale analysis is all that is warranted for data considered in this monograph.

Resource structural analysis is attempted for the Monitor Valley by taking a single protohistoric target date, arbitrarily established at A.D. 1800.[4]

Given the resources of protohistoric[5] *Monitor Valley, what is the probability that this landscape was exploited by a foraging strategy? Or a collecting strategy? Or a strategy of seasonal fusion-fission, drawing from both mapping on and logistic strategies?*

Rather than seek out the optimum exploitative strategy, it is more useful to assess the relative efficacy of the various options. Each strategy exacts a certain cost, and each option brings with it attendant benefits. Primary empirical concern in the Monitor Valley research is to determine how the various hunter-gatherer strategic options stack up against the environmental mosaic of this particular landscape, and how such strategies might change through time.

A thorny linkage problem accompanies this inquiry. We must know how each strategy translates into the archaeological record. The forager-collector continuum defines each strategic option in terms of site heterogeneity. True foragers create only residential bases and procurement localities. True collectors minimize residential mobility by supplementing these two basic kinds of sites (and non-sites) with special-purpose storage facilities and field camps. Intermediate strategies can be operationally defined by the degree of homogeneity or heterogeneity between polar types. Site and non-site variability, if it can be harnessed, can function as an indicator of underlying adaptive strategies.

But each site type must be defined in a clearly operational fashion. *How does one recognize a base camp in the archaeological record?* Some contemporary archaeologists seem to think site types can be recognized from quick inspection of a couple of key features. In truth, base camps are extremely difficult to define in the hunter-gatherer archaeological record. Similarly, *how does one distinguish a single large base camp from a complex palimpsest accumulation of field camps? Is it possible to tell the base camps of foragers from those of collectors? Can one distinguish a forager field camp from a collector field camp?*

It is presently almost impossible to answer such questions because of the lack of relevant mid-range theory and because of the difficulties in monitoring strategic evidence in the archaeological record.

These issues involve operational definitions, rather than hypothesis testing. The objective of chapter 5 is to determine the

archaeological consequences of various site types (in the Desert West contexts) and explicitly define what can (and cannot) be observed in the archaeological record.

To this point, mid-range theory and empirical evidence will have been marshaled along three intersecting but largely independent axes of variability: resource-specific consequences (chap. 4), site type consequences (chap. 5) and specific zonal consequences for the protohistoric Monitor Valley landscape (chaps. 6–11).

But an additional difficulty crops up here when we attempt to monitor archaeologically a series of hunter-gatherer strategies. There is, in a very real sense, a Doppler effect operating in the archaeology of hunter-gatherers (cf. Deetz and Dethlefsen, 1965). That is, although one may be able to project the archaeological consequences of foraging and collecting strategies, it is still necessary to consider the *monitoring position from which that strategy is observed archaeologically.* The archaeological record perceives behavioral events differentially, depending on the geographical positioning of the operating system. Pure foragers create only two site types, but these sites are often differentiated seasonally, spatially, sexually, and functionally. The fall base camp may look quite different from a bighorn intercept blind, yet both can be components of the same behavioral system. The internal variability within each exploitative strategy must be carefully considered because, even with relatively large archaeological regional samples, one can never assume that an entire annual cycle has been monitored.

One must anticipate how the monitoring position biases a given segment of the archaeological record. Areas used for maintenance by foragers may be perceived quite differently in the archaeological record from areas used strictly for resource procurement. Similar problems occur for collectors: *what is the probability that a residentially stable adaptation can be anticipated in the piñon-juniper woodland of protohistoric Monitor Valley?* Each option provides benefits and extracts costs.

Defining monitoring position is an operational issue. When looking at the archaeological record, one must question whether a given site was a residential part of the system (*Is this site inside the camp radius?*), a procurement segment (*Is this site inside the foraging radius?*); or perhaps this site lay in the extreme logistic hinterland. *Are there specific lithic and faunal signatures that allow one to monitor the position of a given site (or nonsite) within its strategic contexts?* This can now be accomplished in some cases, and several chapters in subsequent Parts of this series discuss these possibilities.

We finally arrive at bottom line mid-range theoretical statements: *what exploitative strategies are anticipated across the various microenvironments of Monitor Valley?* Chapters 9–12 develop five strategic models which can, with varying levels of probability, be anticipated for the archaeological record in Monitor Valley. Each strategy can be roughly defined operationally, although there is much work still needed on the linkage between the behavioral and the archaeological.

ENCOUNTERING THE EMPIRICAL WORLD

Once sufficient general and mid-range theory has been marshaled we are prepared to encounter a specific segment of the archaeological record, in this case, the Monitor Valley of central Nevada. Sampling strategies for such regions have been of concern to archaeologists for nearly two decades, and it is clear that hunter-gatherer archaeology will always require some mode of unbiased sampling generally involving probabilistic tactics.

But a concern for unbiased sampling must be balanced against an equal concern for the information quality. One can readily design a probabilistic surface survey to minimize bias in the recovery of archaeological objects. But such samples usually depend only on surface manifestations, and commonly lack certain important kinds of archaeological data: stratigraphic contexts, ecofactual correlates, and perishable debris. The information quality of relatively easy-to-sample surface materials remains distressingly low, introducing bias from another direction (Madsen, 1981).

The alternative, to deal strictly with high-information packages, threatens a return to traditional, good old boy archaeology—center-punching the most conspicuous mounds,

caves, and midden sites around. Information quality may be high, but so is the degree of bias. Taken to the extreme, this strategy flirts with the normative fallacy of the typical site (Thomas, 1979a, pp. 275–279).

What began as a general theoretical concern now becomes a concern with archaeological sampling. For samples adequate to generate worthwhile archaeological objectives one must rely heavily on a variety of complementary sampling tactics: probabilistic surface sampling across the range of ecological parameters, opportunistic sampling to locate high information content buried sites, deep-site testing (for the recovery of chronostratigraphic data), as well as a specialized search for satellite sites such as rock blinds, alignments, ambush areas, and rock art locations. Overemphasis on any one mode of data recovery threatens to undermine the empirical base right from the start.

Beyond sampling, there are also difficulties in approaching even the single archaeological site. Archaeologists still sometimes tacitly assume that a single site must represent a single activity (or, at most, that the major functional focus may have shifted once or twice during the occupational history of that site). In truth, most prehistoric archaeological sites worth excavating contain a prodigious amount of functional variability, depending on which portion of the seasonal round one might be monitoring.

Great Basin archaeology is still predominantly cave archaeology (Fowler, 1977, pp. 26–27) and from what we know about hunter-gatherer mobility, it is most unlikely that any cave or rock-shelter was ever *continuously occupied* by hunter-gatherers for more than a season or so (Steward, 1938, p. 179; Binford, 1978a, pp. 489–490; Peralta, 1981). Much more likely is the proposition that sites with sufficiently dense midden to warrant excavation will contain a wide range of procurement and/or habitation debris, deposited over centuries or millennia. Conditions suitable for adequate life-space are not randomly distributed across the landscape, and the better habitation spots are reoccupied again and again. In addition, abandoned residential bases are known to have been reoccupied time after time by special-purpose groups (e.g., Lee, 1976; Yellen, 1976, p. 58; Kelly, 1980; Binford, 1982a, n.d.).

Given the current state of knowledge, one is hard pressed to distinguish the single residential use from the palimpsest accumulation of dozens of special-purpose assemblages in hunter-gatherer archaeology. In the absence of unusually clear-cut empirical justification for each supposition, it is far safer to begin with the premise of a sporadic, mixed-mode occupation, rather than simply assuming a "continuous" or single-function occupation history; these issues are considered in more detail in chapter 5.

Suppose at this stage that a relatively large and relatively unbiased sample has been recovered from decipherable stratigraphic or surface contexts. We are still unfortunately without any archaeological data. Data consist of the relevant observations made on these objects, rather than the objects themselves (Thomas, 1976, pp. 7–8). *But what are those relevant observations?*

One can ask archaeological objects to perform a number of roles: time-marker, functional indicator, assemblage diagnostic, paleoenvironmental indicator, socioeconomic status indicator. But the linkage problem is manifest: *how do we get from the objects to the data?* And, of equal importance: *how is this information conveyed to colleagues, so that these investigators would reach similar conclusions faced with the same objects?* These issues are addressed in Part 2 of this series.

Additional problems arise in moving from a site-specific to a regional perspective. *How, for instance, does one compare regional surface data with deep-site excavation data?* So far, these have almost universally been treated as independent data sets, with little articulation between the two. But this need not be the case, as considered in Parts 2 and 3.

Similarly, how do we characterize, with operational justification, the nature of the lithic tool assemblages? It is possible, with some degree of assurance, to recognize lithic reduction sequences in some aboriginal stone tools. *But how does one operationally compare two such sequences? What is considered to be the same, and what is different?* This issue has received scant attention, but here again is a key methodological concern (discussed in Part 2).

Archaeology at the regional level also involves issues of general theory and attempts to determine the relationship between key

variables. *What, for instance, is the relationship between residential mobility and microenvironmental factors? How does this relationship differ from those derived in a global perspective? What is the relationship of storage to seasonal changes in a given landscape? How are the problems of spatial and temporal incongruity solved across a mosaic of habitats?* These questions can be addressed provided the variables can be operationally defined and provided that the archaeological record can be encountered in an equally operational, empirical manner.

NOTES

[1] As a historical note it is worth pointing out that the roots of the forager-collector continuum run rather deep. Wagner (1960) distinguishes between foraging and collecting societies, emphasizing storage as a major factor conditioning long-term mobility (Wagner, 1960, especially pp. 161–166). But in a commonly overlooked paper Steward (1968, p. 326) explicitly dichotomizes a *foraging* strategy, "eating foods as they are gathered" from a *collecting* strategy, "extraction of vegetable foods, larvae, and other small items." Steward further discusses the importance of food storage to group mobility and composition. As Don Fowler has pointed out (Fowler and James, 1981), the contribution of Steward to the forager-collector continuum concept has not been properly acknowledged.

[2] The term *hologeistic* refers to the use of worldwide correlational studies to test general theory (after Naroll, 1973a, p. 310; see also Köbben, 1952). In this context, the hologeistic approach has three characteristics: (1) it draws on a worldwide data base; (2) its units of examination—its cases—are whole societies or cultures, although often a particular community is taken as "representative" or "typical" of an entire culture; (3) it tests hypotheses by means of statistical correlations. Although many hologeistic studies of hunter-gatherer dynamics have not yet reached the stage of actual correlational analysis, the logic of analysis remains. Incidentally, Naroll (1973a, p. 355) also defines *holoarchaeology,* a specialized form of hologeistic study that draws strictly on archaeological remains of non-record-keeping societies (see Henke, 1973; Thomas, 1976, pp. 452–456).

[3] Although Binford (1980, p. 16) considers the Ingalik to be an exception, it may not be so. Murdock and Morrow (1970, p. 307, table 1) coded the storage index for Ingalik as "Ch," meaning that they possess significant techniques for food storage and/or preservation, sufficient for the accumulation of substantial surpluses (often used for conspicuous consumption rites such as potlatches or lavish sacrifices); food reserves are stored mainly by individual households. In his scattergram, Binford (1980, p. 4) has compressed the 14 Murdock-Morrow storage codes into a six-part original scale. Although Binford's criteria for pooling these codes are not stated, it would appear that the Ingalik should be scaled as four or five on Murdock's storage scale. If so, the Ingalik case falls directly on Binford's posited curvilinear relation and they disappear as an exception.

[4] This date is sufficiently early to minimize Euro-American technological and ecological inputs (although traces of such input are evident in peripheral areas of the Great Basin). A.D. 1800 is also sufficiently late to minimize significant vegetational change due to environmental variability. Those vegetative changes resulting from Euro-American environmental impacts are becoming increasingly understood, and that source of variability can be controlled for the protohistoric period (chaps. 6–12).

[5] *Protohistoric* is used in this study to denote the period after Euro-American colonization, but before the Native Americans of that area themselves kept written records (after Hole and Heizer, 1977, p. 47). Protohistory can be considered to be "secondary prehistory" in that the past of non-literate peoples can be studied with reference to contemporary documents left by others (Clark, 1954). The year A.D. 1800 is merely an operational point definition of the protohistoric period in the western and central Great Basin.

CHAPTER 3. EXPLORING VARIABILITY IN THE PROTOHISTORIC GREAT BASIN

In the preceding chapter I argued that global studies must be supplemented by well-controlled studies in which both synchronic and diachronic microevolution can be followed. The Monitor Valley research is designed to provide such an alternative framework but before turning to the archaeological record, it is necessary to build an adequate mid-range theoretical framework against which to view the empirical data. The Great Basin Shoshoneans provide a useful beginning point for such theory building.

Shoshonean culture has been described for years in a traditional, often normative framework. In this chapter I discuss that perspective, then provide an alternative viewpoint that emphasizes the variability in protohistoric Shoshonean adaptive systems. Subsequent chapters construct the mid-range theory necessary to project this protohistoric situation against the prehistoric past.

THE TRADITIONAL VIEW OF GREAT BASIN SHOSHONEANS

The aboriginal Shoshonean people inhabited the last area of the continental United States to be settled by Euro-Americans. The persistence of Native American culture and lifeways into relatively recent times has greatly enhanced the ethnographic and theoretical significance of the Shoshonean case.

Although the term Shoshonean was originally used to designate a linguistic family (Kroeber, 1907), it now is generally considered to be devoid of linguistic connotations, and is more commonly used in a geographic sense. The Great Basin Shoshoneans speak a Numic language, a branch of the widespread Uto-Aztecan family (Lamb, 1958; Miller, 1966). All the Numic languages are similar, and a native speaker of any Numic tongue would have little difficulty in learning a second Numic language (Miller, 1972, p. 30). Terms such as Northern Paiute, Western Shoshone, Gosiute, and Kawaiisu (fig. 3) are strictly tribal designations which, despite a high degree of intermarriage, denote roughly discrete tribal entities.

The traditional anthropological approach to Basin Shoshoneans played down the tribal differences, emphasizing instead the sameness and poverty of Shoshonean existence. Kroeber (1925, pp. 582–583) has expressed this in typically poetic fashion: "The very poverty of Nevadan native civilization endows it with an interest .... Subsistence is slender and a constant makeshift. There may be leisure indeed, but it is an intermittent idleness, not the occupied and productive luxury of well-fed time. The imagination has little occasion for flight; or when the opportunity arises, there is but scant stimulus in the concrete basis of life." Elsewhere, Kroeber (1939, pp. 49–50) referred to the Shoshonean lifeway as a "negative fact," characterized by "the absence of nearly all the more intensive cultural manifestations ... no one seems ever to have doubted the close internal cultural unity of the Shoshonean Basin tribes."

The twin themes of cultural deficiency and cultural uniformity are also evident in Steward's view of Basin Shoshonean life. Speaking of a "quantitative simplicity" in Basin Shoshonean culture, Steward (1955, pp. 102ff.) argued that Shoshonean society could best be characterized by a long list of absences: the absence of sharp dialectic, cultural, and political boundaries; the absence of well-defined groups transcending the simple village; the absence of men's institutions; the absence of age grades and women's societies; the absence of significant ceremonialism, extensive recreational activities, and warfare.

The traditional view of Shoshonean society stresses the absence of any significant sociocultural entity above the level of the simple family cluster. According to Steward's cultural ecology, this was "the inevitable response to areas of meager resources, low population density, and an annual cycle of nomadism" (Steward, 1970, p. 115).

There has been an unfortunate tendency within ecological and evolutionary anthropology to point to the Great Basin Shoshonean case as "representative" of simple hunter-gatherers, as somehow typical of a

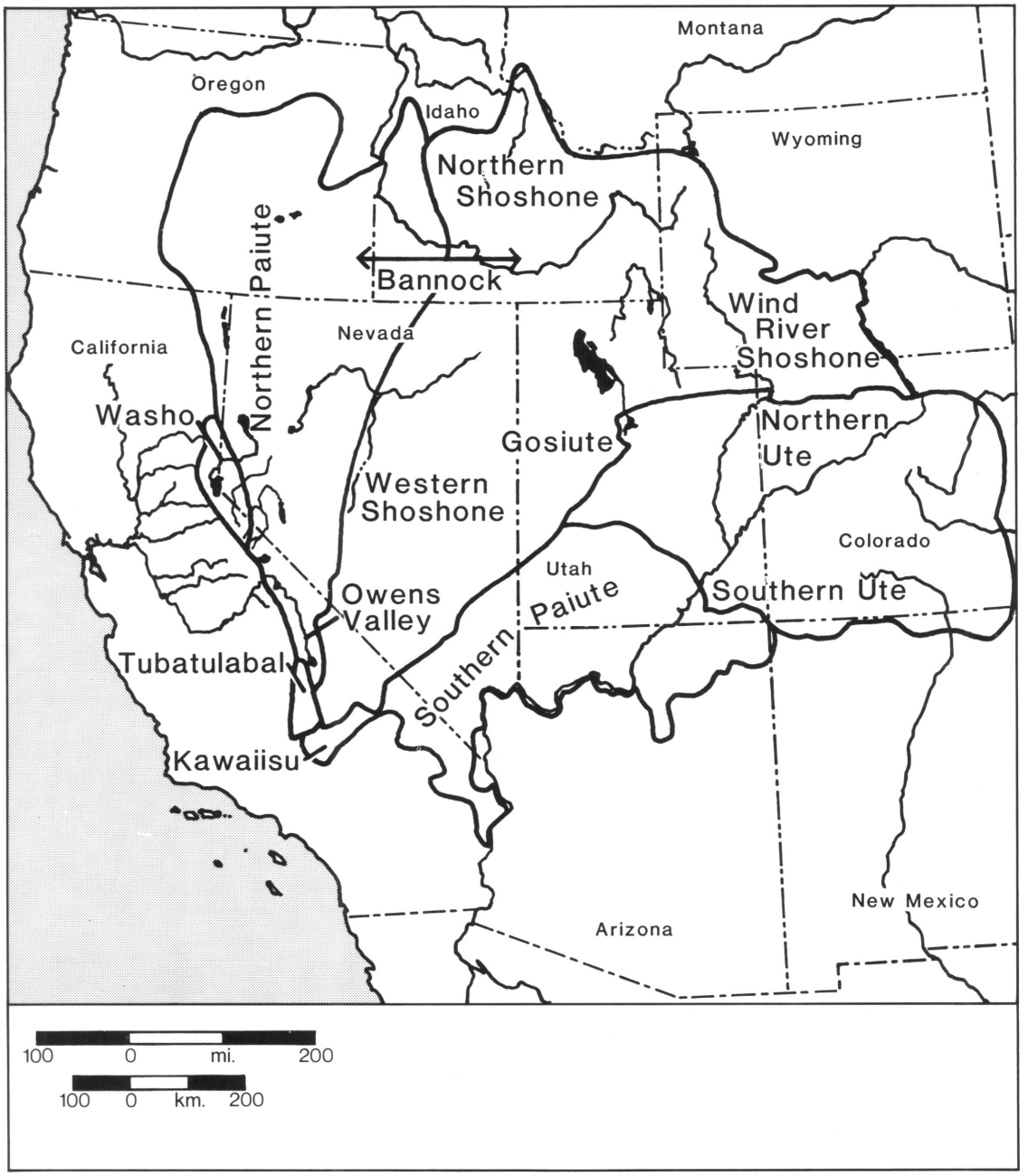

FIG. 3. Distribution of protohistoric tribal groups in the Great Basin.

worldwide monolithic cultural substratum. Accordingly, the Shoshonean case is often called upon to fill the bottommost rung of the evolutionary ladder. In Cohen's "taxonomy of cultural adaptations," for instance, the single, monolithic Basin Shoshonean case is taken to represent the typical primitive forager: "[they] rely primarily on muscular

energy for their exploitative activities . . . they merely stoop to pick up what is available and can do nothing to replenish the stock or find dietary substitutes" (1968, pp. 48–49). Lomax and Arensberg (1977) use the Shoshonean case—"those frequently famine-ridden nomads"—to typify the most primitive societies of the New World. Fowler and Jennings (1982) detect a "second class status" accorded to Great Basin cultures, especially when compared to contiguous developments in the American Southwest and California. In Steward's view "probably no primitive tribe in the world in recent centuries possessed fewer material goods and utensils nor more elementary social, political and religious customs" (1939, p. 528). The Shoshonean case is taken as a single, normative datum point to be compared and contrasted to the global mosaic of hunter-gatherers. Similar views of the Shoshonean case are expressed by Service (1966, pp. 93–95); Lee and DeVore (1968); Damas (1969); Sahlins (1972, pp. 236–266); Harpending and Davis (1977, p. 283); and Yellen (1977, p. 278).

Prehistorians often follow suit, marshaling the "typical Shoshonean case" as ethnographic analogy to particularly primitive forms observed in the archaeological record (e.g., Jennings, 1957, p. 8; MacNeish, 1964, 1972, p. 497; Flannery, 1966, p. 802; Wilmsen, 1970, p. 82; Flannery and Marcus, 1976, p. 207). Aikens (1978, p. 71) has suggested that the importance of the Basin Shoshoneans as ethnographic analogy is due to three salient characteristics: "[Great Basin culture] is one of a handful of classic examples of human society at its most elementary level; it offers a clear-cut example of a close and rigorous relationship between culture and environment; and it is a case of remarkable cultural stability and persistence, spanning some 10,000 years without fundamental change."

This, then, is the traditional view of protohistoric and prehistoric Shoshonean society: a simple, unvarying, uncluttered, pristine, elemental rapprochement between primitive man and marginal environment. This is taken as Steward's so-called model of Great Basin Shoshonean culture, a monolithic summation of an essentially constant lifeway spread across 712,000 sq. km. and 10 millennia.

AN ALTERNATIVE VIEW OF SHOSHONEAN VARIABILITY

The overarching, cross-cultural perspective noted above requires investigators to emphasize the typical and overlook the variability of the modal behavior. This is characteristic of normative thinking (Binford, 1965; Bettinger, 1980; Winterhalder, 1980). Projected against the global background, such normative inferences can sometimes provide useful empirical contrastive sets. But at this scale, there is an unfortunate tendency to lose much of the dynamism of the human adaptive process (Colson, 1979; Winterhalder, 1980).

Rather than view the Shoshonean case as a prospective datum point to be plotted on worldwide graphs, suppose we attempt to seek out and explain variability with this seemingly uniform, monolithic adaptation. Viewed in this way, both Great Basin habitats and Great Basin cultures suddenly provide a startling array of temporal, spatial, long-term and short-term variability.

With a synchronic perspective, we can begin to appreciate the wide range of variety in protohistoric cultural adaptations in the Great Basin. Some areas were almost uninhabited during protohistoric times. Other areas maintained very low population densities, some of the lowest recorded for hunter-gatherer societies. And yet, at the same time and not far away, other Basin Shoshoneans lived in population densities that rivaled those of neighboring groups in California and the American Southwest. Similar extreme variability can be noted with respect to the sizes of maximum population aggregations, degree of social complexity, territoriality and political leadership, as well as nature of religious organization.

Catherine Fowler (1977, 1982b) emphasizes the importance of looking at Great Basin ecology from a variety of perspectives: "It should be clear that at one level—the *actualized* level—they [patterns of settlement and subsistence] were quite varied and variable, while on another—the generalized level—they

were all also basically the same .... One wonders whether the ethnographic data do not present much more of a continuum than Steward (1938, 1970) supposed" (Fowler, 1982b). The notion of a continuum in Great Basin environments and adaptation is not unique (e.g., Dyson-Hudson and Smith, 1978; Eggan, 1978, 1980; Thomas, 1979b; Fowler, 1982, pp. 115–117), and the most recent reformulation of Binford's forager-collector continuum has provided investigators with a fresh framework in which to perceive traditional Great Basin models (e.g., Pippin, 1980; Fowler and James, 1981; Holmer, 1981; Madsen, 1982).

The synchronic aspect of this reanalysis of variability in Great Basin ecology begins with a dissection of three case studies from the protohistoric period: the Kawich Mountain Shoshone, the Reese River Shoshone, and the Owens Valley Paiute (fig. 4). These three groups in one sense typify what Kroeber (1925, p. 583) called the "poverty of Nevada native civilization." They survived in the characteristically arid Great Basin environment. All three spoke Numic languages and had little difficulty in conversing with one another (Steward, 1938, p. 5). The three groups shared an almost identical technology and sometimes even participated in joint religious festivals. In a normative sense, they were all the same.

And yet, these three groups also forcefully illustrate the range of diversity that existed in protohistoric Great Basin ecosystems (see also Thomas, 1981b). The Kawich Mountain Shoshone were a residentially mobile foraging society; the Owens Valley Paiute lived in nearly sedentary band villages and were collectors; the Reese River Shoshone followed a fusion-fission settlement pattern, embodying characteristics of both foraging and collecting strategies. At this level of resolution, there is significant variability in terms of resource structure, regional cultural geography, sociopolitical and kinship organization, ceremonialism, trade, and territoriality.

These cases are deliberately chosen as rather extreme examples because "an 'extreme' case often facilitates comparison with other 'extreme' conditions, and promotes appreciation of variability 'between the extremes' better than does an understanding of a 'modal' case" (Binford, 1979a, p. 255).

These three societies share an essentially identical suite of language, race, and culture. And yet, they array themselves across nearly the entire global range of the foraging-collecting continuum. The challenge is to explain the observed degrees of variability.

I must caution here that these three societies can by no means be taken as "typical" or "representative" of Great Basin Shoshonean adaptations in general. Not only is the normative assumption unnecessary, but we know that a fairly serious distortion exists in traditional and even contemporary Great Basin ethnography. Elsewhere (Thomas, 1979b) I have discussed the "Bias in the Basin" at some length. The problem is that Julian Steward's fieldwork in the 1930s has generally been taken as pan-Basin. It is not. For a variety of reasons, Steward's Western Shoshone and Owens Valley research has received the brunt of attention from ethnographers, cultural evolutionists, and especially cultural ecologists—to the virtual exclusion of other Basin Shoshoneans. It is also possible to detect a progressive oversimplification in Steward's own discussion of Great Basin sociocultural organization (Thomas, 1979b, in press). Too often, Steward's later publications (especially 1955) have been taken as "typical" of Steward's fieldwork, and Steward's fieldwork has been taken as "typical" for Great Basin culture in general. Neither view is correct, and marked distortion exists in many treatments of Great Basin Shoshonean culture, especially those which overlook the apparently more complex lacustrine groups (see also C. Fowler, 1982b). This caution should be kept in mind; moreover, the *specifics* presented here are in no way "typical" of Great Basin Shoshoneans.

The Protohistoric Kawich Mountain Shoshone

The Kawich Mountains, which reach an elevation of 2870 m. (9400 ft.) above sea level, are located approximately 80 km. east of Tonopah, Nevada (fig. 5). Much of the bedrock in this area is volcanic, supporting a piñon-juniper woodland at between 2000 m.

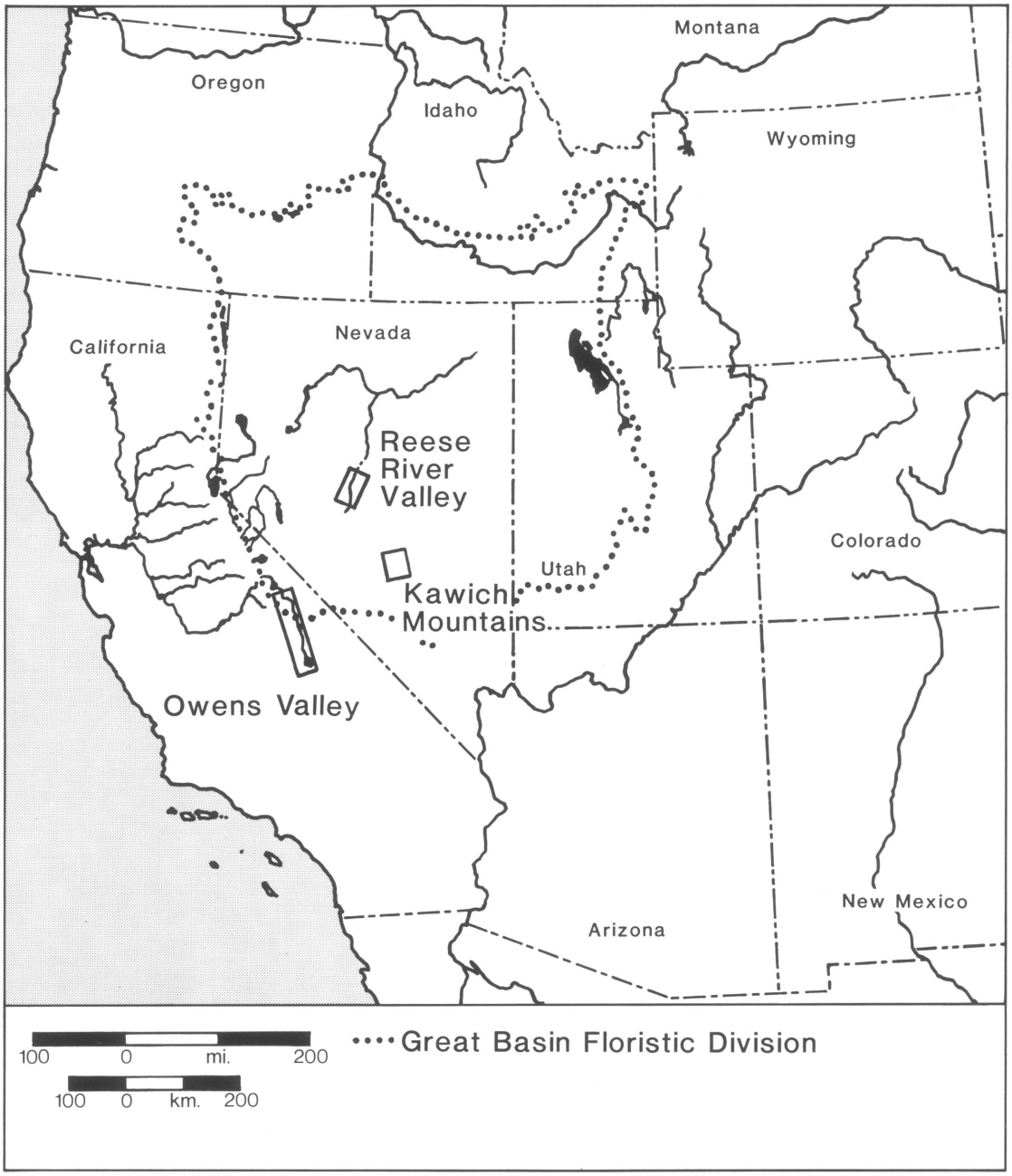

FIG. 4. Location of the three selected Great Basin Shoshonean groups discussed in this monograph.

and 2400 m. The valley floor elevation is about 1680 m., and is dominated by characteristic shadscale vegetation.

The protohistoric Kawich Mountain Shoshone maintained a population density of only about one person per 44 to 58 sq. km. (Steward, 1938, p. 49), an extremely low figure, even by Great Basin standards.

Perennial streams are virtually absent in the Kawich area, and protohistoric residential base camps were generally established near springs; the local Shoshone occasionally camped higher in the mountains, where snow could be used for water (Steward, 1938, p. 111).

Piñon nuts were the major winter staple and a local "piñon chief" directed each family where to gather in times of sparse piñon yield. Families were free to collect piñon nuts wherever they pleased during bumper years. In the event of local piñon crop failure—not an uncommon event—families traveled 40 to 48 km. north into the Monitor Range, some even journeying to the Silver Peak Mountains, over 120 km. away. But regardless where the family located suitable piñon, the settlement pattern remained virtually identical: a residential base camp was established in the piñon-juniper woodland, and task-groups daily exploited piñon-collecting locations throughout the piñon forest. In areas of exceptional yields, caches were established in the woodland and subsequently visited during the winter and spring.

Shortly after the fall piñon harvest, the Kawich Mountain Shoshone established short-term field camps to conduct communal rabbit drives and festivals (*fandangos*); these field camps were inhabited for only a week or so, seldom longer. The Shoshone families then returned to their winter residential base camps.

The spring was difficult for the Kawich Mountain Shoshone, requiring a dispersal into short-term base camps near the available springs whenever bunchgrass, *Mentzelia,* and other grass seeds could be gathered. Daily task groups probably also foraged from these base camps. The men went out daily in small groups, employing an encounter strategy to hunt isolated deer and bighorn sheep (Binford, 1978a).

Under the guidance of a shaman, communal antelope hunts were sometimes attempted in the spring (Steward, 1938, p. 112). In such cases, locations (or even field camps) were established along the valley floor, to the west of the Kawich Range.

Kawich Mountain Shoshone families were almost entirely independent throughout the year, and Steward suggests that had they

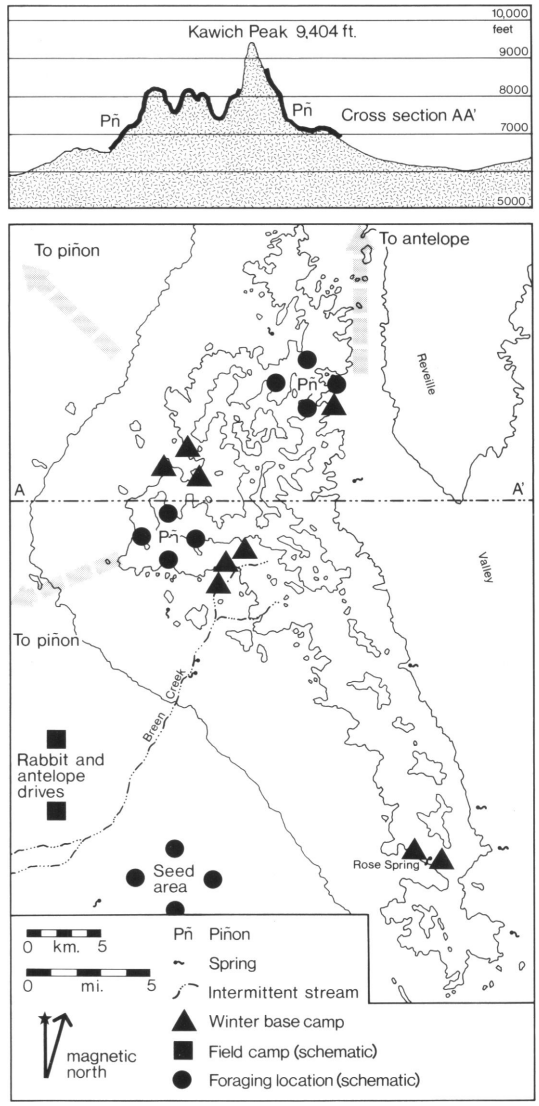

FIG. 5. Generalized settlement pattern of the Kawich Mountain Shoshone, Nevada (after Steward, 1938, fig. 8).

cooperated more regularly in communal hunts and *fandangos,* these scattered families could have formed an effective band. But the vicissitudes of the seasonal round often led Kawich Mountain families to join with their neighbors to the north and south, establishing an extensive, rather than intensive social network. Leadership was exerted only in times of relative stress, and *ad hoc* leaders were

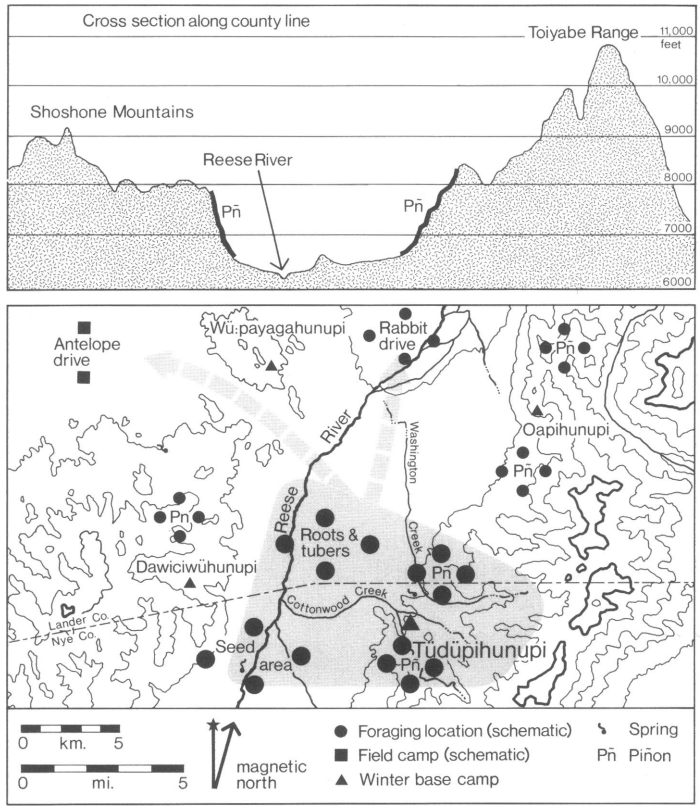

FIG. 6. Generalized settlement pattern of Tüdüpihunupi winter village (shaded section), Reese River Shoshone, Nevada (after Steward, 1938, fig. 8).

responsible for coordinating the communal rabbit and antelope drives.

In sum, the protohistoric Kawich Mountain Shoshone were foragers, whose settlement pattern consisted of individual families who worked throughout an extended core area, generally independent of other family units. Whenever the families did cluster "a kind of village chief" directed socioeconomic functions such as *fandangos,* piñon nut trips, and possibly rabbit drives (Steward, 1938, p. 113); these aggregations became more common during post-contact times. The annual round was consequently quite variable, often taking them up to 120 km. away in lean years.

THE PROTOHISTORIC REESE RIVER VALLEY SHOSHONE

The Western Shoshone living in the Reese River Valley exploited a relatively more stable and generally more resource-redundant environment than did most of their neighbors in surrounding valleys (see fig. 6).

The Reese River Valley is relatively well watered supporting several perennial streams, and the population density was among the highest in the protohistoric Great Basin. Although estimates vary, the best figure for aboriginal population density is probably about one person per 10.4 sq. km. (Steward, 1938, pp. 4, 101).

The central Great Basin area was apparently divided into large protohistoric "districts," including Ione, Reese River, and Smith Creek. Each district was distinct, although not entirely independent. A single chief, *Tutuwa,* extended his influence over several central Great Basin districts during post-contact times, but this was probably uncharacteristic of the earlier protohistoric period.

The ethnographic seasonal round in the

Reese River Valley is well-documented by Steward (1938, pp. 100–109). The primary base camps were established along the lower margin of the piñon-juniper woodland, particularly on the west-facing slopes which receive more precipitation (due to a localized orographic effect). Winter residential base camps were occupied in traditional spots, generally named and "owned" by a local family group. Figure 6 reconstructs the seasonal round ethnographically associated with Tüdüpihunupi, a winter residential base camp located near the confluence of the San Juan and Cottonwood creeks. Although Steward called these sites "villages," the actual designation seems to apply more to a generalized location than to a fixed locus of residence. The families actually lived in somewhat scattered residential areas throughout the hilly piñon-juniper woodland; the "village name" included several more or less contiguous ridge-top settlements. Because of the annual redundancy in local yield, these families were "tethered" to the named areas, and groups commonly overwintered year after year in the same residential base camp.

These winter base camps were well-situated for a variety of resources in addition to piñon, and procurement localities were established nearby for roots, seeds, berries, and so forth. Moreover, the valley floor resources were available within a 6 or 8 km. foraging radius.

Considerable archaeological research has been conducted in the area depicted in figure 6. A number of archaeological scatters were located and mapped, and their distribution corresponds with those described by Steward for winter piñon base camps (Williams, Thomas, and Bettinger, 1973; Thomas and Bettinger, 1976). It is, however, impossible to pinpoint a specific village such as Tüdüpihunupi, since the name actually refers to a complex of ridge-tops, all of which contain archaeological debris.

Apparently families living in these base camps had restricted residential mobility, moving only in the event of local piñon crop failure, in which case they attempted to establish a similar winter base camp in some neighboring range where the local piñon yield was sufficient to fill caches for winter subsistence.

Temporary field camps were set up for a number of purposes such as communal antelope and rabbit drives and *fandangos*. These task-specific moves rarely exceeded 60 to 80 km.

The summer was a time of dispersal to the valley floor, somewhere not far from the Reese River. This summer fission pattern mingled families of the various winter villages. Other than the fish available in the Reese River, the resource patches were scattered over the flats in relatively uniform distribution, in marked contrast to the well-defined clumps of winter resources. As a result, the summer residential camps were more frequently moved, in order to be nearer to the seed procurement locations. Because there was relatively little resource redundancy, summer camps were typically short-lived, expedient affairs.

In some years, the winter caches of piñon nuts permitted families to remain in their winter base camps throughout the spring and even into the summer months. If the following year provided an ample local piñon harvest, such villages could even be regarded as "sedentary," if only on a temporary basis. In such cases, locations and temporary field camps were established to harvest lowland resources, which were then transported for storage and eventual consumption in the foothill base camp.

Resource intensification was practiced by the Reese River Shoshone—and probably many central Great Basin peoples—by deliberately burning the brush in the upland basins behind the winter residential bases and sowing seeds of *Mentzelia* and *Chenopodium* into these cleared areas, to be harvested during the summer. This practice is clearly aboriginal, but apparently of only minor importance in the overall subsistence system. This strategy created artificially clumped resource patches, deliberately situated near the most common residential base.

Both these specially sown seed areas and the nearby piñon groves were locally owned and protected against trespass. Ownership was apparently ascribed to the local base camp, whether or not the residents of that camp were related. Such territorial ownership was unusual among the Western Shoshone, probably reflecting the high degree of annual redundancy in the overall settlement pattern.

The Reese River Valley mobility pattern seemed to be rather stable because nearly all essential foods were available within a short radius of the residential winter base camp; according to Steward, habitual use eventually led to outright ownership.

The pattern of habitual cooperation also extended beyond the members of a winter base camp during the major fall festivals (*fandangos*). At least during the protohistoric period, the *fandango* was held in a central location, creating a temporary residential camp which was much larger than any individual winter camp, but lasted for only a week or so. Historic *fandangos* drew from large areas, but the prehistoric versions were probably more local in nature. In addition to the obvious social and ritual aspects, *fandangos* probably functioned to disperse critical ecological information, perhaps even serving as a device to assist in the overall regulation of regional population density (Thomas, 1972a, 1979a, pp. 123–126). In this case, the temporary *fandango* camp could perhaps be considered to be a *station,* in the sense of Binford (1980, p. 10)—a place where subsistence strategies were planned, but not necessarily executed.

Regional cooperation was also manifest in large spring and summer gatherings, centering around the Round Dance, but these were apparently less important and certainly less frequent than the annual fall *fandango.* The Reese River Shoshone continued to show a considerable degree of nucleation and interregional cooperation during post-contact times.

The people of the Reese River also practiced a custom which Steward termed *pseudo cross-cousin marriage* (1938, pp. 108, 245). True cross-cousin marriage was prohibited at Reese River, but marriage with the MoBr or FaSi stepchild was permitted, in fact encouraged. The "pseudo cross-cousin" is, of course, not a blood relative, but was apparently so considered. Steward suggested that preferred pseudo cross-cousin marriage resulted from the frequent separation and remarriage of couples (1938, p. 245). Marriages were generally arranged by the man's parents and brideprice was apparently customary. Postmarital residence, although temporarily matrilocal, reverted to patrilocal after a short term of bride service.

In sum, the protohistoric Reese River Shoshone lived in a relatively well-watered region, where the seasonal round involved a fusion-fission residential structure—a single winter base camp and several summer dispersal areas—supplemented by a number of task-specific locations and temporary field camps. Most resource procurement occurred within about 8 km. of the traditional winter base camp, although families would occasionally travel up to 80 km. to participate in communal hunts or to attend a *fandango.* Large upland tracts were artificially managed in order to create localized patches of summer-ripening seeds. Both piñon and seed tracts were owned by local villages and were defended against trespassers.

The Protohistoric Owens Valley Paiute

Owens Valley is a long, narrow, block-faulted trough in the eastern portion of central California. The valley itself is more than 160 km. in length, and averages about 16 km. in width. The margins are defined by the towering Sierra Nevada to the west and the stark Inyo-White Range to the east; both ranges exceed 4300 m. (14,000 ft.) in elevation (fig. 7). Direct precipitation in Owens Valley is sparse, and most of the available water originates as either rain or snow from Sierran storms. This produces an unusual amount of runoff on the eastern slope of the Sierra, which in turn creates numerous perennial streams flowing into the Owens Valley proper. These streams often seep into swamps and ultimately drain into the Owens River.

The vegetation pattern thus produced creates an extremely asymmetrical set of resource patches: the well-watered Sierras to the west, the more arid piñon-covered slopes to the east, separated by the sometimes marshy Owens Valley lowlands. The aboriginal population density of Owens Valley is estimated at one person per 5.4 sq. km. (Steward, 1938, p. 48), a denser population than at Reese River (or anywhere else in the Great Basin).

The environment also supported a subsistence and settlement pattern significantly dif-

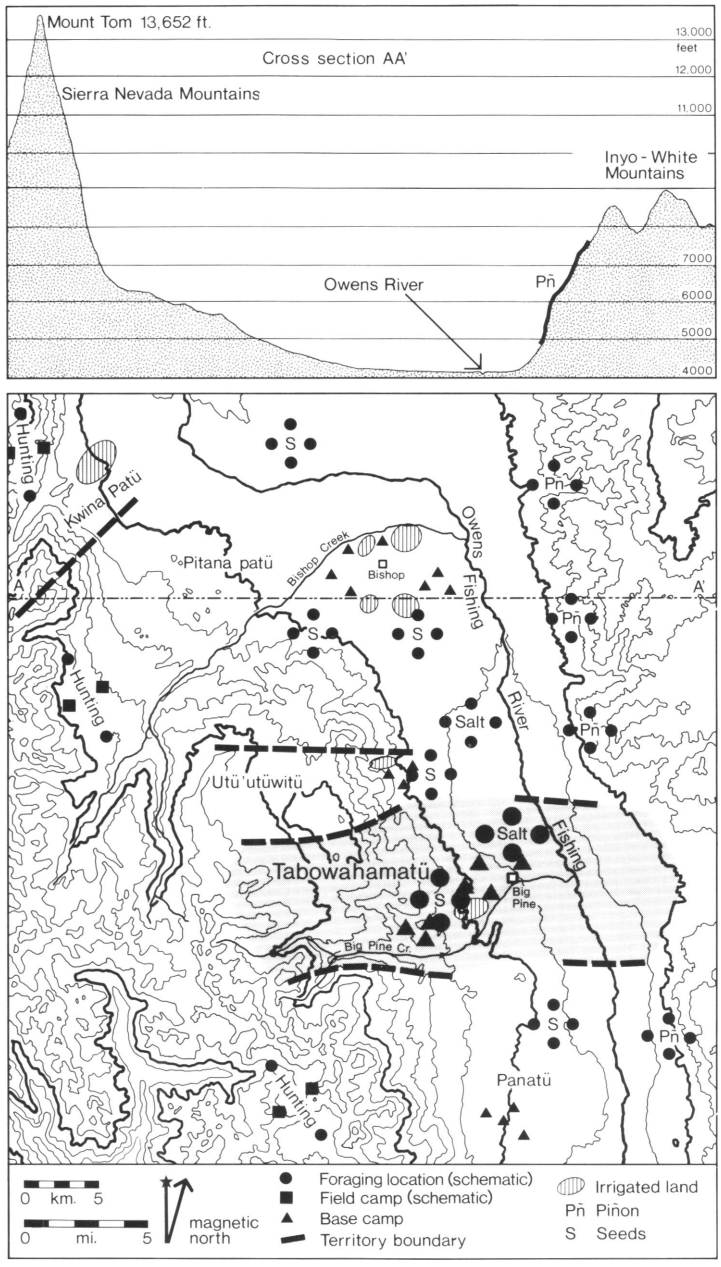

FIG. 7. Generalized settlement pattern surrounding the Tabowahamatü valley village, northern Owens Valley, California. The territory of the Tabowahamatü district is shaded (after Steward, 1933, map 2).

ferent from those discussed above (fig. 7). There were at least 30 relatively permanent residential base camps ("valley villages") within the protohistoric Owens Valley and extensive archaeological research has established the antiquity of both the villages and the pattern (Bettinger, 1976, 1978). Owens Valley base camps are typically located on

the western side of the valley, near one of the perennial streams flowing from the Sierras; sites were commonly located 3 to 6 km. away from the valley floor. The people of each village—or cluster of villages—comprised a true land-owning band. Because of the varied, yet closely packed environmental zones, the Owens Valley Paiute villages were relatively close to all their major resource patches; in the terminology of Binford (1980, p. 15), *spatial incongruity* ceased to be much of a problem for the Owens Valley Paiute; they were effectively able to move resources to consumers with a minimum number of residential shifts. Game was relatively abundant in the high mountains, and hunting locations were rarely more than a day or two from the village. Similarly, the seed procurement locations in the foothills were relatively close by, as were the additional seed areas, roots, fish, antelope, and rabbits of the valley floor. In each case, task-specific locations could be exploited in the dense resource patches; although some of the more distant patches required establishment of a temporary field camp, the task-groups could usually return to the residential base on the same day.

Despite the ecological diversity of Owens Valley, piñon pine still comprised the single major food resource for the ethnographic Owens Valley Paiute. But piñon exploitation was structured rather differently from the cases discussed above. Piñon grew only in the relatively dry Inyo-White Range. During good crop years, temporary residential base camps were established adjacent to the piñon caches within the piñon-juniper woodland, but in relatively poor piñon years, the cached nuts were transported to the base camps on the valley floor.

In other words, the locus of winter residence in Owens Valley was determined, in large measure, by the transportation costs involved with the annual piñon crop.

Owens Valley was also distinctive because of the natural abundance of native seed-producing grasses near the valley villages. Here was another relatively dense, patchy resource which occurred near the residential base camp. At least protohistorically, an extensive irrigation system was operated whereby streams were diverted to intensify seed yield of these native crops (Steward, 1930, p. 15; 1933). Steward himself vacillated as to whether this system was prehistoric, or introduced in post-contact times (Steward, 1955, 1970). The antiquity of irrigation in Owens Valley still remains open to question, but recent investigators seem to agree with Steward's initial assessment, namely that the Owens Valley Paiute did indeed use irrigation prehistorically (Lawton et al., 1976; Bettinger, 1978).

This rather dense and predictable native resource further enhanced the positioning strategy employed by the Owens Valley Paiute in locating their base camps. The pattern contrasts markedly with Great Basin foraging groups who often took round trips of up to 240 km. in order to exploit key resources. The resulting Owens Valley villages were residentially more stable, with relatively constant band groupings cooperating extensively in communal hunts and irrigation projects (Steward, 1938, p. 234).

Each band in Owens Valley owned a distinct territory, the boundaries of which were generally defined by the streams flowing from the Sierras. Bands conducted communal drives for antelope, deer, and rabbits, and held *fandangos* and mourning ceremonies. Bands owned seed areas, piñon territories, and irrigated plots of land; each had a chief and constructed its own community sweat house (which differs from common Great Basin practices, as among the Western Shoshone, for whom the sweat house was an individual or family effort); the typical Western Shoshone settlement pattern was "too unsettled and their villages usually too small to make it profitable to construct a large [sweat] house" (Steward, 1938, pp. 237–238).

The protohistoric Owens Valley Paiute lived in a relatively permanent association of family units, many of which may not have been related. This band maintained headquarters in established residential base camps, which provided a stable locus from which to hunt and forage within the band's territory. Leadership was apparently inherited within the band, and a number of integrative mechanisms were common, such as the sweat house, the group name, and territorial ownership.

UNDERLYING SUBSISTENCE STRATEGIES

Binford's (1980) forager-collector continuum is directly relevant to an understanding of the variability in the three protohistoric Shoshonean cases, but we follow a rather different (yet complementary) structure of inquiry. Rather than looking for global patterning, we emphasize the remarkable variability and attempt to explain it.

The Kawich Mountain Shoshone are almost classic foragers, employing frequent residential moves to solve problems of spatial incongruity within their immediate environment; they follow a "mapping on" strategy, and their site types are limited almost exclusively to residential base camps and foraging locations.

The Owens Valley Paiute occupy the other end of the foraging-collecting continuum, employing a logistic strategy to exploit their environment. They minimize residential mobility by bringing resources to the consumers. This relatively more "sedentary" lifeway demands that goods flow smoothly and regularly from the procurement locations to the locus of consumption, the village base camps. The organizational structure of Owens Valley Paiute society reflects this additional logistic burden.

"*Logistical and residential variability are not to be viewed as opposing principles but as organizational alternatives which may be employed in varying mixes in different settings*" (Binford, 1980, p. 19). This is precisely what happened with the Reese River Shoshone, who employed a decided mixture of foraging and collecting strategies. During the winter, the people of Reese River were organized logistically, establishing a strategically located residential base camp (fusion camps), relying on task-groups for transporting resources to consumers; the winter pattern at Reese River minimized residential mobility. But the summer dispersal (fission pattern) followed a "mapping on" strategy by increasing residential mobility. There are qualitative differences between site types produced during summer and winter activities in many years. But there is also temporal variability; in high-bulk piñon years, the pattern became almost exclusively logistical to the point of approaching temporary sedentism.

While it is true that foraging-collecting strategies are correlated with seasonal temperature variability and the length of the growing season on a global scale, it is also true that there can be tremendous variability in strategic decision-making within a rather small geographic area, provided there is sufficient microenvironmental diversity.

TERRITORIALITY

One relevant issue, mentioned only in passing so far, is the matter of *territory,* defined as the area occupied more or less exclusively by an individual or group, defended either overtly or through advertisement (Stewart, 1939; Dyson-Hudson and Smith, 1978, pp. 22–23; Fowler, 1982a, pp. 120–127; Hunn, 1982, pp. 21, 34; Richardson, 1982, pp. 94–95). According to Brown (1964) considerations of economic defensibility suggest that territorial behavior should be expected whenever the costs of exclusive use and defense of an area are outweighed by the benefits gained from this mode of resource utilization.

Dyson-Hudson and Smith (1978) have estimated the cost/benefit causes of human territorial behavior by exploring a number of case examples, including the Great Basin Shoshoneans. They suggested that territoriality should arise among groups dependent on resources that are both dense and predictable; territoriality should be absent in groups that exploit a sparse and unpredictable resource base.

We suggest that our understanding of territoriality can also profit from an even tighter mode of comparison, monitoring the effects of regional and micro-topographic variability on adaptive responses (fig. 8).

Consistent with the concept of economic defensibility, the Kawich Mountain Shoshone lacked all forms of territoriality (as was true for many Western Shoshone peoples). Summer resources in this area were sparse and scattered, and predictability was so low that Kawich Mountain families often traveled great distances during the summer. The situation improved only slightly during the

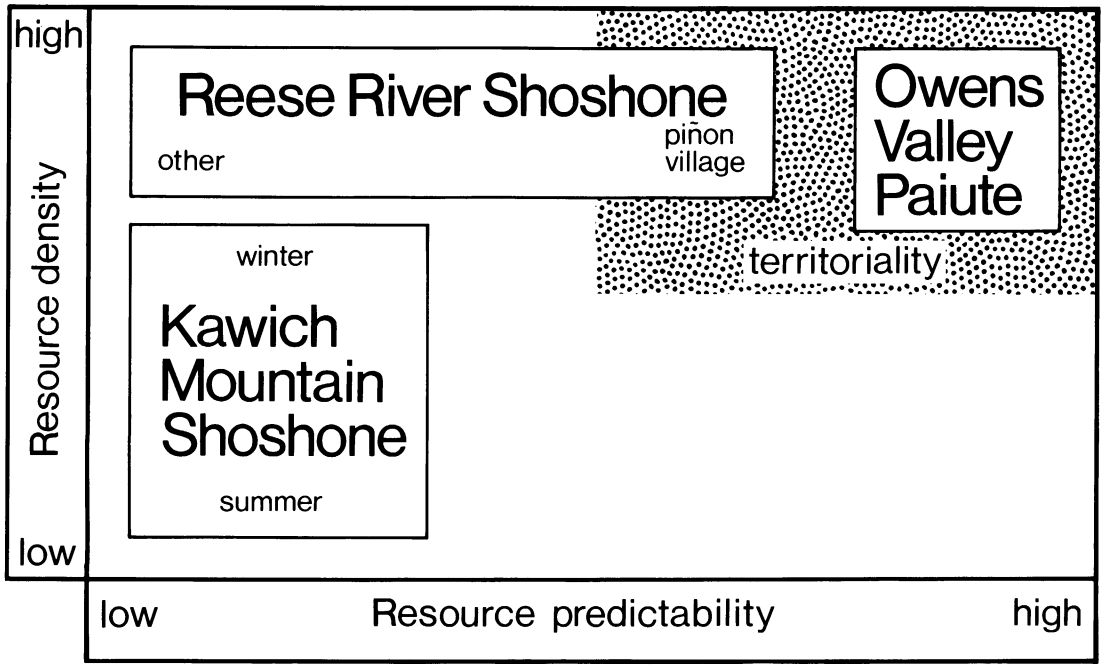

FIG. 8. Territorial model for three Great Basin Shoshonean societies, based on a concept of economic defendability (modified from Dyson-Hudson and Smith, 1978, fig. 1).

winter because the local piñon crops still tended to be widely scattered and erratic, failing to provide a dense and predictable resource base. The great residential mobility and geographic uncertainty vitiated any need for ownership of resources. In this case the costs of territorial behavior drastically outweighed any potential benefits.

But in marked contrast is the well-defined band territorial system of the Owens Valley Paiute. Most major resources fell into territories which were owned and controlled by the valley villages. These "districts" were defended against trespassers and were apparently inherited patrilineally in some cases (Steward, 1938, p. 52). Both the greater absolute density and predictability of the resource base—as well as the higher population density—led to this stabilized territorial system.

The Reese River Shoshone provide an interesting middle ground for the territorial question. At Reese River, only those resources related directly to the piñon villages were owned, namely the small 250 to 500 hectare tracts of piñon woodland and the nearby upland sown seed areas. Both locations in the mountains were immediately behind the village sites. The seed areas were defined by well-known landmarks and defended against trespassers, short of outright fighting or killing. Inheritance of the seed areas was probably patrilineal. Steward notes that such ownership was "contrary to Shoshoni custom" and suggests that the unusual resource predictability and density were such that habitual use led to ownership (Steward, 1938, p. 106).

The nature of this territoriality at Reese River is quite different from that at Owens Valley. Not only is the Reese River system more flexible, but it applies only to resources physically associated with the village area. In Owens Valley, the local village owned all resources which occurred within their "district"; such ownership extended to all hunting, seed collecting, and fishing rights (Steward, 1933, p. 305). At Reese River, there were no strictures regarding valley floor plant resources nor was there any ownership of hunting or fishing territories.

In other words, the Reese River Shoshone extended ownership ard territoriality only to those resources sufficiently predictable and dense to warrant habitual use (namely piñon trees and sown seed areas). Had the settlement pattern been more residentially stable, territoriality would almost certainly have been extended to other major resources, as in the "district" system of the Owens Valley Paiute. If an increase in population density had accompanied such a shift, this would have added another factor increasing the benefits of territoriality. The protohistoric Reese River case is intermediate both in terms of settlement strategy and territoriality.

Thus the concept of economic defensibility (e.g., Brown and Orians, 1970) is useful not only at a global, normative scale, but it also provides a tool to analyze microevolutionary process.

MARRIAGE AND KINSHIP

The traditional view of Great Basin social organization holds that marriage and kinship are ecologically determined, the function being to establish the family as "an economic unit which insured the survival of the individual" (Steward, 1938, p. 241). This emphasizes the single-case view of Shoshonean adaptation.

Recently, Eggan (1978, 1980) has attempted a partitive, systemic analysis of the variability in Great Basin social organization; Eggan's analysis provided "some unexpected findings" (1980, p. 185; see also Fowler, 1982a).

Instead of emphasizing a pan-Basin pattern, Eggan returned to the raw kinship data for 25 valley populations in the Great Basin, examining the variability in marriage practices and kinship groups and how such variability correlated with microenvironmental differences. Eggan concluded that "it is probable that at the simplest levels of subsistence [in the Great Basin] the kinship systems are sensitive to small variations in the underlying ecology so that a simple basic pattern may not exist over a wide area until the subsistence problems are solved by agriculture or pastoral activities that provide greater certainty" (Eggan, 1978, p. 21). This is a far cry from Kroeber's concept of "close cultural unity" among Basin Shoshonean groups. By attempting to explain—rather than explain away—the variability, Eggan begins to deal with social organization in cause-effect perspective.

In the more "extreme" environments—habitats with low population densities and residentially mobile settlements—the kinship system functioned primarily as a social network to disseminate information concerning the availability of food, such as the condition of certain patches of grass seeds, areas of fruitful piñon harvest, conditions and location of game herds, availability of surface water, and so forth. Kinship terminology in such cases reflected the attempt to maximize this information network among relatives.

The greater the unpredictability of resources, the stronger became the built-in restrictions on sharing (Eggan, 1978). The seed harvests in these areas were "owned" by the women who harvested them since they were responsible only for the welfare of their immediate family cluster. In such low density, low predictability areas, brothers and sisters did not have automatic rights to her food supplies. Presumably this was reflected in the kinship and marriage systems operative among foragers such as the Kawich Mountain Shoshone.

Kinship operated rather differently at Reese River Valley, where true cross-cousin and pseudo cross-cousin marriage was often practiced. Brother-sister exchange was common and continued into the next generation, serving to strengthen the within-community bonding, while minimizing social ties with neighboring groups. The kinship system accordingly differentiated between parallel and cross-cousins. According to Eggan, socioecological necessity for institutionalized information-sharing networks was diminished because of the changed resource structure. The kinship structure apparently reflected an increased local integration and band stability.

This tendency was most strongly developed in Owens Valley, where kinship reflected even less family autonomy and a significantly greater degree of village-level integration. Alliances were intensified between families through infant betrothal, and there were special kin terms designating relations between prospective parents-in-law. Because the vil-

lages generally contained several unrelated families, local exogamy was not necessarily practiced.

In this case as well, an emphasis on variability discloses the way in which microenvironmental effects conditioned the sociopolitical organization within the protohistoric Great Basin.

TRADE

Information about trade in the protohistoric Great Basin is sketchy. Steward (1938, p. 203) briefly discusses trade in the northern Great Basin, in which the Fort Hall Shoshone traded buffalo skins to the Yahanduka Shoshone for seeds, roots, dried crickets, and salmon, and to the Nez Perce for horses. But this trade was clearly involved with the historic horse complex, and is beyond the social and ecological network considered here.

In general, the Great Basin Shoshoneans practiced little or no trade (Steward, 1938, p. 45). Some salt may have been exchanged throughout the Basin during this period, as well as a little shell bead money, but Steward thought this trade was of little importance, and that Euro-Americans had inflated the currency significantly after protohistoric times.

The most extensive trade in the protohistoric Great Basin occurred, as one might expect, between the Owens Valley Paiute and their trans-Sierran neighbors, especially the Western Mono and Miwok (described in Steward, 1933, pp. 257–258; see also Bettinger and King, 1971). Steward (1933, map 1) plotted the major trade routes, which generally cut through the well-established Sierran passes. Muir (1894, p. 228) described one such trading party, mainly women carrying large loads of trade goods. Although most trading episodes conducted by the Owens Valley Paiute involved only such brief trips (Steward, 1934), the Mono Lake groups to the north sometimes wintered on the western Sierran slope (near Yosemite) in years of poor local piñon harvest.

The Owens Valley Paiute apparently exported large quantities of salt, pine nuts, grass seeds, as well as obsidian, rabbitskin blankets, tobacco balls, baskets, and buckskins. In return, they received mostly money (shell and glass beads), acorns, manzanita berries, and Californian baskets.

The prehistoric Owens Valley monetary system was based on shell beads, but glass trade beads were quickly adopted during the protohistoric period. Steward (1938, p. 45) reports that the bead currency was used only as far east as the Reese River and Big Smoky valleys; there is some evidence that strings of rabbitskin rope may have replaced shell beads as money in the central Great Basin.

Although most of the Owens Valley trade was trans-Sierran, a limited commerce was conducted with the east, particularly in salt and ceramics. Other low volume trade items included cinnabar (used as a pigment and obtained near the Last Chance Mountains of Death Valley [Steward, 1933, p. 276]), chalk, manganese, and probably also turquoise.

SUMMARY

These three cases make an important point about hunter-gatherer studies. At one level, societies can be viewed in a synchronic, neofunctional framework, and selected features of these "typical" groups can be used to test hypotheses about global hunter-gatherer dynamics. The results are informative and useful in building a general theory of hunter-gatherer adaptation. But the global approach cannot stand alone because it leaves a number of questions unanswered, especially as regards systemic variability and particular system change (evolution).

Only through comparison of controlled cases can a full appreciation of such differentiation be realized. We began this inquiry with a brief examination of the variability within synchronous protohistoric Great Basin Shoshonean groups. The Owens Valley Paiute, the Kawich Mountain Shoshone, and the Reese River Shoshone shared the same basic culture. They spoke mutually intelligible languages. Their technologies were virtually identical. They exploited roughly the same resources. All three systems operated within the same culture area, at the same time and fit neatly within "Steward's model of Great Basin Shoshoneans."

That is, by holding culture constant, we find three structurally different ecological adaptations operating at the same time within a

radius of less than 100 km. We currently lack the theoretical models to explain this variability.

There is also no reason to assume that the year A.D. 1800 was "typical" for any of the three groups. We do not know, for instance, the range of annual fluctuation of the systems, and how they reacted to resource variability.

Finally, there is no reason for us to assume that the people living in Owens Valley were always collectors, or that the Kawich Range was exploited only by foragers. Temporal dynamism is another area in which we lack both data and theory. The data can come only from archaeological investigation and the theory will evolve only when we begin questioning the variability as well as the model behavior.

The microevolution of these different structural poses forms the basis of the Monitor Valley inquiry. The next chapter examines in detail how the resource structures of these various areas conditioned the ways in which central Great Basin hunter-gatherers adapted to local environments. Then we will examine the overall fabric of Shoshonean cultural geography during the protohistoric period. Finally, we will be in a position to consider in detail the potential adaptations to an unknown case, the protohistoric Monitor Valley Shoshone.

CHAPTER 4. MID-RANGE THEORY: SELECTED PROCUREMENT STRATEGIES IN THE PROTOHISTORIC GREAT BASIN

This chapter begins to develop mid-range theoretical analysis of the major subsistence strategies employed during the protohistoric period in the Great Basin. This analysis provides both a working model of the dynamics of the protohistoric period in this area, and also a way to perceive the patterns in the archaeological record. This is not an exercise in ethnographic analogy nor an attempt to derive a model to be tested by the archaeological record. The strategic models stand on their own. But they also provide a direction for approaching the archaeological record.

We evaluate specific resource complexes in terms of four basic criteria:

a. To establish the relevant biogeographic and ethnological parameters;
b. to consider the known aboriginal technologies involved in exploiting that resource;
c. to define the underlying procurement strategy (or strategies) involved for that resource;
d. to establish the general archaeological consequences of that exploitation.

Archaeological expectations are stated at this stage in terms applicable to the Great Basin in general; subsequent chapters apply these concepts to the ecological specifics of the protohistoric and prehistoric Monitor Valley.

I have found it useful to present this analysis according to Northern Paiute native categories (after Fowler and Leland, 1967). At the highest level of abstraction, the Northern Paiute employ a single category: *from people (Indian) on down, everything on down, everything on or above the earth.* The non-human component of the ecosystem is then subdivided into three major categories:

1. *Things that are eaten (as food);*
2. *Things that are used;*
3. *Things that are not used.*

The Northern Paiute then divide *things that are eaten (as food)* into two primary subdivisions: *things that grow in place* and *things that move.* Things that grow in place are further subdivided into those *in the water* and those *in the earth,* and so forth. Fowler and Leland (1967) provide the details of this taxonomy down to the level of the specific plant or animal.

This ethnobiological taxonomy is of interest here because it partitions the universe in terms of how resources are exploited. For instance, although the Northern Paiute have a single term that English speakers would gloss as "plants," plants as such do not comprise a single taxonomic system in their universe. Instead, "plants" are found in all three major categories *(things that are eaten [as food], things that are used, and things that are not used).*

The use of the Northern Paiute ethnobiological classificatory system is not, I hasten to point out, an attempt to read "emic" significance into the archaeological record—a practice which I view with considerable skepticism (Thomas, 1979a, pp. 109–112). Rather, the Northern Paiute perspective is more useful to the purposes at hand than the conventional Linnaean scheme that stresses only cladistic affinity.

This is not an exhaustive or comprehensive discussion of the entire Great Basin resource base. The approach is eclectic, defining the range of resource variability and expanding on those resources considered most relevant to the Monitor Valley setting. There is no attempt for instance, to consider exploitation of the vast Great Basin marshlands; nor do I discuss the extensive riverine and lacustrine fisheries of the western and northern Great Basin; I likewise ignore the mesquite-screw bean-yucca-mescal complex of the southern Great Basin. Those interested in applying the general concepts developed here must evolve the necessary mid-range considerations for these resources.

Finally, since this is not an exercise in *ethnographic analogy.* The concern here is not with particulars, but rather with defining the underlying strategies for exploiting the indi-

vidual resources. In many cases, the resource particulars are radically different, yet the underlying procurement strategies are identical. The reverse is also true.

EATING THINGS THAT MOVE: HOOFED ANIMALS

The caloric importance of game animals was secondary to that of plant foods throughout the protohistoric Great Basin. This conventional wisdom is well expressed by Steward (1938, p. 33):

> The general aridity of the region restricted the numbers of all species of large game and the limited grasslands largely precluded species which occur in great herds . . . . Deer and mountain sheep, occurring alone or in small bands, were taken through the wiles and perseverance of single hunters or small groups of men whenever they happened to be in a locality favorable for hunting . . . . Antelope, forming small herds, lent themselves to communal hunts, but such slaughter so reduced their numbers that years might be required to restore the herd.

Similar arguments regarding aboriginal hunting patterns in the Great Basin have been made by Heizer and Baumhoff (1962, pp. 210–218) and Thomas (1969a, pp. 398–399).

While this is true in the main, the varying tactics of game procurement had a major influence on the positioning strategies of aboriginal foragers and collectors, and it is appropriate to consider this behavior in some detail.

Basic Hunting Strategies

Binford (1978a) has stressed the fundamental distinction between encounter and intercept hunting strategies. Delineating the consequences of these strategies will assist archaeologists in bridging the gap between observable archaeological contexts and unobservable behavioral contexts.

In *encounter strategy procurement* an extremely large area is covered in search of low density, low predictability game. Game hunted in this fashion rarely occurs in aggregations, and actual kills are relatively few.

An intercept strategy, in contrast, exploits game which tends to occur in high density aggregations, following predictable and known movements. In this sense, the game is intercepted in both time and space. Intercept hunting involves extensive monitoring of game movements and attempts to ambush game at pre-established, pre-determined hunting locations.

Intercept strategy hunting can be implemented in a number of ways. *Migration hunting* is the most effective, involving ambush of relatively large herds moving seasonally from one microenvironment to another. It is generally conducted on a year-in, year-out basis, with traditional hunting spots carefully scheduled to correspond with well-established patterns of game movement. Migration hunting is the most cost-effective of the intercept strategies.

The *dispersed intercept strategy* exploits stragglers on major migrations (Binford, 1978a, p. 178). In caribou migration, for instance, cows tend to migrate through the mountain passes later than the rest of the herd, moving more slowly, in a more dispersed fashion. Although these movements are still quite predictable, the volume of game involved is much lower, and hunting parties are correspondingly smaller. Similar behavior can be expected from many other large game animals as well. Although the predictable volume for straggler hunting is lower than for full-scale migration hunting, the strategy remains cost-effective because of the relatively low procurement costs involved.

The *low-volume intercept strategy* monitors and exploits short-term, often diurnal game movements, such as the periodic use of a salt lick, or daily, tethered movements between foraging and water areas in relatively arid environments. The classic intercept strategy is followed—monitoring game movement and ambush at pre-existing locations—but both yields and short-term predictability of success are low.

The game drive and ambush provide the primary tactic for pursuing an intercept strategy. Ambush locations have key characteristics: ready access to a *game lookout,* a *funneling factor* to increase game density temporarily and artificially, and a *change of pace factor* to assist the hunter in temporarily modifying the herd's ability to flee (see also Binford, 1978a). Intercept strategy hunters

commonly construct *facilities* (Wagner, 1960, p. 20) to assist in the ambush: rock blinds, stone cairns, rock walls, corrals.

It makes good cost/benefit sense to invest labor in construction of intercept strategy facilities in known, traditional spots, for use year after year (see also Fowler, 1982a, p. 120). In fact, the construction cost of a specific hunting facility is a good indirect gauge of the stability and overall predictability of a given ambush locality.

Intercept strategies are often facilitated by the systematic use of the *game drive.* Such drives are basically attempts to artificially enhance game aggregation and predictability: to create an artificial herding effect, to introduce artificial funneling factors, and to enforce an artificial change of pace factor. The relative predictability and high probability of success make game driving profitable when intercepting animal herds.

These general hunting strategies operate regardless of locale or game animal. To see how they operate in specific instances, it is necessary to examine animal behavior in a particular context, in this case, the protohistoric Monitor Valley.

Bighorn Sheep

Elsewhere (Thomas, 1970, 1972b), I have reviewed the relationship between Great Basin bighorn behavior and human exploitation of this species (see also Pippin, 1979). But for the specific purposes of this section, we must narrow the focus and discuss only behavior relevant to the protohistoric Monitor Valley case. Bighorn behavior is known to vary significantly across seven races (or subspecies) and we are forced to disregard much of the information available for more northerly bighorn populations; particularly misleading is the now-common analogy between Great Basin bighorn and those of Alberta, Canada and Alaska (especially Geist, 1967). These animals behave rather differently, and simple analogy between the two seriously distorts the Great Basin case (e.g., Thomas, 1969a, 1970, 1972b; Wright and Miller, 1976; Pippin, 1979). Better and more relevant data are now available.

Bighorn Systematics: The issue of speciation in Great Basin bighorn populations is discussed in Part 2 of this series; for now a brief review of the relevant systematics will suffice.

Relying primarily on differences in cranial proportions, investigators have classified Great Basin bighorn populations into three subspecies: Desert bighorn, Rocky Mountain bighorn, and California bighorn. Historically, the Desert bighorn (*Ovis canadensis nelsoni*) inhabited the central and southern portion of Nevada (Cowan, 1940), and approximately 4600 bighorn still survive in the southern two-thirds of Nevada (Hess, 1981). The Rocky Mountain bighorn (*O. c. canadensis*) once lived throughout much of northeastern Nevada, but declined severely in historic times (Hall, 1946; Tsukamoto, 1974). They have, however, been reintroduced into several ranges since 1973, and more introductions are scheduled in the near future (McQuivey, personal commun.). California bighorn (*O. c. californiana*) lived prehistorically in the western and northwestern portions of Nevada, but this subspecies suffered drastically during the historic period. A herd transplanted from British Columbia was introduced into the Sheldon Antelope Refuge, in the northwestern corner of Nevada (Tsukamoto, 1974, p. 49). Other transplants have occurred recently, and more are planned in the future (McQuivey, personal commun.).

About 50 Desert bighorn survive in the Toiyabe Range of central Nevada, the northernmost distribution of the subspecies (Tsukamoto, 1974, p. 50); aerial and random observations recorded since that time support these findings, indicating that the population is indeed low (McQuivey, 1978, p. 16). Another population of Desert bighorn still lives on Lone Mountain less than 75 km. southwest of Monitor Valley (Tsukamoto, 1974, table 1). During the most recent aerial survey, taken on September 24, 1980, 191 individual bighorn were observed on Lone Mountain (McQuivey, personal commun.).

These two central Nevada herds indicate that Desert bighorn probably once lived in the Monitor Valley area as well. Tempting as it may be to discuss a "Monitor Valley herd," we must keep in mind that the historical and contemporary data show that bighorn do not

occupy valley areas as such. Rather, bighorn are exclusively associated with precipitous terrain. Recent sightings confirm that the bighorn on the Toquima and nearby ranges live only in the mountain ranges, not in the valley areas.

It is somewhat arbitrary to assign a subspecific name to the Desert bighorn of this general area. As McQuivey (1978, p. 9) notes, "it is perhaps superfluous, other than from an academic viewpoint, to assign a subspecific name to the various populations in Nevada." We are concerned here with behavior, which is known to vary significantly along a north-south cline, irrespective of specific taxonomic designation.

PATTERNS OF SEASONAL MIGRATION AND GROUP SIZE: Central Great Basin bighorn aggregations fluctuate markedly in terms of group size, sexual composition, and distribution across the landscape. Water is clearly the major limiting factor conditioning bighorn movement in southern Nevada (McQuivey, 1978, p. 38). During the extremely arid summer months, nearly 85 percent of the bighorn in the River Mountains are found within a 35 km. radius of a permanent water source. This tethering effect severely limits bighorn movement through the summer in this area; thus the relatively small home range is partly a function of local summer rainfall. Bighorn herds in southern Nevada are much more widely distributed in the fall and spring.

A markedly different pattern exists in central Nevada, judging from movements of contemporary Toiyabe and Lone Mountain bighorn. Abundance and distribution of bighorn in this area is conditioned by availability of water, vegetation, and escape cover: "Areas that provide a high quality of two of these factors but lack the third will not support resident populations of bighorn" (McQuivey, n.d., p. 9). Surface water is relatively abundant and widely distributed in both the Toiyabe and Lone Mountain areas, allowing maximum flexibility in summer dispersal. The home range is restricted more by the sometimes heavy winter snowfall. Because the higher reaches of these ranges are nearly always inaccessible during the winter months, the bighorn of central Nevada follow well-established seasonal migratory patterns—irrespective of availability of surface water. In this regard, the central Nevada bighorn more closely resemble the northern subspecies than the Desert bighorn groups in southern Nevada.

In the Toiyabe Range, for instance, bighorn spend the summer months at the highest elevations, up to nearly 3600 m. (11,800 ft.) and usually winter in canyon mouths, at an elevation between 1800 and 2100 m. (6000 and 7000 ft.). This seasonal movement involves a linear distance of about 10 km. (McQuivey, 1978, p. 39; n.d.). The actual routes of migration closely follow the general contour of the mountain topography and are both well used and traditional.

A similar pattern has been observed among the contemporary Lone Mountain bighorn. During mid-summer of 1975, 116 sheep were observed to be well distributed across approximately 80 sq. km. of upland habitat. Later that winter (February 1976), this same herd was concentrated at lower elevations, in an 8 sq. km. area (McQuivey, 1978, p. 39).

It is thus possible to use these relic herds to extrapolate a model for the seasonal movement and herd composition for the protohistoric Toquima Range bighorn, which probably became extinct about the turn of the century. The Toquima Range sheep were probably well distributed over the habitat between April and October, ranging throughout the extreme heights (up to nearly 3700 m. [12,000 ft.]).

But it is important not to overemphasize the consistency or predictability in the central Nevada data. Robert McQuivey, Habitat Specialist with the Nevada Department of Wildlife, has researched these herds in some detail, and his comments are particularly valuable in this context:

> Recent data from the Toiyabe, Grant and Lone Mountain Ranges in Central Nevada show that these [bighorn] populations are opportunistic with respect to distribution patterns and seasonal use areas . . . obviously the density of animals on these [lower] areas increases during the winter months as a result of additional animals moving to the lower elevations . . . [but] the migration concept of an entire herd moving from point A (summer range) to point B (winter range)

in Central Nevada is not supported by the data (McQuivey, personal commun.).

Herd group size and cohesion is clearly a function of environmental factors that are seldom constant, so it is difficult to provide a single "typical" (normative) picture of bighorn dynamics in this or most areas. During good forage years, most populations would generally be found in larger groups than would be the case in drier years. This phenomenon is simply a function of food availability, and the population's ability to utilize the resources at hand (McQuivey, personal commun.). During a good moisture year (when forage is abundant), 20 sheep, for instance, might be able to concentrate in a single canyon for several weeks. But during a dry year, those same 20 sheep would have to break up into smaller bunches over a much larger area in order to stay alive.

Group size is also a function of season—partly related to food availability, behavior, and other factors. Rams older than three years are generally found with ewes and lambs only during the late summer breeding season (July through September) forming bachelor ram groups all other times of the year. Such herds are not static from year to year, but vary in terms of numbers and distribution patterns in response to immediate environmental conditions.

Ewe, lamb, and young ram groups also show no marked group cohesion, with interchange between groups being extremely common. Individual herds of bighorn are constantly changing in size, almost on a daily basis (McQuivey, personal commun.). On Lone Mountain, for instance, a bachelor herd of about 20 rams was spotted; the nursery herd consisted of about 30 ewes, lambs, and young rams; over 40 percent of the 116 sheep observed in 1975 belonged to one or another of these two herds during the summer months.

But, this particular sighting on Lone Mountain is only representative of the population for that one day. With melting snow or other varying conditions, these two groups would likely scatter throughout the higher elevations in much smaller groups.

Bachelor and nursery herds generally forage relatively independently at higher elevations from shortly after the rut through early summer; bachelor herds are most evident during the spring lambing season. During the rut (August and September), the rams break up in search of ewes in estrus. Rams at this time continually move from one group to another.

In the fall, the bighorn are forced to lower elevations by heavy snowfall, and they remain in the lowlands throughout the winter. Maximum herd size is reached during the winter because populations are confined to small winter ranges as a direct result of snow cover.

Shortly after the first snowfall, the bachelor herds split off once again, to remain relatively independent until the rutting season (late the next summer). Bachelor herds in the Toquima Range/Monitor Valley area probably wintered independently at elevations between about 2000 m. (6500 ft.) and 2100 m. (7000 ft.).

Midwinter was thus a time of dense bighorn population, distributed throughout a rather small portion of the habitat. This is a particularly important characteristic and very true for most of the central Nevada bighorn populations (McQuivey, personal commun.).

LOW-DENSITY INTERCEPT SUMMER HUNTING: It is clear that the bighorn populations of the protohistoric Monitor Valley/Toquima Range area behaved rather differently than did herds to the north or the south.

Protohistoric Toquima Range bighorn were probably distributed throughout the higher elevations and grouped into bachelor and nursery herds during early summer months. Hunting such animals would be difficult, since bighorn have an uncanny ability to move swiftly and safely over precipitous terrain. Bighorn are, of course, associated with precipitous terrain throughout the year, but even more so during spring and early summer because of the vulnerability of lambs to predation. The summer range is especially selected to provide adequate protective cover (McQuivey, 1978, p. 37).

This behavior has been well described by John Muir, who worked extensively throughout the high country of central Nevada—including both the Toquima and Toiyabe ranges: "possessed of keen sight and scent, and strong limbs, he dwells secure amid the

loftiest summits, leaping unscathed from crag to crag up and down the fronts of giddy precipices, crossing foaming torrents and slopes of frozen snow, exposed to the wildest storms, yet maintaining a brave, warm life, and developing from generation to generation in perfect strength and beauty" (Muir, 1894, p. 300). An encounter strategy involving individual stalking is not very productive for hunting bighorn in their summer range (except, of course, for the southern herds, which concentrate around waterholes and are particularly vulnerable).

Summer hunting patterns in protohistoric Monitor Valley probably followed a low-density intercept strategy. Specifically, hunters would be required to monitor diurnal movements—such as daily foraging shifts, trips to water, and so forth—and determine which of these movements were sufficiently predictable to allow interception at a pre-designated spot (see Lowie, 1924, p. 195). Ambush could be assisted by the construction of permanent hunting facilities, the cost of which could be justified by the relatively high predictability of the diurnal movement.

Specific technology for this low-density intercept hunting strategy is well known. Muir (1894, p. 320), for instance, made some relevant observations on historic Basin Shoshoneans in western Utah and Nevada: "Considerable numbers of Indians used to hunt [bighorn] in company like packs of wolves, and being perfectly acquainted with the topography of their hunting-grounds, and with the habits and instincts of the game, they were pretty successful."

In his wanderings throughout the mountains of the Great Basin, Muir noted a number of "nest-like" enclosures on the top of nearly every Nevada mountain he explored. According to Muir, some hunters concealed themselves in these blinds, while others worked their way up the mountains. The alarmed sheep rapidly fled uphill, ultimately arriving at the blinds, where they were ambushed. (This is not to say that all high altitude rock blinds were used for bighorn; several other known functions can be documented, as discussed in subsequent parts of this series.)

Muir also describes a high-walled corral, with long guiding wings, as well as soldier stones ("dummy hunters") on top of Mount Grant, in the Wassuk Range, roughly 300 km. to the west of Monitor Valley. He ascribed this large facility to prehistoric bighorn procurement:

> On some particular spot, favorably situated with reference to the well-known trails of the sheep, they built a high-walled corral, with long guiding wings diverging from the gateway: and in this inclosure they sometimes succeeded in driving the noble game. Great numbers of Indians were of course required, more, indeed, than they could usually muster, counting in squaws, children, and all; they were compelled, therefore, to build rows of dummy hunters out of stones, along the ridge-tops which they wished to prevent the sheep from crossing. And, without discrediting the sagacity of the game, these dummies were found effective; for, with a few live Indians moving about excitedly among them, they could hardly be distinguished at a little distance from men, by anyone not in the secret. The whole ridgetop then seemed alive with hunters (1894, p. 322).

Similar practices were noted by Steward (1933, p. 253) for the Owens Valley Paiute.

Frison (1978, pp. 258–267) discovered somewhat similar features high in the Absaroka Mountains of Wyoming. Evidence consists of stones with occasional remnants of wooden logs and stumps. The protohistoric mountain sheep traps were constructed of wood, at an elevation of over 2500 m. (8000 ft.).

Dogs were probably also used in low-density summer hunting. Among the Shoshonean groups of Idaho, bighorn were hunted by teams of at least three males, who drove the animals with dogs toward predetermined natural facilities such as ledges or steep inclines (Liljeblad, cited in Miller, 1972, p. 80). The sheep were forced to jump off cliffs where they were killed or sometimes impaled on sharpened and poisoned sticks. The use of dogs for hunting bighorn is also presented by Lowie (1924, p. 195) and Steward (1941, p. 272).

MIGRATION HUNTING IN LATE FALL–EARLY WINTER: The first significant winter snowfall provided the only opportunity for aboriginal hunters to employ a migration-intercept

strategy: "When the winter storms set in, loading their highland pastures with snow, then, like the birds, they [bighorn] gather and go to lower climates, usually descending the eastern flank [of the Sierra]" (Muir, 1894, p. 306). This seasonal movement followed traditional migration routes, and relatively high numbers of individuals were involved.

Here is a case in which the classic migration strategy could be applied (Binford, 1978a, p. 172). The herd location had to be monitored, with ambush occurring at a predesignated hunting site. Although there is considerable year-to-year variability in modern highland areas such as the Toquima/Monitor ranges, the initial snowfall normally occurs in the high country during September; October has fairly clear weather; and the first really significant snowfall and accumulation do not occur until early November.

The start of winter weather is a more or less predictable factor, producing a markedly clumped distribution of game. The critical factor here is the traditional use of travel corridors that are within or adjacent to precipitous terrain. This has been well documented by current studies of Great Basin bighorn:

> trails are extremely evident throughout southern Nevada and generally follow ridge lines that provide escape on either side. I think this factor is particularly important on the Toquima Range since much of the mountainous area does not provide adequate escape cover and was probably not used on a regular basis. Current sheep populations throughout Nevada are associated with this habitat characteristic and I'm sure historic populations were as well. I would be willing to bet that the limiting factor for sheep in the Toquima Range was the lack of adequate precipitous terrain throughout much of the area . . . evidence from throughout [Nevada] shows a lack of sheep use in areas of gentle terrain and an abundance in areas of precipitous terrain (McQuivey, personal commun.).

Because migration occurred during the early winter months, this would have been perhaps the time of greatest potential return for bighorn hunting efforts, particularly along these traditional migration routes. In early winter, well-coordinated communal efforts could easily have been mounted (especially if other fall-ripening resources, such as piñon nuts, had already been cached).

The tactics for staging the fall migration hunt undoubtedly varied, but there is ample evidence for communal hunting among ethnographic Numic speakers (Muir, 1894; Steward, 1933, p. 54; 1941, p. 272; Frison, 1978). Rock walls, lines of stone cairns, and hunting blinds can all be associated with these fall migration routes, which themselves are established along traditional trails (McQuivey, 1978).

The best locations for such bighorn hunts are along the numerous trails, which commonly run along ridgelines. These areas, associated as they are with side canyons, provide both "change of pace" and funneling factors necessary for successful intercept hunting. Granted that weather patterns can be somewhat erratic, fall migration hunting remains a relatively predictable and productive method of procuring bighorn in the central Great Basin.

HUNTING IN THE WINTER RANGE: Central Great Basin bighorn spent the winter primarily in the lowland canyon portions of the mountains, generally at an elevation between 1800 and 2100 m. (6000 to 7000 ft.). Snowfall can be significant even at these lower levels, and Kelly (1964, pp. 48, 50) has noted how snow hampered aboriginal hunting of both bighorn and antelope. Based on his own observations of the central Great Basin bighorn, however, McQuivey suggests that winter conditions may have worked in just the opposite fashion: "I would think that winter would be the easiest time and certainly the most predictable for early inhabitants to hunt bighorn because of the concentrations of animals in select locations. The Toiyabe herd, for example, winter at the lower elevations of only certain canyons because of escape cover requirements. Studies in Smith Creek Canyon of the Snake Range also support this premise" (McQuivey, personal commun.). In particular, the presence of fetal sheep remains at Amy's Shelter (Miller, 1979) would strongly suggest winter hunting, if it could be established conclusively that these bones had been deposited from human butchering activities.

Thus, it would seem, depending on local ground cover and weather conditions, that a simple encounter strategy might be productive during the winter months: a few hunters attempting to ambush isolated individuals or

small herds. Other than perhaps the isolated blind, one expects little prior investment of energy in this winter strategy. The return could vary from sparse to respectable, depending on how the animals congregated locally.

SPRING MIGRATION TO THE UPLANDS: The peak lambing season occurs between April and mid-May, as sheep are gradually working their way into the uplands to their summer range. But this migration is quite different from the downward fall migration. In the spring, bighorn herds essentially follow the snow melt, gradually moving upward to graze on newly exposed grasses, shrubs, and forbs.

This slow methodical movement to the high country precludes a migration intercept strategy. Hunting would have proceeded on either an encounter or limited low-density intercept basis. The predictability of success once again would be low, probably not justifying construction of extensive hunting facilities (although occasional blinds and rock alignments conceivably could have been constructed at intermediate elevations to assist in these casual hunting enterprises).

It is also possible that hunting blinds in the Toquima Range were associated with selected areas of seasonal concentration—particularly in areas with adequate escape cover (McQuivey, personal commun.). These blinds could have been used in any season, as opposed to those in migration settings that would have been used only during the fall season.

LOCAL FACTORS REGULATING BIGHORN HUNTING PATTERNS: For convenience, this section has been arranged according to a seasonal model; but it is important to point out that "migration" is only a relativistic, probabilistic concept when applied to bighorn sheep. Recent data from the various central Nevada bighorn herds also emphasize their opportunistic approach to distributional patterns and seasonal use areas.

Thus, the seasonal models suggested above should be viewed as general trends rather than specific year-to-year movements.

A second predictive factor also crosscuts the seasonal considerations:

> the most important concept relative to abundance and distribution of bighorn in Central Nevada is the presence or absence of adequate precipitous terrain which is used by sheep for escape from predators. Most of the ranges in Central Nevada provide only marginal escape cover, and I would guess that population numbers and distribution patterns were always limited because of the lack of this important characteristic. Virtually all of the populations of bighorn that were extirpated in Nevada were in areas where escape terrain is limited. Conversely, all of the populations that have survived through the present day are located in areas of extremely high quality precipitous terrain. A single example is the continued presence of a viable herd on Lone Mountain which is extremely rugged and the disappearance from the Toquima Range which is certainly steep throughout, but rugged in only select and isolated locations (McQuivey, personal commun.).

This factor is clearly important in establishing the bighorn procurement potential of individual areas.

GENERAL ARCHAEOLOGICAL CONSEQUENCES: Bighorn procurement is a relatively high visibility activity, and the archaeological consequences are rather clear-cut. In areas which have high mountains and few discrete passes, bighorn probably followed well-defined and traditional routes of migration, particularly in the central and northern Great Basin. Because herds annually moved from summer range in the high country to wintering grounds not far from the valley floor, migration trails provided first-rate areas for intercept hunting. Located at intermediate elevations should be a series of hunting facilities, some of which may have required considerable investment of labor: rock walls, blinds, perhaps corrals, and even monitoring stations. Depending on the local topography and the overall importance of bighorn procurement in that area, these features should be a relatively visible and regular aspect of the archaeological record.

The high country—over, say, 2700 m. (9000 ft.)—should contain evidence of low-density intercept hunting, namely facilities such as blinds, cairns, and rock alignments, constructed in areas exhibiting either natural "change of pace" or "funneling" environments. The artifact densities in the highland summer range should be quite high. Since an intercept (rather than encounter) strategy is suited to these areas, these artifacts should be highly clumped around traditional ambush spots. Such intercept strategies generally

imply a logistic use of the area, involving establishment of all-male, special-purpose field camps. Because the bighorn lived in these high altitude areas during the arid summer months, water would have been an important factor in positioning both the hunting facilities and also the temporary hunting camps. Based on our Reese River experience, we expect the camps and blinds to have been set up some distance from water, to keep from alerting the animals as they came to drink. Artifact assemblages at these field camps should be limited to tools and weapons required for kill and primary butchering.

Bighorn reach maximum herd size in the winter, when they are confined to small, rather traditional ranges by snow cover. Individuals were probably hunted there on a low-yield encounter basis. Fewer permanent hunting facilities are expected in such areas, and evidence of encounter strategy hunting will probably be limited to relatively scattered, low-density hunting losses. The archaeological visibility of bighorn hunting in the winter range is quite low, and almost no evidence should be found on the valley bottoms.

Bighorn could also be hunted in the intermediate uplands as they gradually filed into the summer range. Game was relatively dispersed then, and the movements of the animals were not nearly as predictable as in the early winter. Encounter strategy hunting, pursued at this time, would have produced an archaeological record of relatively sparse and dispersed kill-butchering losses and discards. It is quite possible that features constructed primarily for early winter migration hunting would be reused as *ad hoc* ambush locations during the springtime.

Antelope

Antelope, probably ranking second only to bighorn sheep in terms of their importance to prehistoric hunters, are rather smaller than bighorn; adult antelope in Alberta weigh as much as 57 kg., whereas those in Texas average about 40 kg. (O'Gara, 1978, p. 1). Antelope ethology, so different from that of bighorn, required a different aboriginal hunting strategy. In this section I explore the antelope procurement strategy in the Great Basin at large, and then suggest some general archaeological expectations.

Antelope Behavior: It has been estimated that some 35 million pronghorn antelope (*Antilocapra americana*) inhabited North America before white contact, but this population had decreased to fewer than 20,000 animals by 1924 (O'Gara, 1978, p. 4). Since then, pronghorn antelope populations have begun to increase due to relatively effective law enforcement, habitat improvement, and wildlife management techniques.

Although their numbers remain depressed, and their range severely restricted, pronghorn survive throughout Nevada. The largest herd lives on the Sheldon Antelope Refuge in northwestern Nevada, and relic concentrations are scattered throughout the state. In fact, a few antelope still live in Monitor Valley, several having been sighted in the course of the archaeological fieldwork during the 1970s (see Part 2). The Monitor Valley pronghorn are probably *A. a. oregona* (O'Gara, 1978, p. 1), although Hall (1946) previously considered the Nevada pronghorn to belong to *A. a. americana* (see also Hall and Kelson, 1959, map 495).

O'Gara (1978, p. 3) describes pronghorn as "dainty feeders" exploiting a wide variety of plant foods, primarily sagebrush, buckbrush, rabbitbrush, and other browse, as well as some grasses. Great Basin pronghorn favor open, flat, treeless territory, and there is no reason to think that protohistoric herds behaved differently.

There seems to be some difference of opinion regarding the migration habits of antelope (e.g., Heizer and Baumhoff, 1962, p. 214). Hall (1946, p. 630) refers to the animals as migratory, in the sense that they tend to move uprange during the summer and down to less snowbound areas in the winter. Einarsen (1948) argues that the herds in Oregon are not migratory in this sense: "They may change feeding grounds several times within the year, but their drift from one range to another is not usually a long trek, lacks rhythm and will as often be northward as southward in winter" (1948, p. 11; see also Mace, 1956, p. 15).

O'Gara (1978, p. 3) suggests that the timing and length of seasonal movements varies considerably with altitude, latitude, and range

conditions, but in general animals from large wintering herds disperse in the spring. Deep snow conditions sometimes force pronghorns to move as much as 160 km. from the summer area. Once on the summer ranges, does generally collect in herds of a dozen or less, young bucks form slightly larger bachelor herds, and old bucks claim territories. Formation of the summering bands of does and fawns takes place gradually over a period of weeks.

The size of wintering herds is determined by geography, range conditions, and severity of winters. When the snow gets deep, pronghorns must usually reach browse or perish, thus, large herds gather on sagebrush ranges during some winters (see also McLean, 1944, p. 225; Hall, 1946, pp. 629–630; Einarsen, 1948, pp. 41–42).

Pronghorn also depend heavily on their keen eyesight for survival (Caton, 1877; Einarsen, 1948; see also Prenzlow, Gilbert, and Glover, 1968), and they are almost never found in areas where their view is restricted by the terrain or other natural features. This makes it extremely difficult for predators to approach within 100 or 200 m. without being detected.

Antelope differ from bighorn primarily in that their defense is to flee from danger; they are known to run up to 100 km. per hour, if open space allows (Frison, 1978, p. 251).

Antelope are capable of sensing even slight movement or disturbance, and they often investigate, either staring or approaching for a closer inspection. As Einarsen (1948) points out, their curiosity often outweighs their judgment, and pronghorns have approached people who honked horns, discharged pistols, or made even the slightest movements (Prenzlow, Gilbert, and Glover, 1968, p. 2).

ABORIGINAL HUNTING STRATEGIES: Antelope spend most of their lives in the open treeless steppe environment, and the broad vistas of their central Great Basin habitat make surprising them particularly difficult, especially since they have such excellent eyesight.

Caton (1877, p. 59) has discussed methods of stalking individual pronghorns: "This feat is extremely difficult though not impossible in the naked plains . . . . Stalking among the sage brush is of course much less difficult . . . ." By contrast, Frison (1978, p. 252) argues that "antelope are easy to hunt. They are creatures of habit and appear regularly at waterholes. The hunter can either stalk the animals or sit tight in a good location and let the animals come to him. Either method is effective." The ethnographic Basin groups sometimes accomplished such encounter stalking by wearing an antelope disguise (Lowie, 1909, p. 185; 1924, p. 197; Driver, 1937, p. 62; Steward, 1941, p. 219). Although the Southern Paiute apparently did not commonly use disguises, they covered their approach by hiding behind tufts of rabbitbrush held in front of the body (Kelly, 1964, p. 50).

An encounter strategy could be employed anytime of the year, anywhere within antelope range. Few people would be involved in any single encounter, and the number of animals killed by this method would be low.

A considerably more common—and vastly more productive—method of pronghorn procurement was the well-known antelope drive. A number of ethnographic and modern accounts of antelope driving are available (e.g., Egan, 1917, pp. 238–241; Steward, 1933, p. 253; 1938, pp. 33–34; 1941, p. 272, fig. 1F; Heizer and Baumhoff, 1962, pp. 214–216; Frison, 1978, pp. 251–252). The purpose here is not to reiterate ethnographic detail, but rather to expose the strategy behind communal antelope procurement.

As is true of classic intercept hunting in general, three basic tactics are required for successful intercept procurement of pronghorn: monitor the herd location, funnel the game into restricted space, then artificially change their pace so they can be harvested. In addition, antelope can be "charmed," a further aid in intercept hunting.

Before the hunt begins, the pronghorn herd must be monitored so that the hunters are in proper position, with sufficient time to construct driving facilities. Although bighorn require extensive monitoring—because of changing locations, habitats, and herd sizes—monitoring pronghorn is relatively casual, the large herds being quite visible on the sagebrush flats. Several Great Basin groups simply sent out scouts a few days before to locate

the herd, then the rest of the drive team followed (see Steward, 1941, pp. 219–220). Among the Surprise Valley Paiute, the local headman simply sent "one or two young fellows to look around for a band of antelope" (Kelly, 1932, p. 83). Pre-established lookouts were unnecessary and no facilities were constructed for that purpose.

Once the herd was spotted, it was a relatively simple matter for the hunters to prepare the drive site by constructing funneling and kill features. These features were sometimes quite permanent—commonly constructed of rocks and timbers—only requiring refurbishing immediately before use. Egan (1917, p. 239) commented that one such facility made of thick cedars was "strong and high enough to withstand the charges of a herd of buffalo"; other antelope drive features have been described by Steward (1941, fig. 1F); Rudy (1953, pp. 18–20); Wetherill (1954); Euler (1966, p. 26); and Frison (1978, p. 254).

But using a permanent drive feature requires that the hunt be conducted in a given spot, not allowing for much logistic flexibility. The common Great Basin antelope drive employed walls constructed at the last minute, in the most advantageous spot. These V-shaped bottleneck fences and corrals funneled the pronghorn into a central spot, artificially increasing the game density and channeling the animals into the immediate kill area. The drive walls were not very high because antelope rarely jump even the lowest obstruction—an inability Caton (1877, p. 47) attributes to the fact that antelope evolved on the plains. Thus even relatively low drive walls seem to suffice, and these are commonly constructed of sagebrush or tree snags, depending on the habitat. These sagebrush driving wings could extend 2 km. in length. Bonneville, for instance, observed one such antelope drive site on the upper Lewis River, noting how a "small hedge" less than 1 m. high was sufficient to drive antelope to their death (cited in Caton, 1877, p. 47; see also Egan, 1917, p. 238; Kelly, 1932, p. 83; 1964, p. 50; Steward, 1938, p. 34; 1941, p. 219; Lowie, 1924, p. 197; 1939, p. 325; Davis, 1965, p. 27).

The same funneling effect can be accomplished by fire, a technique reported for the Little Lake and Egan Valley Shoshone (Steward, 1938, p. 82; 1941, pp. 220, 272). Fire driving, of course, has a number of additional ecological effects, which could be either helpful or harmful, depending on local edaphic factors (Lewis, 1973, 1978).

The pronghorn were then directed into a specific kill area. The simplest possible construction was a straight sagebrush barrier, with an opening in the center, where antelope could be ambushed as they passed through (Kelly, 1934, p. 50). The Southern Paiute constructed one such wall over 150 m. in length (Kelly, 1934, p. 50). Such drive walls sometimes terminated in snares and deadfalls, often located along game trails (Driver, 1937, p. 61; Steward, 1941, p. 271; Gilmore, 1953).

But the most common antelope kill occurred in what Caton (1877, pp. 47, 60) terms a "slaughter-pen," where hunters took turns "worrying down" the antelope so they could be readily dispatched with clubs or arrows. These corrals were commonly constructed of sagebrush, and often extended up to 1.5 km. in diameter (Kelly, 1932, p. 84; Steward, 1938, pp. 82, 220; 1941, p. 219; Frison, 1978, p. 254); brush, wood, and stone could also be used. In areas of particularly sparse ground cover, sagebrush ropes were braided beforehand, then used to make a fence and corral (Kelly, 1932, p. 84; Riddell, 1960, p. 40).

One final aspect of pronghorn procurement also deserves mention, the well-known *antelope charming complex.* The curiosity of antelope is legendary, and this trait makes them susceptible to "charming" by specially talented antelope shamans (Kelly, 1932, p. 83; Steward, 1938, 1941; Lowie, 1939, pp. 324–325). The attention of a pronghorn is often attracted by unusual objects, such as a flag, or perhaps a newly constructed cairn visible on the skyline. Hunters, both protohistoric and modern, have utilized this unusual curiosity of antelope to lure the unwary animals into ambush. It is conceivable that such charming could be visible in the archaeological record in the form of cairns or perhaps unusual alignments.

The ethnographic detail regarding communal antelope hunting is rich and varied.

But the concern here is not with specifics, but rather with the underlying strategy employed. It is clear that pronghorn procurement involves all the features of classic intercept strategy hunting: monitoring, funneling, and final dispatching.

GENERAL ARCHAEOLOGICAL CONSEQUENCES: Although antelope occasionally venture into mountainous areas, they dwell predominantly on the valley bottoms, and this is where the archaeological record of antelope procurement is to be found. Two hunting strategies are possible for antelope, and each carries with it distinct archaeological consequences. The very low-density encounter/ambush strategy is most profitably pursued near lowland water sources. If water is a point resource, this ambush hunting can be rewarding; however, linear water resources permit the antelope considerably more latitude, making encounter hunting more difficult and less productive. It is quite possible that small individual blinds were constructed in such ambush spots—particularly those associated with point water sources—and the artifact inventory would then be restricted to low density, slightly clumped kill-butchering losses and discards.

The intercept strategy for pronghorn procurement is both more productive, and more visible archaeologically. Large communal antelope driving features were commonly constructed on the valley floors, and probably also near the lower alluvial slopes. "Wings," corrals and cairns could all function as part of this strategy. Although such facilities are usually constructed merely of brush and branches, some well-constructed pronghorn facilities are made of heavy beams and rocks, which though preserved in the archaeological record, are commonly overlooked in the traditional archaeological survey.

Except for the unusual case in which antelope traps were continually reused over long periods of time, the artifact assemblage associated with pronghorn procurement would be sparse, although locally clumped. Artifacts should be restricted to kill and butchering implements. Since most pronghorn hunting facilities were made of perishable materials—and easily destroyed by fire—such clumped artifact scatters might be found in seeming isolation almost anywhere on the valley floor.

DEER

Mule deer (*Odocoileus hemionus hemionus*) are ubiquitous in the contemporary Great Basin. Deer generally inhabit broken country, open plains, brush, or woods, and their bounding gait is well-suited for rough terrain. Mule deer browse on a variety of woody plants, but also graze on grasses and forbs. Unlike antelope, deer are not usually evident during the day, especially in warm weather (Frison, 1978, p. 271). Because of their current abundance, some investigators have relied heavily on modern deer migrations for reconstruction of prehistoric Great Basin hunting patterns (e.g., Heizer and Baumhoff, 1962, pp. 210–213). But an examination of the faunal inventories of Great Basin sites indicates that deer were relatively unimportant in the prehistoric past (Thomas, 1970).

This idea can be traced to Durrant (1952), who cited historical evidence documenting the scarcity of deer in Utah in 1776; Escalante and other explorers were forced to eat their horses in areas which today support a high deer density. Taylor (1954) repeated this notion on evidence from the Garrison Site, and Jennings (1957) noted that the faunal materials from Danger Cave also reflected the same peculiar absence of deer bones. Subsequent excavations at dozens of sites support this initial impression.

Buechner (1960, pp. 150–152) has argued that deer were relatively scarce in the Sierra Nevada until the beginning of the 1830s. They were so rare in central Nevada historically that a deer hunt usually attracted the attention of local newspapers (McQuivey, n.d.). The central Nevada herd population apparently exploded in the 1920s and 1930s.

BEHAVIOR OF MULE DEER: It was unfortunate for the aboriginal hunter that deer densities were so low during prehistoric times. As Frison (1978, p. 271) points out, deer are not very difficult to hunt, often demonstrating a "fatal attribute in their behavior pattern": they will run only a short distance when frightened, and then stop to look back, making them easy prey for a hunter. Frison suggests that mule deer are a dependable source of food when they are present in an area.

Although deer follow distinct and tradi-

tional migration routes (e.g., Russell, 1932), little is known about specific migration patterns in the central Great Basin. Furthermore, the available information is of questionable relevance to the prehistoric condition, given the dramatic and radical population increase documented within the last 50 years.

Steward (1941, p. 218) had argued that deer was the most important game animal throughout the protohistoric Great Basin, except for Death Valley and the central Nevada area, where deer were said to have been scarce.

Following Steward's lead (especially 1938, p. 36), most investigators have argued that deer hunting was primarily conducted on an encounter basis (for an exception, see Heizer and Baumhoff, 1962, p. 213). Encounter strategy hunting is well described by Powell (Fowler and Fowler, 1971, p. 47):

> The Indian as a hunter exhibits great patience and his success is chiefly due to this characteristic . . . . His practiced eye discovers the tracks or sees an animal at a great distance, and when the game is discovered he will walk around for a long distance to get in such a position that the deer will be to the windward. Great care is taken to crawl upon the deer so as not to frighten him, and for this purpose an Indian will often crawl upon the ground many hundred yards so managing that the little trees and bushes even, or the inequalities of the ground, will cover his approach . . . . If the deer occupies some position so that he cannot get quite near enough to him without exposing himself he will lie down and gently wait until his position is changed, even though it may be necessary to wait in such a place for hours.

For other ethnographic and historic accounts of encounter strategy deer hunting, see Lowie (1909, p. 185; 1924, pp. 195–196); Kelly (1932, pp. 81–82; 1964, pp. 48–49); Steward (1933, pp. 252–253; 1934, 1938, p. 36; 1941, p. 218); Gilmore (1953); and Davis (1965, pp. 26–27). Deer were procured in encounter strategy hunting in a number of ways including the surround, woodland firing, and ambush along migration routes; deer disguises were sometimes employed.

Snares were also set across game trails; these well-made *Apocynum* snares were formed into a noose, with fine lines attached to a trigger mechanism, and then covered with leaves and debris; a cache of nine such snares has been discovered in Owens Valley (Osborne and Riddell, 1978; see also Steward, 1941, p. 273).

Encounter strategy hunting was undoubtedly important for procuring deer in protohistoric times, but there is evidence that deer were taken at least occasionally on an intercept basis (Steward, 1938, pp. 53, 66). Communal deer hunts were conducted ethnographically in the White and Sierra ranges, directed by the district headman, with women and older men remaining in camp to process the meat (Steward, 1933, p. 353). Men hunted communally over a large region, stationed at 100 m. intervals, firing the brush and driving the deer into a great circle where they were shot; apparently deer locations were previously monitored in such hunts (see also Lowie, 1939, p. 326; Patterson, Ulph, and Goodwin, 1969). Keyser (1974) has also reported a large wooden corral and an extensive system of wings used to channel deer into the corral, located in southwestern Montana, at an elevation of nearly 2400 m. (8000 ft.). This feature was probably constructed by Shoshoneans between about 1800–1850. Steward (1943, p. 359) describes how such a feature may have operated:

> [the enclosure was] used when deer migrated, probably to the valleys, in the fall. Brush wings led to a corral of cedar posts, 20 to 30 feet in diameter, placed on the deer trail. The entrance to the corral was barred by a hurdle of posts leaning inward, so that the deer could leap in but not out . . . . A man . . . near the end of one wing . . . frightened the animals toward the corral by striking sticks together. Once inside, the deer was killed with an arrow and removed; then the hunter waited for another. 5–15 were said to have been taken in a single night.

GENERAL ARCHAEOLOGICAL CONSEQUENCES: Deer occur throughout most habitats in the central and northern Great Basin, but this relatively high density is probably a recent phenomenon. Most protohistoric deer hunting was probably conducted on an encounter basis, and it seems obvious that the high country was hunted during summer months only; the lower slopes and valley floor were

hunted mostly during the winter, although deer can be found in these areas almost anytime of the year.

If deer was a significant dietary item during the prehistoric period—a dubious proposition—then the archaeological record would involve isolated losses from both hunting and kill-butchering, scattered in somewhat clustered fashion from the lower valley slopes up to the summit crest. Although ambush and drive features may have been constructed to assist in such encounter hunting, these facilities would have been of more use in procuring bighorn, and only incidentally reused for deer.

In other words, deer hunting in the protohistoric Great Basin has very low archaeological visibility. The artifacts and features employed are indistinguishable from those used for bighorn, and they should be distributed in roughly similar fashion across the landscape; however, artifact and feature densities differ significantly between deer and bighorn procurement. This proposition can, of course, be tested by examining the occurrence of deer remains in archaeological sites from the protohistoric period; few such bones are expected.

EATING THINGS THAT MOVE: CLAWED ANIMALS

Trapping, hunting, and collecting small and medium-sized mammals was another focus of the protohistoric Great Basin subsistence effort, although these resources probably comprised a relatively small proportion of the overall caloric intake. Small animal byproducts also supplied craft materials used for fabrication of clothing, implements, and domestic equipment.

Extensive encounter strategy hunting was conducted throughout the Great Basin, and the list of species exploited in this manner is truly impressive: jack rabbit (*Lepus californicus*), cottontail rabbit (*Sylvilagus idahoensis, S. nuttallii, S. audubonii*), pika (*Ochotona princeps*), porcupine (*Erethizon dorsatum*), beaver (*Castor canadensis*), fox (*Vulpes fulva, V. cinereoargenteus, V. macrotis*), wolf (*Canis lupus*), bobcat (*Lynx rufus*), bear (*Ursus americanus*), badger (*Taxidea taxus*), marmot (*Marmota flaviventer*), plus literally dozens of species of rodents, including ground squirrel, chipmunk, prairie dog, wood rat, and mice (Lowie, 1909, p. 187; 1924, pp. 195–199; 1939, pp. 326–327; Chamberlin, 1911, p. 28; Kelly, 1932, pp. 86–93; 1964, pp. 52–55; Steward, 1933, pp. 253–255; 1938, pp. 38–40, 1941; Driver, 1937, pp. 61–62; Alcorn, 1940; Harris, 1940; Hall, 1946, pp. 290–292; Riddell, 1960, pp. 32–40; Davis, 1965, pp. 31–36; Wheat, 1967, pp. 9–16; Fowler and Fowler, 1971, p. 48).

The Great Basin Shoshoneans were perfectly willing to exploit small meat packages, a strategy which continually amazed and amused early explorers and settlers (e.g., Frémont, 1845, p. 435; Simpson, 1876; Powers, 1877, p. 450; Coville, 1892, p. 351; Leonard, cited in Wagner, 1904; Wells, 1978; Dansie, 1979).

Ethnographic and historic sources document a wide range of specific small mammal procurement methods. Spring-pole traps were used for many of the smaller mammals and snares for larger animals such as wolves and foxes. Deadfalls and snares were commonly used on a variety of small game, and pitfalls were employed for somewhat larger game animals. Rodents and rabbits sometimes were prized from their holes with specially constructed rodent skewers and reptile hooks or they were excavated with digging sticks. In addition, they were smoked out or their burrows were flooded (Steward, 1941).

Despite this diversity, a single thread runs through all this low-density encounter strategy hunting: procurement was always a low-yield process unlikely to figure prominently in the mobility strategy of Great Basin aboriginal groups. Small game procurement has a limited archaeological visibility; there was always isolated breakage and loss of weapons and general utility tools, creating sparse, ill-defined non-sites wherever hunting and trapping occurred.

On the other hand, such activities may occasionally show up if the more seasonally specialized tools—such as rabbit nets, snare parts, and so forth—were temporarily stored in tool caching areas. The importance of tool caching is directly correlated with the degree of environmental predictability and the degree

of redundance in the annual positioning strategy.

The communal rabbit drive—it actually involved hares rather than rabbits—was an exception. The drive was accomplished by a variety of techniques, but the following account for the Washo paints the general picture (Lowie, 1939, p. 327):

> The rabbit chief . . . set the time for the drive. People met with bows and arrows. Possibly 15 men had nets, which they united into an enclosure about 200 yards long and 4 feet in height, held by sticks 6 or 7 feet apart. The line was straight except at the ends, where it was crooked. About 200 Washo, the "boss" among them, joined in the drive, scaring their quarry. An old man with a boy stayed at one end of the net, which Dave compared to the wire fence of a chicken coop. Some people shot the game with bow and arrow. The rabbits thought they were escaping and rushed into the net, where most of them were caught. The boy would get up and kill them with a stick. The drivers killed most of the rabbits, possibly 3 or 4 apiece, with a total kill of 400 to 500 a day. On the following day the hunters went in another direction, perhaps 6 miles away. When heavily loaded, they went home.
>
> Rabbits, when caught were hit on the head with a club . . . then they removed the hide and the women gutted the animals. The men tore the skin from the legs with their hands, then cut the hides into string. The string was wound around small straight willow sticks. String was twisted into one piece 14 feet long. After drying them for a day and a half, they would take them down. Twenty-five strings made one jack rabbit blanket to cover two people. When first finished, they were 2½ inches thick and so warm that in winter the Indians would undress completely under such a covering.

Variations on this technological theme are described by Powers (1877, p. 452), Chamberlin (1911, p. 28), Egan (1917, cited in Steward, 1938, pp. 38–39), Steward (1933, pp. 253–254; 1941, pp. 220–222), Kelly (1932, p. 88; 1964, p. 50), Sapir (in Kelly, 1964, p. 51). Wheat (1967, p. 14), Powell (Fowler and Fowler, 1971, p. 48). Several historic accounts for the area Austin, Nevada are reproduced by Rosen (1978, p. 53).

In spite of variations, certain structural similarities are common to all rabbit drives. First of all, rabbit drives were labor intensive, and often held in sequence throughout the lowland sagebrush-grass zone. Both timing and location were doubtless conditioned by the amazing population booms among the black-tailed jack rabbit (*Lepus californicus*) (Woodbury, 1955). Jack rabbit populations can reach near plague proportions, and rabbit drives were commonly conducted by plains farmers in the midwest during the 1930s in order to rid their farmland of these pests, which destroyed crops and created health hazards; within this past year, farmers have once again instituted communal rabbit drives for precisely the same reason.

The causes for these explosive population increases have been traced to drought, and, to a lesser extent, historic overgrazing (Wooster, 1935; Taylor and Lay, 1944; Bronson and Tiemeier, 1959). As vegetative cover in an area is reduced through either drought conditions or overgrazing (or, perhaps, fire in aboriginal times), jack rabbits congregate in massive herds, living in small pockets of relatively drought resistant areas. There are reports of literally "hundreds of jack rabbits per square mile" (Bronson and Tiemeier, 1959, p. 197) along minor, well-watered "edges" at such times, and this is probably when and where the aboriginal rabbit drives were conducted. Since the primary function of the aboriginal rabbit drive was to acquire pelts, the drives were commonly held in the fall, when the fur was in prime condition (Lowie, 1939, p. 327; Steward, 1941, p. 222; Wheat, 1967, pp. 75–77; Rosen, 1978, p. 53). But the drives also produced a remarkably high bulk food resource. Adult black-tailed jack rabbits can weigh over 2.7 kg. (Hall and Kelson, 1959, p. 279); the meat produced on the Washo rabbit drive described above by Lowie can be conservatively estimated in excess of 680 kg. Rabbit meat was often consumed immediately, but sometimes the meat was dried and preserved with the winter cache (Chamberlin, 1911, p. 28).

The rabbit drive thus consisted of a short-term communal harvest of a high bulk resource staged on an encounter basis. Large field camps were often established near the location of such drives (Steward, 1938, pp. 38–39; 1941, p. 222). But other drives were

conducted by hunters who returned home each night to celebrate in the sweat house (Steward, 1933, p. 254); this implies that drives were carried on in both the foraging and the logistic ranges (Binford, 1982a; see also chap. 5 this volume).

Rabbit drives were commonly held in conjunction with regional festivals and *fandangos,* the high bulk food resource offsetting much of the economic cost of such rituals.

EATING THINGS THAT MOVE: FLYING AND CRAWLING ANIMALS

The Basin Shoshoneans not only exploited a large number of avian species—Steward (1941, p. 277) lists 32 species for the Western Shoshone alone—but they also collected and ingested such tiny game packages as grubs, locusts, cicada, caterpillars, fly larvae, lizards, snakes, and the desert tortoise (Connolly and Eckert, 1969). While all of these resources could be consumed immediately—often as *famine food* (Ogbu, 1973; Colson, 1979, p. 25)—in relatively food-abundant years, they were cooked, dried, and stored as back-up resources (e.g., Powers, 1877, p. 453; Chamberlin, 1911, p. 28; Steward, 1933, p. 256; Heizer, 1950; Wheat, 1967, pp. 9–16; Fowler and Fowler, 1971, p. 48).

Flying and crawling animals were all taken individually on a limited encounter basis, but there were occasions when insects could be harvested in great abundance. Diverse species were involved, but a general harvest technology is well illustrated by the case of *kutsavi,* the larva of a small fly (*Ephydra hians*). Heizer (1950) has documented the extensive exploitation of *kutsavi* across much of the Great Basin: excellent accounts being available for the Owens Lake, Mono Lake area, the Great Salt Lake, throughout Washington, Oregon, California, and near Pyramid Lake, Walker Lake, and sloughs at the Quinn River (although apparently the *Ephydra* fly did not breed in Humboldt Lake, Carson Sink, or Pyramid Lake proper).

Both the *Ephydra* fly and its larva are quite small; the fly is 3.2 to 5.6 mm. long; the larva is 12 mm. long (Essig, 1934). But *kutsavi* larvae occur in tremendous quantities. Brewer (1930, p. 417) has noted that both larvae and flies "drift up in heaps along the shore . . . *hundreds of bushels* could be collected. . . . The Indians come [from] far and near to gather them." Browne (1865, p. 417) observed a *kutsavi* concentration at Mono Lake "about two feet high by three or four in. thickness, [it] extends like a vast rim around the shore of the lake. I saw no end to it during a walk of several miles along the beach." While at Mono Lake, Mark Twain observed the Paiute collecting *kutsavi.* He notes (1913, p. 261) "if you dip up a gallon of water, you will get about 15,000 of these."

Once collected, larvae were dried and the shell rubbed off by hand. They were then boiled into mush. There is also evidence that larvae, either this species or something similar, were collected in baskets when blown up on the shore, then dried with seeds and rabbit meat for winter food (Steward, 1933, p. 256).

Kutsavi larvae are available only during warm weather (Leonard, in Wagner, 1904, p. 166). Loew (1876, pp. 189–190) noted that the larvae occur in especially great numbers during August and September, and it was at this time that the Indians congregated to scoop them up with baskets.

Although the availability of *kutsavi* may have been seasonally erratic and occasionally subject to conditions which did not permit the *Ephydra* flies to produce eggs from which larvae could be hatched (Heizer, 1950, p. 37), the Mono Lake groups which depended heavily on *kutsavi,* apparently had a backup strategy, relying on pandora moths and bird eggs in years of *kutsavi* shortage (according to Browne, 1865, p. 418).

Because *kutsavi* also served as forage for birds, an interestingly short term yet high density food chain was created. Mark Twain (1913, p. 261) described the situation well: "providence leaves nothing to go by chance. All things have their uses and their part and proper place in Nature's economy. The ducks eat the flies—the flies eat the worms—and the Indians eat all three." The seasonally abundant *kutsavi* may have provided not only foodstuff directly, but also "bait" for bird populations, particularly migratory birds.

Insect collecting could thus occasionally produce sufficiently high-bulk returns to influence mobility patterning. The same is

true of bird exploitation, which often could provide a rich and storable harvest. Migratory birds pass through much of the Great Basin between late spring and fall, flocking on nearly all available standing bodies of water (Linsdale, 1938) and occurring in large numbers in the areas of abundant wetlands such as the Humboldt and Carson sinks. Ducks and mud hens could often be netted near the marshes: individual hunters hung their nets at an angle above the water, supported by forked sticks, and feeding ducks were then frightened into the nets (Wheat, 1967, p. 10; Heizer 1970, p. 233). Waterfowl could also be taken at blinds (Steward, 1941, p. 274; Kelly, 1964, p. 53), sometimes with the assistance of duck decoys constructed for the purpose (Steward, 1941, p. 274; Wheat, 1967, pp. 47–54).

Birds and reptiles were trapped during the summer months with deadfalls and spring-pole traps (Steward, 1941, p. 273; see also Wallace, 1978). Ducklings could also be taken by hand during the summer when they were of good size, but unable to fly; older birds molted flight feathers at this time, and were vulnerable to either individual encounter hunting or limited driving.

The general characteristics of communal bird procurement are well illustrated by the case of the sage grouse, a relatively large upland bird that could occasionally be taken in abundance. During the early twentieth century, sage grouse were found virtually wherever sagebrush occurred, throughout many of the western and intermountain states. Although drought and overgrazing drastically reduced sage grouse numbers during the 1930s, this hearty species has rebounded in the last couple of decades. It was estimated that 11,765 sage grouse were killed in Nevada in 1968 (Johnsgard, 1973, pp. 157–158).

The predictable behavior of sage grouse lends itself well to the communal drive. Writing about sage grouse at Kingston in Big Smoky Valley, Linsdale (1938, p. 54) noted how the birds rapidly became accustomed to the presence of human beings: "this makes killing of them by hunters too easy and results in much waste." Johnsgard (1973, p. 172) remarked on the large size and poor agility of sage grouse. These characteristics, along with their odd territorial sexual behavior, make hunting sage grouse relatively easy.

The seasonal movement of sage grouse is well-known and quite predictable. Depending on local weather conditions, their wintering areas are often 50 to 80 km. from their fall and spring habitats (Dalke et al., 1960, 1963), at altitudes as low as possible and almost exclusively in sagebrush-covered areas, generally free of snow (Rogers, 1964).

In late winter, males travel to the traditional strutting grounds, characteristically established on wind-swept ridges and knolls with relatively open ground cover (Patterson, 1952). Dalke et al. (1963) found that males commonly occupy the grounds in late March or early April, and females follow shortly thereafter. Females then move off the strutting ground proper to a distance of a kilometer or so to establish their nests (Johnsgard, 1973, pp. 164–165). Following nesting, the hens gradually move their broods to places where food is plentiful, usually to areas of abundant moisture. The family units generally break up during the summer months, and then in the fall the grouse migrate to their wintering area, often gathering in flocks near water holes (Dalke et al., 1963). During severe winters, flock size can reach as high as 1000 birds (Johnsgard, 1973, p. 164).

Protohistoric Basin Shoshoneans exploited sage grouse with some regularity. De Smet (1905, p. 1033) gives an early ethnographic account of sage grouse hunting in Utah (see also Lowie, 1909, p. 185; 1924, p. 195). Steward provides the details of sage grouse hunting: "bird nets seem most often to have been used for sage hens, which were caught early in the morning when the roosters 'danced.' Antelope disguises were often used to herd the birds" (1941, p. 222, fig. 1g). Long, low sagebrush walls were sometimes arranged in a "V" shape, funneling the birds into a tunnel-like brush enclosure.

Communal bird procurement involves a high bulk strategy. Birds follow relatively predictable migratory patterns, and many occur in dense patches at known times. In the case of migratory waterfowl, these patterns are well established around wetland areas; upland birds like sage grouse return to the traditional winter grounds and booming

areas year after year, and the birds are vulnerable at this time. Much labor/material was expended in the construction of decoys and nets for use in the marsh, and the implements may have been cached for seasonal use. In the uplands, the predictability of birds like sage grouse could justify the high costs of constructing walls, blinds, and artificial barriers. These high cost facilities also condition the positioning strategy which generally required logistic parties to establish a field camp nearby.

By contrast, encounter strategy hunting and collecting of birds, reptiles, and insects would rarely justify either construction of artificial facilities or establishing of base camps; encounter hunting was probably in most cases done within the foraging radius of the base camp.

EATING THINGS THAT GROW IN PLACE: SEED PROCUREMENT STRATEGIES

As he approached his ethnographic fieldwork among the Panamint Shoshone, Frederick Coville was obviously unimpressed with the Great Basin environment as a place in which to make a living:

> Those who are not familiar with the desert can imagine an apparently limited plain, devoid of trees and grass, without streams or springs, but provided with a vegetation of cactus and scattered low shrubs of greasewood and creosote bush. Nor does a closer inspection affect one more pleasantly, for all the shrubbery is either woody or indigestible, or resinous and rank both in smell and taste . . . the very first necessaries of life appear to be absolutely wanting, and this state of affairs exists not for one mile only, nor for ten miles, but for hundreds (Coville, 1892, p. 351).

And yet, the fact that the Panamint Shoshone did indeed survive in this environment intrigued Coville: "the desert Indians' means of subsistence [became] a subject of unusual interest." Coville recognized immediately the overriding importance of plant foods in the diet of the Panamint Shoshone, a fact verified by both previous and subsequent investigators. It is well-known, well-documented, and undisputed that seeds were the major dietary item for the protohistoric Shoshoneans (e.g., Lowie, 1909, pp. 187–188; 1924, pp. 200–202; Chamberlin, 1911, p. 29; Kelly, 1932, pp. 97–104; 1964, pp. 36–39; Steward, 1933, pp. 238–239; 1938, pp. 19–21; Wells, 1978; Zigmond, 1981). But a wide variety of behavior can be masked under the rubric of "seed procurement" and it is necessary to consider the technology, seasonality and strategies required for harvesting various kinds of seed crops available during the protohistoric period.

Seed Procurement Technology

The general technology for procuring wild seed crops is amply documented throughout the ethnographic and historic literature (e.g., Chamberlin, 1911, pp. 32–33; Riddell, 1960, pp. 32–38; Wheat, 1967, pp. 8–11; Fowler and Fowler, 1971, pp. 39–42; Zigmond, 1981, pp. 46–47). Once again, our concern is not to construct a pedantic listing of technological variability, but rather to use these data to build mid-range theory regarding the underlying strategies involved.

Six steps are generally involved in Great Basin seed procurement: collecting, threshing, roasting, winnowing, milling, and storage.

Techniques of *collection* varied with the specific seeds being exploited, but large twined baskets were almost always used for initial gathering (Steward, 1938, p. 32; Kelly, 1964, p. 62). Seeds could be knocked into these containers with seed beaters made of basketry or sometimes wrapped sticks (Steward, 1938, p. 32). Carved sticks, shaped like knives were also used for striking off the ripe spikes and seed heads (Chamberlin, 1911, p. 32). A number of plants, particularly ricegrass, were harvested by cutting off the entire seed heads, which were then tied into bunches and placed in burden baskets (Kelly, 1964, p. 41; Wheat, 1967, p. 11; Wilke et al., 1972; Zigmond, 1981, p. 47; Bettinger and Baumhoff, 1982).

Pine nuts—which are "seeds" in a strict sense—required a slightly different gathering technology, involving either pulling the mature cones from trees with piñon hooks, or collecting fallen cones and seeds on the ground (e.g., Dutcher, 1893; Maule, 1930;

Wheat, 1967, pp. 29–39; Zigmond, 1981, pp. 50–51).[1]

Once secured, seeds were generally transported back to the residential base or field camp, depending on the positioning of the overall procurement strategy. The harvested seeds were then *threshed* with sticks or paddles until the chaff, pods, and other accessory parts were fully loosened from the seeds. Sometimes the large chaff was sorted by hand, and the seeds were often winnowed to complete the threshing process. Seeds could be also freed by burning or pounding (Chamberlin, 1911, p. 33; Wheat, 1967, p. 11; Fowler and Fowler, 1971, p. 39; Zigmond, 1981, p. 46).

Roasting of smaller seeds was accomplished by adding charcoal and ashes to the cleaned seeds, placing the mixture on large parching trays, then carefully shaking and agitating until they were thoroughly cooked. Hunter-gatherers skilled in this technique kept the tray in constant motion to avoid scorching. As they cooked, the seeds often would swell and burst; Powell compared them at this stage to freshly popped white popcorn (in Fowler and Fowler, 1971, p. 42). The cooked seeds were then cleaned by *winnowing,* to remove both remaining chaff and charcoal.

Seeds could be consumed at this point, but most were *milled* using the conventional mano and metate. As they were milled, some seeds (such as *Mentzelia*) produced a paste-like mixture; others were mixed with water to form a thick mush (Kelly, 1964, p. 41). Meal-like mixtures could be patted into cakes and dried or baked, or they could be mixed into gruel (sometimes with berries added). Some seeds were boiled in pots or baskets instead of being milled (Steward, 1938, p. 32).

The final step in seed procurement depended on whether the food was to be eaten immediately or stored for later consumption. If stored, the processed seeds were then placed in prepared *caches,* commonly grass-lined and sometimes covered with tree bark and earth (e.g., Chamberlin, 1911, p. 34; Lowie, 1924, pp. 198–202; Steward, 1933, p. 241; 1941, pp. 231, 280–281; Shutler, 1956; Fowler and Fowler, 1971, p. 49). Although caches were generally built at the winter residence (Chamberlin, 1911, p. 29), caching depended heavily on size and weight of the specific crop, as well as the nature of the collecting/foraging strategy. High bulk crops such as pine nuts were commonly cached near the harvesting location, and then subsequently transported to the residential locality. In other cases, caches were established throughout the logistic radius, often in caves or shelters (Kelly, 1964, pp. 37–39).

Although brief, this sketch sufficiently describes the tactics involved in protohistoric Great Basin seed procurement. There is considerable variation in behavior associated with specific crops, and one must consider the behavioral concomitants of specific seed collecting strategies to project the major implications for each in the prehistoric Monitor Valley.

Piñon Procurement and Processing

The mechanics of piñon procurement in the protohistoric and historic Great Basin pose little mystery, and the details need not detain us. Direct ethnographic accounts regarding piñon processing by Basin aboriginal peoples can be found in Dutcher (1893); Muir (1894); Lowie (1924, pp. 291–293); Maule (1930); Kelly (1932, p. 99; 1964, p. 43); Steward (1933, pp. 241–242; 1938, pp. 27–28); Price (1980, p. 47); and Zigmond (1981, pp. 50–51). Pine nuts were harvested throughout the historic period, and newspaper accounts contain ample information regarding technology and even data on annual pine nut yields (e.g., Wells, 1978).

Great Basin residents, of course, continue to harvest pine nuts in great quantities, and literally dozens of contemporary accounts and "how to" articles are available (e.g., Wheat, 1967, pp. 29–39; Lanner, 1981, pp. 67–72). Pine nuts are also marketed commercially. Put simply, pine nuts were, and still are, good food. As one Owens Valley Paiute informant recently remarked, "they're nice to eat while watching T.V." (Roberts, 1965, p. 18).

As tempting as it is merely to extoll the unique virtues of the pine nut, a mid-range theoretical approach goes beyond generali-

zations from empirical details to define the basic underlying strategy.

There is a critical and generally overlooked similarity between the strategy of harvesting pine nuts and the intercept strategy of harvesting game animals. The structural similarities are striking: both resources must be carefully monitored long before procurement; residential and logistical positioning must be adjusted beforehand to allow successful and economic harvest; the decision must be made whether to transport high-bulk items or to move the base camp to the location of procurement; timing is absolutely critical, since the "window" for successful harvest is often distressingly short.

There are, of course, differences between intercept hunting and piñon harvesting, primarily in the time-space framework. Intercept hunting requires that game be "intercepted" in both time and space; "intercepting" piñon requires primarily temporal interception, since the resource is stationary. But even this distinction is not overly important, since the annual variability of local piñon productivity injects a certain amount of spatial interception as well.

In order to establish the strategic parallel between these two disparate resources, it is necessary to consider their procurement structure in detail. Intercept hunting has already been discussed, and the following sections develop a similar perspective on pine nuts.

We can characterize the nuts of *Pinus monophylla* as follows: pine nuts provide a short-term, high-bulk, extremely nutritious, storable, cost efficient resource; although pine nut productivity is notoriously erratic, yields are at least in part predictable. These points are critical to an understanding of the protohistoric structure of Monitor Valley and will be developed individually.

PINE NUTS ARE A SHORT-TERM RESOURCE: The "pine nut" is, of course, not really a nut at all, but rather a wingless seed. As Lanner (1981, p. 50) has aptly put it, the pine nut is "big and clumsy .... If left to its own devices, a tree would eventually drop its seed to the ground beneath its crown." Once they sprout, seedlings would be rapidly shaded out, and "of little help in the perpetuation of these woodlands."

The biology of *Pinus monophylla* is unusual because this species of tree is completely dependent for its survival on corvid birds. Today, if Stellar's Jay, Clark's Nutcracker, and the Piñon Jay were to disappear, so would piñon pine trees.

This is clearly a symbiotic relationship: "Tree feeds bird and bird plants tree .... Piñons were invented by jays. The jays still hold the patent—and continue to collect most of the royalties" (Lanner, 1981, pp. 52, 55).

All of this has the makings of an ecological "Just So Story," until humans enter the picture. The close ecological relationship between jay and piñon evolved long before humans began exploiting pine nuts and, in a real sense, the evolutionary deck is stacked against the human consumer, in favor of what Lanner calls the "feathered cultivator."

Competition from the corvids is so stiff that, if the humans are not careful, they could lose out entirely. Once ripe, the available pine nuts usually disappear in a few days to a couple of weeks.

The initial requirement for a successful piñon harvest is thus to beat the competition to the nuts. The aboriginal harvesters were, of course, well aware of this necessity. Steward's informants estimated that their effective piñon harvesting period was about two to three weeks, rarely longer (Steward, 1938, p. 27); the Ruby Valley informants said they only had 10 days to harvest their piñon crop.

Pine nuts vary from region to region, and generally ripen earlier at the higher elevations; so it would be possible in some cases to schedule more than one harvesting locus in a single season. Nevertheless, to harvest piñon in quantity, one must be on hand, at the right spot, at the proper time. This condition is a direct parallel to classic intercept hunting of game animals.

PINE NUTS ARE A HIGH-BULK RESOURCE: A number of estimates are available for the bulk of pine nut stores. Dutcher (1893) observed a group of 10 to 12 Panamint Shoshone women harvesting and processing one or two bushels of pine nuts per day; but one does not know whether these figures apply to hulled nuts or cones, how much time was

actually spent on this each day, or the exact weights implied by Dutcher's units of measurement (see Jones, 1981).

Steward (1938, p. 27) estimates that about 23 kg. of pine nuts could be harvested in a single day, and he further suggests that for a family of four, roughly 540 kg. of nuts would be required for winter survival (if only pine nuts were consumed).

The specific quantities involved in piñon harvesting are considered below, but it is clear that (1) pine nuts are heavy and (2) if they are to function as a staple, a great quantity is required.

Once again, the relatively difficult transport problem after harvest makes pine nuts remarkably similar in economic structure to intercept hunting.

PINE NUTS ARE AN EXTREMELY NUTRITIOUS RESOURCE: Recent analysis by Farris (1980) demonstrates that nuts of *Pinus monophylla* are relatively low in both fat (about 30%) and protein (less than 10%); but pine nuts have an extremely high proportion of carbohydrate. Farris suggests that piñon nuts compare nutritionally to acorns, concluding that "the nutritional data show the [nut of *P. monophylla*] to be an even more remarkable food item than it appeared to be" (see also Little, 1938; Botkin and Shires, 1948).

Lanner (1981, table 1, pp. 99–105) likewise praises the nutritive value of pine nuts, noting that eight of the nine essential proteins are more abundant in the nuts of *P. monophylla* than in *Amaranthus,* a common and important Native American resource.

PINE NUTS ARE A STORABLE RESOURCE: Properly cared for, pine nuts can be readily kept for two or three years after harvest. Once the nuts have been scorched—a process often necessary for removal from the cone anyway—they must be stored in a dry, relatively well-ventilated area (Steward, 1938, p. 27; see comments by Harriet Lanner, in Lanner 1981, pp. 151–153; Zigmond, 1981, p. 51).

Aboriginal Great Basin groups stored pine nuts in a number of ways. A historic pine nut cache has been discovered by Shutler (1956) in the lower Monitor Valley, consisting of an 8-bushel enclosure which had been covered with a rock and sealed with pine pitch. Kelly (1934, pp. 37–39) describes the pine nut caches of the Southern Paiute, in which nuts were wrapped in cliffrose bark or put into a sinew-sewn deerskin bag, then placed in bark-lined pits in the floors of caves or shelters, covered with bark, and concealed with earth and rocks (see also Davis, 1965, p. 12; Fowler and Fowler, 1971, p. 39; Zigmond, 1981, p. 51). Specific cache configurations are considered in more detail below.

PINE NUTS ARE A COST EFFECTIVE RESOURCE: A number of recent investigators have suggested that the general principles of evolutionary ecology will assist in unraveling the processes behind hunter-gatherer adaptive strategies (chaps. 2–4). Especially interesting is the *cost/benefit ratio*: the relationship between time required to search for, harvest, and process a given resource, as balanced against the energy yield realized (e.g., O'Connell and Hawkes, 1981).

An interest in the relationship between procurement costs and benefits can be traced rather far back in the literature of Great Basin anthropology. As discussed above, Dutcher (1893) provided some interesting quantitative data on a piñon harvesting episode among the Panamint Shoshone.

Nearly four decades later, Steward (1938, p. 27) took Dutcher's data one step further by attempting to pin down how much piñon would be required to sustain a family during the winter, and how long it would have taken them to gather such a supply. Using informant estimates and Dutcher's figures, Steward concluded that a family of four pickers, working for four weeks, could amass a 540 kg. cache of pine nuts. If no other food were eaten, this supply would have lasted this family only four months. Steward (1938, p. 27) concluded that "it is not difficult to see why starvation by early spring was very common."

Lanner (1981, p. 102) has recently supplied some more data on piñon collection. After seedfall, one can pick up about 9 kg. of seeds per day from the ground. Shaking a tree at the right time, and catching the nuts in a blanket, one can accumulate perhaps 32 kg. per day. Up to 68 kg. of nuts can be collected by a two-person team raking up the woodland litter after seedfall and separating the nuts with wire mesh screens. Lanner also men-

tioned "a favorite Navaho trick" of robbing a packrat nest of its accumulated wealth of nuts; such packrat caches are known to hold up to 20 kg. of nuts.

Jones (1981) provides the first well-controlled data on cost/benefit relations for pine nuts. Based on collections of *Pinus monophylla* made near Crystal Peak in west-central Utah, Jones found that a final yield of 380 grams of pine nuts required 15 minutes of gathering time and 88 minutes of processing time, providing a fuel value of 4880 kcal/kg., and a cost/benefit (E/t) ratio of 1080 kcal/hour (Jones, 1981, table IB).

Jones suggests that his figure for pine nut yield "is close to or lower than the yields obtained by native gatherers." He properly stresses the tentative nature of these findings: such estimates will not have much generality until attempts are made to control for the variability involved in patch density, differential annual yields, local topography, and varying expertise in collection and particularly processing times.

These cautions aside, we accept Jones's conclusion: "pine nuts are a much more economically viable resource than are cattail rhizomes, and are significantly better than [grass] seeds . . . . Other things being equal, in solving the problem of which of these resources to exploit for winter food, pine nuts should be preferred over grass seeds, which should in turn be preferred over cattails." We expect that further, more closely controlled experimentation will uphold these ordinal relations, which emphasize the favorable cost/benefit ratio of piñon procurement.

PINE NUTS ARE A NOTORIOUSLY ERRATIC RESOURCE: Although Steward stressed the importance to Great Basin Shoshoneans of piñon as a staple, he also repeatedly lamented the erratic nature of the harvest (1933, p. 241; 1938, pp. 27, 65, 70, 88): "Had crops been reliable each year . . . the harvest would have supported many times the population" (1938, p. 27).

Pinus monophylla has distinct cycles of good and poor seed years, spaced at intervals of varying length and consistency. These cycles still remain to be satisfactorily explained (Lanner, 1981, p. 78). Forcella (1978) suggests that such cycles may have evolved as a defense against the destructive larvae of *Eucosma bobana,* the cone moth (see also Little, 1941, 1943; Foster and Gifford, 1974; Lanner, 1981, pp. 176–177). It is also possible that piñon trees maintain insufficient levels of carbohydrates to construct an adequate number of cones and seeds more than once every few years.

Whatever the explanation, it is known that one bumper crop year is rarely followed by a second consecutive bumper year. The most common interval between bumper crops seems to be on the order of three to seven years. Previously, I attempted to simulate local piñon productivity using a Markovian approximation and a Monte Carlo simulation (Thomas, 1971b, 1972b, 1973). Production data were lacking for *P. monophylla,* so annual fluctuation data for *P. edulis* were substituted; the species behavior is roughly similar, but the actual degrees of differences are unknown. The *BASIN I* simulation data seemed satisfactorily to mirror the roughly three to seven year periodicity between bumper years.

The computer simulation also suggested that in a dense piñon-juniper woodland, increased probability of local success diminishes significantly after about 50 km. These figures are roughly consistent with Steward's informant testimony that Basin Shoshoneans preferred to harvest piñon within 30 km. of their winter residence (1938, p. 232), but were willing, when necessary, to travel up to 60 km. or even 80 km. to secure a good piñon harvest (1938, p. 101). The density computations also suggest that in a good piñon year, upward of 80 to 120 people could easily be supported for an entire winter on less than 93 sq. km. of piñon woodland (Thomas, 1971a, p. 31; 1977b).

PINE NUT PRODUCTIVITY IS, IN PART, PREDICTABLE: An individual pine nut (seed) matures over three growing seasons (Lanner, 1981, p. 77). During this 26-month period, the pine nut crop is vulnerable to a number of factors which threaten to reduce—if not totally destroy—productivity in a given locality: periodic cold snaps, heavy rains, beetles and cone moths, rodents and jays, as well as intrinsic factors characteristic to the piñon trees themselves.

Nevertheless, the lengthy maturation period required for individual piñon crops has previously led me to explore the possibility that local piñon production was, at least in part, predictable well in advance of the fall harvesting date (Thomas, 1972a, 1972b, p. 145).

There can be no doubt that the Basin Shoshoneans were first-rate ethnobotanists. As Chamberlin (1911, pp. 24, 29) put it: "Nature's severe parsimony in this land forced him [the Gosiute] to know minutely and to use to the utmost such resources as she had bestowed .... [the Indian] knows the quality of root and leaf and seed of its plants .... from root to fruit they knew the plants in form and color, texture and taste and according to season and habitat." Similarly, Zigmond (1981, p. 4) has noted: "The botanical traditions of the Kawaiisu permeated every facet of their culture .... Yields varied from year to year, and abundance or scarcity provided a common subject of conversation."

Given the critical importance of piñon procurement in the diet of protohistoric Shoshoneans living within commuting distance of the piñon-juniper woodland, it is inconceivable that they were unaware of the 26-month maturation period of pine nuts. Further, since predictability is such a key factor in scheduling a hunter-gatherer procurement cycle, it is entirely credible—in fact, likely—that the Basin Shoshoneans attempted to schedule, as far as possible in advance, the residential and logistical movements required for adequate piñon procurement in a given year, at a given spot. Julian Steward, incidentally, agreed that harvest predictability was quite possible (personal commun., in Thomas, 1972b, p. 144), given the importance of the piñon in the seasonal movements of many Basin Shoshonean peoples.

The sequence of pine nut maturation is as follows (after Thomas, 1972b, p. 144):

a. Cone primordia form within a newly sprouted bud in year n (these buds are not visible to the eye);
b. this bud overwinters, changing only microscopically;
c. during the next spring—year $n + 1$—the dull red conelet (female flower) emerges; after the scales part, pollen enters and the scales close once again. By the end of summer, the brownish cones are about 1 cm. in diameter and easily visible from a distance;
d. the following spring—year $n + 2$—fertilization takes place, and cone growth becomes rapid during the summer. The actual seeds (nuts) develop during the summer of year $n + 2$;
e. by fall, the cone has matured and dries out; the scales part and the seeds eventually fall out.

In theory it is possible to predict the crop of year $n + 2$ as early as the spring of year $n + 1$—a full 18 months prior to actual harvesting. This prediction is readily made by simply observing the small conspicuous, red female flowers.

But as Lanner (personal commun.) put it, there's many a slip 'twixt the cup and the lip. Predictions of absolute crop abundance are extremely risky because of potential—and probable—local perturbations: weather, jays, insects, and rodents. It is, however, a simple matter to recognize areas where the nut yield will be poor. A full 18 months prior to harvest paucity of developing cones can be easily observed (see Lanner, 1981, pp. 80–81).

The piñon crop must have been closely monitored during the protohistoric period, and areas of poor pine nut yield were known well in advance. Elsewhere (Thomas, 1972b), I have suggested that this information was exchanged during large gatherings such as *fandangos*; this simple act of information exchange would create an extremely large *extended radius,* the area in which critical resources are monitored (Binford, 1982a).

The importance of such predictability and monitoring cannot be overemphasized. As Lanner (1981, p. 81) notes, no cultivated food crop has such a long developmental period as the pine nut: what domesticated crop allows one to know about crop failures so long in advance?

GENERAL ARCHAEOLOGICAL CONSEQUENCES: It is against this biological and human behavioral background that we can examine

the archaeological consequences for the protohistoric period in Monitor Valley.

Little specialized equipment is required to harvest pine nuts: the ubiquitous piñon hook (see Dutcher, 1893; Egan, 1917, p. 241; Lowie, 1924, p. 203; Kelly, 1932, p. 99; 1964, p. 43; Steward, 1933, p. 241; 1938, p. 27; Wheat, 1967, p. 30; Zigmond, 1981, p. 50), the conical burden basket (Kelly, 1932, plate 24; Steward, 1933, pp. 348–350; Wheat, 1967, p. 31; Fowler and Matley, 1979, pp. 11–22, 112, 118–119), and the flat winnowing tray (Kelly, 1932, plates 21, 25, 26; Steward, 1933, p. 350; Wheat, 1967, pp. 31–37; Fowler and Matley, 1979, pp. 108–109). These piñon procurement artifacts have been found in historic and protohistoric piñon camps (e.g., Bettinger, 1975, pp. 199–200; Fenenga, 1975, p. 209, fig. 7).

Unfortunately, such artifacts will be radically underrepresented in the archaeological record because they do not preserve on the surface for more than a couple of hundred years. Additionally, piñon camps are rarely associated with caves or rock-shelters—areas where preservation can be prolonged indefinitely—so the long-term archaeological visibility of pine nut harvesting is close to nil.

Once harvested, piñon nuts were processed at a number of locations throughout the piñon–juniper woodland. Although manos and metates were commonly used for this task, it has been suggested by Elston (personal commun.) that the "piñon huller," used to crack the shells without injuring the kernels, may be a specialized tool diagnostic of piñon processing (see Wheat, 1967, p. 33). Loud and Harrington (1929, pp. 136–138), however, show several such hullers, found in contexts far away from areas of piñon processing; these specimens were probably used for harvesting hard-shelled seeds.

Grinding stones used for field processing of pine nuts were rarely transported back to the residential base; instead, the bulky grinding stones were cached near the piñon procurement location, for future use (Kelly, 1964, p. 37; Davis, 1965, p. 29; Wheat, 1967, p. 36). At the Flat Iron Ridge site, in Reese River Valley, we found two such grinding stones cached near the house. One of these, a large granitic slab metate, had been left cached over a clothes iron, which obviously had functioned as a mano during historic times (Thomas and Bettinger, 1976, p. 314). Grinding stones are also commonly reused as construction materials in historic house foundations; in such cases, they served a dual function, since they could always be reclaimed for seed processing.

The field processed pine nuts must then be cached. In bumper years, the sheer bulk of harvested pine nuts involved extremely high transportation costs, so the decision would commonly be made to move the residential base to the harvesting area (Steward, 1933, 1938, pp. 27–28). In such cases, caches were established throughout the piñon woodland, and the nuts were transported, as necessary, back to the base camp. In years of more meager yields, pine nuts were transported directly to the base camp and cached there. But both logistic and residential mobility required construction of piñon caches, and these features provide the most archaeologically visible evidence for piñon harvesting and processing. One must be careful, however, when inferring the *type of cache involved,* since identical facilities can play vastly different roles in the overall seasonal round.

Hoffman (1878, p. 473) provides a good description of the "typical" piñon cache: ". . . a number of stones are collected, each of them from one-half to one cubic foot in bulk, which are arranged in the shape of a circle having a diameter of from 2 to 4 feet. When fruit is abundant (which happens but once in three years in respective localities), it is collected and piled into this circle, covered over with sticks and leaves, and finally a layer of earth, so as to secure them from rodents and birds." Similar descriptions are found in Lowie (1924, p. 201), Steward (1933, p. 241; 1938, pp. 27–28; 1941, p. 231), Wheat (1967, pp. 12–13), Powell (Fowler and Fowler, 1971, p. 49), and Zigmond (1981, p. 35). Sometimes the same feature is used both to roast and cache nuts. Such distinctive piñon caches are readily recognized on surface archaeological sites, if one is aware of what one is seeking (Bettinger, 1975, pp. 152–153; Thomas and Bettinger, 1976, pp. 332, 335).

We have already mentioned the historic

piñon cache in Monitor Valley, a small natural hole in an outcrop; Shutler (1956) estimates that this feature would have held about 8 bushels of pine nuts. Kelly (1964, p. 43) also notes that the Southern Paiute stored dried, unhulled pine nuts in buckskin bags for winter use.

Because of the extensive caching and logistic mobility involved in piñon processing, there is no direct relationship between the occurrence of pine nuts *per se* and their presence in archaeological sites. Archaeologists must not make the simplistic mistake of equating presence of pine nuts in a site with the procurement and on-site processing of pine nuts as food.

Although there seems to be a feeling among some archaeologists that pine nuts are rarely found in archaeological sites (e.g., Madsen, 1981), the evidence is quite to the contrary. The lack of flotation so far in Great Basin archaeology has seriously skewed the archaeological record in favor of animals and against plant foods in general, but the truth is that pine nuts have been found at plenty of Great Basin sites. Pine nuts were found, for instance, in the deposits of Coville Rockshelter (Meighan, 1953, p. 53), Big Spring Shelter (Pastron, 1972), Leonard Rockshelter (Heizer, 1951, p. 92), to name but a few. Additionally, pine nuts have been found in apparent cache pits at Lovelock Cave (Loud and Harrington, 1929, pp. 9–10; Clewlow and Napton, 1970, p. 64); Mno472 and Mno455 (Davis, 1964, p. 297); and Spotten Cave (Mock, 1971, p. 80). Hearths at Sherwin Grade (Garfinkel and Cook, 1979), Wildrose Canyon (Wallace and Taylor, 1955, p. 360), and excavated sites in Owens Valley (Bettinger, personal commun.) also contain pine nut residue. Hunt (1960, p. 9) notes that "pinyon nutshells are common on the winter campsites of the Indians in the sand dunes around the [Death Valley] salt pan, and the nuts must have been carried down from the mountains, presumably in the fall." Other instances could be cited as well.

But the mere occurrence of a pine nut in an archaeological site does not—in itself—justify the conclusion that human piñon consumption took place. There are many explanations for the introduction of pine nuts into archaeological sites: as firewood (Thomas, 1981c), by rodents, by corvids, by slopewash. Occasionally, the archaeologist will find *direct* evidence of piñon consumption—such as the pine nut hulls found in coprolites from Hidden Cave (Roust, 1967, p. 66) and Danger Cave (Fry, 1970)—but such circumstances are rare and of little importance when attempting to determine patterns rather than reconstruct single events.

To summarize, the archaeological visibility of piñon procurement and consumption is very low. Archaeologists will occasionally find piñon caches and roasting features scattered throughout the piñon-juniper woodland. Once in a while, a cached metate will also be found amidst the modern piñon forest. Historic period piñon collecting tools have been found, but these perish rapidly. It is even possible to recognize the occasional piñon cache in a stratified cave deposit.

But, unfortunately, the behavioral importance of piñon procurement is simply not reflected in the archaeological record at either the artifact or feature level. There are no distinctive "archaeological signatures" for piñon processing. If we are to recognize piñon procurement in the archaeological record, it is necessary to use techniques of pattern recognition at the site and non-site levels; mere search for "diagnostics" will produce unsatisfactory results, and lead the unwary archaeologist to conclude that piñon processing was absent. The archaeological patterning to be expected from the piñon harvest is part of a complex picture.

Summer-Ripening Seed Procurement and Processing

The second major category of seeds includes the small, hard-shelled seeds commonly collected between June and August, although sometimes these crops are available into the early fall (Kelly, 1964, p. 36). Most investigators consider Indian ricegrass (*Oryzopsis hymenoides*) to be the single most important of these seed resources, particularly in the southern and central Great Basin (e.g., Coville, 1892, p. 353; Steward, 1933, p. 244; 1938, p. 26; Kelly, 1964, p. 41; Wheat, 1967, p. 10; Zigmond, 1981, pp. 46–47).

But there is marked local variability in seed

production, and a number of other seed-forming plants were also exploited: *Atriplex, Helianthus, Chenopodium, Amaranthus, Elymus,* and *Mentzelia,* to mention but a few. Chamberlin (1911, p. 31) noted: "*Atriplex* and *Chenopodium* . . . . Plants of these genera are so often seen growing thickly over wide areas that they would seem in places to have furnished a food supply limited only by the capacity and inclination of the Indians to harvest it." These important seed resources are also discussed by Coville (1892, p. 353); Steward (1933, p. 244; 1938, pp. 24–28); Riddell (1960, pp. 32–34); Kelly (1964, pp. 36–41); and Wheat (1967, pp. 8–11).

Despite their ubiquity, a planned harvesting strategy was required for successful procurement. Timing was a critical factor. As was the case with piñon, seeds simply disappear if the collector is not on hand at the right time. Ricegrass seeds, for instance, fall to the ground shortly after ripening; if not harvested immediately, they cannot be retrieved (Wheat, 1967, p. 10).

There is also direct competition from rodents, rabbits and birds for the ripened seeds, another reason for careful monitoring and quick exploitation (Twisselmann, 1967, p. 188). Zigmond (1981, p. 47) cites a Kawaiisu folk tale about the competition between Indians and kangaroo rats for the ripe seeds of *Oryzopsis*; Steward's informants (1938, p. 26) believed that the effective harvest period for ricegrass and similar resources is limited to no more than a few weeks each year.

The patterning of harvest is not entirely clear. Wheat (1967, p. 10) reports that foraging parties of men, women and children moved into good seed areas and harvested until the local resource was exhausted. The women did most of the actual collection and seed preparation, while the men followed an encounter strategy to hunt rats, squirrels and birds: "When one crop was harvested, they knew where the next one was ripening, and so over the hills they trudged again, with their baskets, blankets, water jugs, and their babies on their backs, sleeping wherever night found them."

This procedure suggests that foraging proceeded according to a *complete radius, leapfrog pattern,* which Binford (1982a, p. 18) suggests is commonly used by highly mobile summer foraging groups.

Even less is known about the cost/benefit relationships for summer-ripening seeds. Powell (in Fowler and Fowler, 1971, pp. 39–42) has provided some data on the problem, based on his work with the southern Numic groups. Noting that women and children did most of the harvesting, Powell determined that two to three bushels could be harvested in an hour or two, in the more productive areas. To process these seeds, a gallon or more was placed in a parching tray with charcoal or ashes, then winnowed: "not infrequently a day's labor is rewarded with three or four pecks of seeds." While quantitative information like this is interesting, the vagaries of Powell's data preclude much in the way of cost/benefit inferences.

Newer data are now becoming available. Jones (1981) recently harvested seeds of Indian ricegrass, from a patch near Sigurd, Utah. Working in a relatively dense stand (25 to 50 plants per 100 sq. m.), he stripped the seed heads by hand, threshed them by hand, parched the seeds and then winnowed the cooked seeds. A gathering time of 15 minutes required a processing time of about 20 minutes, for a yield of 75 grams of cooked ricegrass seeds. This produces a "fuel value" of 2850 kcal/kg. and a cost/benefit ratio (E/t) of 336 kcal/hour (Jones, 1981, table IB).

As in the pine nut experiment, these results must be used cautiously, but Jones's conclusion is of interest: feeding a family of four for 30 days would require 33 person-days to gather and process sufficient pine nuts, and 107 days to obtain the same calorie-equivalent by exploiting ricegrass seeds.

That is, for a given unit of time, pine nuts yielded over twice the calories obtained from ricegrass seeds. If these preliminary data hold up for ricegrass and other summer-ripening seeds, then this is an important contrast between the two kinds of seed crops. Compared to piñon, summer seeds are probably lower bulk, somewhat less nutritious, equally storable, less cost-effective, less erratic and more predictable in terms of annual resource patches. Although piñon and summer seeds overlap in space, there is no temporal overlap.

GENERAL ARCHAEOLOGICAL CONSEQUENCES: Encounter strategy foraging for summer-ripening seeds has a very low archaeological visibility for a number of reasons. First of all, such foraging is a highly curated endeavor; residential mobility is generally high at this time, and only a few prized artifacts are transported. They are rarely discarded during this initial foraging period. As with all highly curated technologies, artifacts are simply not very often lost where they are being utilized (see Binford, 1976).

Secondly, the foraging areas are widespread rather than localized; this means that whatever debris is discarded will accumulate in non-sites, extremely low-density scatters lacking definable boundaries. Moreover, few artifacts are "diagnostic" of harvesting summer seeds—although the seed beater and seed knife do come to mind—and these will not be preserved except under highly unusual circumstances.

Finally, the leapfrog, complete radius foraging pattern is land extensive and specific resource predictability is very low. This means that the tool cache—unlike the pine nut milling stones—will not occur with encounter foraging. Such tool caches require a high degree of spatial redundancy which is lacking in summer-ripening seed harvesting.

Later, we discuss the residential structure associated with seed harvesting; for now it is sufficient to point out that because ricegrass and similar crops are harvested in water-short periods, the encampments associated with the harvesting locations will tend to be tethered to dependable water sources; this contrasts with the pattern expected for the piñon procurement camps, where water is irrelevant.

EATING THINGS THAT GROW IN PLACE: ADDITIONAL PLANT RESOURCES

Although seeds provided the bulk of the plant diet, a number of additional species were exploited as short-term staples, prepared for winter storage, or as condiments for flavoring mush and bread.

I find it useful to use the Northern Paiute native categories to describe these residual plant resources (after Fowler and Leland, 1967):

Berries: e.g., wild rose, elderberry, huckleberry, buffalo berry, chokecherry, serviceberry, red raspberry, *Lycium*, juniper berry.
Greens: ("onion-like plants whose tops were eaten"): e.g., *Allium* sp., wild onion, arrowroot.
Roots: e.g., Indian potato, sego lily, *yamba* (*Carium*).
Flesh: "Indian asparagus," mushrooms.

Obviously an extremely wide range of non-seed plant elements were exploited throughout the Great Basin, and no attempt is made to compile a complete list of species procured (see Coville, 1892, p. 354; Chamberlin, 1911; Steward, 1933, pp. 242–246; 1938, pp. 19–22; Riddell, 1960a, pp. 32–41; Fowler and Fowler, 1971, pp. 39–42; Zigmond, 1981).

Methods of procurement and storage were generalized, requiring little specialized technology. Berries were picked, placed in a conical basket for transport, then dried and stored. Berries were also ground on metates, stirred with water, then drunk "like canned tomatoes" (Chamberlin, 1911, p. 34; Kelly, 1934, p. 43; see also Steward, 1938, p. 32; Wheat, 1967, pp. 8–11; Fowler and Fowler, 1971, p. 42; Zigmond, 1981, p. 35).

Roots were commonly dug with fire-hardened digging sticks (Kelly, 1964, pp. 45–46), and large quantities were often stored for the winter.

Although timing is critical for some berries and greens, scheduling is much less a factor than for the seed-producing plants. Steward (1938, p. 19) notes that edible roots were often dug at leisure without residential movement required.

The other point to be made regarding these residual plants is the importance of storage for winter, the caches being "located as near as possible to the winter village" (Chamberlin, 1911, p. 34; Kelly, 1934, p. 45; Steward, 1938, p. 32; Wheat, 1967, p. 11; Zigmond, 1981, pp. 35, 39).

The non-seed plants were not critical in the overall nutritional budget of the central Basin Shoshoneans, but roots, berries, and greens did provide excellent "emergency food,"

which could be gathered at leisure—often embedded in other more tightly scheduled activities—and then stored for use when plant productivity was low.

GENERAL ARCHAEOLOGICAL CONSEQUENCES: Harvesting and storing non-seed plant resources is almost invisible in the archaeological record: foraging is casual, not involving much impact on the environment; resources are spread throughout the diverse microenvironments of each valley system; no specialized technology is required; storage occurs near residential bases rather than in areas of collection.

There will be, from time to time, evidence of non-seed plant procurement in archaeological sites, such as the isolated cache in the habitation site, macrofossils found in midden and hearth deposits, and even caches of seasonal tools (such as digging sticks and seed knives). But these are rare finds, and the evidence will never be sufficient for establishing anything except the unique event. As with other plant procurement mentioned above, the key to recognizing these strategies in the archaeological record lies in overall pattern recognition, examining both areas of residence and logistic usage.

THINGS THAT ARE USED

Ethnobiological categories of the Northern Paiute distinguish *things that are eaten* from *things that are used,* with little attention to Linnaean protocol. *Things that are used* includes a wide variety of medicines, gums, forest products, willows, cattails, tules, moss, cane, wildrose; inanimate objects are all grouped here (Fowler and Leland, 1967, p. 383).

The ethnopharmacology of Basin Shoshoneans was highly specialized, and those people living in the higher valleys and montane environments apparently accumulated a greater knowledge of medicinal plants and their uses than did people inhabiting the lower valleys and deserts (Train, Henrichs, and Archer, 1941). Although the reason for this is not altogether clear, it may be because the sagebrush-grass and piñon-juniper biotic communities have much higher percentages of curative plants than either the high summit crest areas or the low deserts and marshes (Smith, 1972, p. 75). It may also be that the lowland groups had been subjected to more intensive acculturative pressures by the time they were interviewed by Train and associates, in the 1930s.

At any rate, dozens of medicinal substances were chewed, liquefied, sprinkled on the body, used as eyewash, sucked or dissolved in the mouth, smoked, drunk, used as shampoo, as purifiers of the blood and as emetics (e.g., Palmer, 1878; Chamberlin, 1911, pp. 35–36; Steward, 1933, pp. 317–318; Train, Henrichs, and Archer, 1941; Stewart, 1942; Fowler and Leland, 1967; Bye, 1972; Smith, 1972; Zigmond, 1981). Although these substances were essential to well-being—and a substantial folklore developed regarding plants and animals with curative properties (Zigmond, 1981)—the physical acquisition of medicine had little effect on the annual or seasonal positioning strategies of Basin foragers and collectors. In nearly all cases, these items could be obtained within the foraging range of well-positioned base camps, or procurement was embedded in strategies designed for other subsistence items.

More important in the positioning strategies of protohistoric Shoshoneans was procurement of raw materials used for manufacture of weapons and harvesting equipment, domestic as well as ritual and gaming paraphernalia. Pelts for rabbit skin blankets, for instance, quite naturally resulted from the successful jack rabbit drive; a single hunt could produce several hundred of these skins, preferably in the fall when the pelt was in prime condition. Rabbit skins were woven into blankets or clothing, and sometimes used for trading and as units of currency. Undoubtedly the timing and location of rabbit drives were conditioned both by need for procurement of food and of raw materials for artifact manufacture.

An almost unimaginable variety of items was extracted from the landscape for use in artifact manufacture. Much of that technology is now unknown, even for the protohistoric period. But the diversity is evident from the small glimpse obtained by examining a partial inventory of prehistoric caches excavated in Humboldt Cave, on the margin of

the Humboldt Sink (Heizer and Krieger, 1956, pp. 91–101): eagle and hawk feathers, a mass of lake scum, a piece of galena, a mass of *Typha latifolia* "fuzz" for use as sandal lining and padding, a roll of flattened tule, obsidian and chert flakes, pieces of *Apocynum* to be used as cordage and twine, an animal tail, 3 animal feces, unsmoothed flat stones, a buckskin wrapping tied with string, mountain sheep horn, fawnskin pouch, one scrotum pouch containing pitch, a clump of saltgrass, an intestine pouch, waterfowl bills, mammal mandible, large mammal scapulae.

This listing underscores the point that people engaged in raw material procurement all the time, often without previously planned or specialized mobility. As one Nunamiut informant explained to Lewis Binford: "Catch things when you can, if pass good stone for tools, pick 'em up, if pass good wood for sled runner, catch 'em then .... Every dead Eskimo can remember something he did not pick up when it was around" (1979a, p. 258).

This is not to suggest that raw material procurement was a casual affair. Many such resources were limited, in either space or time (or both). Temporal restriction is well-illustrated by willow procurement, one of the most versatile of raw materials.

Willows are available in the proper condition for fabrication only after the leaves drop in the fall and before the buds begin to swell in the spring (Kelly, 1932, p. 120; Steward 1933, p. 270; Wheat, 1967, p. 92). Only the year-old wands without branches were harvested (Coville, 1892) and these were sorted by size and length: short, slender willows were saved for hoods of cradleboards; long, coarser stems were laid aside for the warp of the burden baskets, water jugs and winnowing trays, and the lattice work of the cradle. Those with the smallest leaf scars were split and peeled to obtain the tough, flexible sapwood, suitable for the weft element in all basket weaving. Prime stands of willows were known to all basket makers, who often favored willows from particular areas. (The disappearance of so many willow stands posed a major problem for historic-period basket makers.) Once collected, slender willow wands were scraped and carefully wrapped into bundles, together with coils of willow sapwood. These raw materials would then be cached or transported, depending on the overall mobility mosaic.

Similarly, raw materials were procured for the production of twine and cordage, a critical element in Shoshonean material culture.

> Lacking nails, bolts, and screws, and having little to use for adhesives, the Paiute Indians tied their world together. They tied their wood and willows into bundles to carry them into camp; they tied small game onto their waist bands; they tied the tules to make boats, and cattails to make houses; they tied babies in baskets, and arrowheads to shafts. They used cords in place of buttons and safety pins, to make traps, to catch fish and hang them to dry (Wheat, 1967, p. 55).

The raw material of cordage and twine is usually *Apocynum* (Indian hemp or dogbane) that grows in the moist soil along stream beds or wherever the water table is high. The green stalks appear each year, grow to shoulder height, and then dry up in the fall. These stalks can be used for cordage only when they are new, covered with reddish brown outer fibers (Wheat, 1967, p. 55; Heizer, 1970). Areas where *Apocynum* grew the tallest and developed the fewest branches were prized for cordage materials, and large quantities were cut and sorted and then cached; only first-year stalks were used.

Apocynum is another critical resource requiring scheduling. Although adequate supplies could often be taken within the foraging radius of camp, occasional logistical forays were undoubtedly required to obtain ample raw materials in years when the annual mobility took them away from the traditional areas of procurement.

Procuring raw material for making chipped stone tools has attracted much attention from archaeologists because these tools and byproducts are so visible in the archaeological record, and new technology now allows accurate *fingerprinting* to determine where these raw materials were initially quarried.

This is one case in which too much attention may have been harmful. Although specialized exchange networks are known to have existed—especially among the Owens Valley Paiute who had access to excellent local obsidian sources—too much emphasis has been

placed on the movement of this single resource, accompanied by too little consideration of how one actually acquires raw lithic materials. We must not overlook the fact that hunter-gatherer groups commonly acquired such specialized items as part of an embedded strategy, in anticipation of some future need (Binford, 1979a, p. 266). Finding "exotic" raw materials certainly does indicate something about long-distance procurement, but how that procurement was conducted is a matter for inquiry, not an automatic recitation of the tired *trade-culture contact-influence* litany.

One final *thing that is used* remains to be considered: water. Investigators sometimes mistakenly assume that because the Great Basin is a water-deficient environment, the seasonal round of the Basin Shoshoneans must always have been conditioned by the availability and distribution of surface water. The analogy to true desert areas has not served us well in this case.

Water, like the other resources must be viewed in terms of both absolute abundance and overall structure within the habitat (Thomas, 1972a, 1981b). The relationship between precipitation and population density is not particularly strong within the Great Basin as a whole; the correlation coefficient ($r = >0.34$) is not significantly different from zero.

Water exerts an obvious limiting effect in certain Great Basin habitats; for example the sparseness of the population in the Kawich Mountain area may be largely due to aridity. Not only is surface water at a premium, but the flora and fauna exist at relatively low levels of productivity, limiting the human potential still further.

Local effective precipitation is generally a function of elevation and topography. Within the Great Basin one can expect approximately a 50 mm. increase in annual precipitation for every 300 m. increase in elevation (Thomas, 1972a, fig. 2). Also relevant is the *rainshadow effect* which causes significant amounts of moisture to be precipitated by abrupt mountain ranges; the rainshadow effect accounts for the relative abundance of surface water in the Owens Valley. Less than 150 mm. of precipitation falls annually at lowland communities such as Bishop, on the floor of Owens Valley, but runoff from the Sierras produces an almost oasis-like situation on parts of the valley floor itself. Runoff from the Toiyabe Mountains creates a similar, yet considerably less striking series of semipermanent streams in the Reese River Valley.

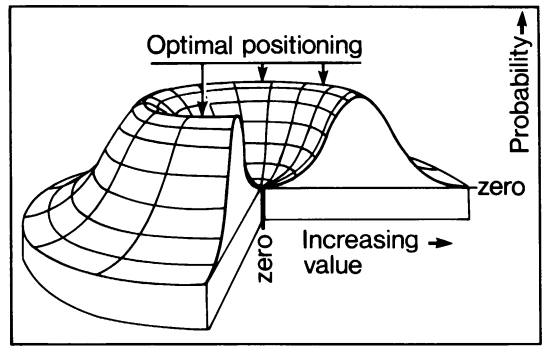

FIG. 9. A probabilistic model describing potential residential and field camp positioning for exploiting a point resource.

With these parametric relationships in mind it is possible to construct mathematical expressions of how water structures the micropositioning of residential bases. Consider, for example, the water resources of the Kawich Mountains. Annual rainfall averages less than 250 mm., and water occurs only in springs, not as flowing streams or rivers. Consequently for the Kawich Mountain Shoshone, water becomes in effect a *point resource* (fig. 9). Absolute abundance aside, point resources are self-limiting because they can be exploited only radially. Resources tend to have optimum residential distances associated with them. For water this distance cannot be so close that game is unable to approach, nor so far as to raise the transportation costs of bringing water back to camp. The resource-to-campsite distances can be expressed in two-dimensional form, often structured as a normal curve.

For point resources, such as springs, the potential areas of residence are limited because the mean of the infinitely available normal curves forms a doughnut-shaped ring of probability around each spring. This means that only a few select localities around each point resource are available for residence.

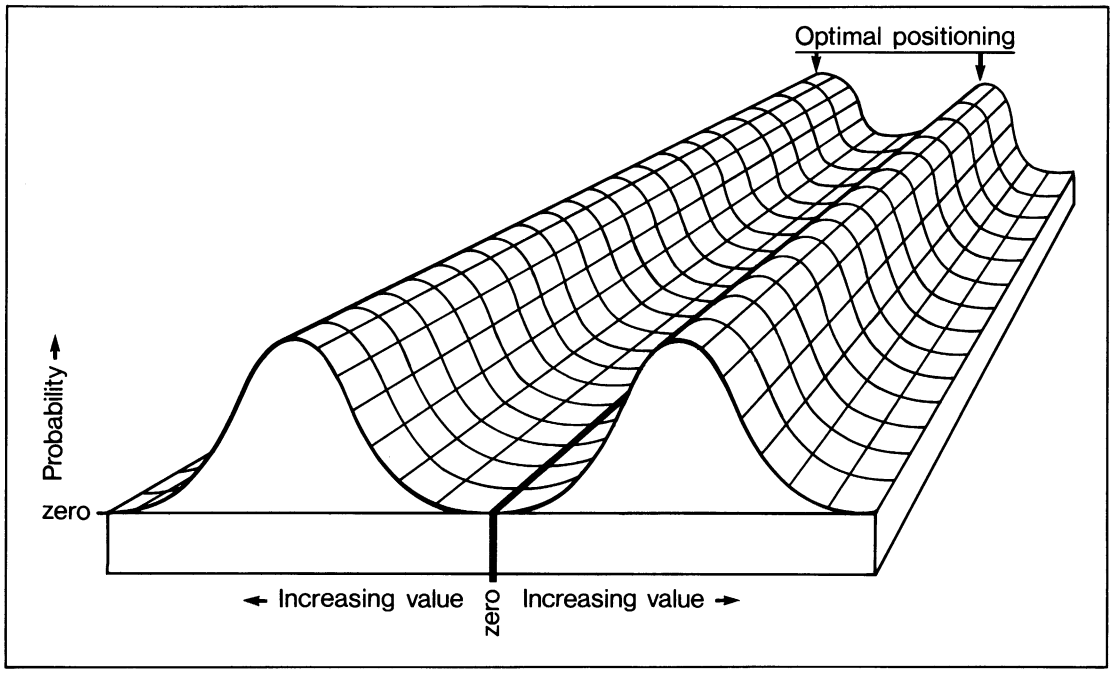

FIG. 10. A probabilistic model describing potential residential and field camp positioning for exploiting a symmetrical linear resource (after Thomas and Bettinger, 1976, fig. 9.7).

Base camp location, therefore, must be chosen primarily because of water availability, with little positioning latitude left for considering other resource structures.

Water, as a resource, affords a higher residential potential in the Reese River and Owens valleys for two reasons. There is the obvious increased availability of surface water due to the rainshadow effect. But an equally important difference is the pattern in which this surface water is available. Both valleys are quite vertical, with water flowing for the most part in permanent or ephemeral streams. For both Owens and Reese River valleys, water becomes a *linear* resource (see fig. 10).

Consider a mathematical abstraction of this resource. If the stream were a perfectly straight line, one could live on either side of this line. The distance to this water source is once again conditioned by a number of factors that create an optimal distance for the location of the campsite: not too close, yet not too far. The areas of potential settlement at a stream constitute two parallel bands on either side of the line. In the case of Reese River and Owens valleys, water is a linear resource, and the settlements can be arranged *symmetrically.* The symmetrical linear resource provides a high degree of latitude in establishing a residential base or field camp. One can move, for instance, up or downstream and still maintain that optimal distance from water. This is important since *resources other than water* can be taken into account when selecting optimum settlement locations.

To summarize, water was the prime limiting factor in the Kawich Mountain Shoshone ecosystem: not only was the absolute amount of water limited, but the available water was distributed only as a point resource. This combination of circumstances left little latitude for the aboriginal settlement pattern; similar cases occurred throughout the more arid portions of the Great Basin.

By contrast, water was not a directly limiting factor in the ecosystem of the Reese River Shoshone or the Owens Valley Paiute. By Great Basin standards, water was rela-

tively abundant, and because water occurred in linear fashion, considerable latitude was available for establishing village locations. Resources other than water served to condition the residential positioning strategy in both Reese River and Owens Valley ecosystems.

NOTES

[1] The pine nut is still, of course, of some importance throughout the contemporary Great Basin. The Bureau of Land Management recently reported that more than 78 tons of pine nuts were harvested commercially during the fall of 1981 on BLM-managed lands in Nevada (*Reese River Reveille,* January 21, 1982). Commercial harvesters are now required to purchase permits from the BLM; the price for harvesting pine nuts ranges from 10 to 23 cents per pound. Traditional pine nut areas have also been set aside for Native Americans, who are permitted to harvest without charge. In addition, non-Indians are allowed to gather up to 25 pounds of nuts without a permit.

CHAPTER 5. MID-RANGE THEORY: CULTURAL GEOGRAPHY OF THE PROTOHISTORIC GREAT BASIN

The strategies used to procure selected resources in the protohistoric Great Basin were addressed in chapter 4 with emphasis on the central Nevada area. I take this argument a step further in this chapter, by considering how these procurement strategies conditioned the overall cultural geography of these three groups. *Specifically, what kinds of sites (and non-sites) are produced in the course of resource procurement; and what are the annual and long-term mobility strategies involved?*

But first it is necessary to address a particularly nettlesome question: *how are strategies linked to the archaeological record?*

THE LINKAGE PROBLEM

The issue of linkage bedevils the contemporary archaeologist attempting to bridge the gap between the behavioral event and its archaeological consequences. Mid-range theory can provide an overarching framework for bridging this gap, but this theory must still be translated into concrete, observable, testable archaeological categories. This is not merely a correlation problem: archaeologists have been much too quick in making the facile leap to the archaeologically observable from the behaviorally inferential. Much of the contemporary archaeological literature—including that of the Great Basin—implies that we know more than we really know.

Acceptable linkage between behavior and the archaeological record requires a consistent set of function-specific terminology, applied both to definition and observation. While I am not interested in niggling, pedantic list-making, it is appropriate to set out some general assemblage-level guidelines for describing both the behavioral implications of the various procurement processes and the analytical framework within which the archaeological remains are considered.

I am most comfortable with the criteria proposed some years back by Howard Winters (1969, chap. IV), in his now classic analysis of the settlement and subsistence patterns of the Riverton culture in the central Wabash Valley of Illinois. In general, I accept Winters's criteria, as translated into technology specific to the Great Basin context. This listing is deliberately biased toward archaeologically visible material culture.

Archaeological assemblages can be divided into seven functional categories: general utility tools, weapons, harvesting equipment, fabricating equipment, domestic equipment, recreational equipment, and ceremonial equipment. The correlates of each category apply to the Great Basin Shoshoneans of the protohistoric period.

General Utility Tools

These are "tools of such generalized nature that they could have been used in connection with a variety of activities . . . [an] admittedly unsatisfactory term" (Winters, 1969, p. 32): knives (stone and bone), scrapers (stone, bone, and horn), choppers, hammerstones.

Weapons

Weapons are "any implement designed primarily for the killing or procurement of fauna . . . . The basic criterion is the possession of properties appropriate to the effecting of an untimely demise of some member of the faunal community . . ." (Winters, 1969, p. 37): bows, arrows, fishing equipment, nets, snares, traps, nooses, rabbit and reptile hooks, disguises, decoys, rabbit clubs.

Harvesting Equipment

Winters (1969) does not define a specific category for plant procurement so we paraphrase his definition for a faunal procurement assemblage. Harvesting equipment includes *any implement designed primarily to facilitate the untimely demise of some member of the floral community*: seed knives (wood, stone, and bone), piñon hooks, seed beaters, seed fans, seed baskets, sickles (horn or bone).

Domestic Equipment

This includes "any items designed for use in processing, consuming, or storing food, or

whose normal function would be concerned with the maintenance of dwelling or clothing, and items of household equipment" (Winters, 1969, p. 61): milling equipment (manos, metates, mortars, pestles), cooking equipment (bowls of ceramic or stone, basketry containers, mush stirrers), woodworking tools (adzes and axes), digging sticks, firemaking equipment (firedrills, hearths, flint and steel apparatus), all items of clothing (skirts, shirts, dresses, aprons, sandals, moccasins, leggings, caps), spoons (bark and bone), dippers (turtleshell, mountain sheep horn, deer skull, ceramic, basketry), dishes (horn, basketry, stone, and ceramic), water jugs, sleeping mats, ornaments (pendants of stone, bone, or shell, shell and bone beads, bone tubes, bone and hoof tinklers, animal claws and teeth), pipes, blankets, cradles.

Fabricating or Processing Tools

These are "any implements utilized primarily in the alteration or assembling of raw materials for use in the various stages of manufacture of other implements or equipment" (Winters, 1969, p. 47). In other words, fabricating artifacts are tools used to make other tools: flakers, perforating tools (bone or cactus spine awls, drills, perforators, gravers), sewing implements, weaving tools (such as shuttles for making nets, shaft straighteners, edge-abraded cobbles).

Ceremonial Equipment

"Probably any definition of a category such as ceremonial items will be unsatisfactory . . . . We shall define our category as composed of artifacts the use of which can be assumed from primary and secondary attributes to be associated with sacred or secular rituals, either personal or communal, or to be symbols of status within an organized group" (Winters, 1969, p. 68): flutes, ocher, grave goods, shaman equipment (such as feathers, eagle down, clay, dewclaw or hoof rattle, sucking tubes).

Recreational Equipment

"The very concept of a category of recreational equipment derives from a defective and particularizing view of the nature of such artifacts in primitive societies . . . . All that we can say at present is that the similarity of these items to ethnohistoric examples of recreational equipment seems to provide a better basis for inclusion of these artifacts in [this] . . . category than in any other" (Winters, 1969, p. 83): gaming items (cane dice, counting sticks, hand-game bones), pucks (stuffed skin or braided hide), bullroarers, drums, flutes, rattles, toys.

This listing is not exhaustive, and it does not take into account known technological changes from the prehistoric past. My intention is merely to provide operational common ground to avoid repeating detailed artifact inventories in the discussion to follow.

SITES AND NON-SITES

We can now address the variability in protohistoric Great Basin Shoshonean sites and non-sites. Wherever possible I follow the terminology of Lewis Binford (especially 1980). Although other investigators have expressed similar thoughts relative to hunter-gatherer subsistence, Binford's formulation is best suited for bridging the behavioral-archaeological gap.

The Residential Base

It is axiomatic that all hunter-gatherers live in residential base camps, "the hub of all subsistence activities" (Binford, 1980, p. 9) (what Steward [1933, p. 238] called the "headquarters"). Base camps are where most processing, manufacturing, and maintenance activities occur.

The typical base camp may contain evidence of domestic dwellings and site furniture, specialized utilitarian structures and outdoor work areas, service centers, diversified tool fabrication and repair, child rearing, diversified food consumption (and perhaps storage), temporary storage of raw materials and tools, a relatively high degree of internal site structuring, luxury items, and debris from recreational and ceremonial activities. Variability in these remains is directly conditioned by the overall subsistence strategy in which that residential base functioned.

Behavioral Correlates: The protohistoric Shoshonean base camp was not complex: a cluster of small, randomly placed

houses, generally some distance apart (Steward, 1941, p. 234). The most substantial structures were those of the Owens Valley Paiute, who built winter houses (*toni*) from 4.5 to 6 m. in diameter, set into a pit about 60 cm. deep (Steward, 1933, p. 236). *Toni* were sometimes earth covered, with the fire near the center, the larger houses accommodating one large, or several small families (Steward, 1933, p. 264). Specialized *mountain houses* were about 4.5 m. long and lacked earth covering. *Summer houses* were smaller still, from 2.5 to 4.5 m. in diameter, sometimes accompanied by sun shades. In all cases, most of the domestic activities occurred outside the house.

The largest houses were built in the northern end of Owens Valley, in the area with the most permanent and well-defined band territories. In neighboring areas the houses were smaller and less permanent. The Mono Lake winter house, for instance, was conical, about 3 to 4.5 m. in diameter, set in a 60 cm. deep pit, and not covered with earth.

The protohistoric Reese River Shoshone constructed houses that reflected their basic fusion-fission settlement pattern. The winter house was a tripod or conical shape, often with an interlocking four-pole foundation, and set into a pit about 60 cm. deep (Steward, 1941, p. 383). The perimeter of the house was variable in size and only rarely encircled with stones. These winter houses were often covered with bark and pine humus, with the direction of the doorway variable. The central fireplace frequently had a smoke hole directly above it. Lowland summer dwellings were considerably less substantial, often little more than a windbreak/sunshade, constructed of available brush or willow.

We excavated a historic period Reese River Shoshone house about 10 years ago (Thomas and Bettinger, 1976, pp. 313–327). This house measured about 5.5 m. north–south and 7.5 m. east–west. A large quantity of historic period artifacts were scattered across the floor, surrounding a hearth located slightly off-center. The house was probably occupied no earlier than 1860, and the terminal occupation was sometime between A.D. 1880 and 1890.

Recent excavations in Grass Valley provide additional information about central Nevada Shoshone houses. These houses were built in large circular depressions ranging from 5 to 6.2 m. in diameter, with a maximum pre-excavation depth of .2 to .5 cm. at the center (Ambro and Wallof, 1972). House 5 at Ridge Village North contained little except four cache pits (in contrast to Steward's findings [1941, p. 284] that internal cache pits were absent).

Two smaller house structures were also excavated at Ridge Village North; the depressions ranged from 2.75 to 5 m. in diameter, with an unexcavated depth of 25 to 63 cm. A central hearth appeared in one of the houses and the excavators suggest that they were probably conical or domed wickiups. Two similar structures were excavated in House Pasture Village No. 1 (Ambro and Wallof, 1972, pp. 1–12). All of these houses date from the early historic period.

Direct evidence is lacking about the houses used by foragers such as the protohistoric Kawich Mountain Shoshone, but neighboring groups used domed wickiups both summer and winter (Steward, 1941, pp. 282–283). Constructed of bent willows and sometimes around a central post, these houses were about 2 m. high and of variable diameter. There was no house pit as such. They were covered with layers of grass, tules, or brush; the doorways often faced east, and cooking fires were apparently built outside. Tripod houses, similar to those of the Reese River Shoshone, were also built for winter use. Steward (1941, p. 283) reports that they also constructed gabled houses for winter use with two vertical posts and a ridgepole. One such house was 1.5 m. high, 3 m. wide, and 4.5 m. long, built over a 60 cm. deep pit and covered with brush and pine sod. The doorway was on the side, and the fireplace was inside.

Wheat (1972, pp. 104–109) illustrates similar houses for the Northern Paiute, noting that these relatively small houses—roughly 2.4 to 3.7 m. in diameter—were used as living quarters for one or two people, or for storage of food and implements.

Remy and Brenchley (1861) report that the more mobile Shoshoneans did not use houses at all, sometimes living temporarily in caves. Simpson (1876, p. 64) also noted that some Shoshoneans used only brush shelters both summer and winter.

In addition, a number of specialized struc-

tures and facilities have been found at protohistoric Great Basin residential base camps. The sweat house is a pan-Basin feature, but the configuration depends on local mobility patterns. The Owens Valley Paiute sweat house (*mu:sa*) was a large, gabled, earth-covered subterranean structure which served as a men's club and dormitory, as well as for ritual purposes (Kroeber, 1925, p. 591, pl. 56; Steward, 1933, pp. 264–265, fig. 4, plate 6; 1938, pp. 54–55; 1941, p. 233). It is larger and more substantial than the winter house, up to 7.6 m. in diameter, with a stout center post, central pit, and a large range of uses. The sweat house, communally constructed and owned, was used for several years before it fell apart (Steward 1934, p. 433). Such sweat houses, constructed whenever there were enough people to make it worthwhile, served as meeting places and were important for integrating residents of the larger territories (Steward, 1938, p. 98).

The Reese River Shoshone sweat house, which was not set into a pit, was built as a domed frame wickiup and covered with brush and pine humus. Rocks, heated outside, were placed into a central pit where water was poured over them. The house, used by both men and women for curing as well as for bathing, accommodated more than two people at one time. The Reese River sweat house was owned communally.

The mere presence of a sweat house does not necessarily indicate that the entire ceremonial complex was involved (Steward, 1941, p. 234). Heating was partly functional, and the house was also used for praying, ritual, curative sweating, shamanistic treatment, smoking, and a cold bath after sweating.

Once again, no direct evidence is available for the Kawich Mountain Shoshone, but Steward (1938, pp. 237–238) believed that the settlement pattern of such groups was "too scattered and too unsettled" throughout most of the year for the construction of a communal sweat house; therefore, individuals often built small ones for personal use. In neighboring areas, Steward (1941) reports conical type sweat houses, with a circular ground plan, 3 to 4.5 m. in diameter, sometimes set into a 60 cm. deep pit; gabled structures may also have been used.

There were other camp facilities, depending on the local setting of the residential base. At repeatedly occupied winter camps, for instance, snow dams—made of brush, sticks, and mud—provided a water source; the location of such winter camps was, of course, independent of any permanent water source. Steward (1933, p. 287) reports that hockey or shinny games were sometimes played on a field some 100 m. long, with paired goalposts. Additional facilities might include storage pits and aboveground caches, windbreaks, menstrual huts, bedrock milling features, as well as occasional dog houses and even specialized grinding structures.

Cemeteries in the Great Basin seem to have been restricted to collectors like the protohistoric Owens Valley Paiute. The dead were buried as close as possible to the residences of living relatives; sometimes houses of the deceased were burned. Regularly scheduled mourning ceremonies were usually held in the spring (Steward, 1933, p. 298). Established, traditionally used cemeteries may be diagnostic of logistically organized groups.

ARCHAEOLOGICAL CORRELATES: The residential base forms the focal point of hunter-gatherer existence, and its importance is reflected in the archaeological record.

The function and position of the base camp is conditioned by three requirements: adequate life-space, protection from the elements, and a location central to survival resources (Wagner, 1960, chap. 8; Binford and Binford, 1966, p. 268; Binford, 1980; Kelly, 1980). The base camp might contain evidence of dwellings, weapons, domestic equipment, fabricating tools, as well as ceremonial and recreational equipment. Although these characteristics are common to most hunter-gatherer base camps, the nature of the assemblage and the degree of archaeological visibility varies, depending in large part on how the base camps were integrated into the overall subsistence and social framework.

The positioning strategy for residential base camps is considered subsequently. For now, we consider only the structural and assemblage level correlates of residential activities.

STRUCTURAL CONSEQUENCES: Dwellings and other houselike constructions vary markedly, and Flannery (1973) suggests that the form and size of domestic dwellings is indic-

ative of the society which produced them. This may be true in a global sense, and perhaps also at the hunter-gatherer level. Dwellings built by collectors, for instance, show more concern with resource storage, and cache features are commonly associated with base camp dwellings. People pursuing a logistic strategy also store relatively large quantities of raw materials transported for tool manufacture and maintenance (Wagner, 1960, p. 166). Indications of long-term storage and long-distance transport may assist in distinguishing the dwellings of the nearly sedentary from those of the nearly nomadic. But assemblage-level correlates are complex, and can be considered only in light of the entire range of logistic or mapping-on behavior (see below).

Unfortunately, there is no direct, infallible correlation between subsistence strategy and house type or even size. In the protohistoric Great Basin, as Catherine Fowler (1982b) has warned, even substantial and seemingly "permanent, semisubterranean pit houses do not necessarily make a village."

Protohistoric Great Basin foragers and collectors tended to build similar houses in all seasons: all houses were roughly the same size, about the same shape, and constructed in the same manner—with the possible exception of storage facilities mentioned above. Another possible exception may have been the substantial valley village house (*toni*) built by the Owens Valley Paiute.

While the *toni* is hardly a clear-cut archaeological signature for logistic procurement, the Owens Valley case suggests that dwellings constructed in systems with long-term residential stability required more labor investment and may be more visible archaeologically. Logistic base camps also manifest a greater variability in types of domestic structures, as well as specialized outdoor work areas.

There is a suggestion that residential bases in a logistic system exhibit a higher degree of internal differentiation than do forager base camps. Residentially stable settlements tended to have houses arranged in random fashion, often some distance apart. But more temporary residential camps were sometimes quickly constructed domed wickiups, arranged in a circle, sometimes around a central communal dance area (Steward, 1941, p. 234). Yellen (1976, fig. 2.2) shows a similar configuration for the foraging base camp of the Dobe San.

Wagner (1960, p. 170) considers such central areas to be *service centers*: places in which public religious rites and group celebrations might occur (as well as individual acts such as preparation for transport, storage, display, and artifact repair). Flannery and Marcus (1976, pp. 206–207) have traced the evolution of such public spaces in Mesoamerica to a preceramic, hunter-gatherer adaptation. At sites such as Gheo-Shih, central areas were apparently set aside for public rites (as opposed to "secret" rites like those conducted in Southwestern kivas). Central zones comprised an "impermanent feature," presumably used for *ad hoc* ritual, and requiring little long-term maintenance or architectural skill (Flannery and Marcus, 1976).

The most visible architectural service center in the Great Basin is the *sweat house.* Logistic sweathouses are readily observable in the archaeological record. Robert Bettinger once showed me the now caved-in ethnographic sweat house at Big Pine in Owens Valley; such a feature will be distinctive and striking to any future archaeologist encountering it. These relatively permanent, earth-covered structures, built in a definite pit, with evidence of extended usage, occur only in association with very low mobility base camps (which have a number of distinctive and obvious residential features).

Sweat houses constructed by foragers are considerably smaller, and difficult to distinguish from residential dwellings (Steward, 1938, p. 238). The artifact inventory is more functionally limited, and the overall debris/artifact density is very low.

In sum, the collector residential base camp should have randomly distributed structures built with higher labor costs, associated cache features, and showing signs of frequent reuse. Logistic strategy base camps also have communal structures such as well-established sweat houses, cemeteries, well-defined public places, traditional loci of debris disposal, high cost procurement facilities (such as snow dams, stream irrigation networks, and fishing dams).

ASSEMBLAGE-LEVEL CONSEQUENCES: Base camps contain evidence of artifact fabrication and repair, food preparation and con-

sumption, as well as limited evidence of luxury goods, ceremonial paraphernalia, and recreational devices.

Except for the meals consumed at field camps and those items eaten as "snacks" at procurement locations, food preparation and consumption tends to occur at the residential base. The archaeological record should contain a diversity of food consumption and preparation items: cooking equipment, milling equipment, butchering equipment, firemaking equipment. Sometimes these items have been deliberately cached for future use, especially in the more predictable, logistic situations.

Residential bases also contain the byproducts of food preparation and consumption, such as hearths and firecracked rocks. Although plant remains are rarely well-preserved in such contexts, the diversity of the surviving plant remains should be higher in base camps than anywhere else; field camps should have a very narrow range of plant foods.

Similarly, residential bases contain a wide variety of faunal remains: herbivores, hares, rabbits, rodents, birds, and reptiles. There is the ever-present difficulty in determining just how these bones were introduced into the archaeological record (Grayson, 1978, 1979, 1981), but that is an independent problem.

The residential base should also contain evidence of differential butchering practices, particularly of the larger mammals. Some field dressing will always occur (even at limited encounter kill sites), but in the event of high-bulk intercept strategy procurement, extensive field butchering may have been undertaken, to reduce the transport costs of bringing the meat back to base camp. Faunal remains of a base camp should be heavily biased toward high utility faunal items such as ribs, vertebrae, pelvis, femur, scapula, and humerus (Binford, 1978a, table 2.7). Phalanges, metatarsals, tarsals, and carpals should be rare or absent; antlers, horn cores, and crania should be present only if they have been used for tools, disguises, or ornaments. Furthermore, the proportion of high/low utility faunal remains should be a clue as to whether foragers or collectors lived on the site: logistic hunters commonly discarded all but the highest utility elements at the area of primary kill-butchering.

The base camp is also the primary locus of tool fabrication and repair. Although *ad hoc* manufacture of expediency tools can occur anywhere at all in the annual round, most primary artifact manufacture occurs at base camps, and is visible in several ways: high proportion of fabricating tools, diversity of raw materials, characteristic byproducts, and high proportions of spent artifacts.

Additional fabrication occurs at the base camp as well: house construction, clothing manufacture (using both plant and animal byproducts), crafting of cordage, netting, basketry and woven items, as well as manufacture of ceramics and finished hide preparation. Fabricating tools—artifacts to make artifacts—enter the archaeological record of the residential base as unretrieved caches, unintentional losses, and deliberate discard from breakage or attrition.

This relationship is obscured somewhat by the tendency of logistic parties to transport particularly portable and important fabricators—such as flakers, small hammerstones, and sewing implements—as part of their "travelling gear" (Binford, 1979a). Nevertheless, the proportion of fabricating tool discard is much higher in base camps than in field camps because items of traveling gear are temporarily more heavily curated, and hence more valuable, at least for the moment.

In addition, parties "gearing up" tend to take fully serviceable implements as part of traveling gear (Binford, 1979a, p. 263). Tools with relatively long use-lives (such as flakers and hammerstones) are much more likely to be discarded at the base camp since worn out items are culled in the process of "gearing up" for special-purpose trips. Nevertheless, there is hardly a one-to-one relationship between tool usage and discard behavior.

The residentially stable base camp should exhibit a wide range of manufacturing activities, reflected in the diversity of raw materials specifically collected for that purpose. As Gould (1980, p. 126) has noted, nonlocally available quarried lithics are more likely to be transported to a base camp than anywhere else, so residences should have a relatively higher proportion of exotic lithics, as well as greater diversity of stone types.

The lithic reduction sequence at a base camp may also be distinctive. Reduction strategies are variable and suited to the task

at hand, depending both on the nature of the raw material involved, and the immediate positioning within the annual round. In areas of *ad hoc* manufacture of expedient tools—as at a field camp or hunting stand—*ad hoc* tools are commonly manufactured from locally procured materials (Binford, 1979a, p. 267). Because these stones are often second-rate, technology can differ sharply from that used in the base camp, where lithic reduction is better planned, executed on higher quality materials, and designed to make more permanent (rather than expedient) tools (Binford, 1979b).

The base camp is commonly where one *intends* to do artifact manufacture, and where both raw materials and fabricators are stockpiled for that purpose. Although tools can be made elsewhere, such manufacture is generally in response to unplanned exigencies.

Residential bases should show a wide range of lithic production stages. *Ad hoc* tools are manufactured during "dead time," and such boredom reduction is reflected by a predominance of "staged" artifacts and debris at field camps (Binford, 1979a, p. 270). Base camps, by contrast, tend to reflect a wider range of lithic reduction, often from quarry roughout through finished tool production and even repair; similarly, the debitage should reflect both ends of the reduction sequence.

Base camps should also contain copious tool production debris, often in designated dump areas. These byproducts commonly include lithic debitage and faunal discards from manufacture of tools and luxury items such as beads, as well as a host of perishable byproducts.

Finally, since most food consumption and nearly all tool manufacture occur at base camps, there should be a direct and observable relationship between the debris from consumption and fabrication (Binford, 1976, p. 243). The base camp should have high frequencies of both food garbage, and discards from tool production and repair. By contrast, the field camp might contain many discarded tools, but little manufacturing debris (or perhaps the reverse); field camps should lack considerable accumulations of food debris, unless they were habitually reoccupied.

The base camp—particularly one inhabited by collectors—should exhibit the storage of food and implements and raw materials for tool manufacture. High bulk domestic items, such as ceramic and stone vessels, as well as bulky milling equipment, often enter the archaeological record as site furniture (*ad hoc* caches). Residential bases commonly have associated meat caches (predominantly high utility elements), bulky plant caches (such as those for pine nuts) and also caches specifically constructed for dried seed-cakes, berries, and roots. Specialty caches of kaolin for ceramics (Steward, 1933, p. 266), willow for basketry, *Apocynum* for cordage, medicinal roots and plants, tobacco, lithic raw materials, shamanistic equipment might also be encountered inside the structures, in outside pits, or in nearby caves, crevices, or shelters.

Children were reared mostly in base camps since the young rarely accompanied parties to zones of animal procurement and would never stay at field camps. Although the archaeology of children is low in visibility, any occurrence in the archaeological record of toys, miniature artifacts, dolls, cradle boards, etc. should be in either a residential or a mortuary context.

Finally, the residential base is expected to have a relatively high proportion of luxury items, as well as goods used for ceremonies and recreation. Although pipes were sometimes smoked ritually, non-ritual smoking was common among men in the protohistoric Great Basin (Steward, 1933, p. 320; 1941, p. 309); pipes should be found largely in the base camp context.

But caution is in order here. Ceremonial and recreational gear was also used away from the residential base. Hunters took boredom-reducing items like gaming pieces, partially completed luxury items, and musical instruments as "gear" on hunting expeditions (Binford, 1976, 1979a); some of these objects could even be cached at blinds and hunting stands. Similarly, ornaments could fall from clothing at a field camp or procurement location and money could be dropped anywhere.

Because of the high rate of curation involved, there is no necessary or direct relationship between the context of usage and the

context of deposition. Still, one expects to find more rosary beads in a church than in the city dump. The presence of "service center" diagnostics, such as sweat houses, mortuary areas, dance areas, and ritual paraphernalia also assist in distinguishing between the areas of residence and field usage.

The Field Camp

Field camps are temporary centers of operation where a special-purpose task group sleeps, eats, and otherwise maintains itself while absent from the residential base (Binford, 1980, p. 10). Field camps are established whenever task groups are required to travel beyond the daily foraging radius, commonly estimated to be about 10 km. Because people actually *live* at a field camp, its position is determined in part by the same factors conditioning residential base camp placement: shelter, fuel, temporary food supplies, and water. But domestic criteria can sometimes be superseded by specialized functional requirements, such as plant harvesting, intercept hunting, collecting or quarrying of raw materials, and trading. Field camps are task-specific and their structure is quite variable, reflecting the differentiation in both target resources and overall positioning strategies. They are, of course, considerably more common among collectors than foragers.

Field camps were commonly established by Basin Shoshonean groups in conjunction with communal antelope and rabbit drives. This intercept strategy hunting is best accomplished with a relatively large number of people, who temporarily establish residence at the procurement area. That men and women might cohabit in a single field camp is irrelevant, since they were clearly setting up a special-purpose, short-term camp, independent of their residential area (although foragers might actually establish temporary residence at such areas). Most antelope and rabbit drives lasted for only a few days (Steward, 1934, p. 433; 1938, pp. 38–39), although once in a while communal drives lasted up to six weeks (Steward, 1941, p. 222); in such a case it becomes impossible to draw a meaningful distinction between a field camp and a temporary base camp.

Special positioning circumstances attend these temporary rabbit and antelope camps, since they were established on the flats, sometimes away from reliable fuel, shelter, and water. In this case, the short-term gain of high-bulk animal procurement temporarily offset the high costs of transporting essentials such as firewood and water.

Social functions also commonly accompanied these antelope/rabbit camps: dancing, singing, gambling, feasting, courting, and visiting were all an integral part of the traditional rabbit camp (Steward, 1941, p. 219). Sometimes special dance corrals were built at these field camps (Steward, 1933, pp. 320–323; 1938, pp. 38–39). Temporary sweat houses were also occasionally built at antelope sites (Steward, 1933, p. 254).

In fact, on some rabbit and antelope drives, especially those held in the fall, animal procurement was overshadowed by the ritual function, and the gathering turned into a full-blown *fandango.* Although it is possible to consider the temporary *fandango* encampment as a field camp, the function and configuration of the *fandango* is really a distinct site type. *Fandangos* and their archaeological implications are taken up subsequently.

Although ethnographers rarely mention specific field camps, such temporary encampments were commonly established, particularly among the logistically mobile groups, in the procurement of a wide range of plants and animal foods. The Owens Valley Paiute also commonly conducted trans-Sierran trading ventures (Steward, 1933, pp. 257–258; 1934)—a string of one-night stands across the Sierra. The sites in this exchange network were all field camps, except when Mono Lake groups overwintered in Yosemite in years of poor pine nut yields (Steward, 1933, p. 257).

Archaeological Consequences: Field camps involve a diverse set of distinguishing criteria. First of all, subsistence in such areas is highly specialized, heavily biased toward consumption of either plants or animals, rarely both. Field camps are also established relatively close to procurement locations, so there can be occasional evidence of extraction.

Consider the case of the temporary en-

campment established near an intercept hunting location. If the ambush spot is sufficiently close to the base camp, no field camp is required at all; the hunting party simply returns home that night. But if the location is some distance away, then a temporary base of operations may be set up logistically. Little investment is required for dwellings or camp facilities, since the time of use will be short; caves and rock-shelters were probably used for such short-term camps. Positioning is not as critical as for a base camp since task groups can temporarily disregard the concern for fuel, water and food exhibited at a base camp.

The artifact inventory at such a logistic camp would be small, consisting primarily of highly curated personal "gear," specialized implements for extraction, and debris from limited artifact repair. Boredom reducers might be brought along, but since they are quite portable, only the byproducts—such as debitage or whittling debris—would enter the archaeological record. Primary manufacture would rarely occur in such a camp, although artifacts might be "staged" if adequate lithic resources were available nearby. Such field camps should contain few high bulk artifacts, except those left as site furniture. Specialized artifact caches are expected only in highly logistic systems.

Food consumption at such a field camp would be primarily "snacking," such as extracting marrow from low utility faunal elements like phalanges, mandibles, carpals, tarsals, etc. Rarely should high utility items enter the archaeological record of such field camps, since these items would be either dried and cached or transported directly back to the base camp.

This example well illustrates the archaeological character of the temporary field camp: there will be remains indicative of specialized subsistence, limited artifact inventory, low diversity byproducts, restricted faunal (and floral) inventory, little investment in construction of dwellings or features, absence of child-rearing, more concern with logistic than domestic positioning.

But these characteristics do not provide us with the clear-cut archaeological signature we desire. In truth, it is extremely difficult to distinguish field camps from base camps in the archaeological record. There are behavioral differences to be sure, but those differences are commonly subtle and off-the-cuff field designations should always be mistrusted.

One difference between the residential base and the field camp is *duration.* Field camps are short-term occupations. But there is a range of variability here, and some logistic field camps were undoubtedly occupied longer than some foraging base camps. Also, depending on the long-term strategy, field camps may be occupied year after year, but base camp positions can change annually. Although duration of stay may be a good behavioral indicator, there are many exceptions, and it is difficult to separate the two site types on this basis alone.

Subsistence and domestic functions also differ between base camp and field camp, but that separation can be easily blurred by the archaeological record. Areas that had once been a residential base are often reoccupied by task groups, such as plant harvesting parties, or hunters preparing an intercept ambush, or women collecting raw materials for basketry or cordage.

These short-term visits would tend to be indistinct when superimposed on one another. Simple reuse of field camps by different logistic groups creates a multifunction archaeological palimpsest out of discrete behavioral entities. Grain-size in a stratum is more commonly due to geomorphological rather than cultural factors (Binford, 1982a), creating major operational problems in any attempt to separate base camp from field camp.

Even more severe problems arise when wholly different site types are superimposed stratigraphically. Base camps, for instance, are generally positioned favorably with respect to shelter, fuel, water, and seasonally available local foodstuffs. But after abandonment, these base camps become available for short-term logistic parties throughout the rest of the year (Binford, 1982a). Scavenging can occur in abandoned residences, and site furniture is useful to all. Thus former residential bases can readily become temporary field camps just a few months later. In this case, the functional separation approaches invisibility, since there is nothing particularly dis-

tinctive about a field camp inventory; field camp assemblages are merely subsets of base camp assemblages.

Distinguishing field camps from base camps remains a major difficulty for archaeologists intent on reconstructing the settlement structuring in a set of related archaeological sites.

The Cache

Although *caches* are commonly associated with logistic mobility, there are actually two major kinds of caches—resource caches and artifact caches—and each with rather different implications for the underlying strategies.

Caching was extensively practiced in the protohistoric Great Basin, and there is no better explanation of how caches work than that by John Wesley Powell (Fowler and Fowler, 1971, p. 49). Although Powell specifically described caches among the Southern Paiute and Ute, the following passage adequately sets out the process of caching in general:

> A cache is a hiding or storing away of any articles of value which may be used at some future time. When the season for gathering seeds is passed many of the baskets used for this purpose are thus placed away to be ready for next year, but stores of food are the principal objects thus temporarily put away. I have observed two methods of making caches; one was to dig a hole in the ground, and in it place the articles to be preserved. It was then covered with stones, and sand raked over the top. Then a fire is built over this and kept up perhaps for two or three days which serves a double purpose first to hide all evidences that might otherwise have appeared to indicate the position of the cache, to persons who might be passing, and second, . . . to destroy the odor by which wolves or other animals might be attracted to the spot.
>
> Many caches are made in caves and crevices, which are everywhere to be found in this region of cañons and cliffs, and seeds or other articles being placed in baskets or sacks, and sometimes covered with bast of the cedar, and over the whole a huge pile of stones is placed.
>
> It should be remembered that this climate is exceedingly arid, and if these caches are properly secured from rain they remain permanently dry . . . .
>
> The people of the same tribe never disturb a cache belonging to one of their own number although it seems that no pains are taken to conceal their situation, but they are probably so thoroughly hidden, others would rarely discover them.

A number of additional cache types are documented for the protohistoric Great Basin, using basketry, pots, bark bags, rock crannies, caves, and rock-shelters. Sometimes caches make no direct impact on the archaeological record at all, as when cured meat was simply hung in trees for use whenever hunters returned that way (Steward, 1933, p. 252; 1941, p. 281; Harris, 1940, p. 41; Fowler and Fowler, 1971, p. 48).

An extremely wide range of seasonally available resources were also cached: pine nuts, dried roots, seeds, and berries, cured meat, larvae, dried rabbits (Lowie, 1924, p. 198), salt, processed seeds, lizards (Fowler and Fowler, 1971, p. 48), cut grain (Lowie, 1924, p. 202), acorns, basketry and cordage raw materials, lithic raw materials, medicines, and ocher.

The resource cache helps to conquer *temporal incongruity* in an ecosystem (Binford, 1980, p. 12). Since some resources are available for only a limited period of time, their practical availability can artificially be extended by protecting them from deterioration or consumption by other organisms. Storage, often by drying or freezing, allows consumers to reduce the temporal phasing of key resources.

But the act of storage can also create certain difficulties of *spatial incongruity*. In a logistic system, relatively small numbers of people often acquire resources for a relatively large number of consumers, requiring a high-bulk storehouse. Caches provide the means for storing that bulk, but create in turn a transportation problem (since that bulky resource must still be made available to the rest of the consumers). The bulk of some cached resource may be sufficient to warrant repositioning the residential base closer to the storage site. In other cases, storage facilities are merely created as temporary holding areas, to store the resource for future transport to the residential base.

The tool cache is constructed for rather different reasons, primarily to minimize

transport costs of seasonally important artifacts. Milling stones for pine nuts, for instance, were commonly left in the piñon-juniper woodland, for use the following season (Wheat, 1967, p. 36). Rabbit nets, bird nets, deadfall parts, fishing equipment, digging sticks, snares, and specialized traps were also cached (Schellbach, 1927; Osborne and Riddell, 1978; Janetski, 1979; Echlin, Wilke, and Dawson, 1981). Ritual items were occasionally cached away from residential areas, to keep them from the view of others, or to relate to some seasonal activity conducted elsewhere (such as an antelope drive or *fandango*). Trade items were also cached, keeping them safe and out of the way until the next trading episode. The Owens Valley Paiute also cached salt, obsidian, rabbit skin blankets, balls of tobacco, baskets, and buckskin (Steward, 1933, p. 257).

ARCHAEOLOGICAL CONSEQUENCES: Storage is the primary distinction between the collector and the forager, and the cache is an excellent mechanism for monitoring that difference. But, as with most indicators, the cache is not absolutely diagnostic of logistical planning, since foragers do, on occasion, construct caches of their own (Binford, 1980; Schlanger, 1981).

Caches are invaluable to the archaeologist attempting to look beyond the artifact and feature for the underlying strategy. Caches can have a high degree of archaeological visibility; their locations and contents are directly conditioned by the role they played in the settlement strategy which created them. Tool caches, for instance, were generally constructed near where those tools were intended to be used. The meat caches were built near where the game was killed and field-butchered, or at the locus of projected consumption. In either case, transport cost decisions can be reflected by cache contents (or at least in the faunal evidence that a cache was once constructed nearby). High-bulk plant caches were built near where harvesting occurred. The trading cache was constructed where it was convenient for the trading party to return before the next exchange encounter.

In other words, the cache is a fairly reliable signature denoting both the system that produced it and also the position of specific activities within the overall strategy.

THE LOCATION

The *location,* common to both foraging and collecting strategies, is where daily extractive activities were carried out (Binford, 1980). Locations occur within the foraging radius, generally less than 10 km. from a residential base camp.

Collectors, such as the Owens Valley Paiute, utilized an extremely wide range of procurement locations, which were nearly continuous across the communal territories of protohistoric Owens Valley (Steward, 1933, map 2). Probably most unusual of these were the large patches of irrigated seed plots, all located on the floor of Owens Valley, within foraging radius of the major winter villages. The average distance between residential base and irrigated seed plots (mostly around the Bishop area) was less than 3 km., although exceptions did occur (Steward, 1933, map 2). The largest of these seed plots was 6 by 2.4 km. (Steward, 1933, p. 247). Associated dams and ditches comprised permanent, communally owned and maintained facilities.

Very often communal irrigation was coordinated with fishing activities. Sometimes the fish were stranded, or drugs were used to stupefy them (Steward, 1933, p. 251; 1934, p. 433). Fishing occurred both on the Owens River and tributaries from the Sierra Nevada. Separate fish dams were constructed of boulders, brush, sticks, and mud as permanent facilities, and their operation was coordinated by the district headman.

Large areas for harvesting wild seeds were independent of the irrigated seed plots. The wild seed plots occurred throughout the floor of Owens Valley, generally in direct association with valley residential bases. There are isolated cases, however, where the wild seed areas were up to 8 km. away from the residential base camp. It appears, however, that female collectors always returned to the base camp where actual processing—threshing and winnowing—occurred (Steward, 1933, p. 239).

The Owens Valley Paiute also made communal collecting trips, involving entire families to gather *piuga,* a fleshy caterpillar abundant in July; long trenches were excavated and the caterpillars were cached in the mountains, in anticipation of a fall residential move

(Steward, 1933, p. 256). *Kutsavi,* commonly appeared on lakeshores and were also collected communally and cached with seeds and rabbits for use as winter food (Heizer 1950; chap. 11 this volume).

Salt collecting locations in the lower Owens Valley were not far from the residential base. Salt was scraped by hand, then molded into cakes for storage and trade (Steward, 1933, p. 250). Manganese for trade was collected near Mono Lake. Tobacco also grew in this area. The plots were burnt in the spring, and the tobacco leaves were gathered in the late summer and cached (Steward, 1933, p. 319).

In sum, procurement locations on the floor of Owens Valley involved specialized collection areas for both irrigated and wild seeds and roots, as well as for items of trade. Although people sometimes remained away from home for several days—making these, technically speaking, field camps rather than locations—it was usually possible to return to the base camp within a day or two (Steward, 1938, p. 50).

Upland procurement localities in the Sierra Nevada and Inyo-White ranges provided a rich mosaic, varying in both resource abundance and diversity: ample game, several lakes and streams, springs, assorted seed and root crops, pine nuts, as well as trade items.

Individuals were permitted to hunt anywhere, but communal hunting was conducted only within the district territory (Steward, 1933, pp. 252, 329). Several excellent passes and trails were well known and used in both individual and communal hunting. Deer were often trailed and ambushed, sometimes with hunting dogs. Communal deer drives were directed by district headmen, with entire families temporarily moving into the uplands (it is unclear whether they stayed overnight). Some meat was cured and left hanging in the mountains "theft being impossible as anyone in need was welcome to it" (Steward, 1933, p. 253).

Several accounts are available describing encounter hunting of deer in the uplands. The meat from such hunting was generally transported to the base camp immediately; one of Steward's informants even reported transporting a deer and a bighorn simultaneously to the valley village (Steward, 1933, p. 428).

Bighorn were often hunted by large communal groups, directed by the village headmen. Brush corrals were constructed in the necks of narrow canyons, and stone enclosures, dummies, and corrals were also used.

The upland hunting system of the Owens Valley Paiute employed both encounter and intercept strategies. Ambush locations were often enhanced by construction of permanent facilities; hunting stands (Binford, 1978a, p. 330) were probably also used, allowing prediction of game movements and preparation for the best mode of procurement.

Pine nuts grow in stands throughout the Inyo and White ranges to the east of Owens Valley. These areas were owned, and permission was required prior to harvesting. Nuts were gathered by large work parties who were prepared to establish field camps during the fall and winter (Steward, 1933, p. 241). In poor pine nut years, the nuts were transported back to the valley villages; thus pine nut harvesting could involve either a procurement location, field camp, or actual residential shift.

Acorns were available on the western side of Owens Valley, but they were of minor importance, and often obtained in trade from the Western Mono groups.

Trade items were also procured in upland locations. Cinnabar, for instance, was collected near Last Chance Mountain in Death Valley. In addition, chalk was collected somewhere east of Owens Valley. A number of very important obsidian sources also occurred nearby: near Fish Lake, south of Big Pine, and near Bishop (Steward, 1933, p. 262; see also Bettinger and King, 1971).

Procurement locations common to foraging groups such as the Kawich Mountain Shoshone differed both quantitatively and qualitatively from those of collectors. Because of the high degree of residential mobility, few specialized procurement locations and almost no permanent facilities were established. Scattered around the residential base camps were pine nut harvesting locations, seed collection areas, short-term drive facilities for antelope and deer, as well as the sites for the festivals, often held after successful pine nut harvests.

Detailed information is generally lacking for the Kawich Mountain Shoshone, but they probably conducted extremely flexible encounter system hunting. Deer were both

driven and ambushed (Steward, 1941, p. 271) by hunters utilizing disguises, poisoned arrows, and fire. Overnight camps were probably established when the body size of the prey animal was large, the distance back to camp great, or the weather warm; in these cases, meat may have been dried first, then transported to the base camp (see Binford, 1980, p. 8). Brush corrals were undoubtedly constructed, and antelope were charmed with the assistance of a shaman. Similarly, bighorn were taken by both stalking and driving, aided by fire and dogs.

Communal rabbit drives were conducted by task-groups with nets and clubs. Rabbit hunts among Basin Shoshonean groups were known to last from two to 30 days, so they could involve simply a daily procurement area, or a more elaborate field camp. Smaller animals were taken by snares, nets, deadfalls, and pitfalls.

Blinds and hunting stands undoubtedly were built, but less frequently than among logistically organized groups. Temporary hunting facilities were used to take deer, antelope, bighorn, plus a variety of birds, including bluebird, doves, grouse, sage hen, and waterfowl. Fishing undoubtedly occurred in the Kawich Mountain area, but was of extremely limited importance in the subsistence pattern.

ARCHAEOLOGICAL CONSEQUENCES: The procurement location is common to all hunter-gatherers, but archaeological visibility varies radically depending on the resource exploited and how that exploitation is woven into the overall settlement strategy fabric.

Foragers, such as the Kawich Mountain Shoshone, typically exploited low-density resources, with spatial incongruity commonly solved by residential rather than logistic mobility. This means that the cost of constructing relatively permanent procurement facilities was usually outweighed by the advantages of simply moving on. Forager locations are generally lightly used and lacking in high-cost facilities. The primary entry into the archaeological record of such activities is as low-density tool and debris loss, distributed haphazardly and reflecting the encounter strategy which characterizes so much of foraging economics. Of course some foragers are more highly tethered than others, and the increased degree of ecological redundancy drastically affects the archaeological visibility of the foraging localities.

Collector locations include the low-density non-site, but also much more. Because the collecting strategy is best suited to areas of relatively high resource density and predictability, it makes good cost/benefit sense to construct relatively permanent procurement facilities: dams, canals, blinds, hunting walls, corrals, and stone dummies as "soldier rocks." Although the mode of hunting might be identical, other things being equal, facilities constructed by collectors will be more visible archaeologically than those built by foragers.

The archaeological consequences of large animal procurement are relatively straightforward, self-evident from the discussion in the previous chapter. The specifics of artiodactyl procurement depend largely on the local topography; elevational differentials conditioning summer and winter ranges, the funneling effect of local barriers on migration routes, the quantity and distribution of water through the year, the nature of forage and browse, and the exact species involved. Chapters 10–11 consider these parameters in detail for the protohistoric Monitor Valley area.

More problems are encountered when attempting to project the archaeological visibility of plant procurement. Although plants provided a high proportion of the protohistoric caloric intake, and plant availability played a major role in seasonal and annual positioning and mobility, the fact is that plant procurement *per se* is almost invisible archaeologically. Furthermore, traditional archaeological analysis is not only heavily biased toward animal procurement—because of its higher visibility—but it is also significantly biased toward the presence of males over females.[1]

Chapter 4 has already developed mid-range theory necessary to understanding the strategies required for plant procurement. But it remains to recast that theory specifically in terms of archaeological visibility. To recap briefly, basically two kinds of seeds—pine nuts and summer-ripening grass seeds—were exploited in the central Great Basin, supplemented by a wide variety of roots, greens, and other collectibles.

Pine nut, the most important plant food in those areas where it occurs, is a short-term, high-bulk, extremely nutritious, storable, cost effective resource. Although local pine nut productivity is notoriously erratic, annual yields are, at least in part, predictable. Pine nut collecting is the most visible of all plant procurement strategies considered here. Although pine nut harvesting artifacts will rarely appear in the archaeological record, the great bulk of the harvest almost always required construction of caches in the harvesting locality; pine nuts are the only plant resource of this area requiring such large caches. Milling stone caches—also important for pine nut procurement—may sometimes be found in the pine nutting area.

Still, the behavioral importance of pine nut procurement is poorly reflected in the archaeological record. Most of the visibility of pine nut processing results not from the harvesting process itself, but rather from the residential bases, field camps, or caches which must be established nearby because of the high cost of transporting pine nuts. There are few distinctive archaeological signatures for the harvesting and processing of piñon.

If the visibility of pine nut harvesting is low, procurement of other seed crops is virtually invisible. Caches are rarely made in the area of harvest because of the relatively low transport costs of summer seeds, berries, and roots. When caches are made—primarily for winter consumption—they are constructed near the projected winter residence, not in the area of procurement. Moreover, because these plants are procured on an encounter basis, their low predictability means that tools are rarely cached. Although the seed beater, the seed knife, and the digging stick are diagnostic artifacts of plant procurement, these tools are highly curated, almost never discarded in the areas of their use; instead, they are discarded in areas of repair or perhaps in artifact caches associated with the residential bases, not the harvesting areas.

To summarize, the location is a very low-visibility element of the hunter-gatherer archaeological record. Animal procurement locations are more visible than areas of plant or mineral procurement. Furthermore, intercept strategy hunting locations tend to be more visible than encounter strategy locations (because of greater annual reuse rate, and the greater numbers of people involved).

Artifact losses in such areas tend to be extractive tools and debitage, particularly items involved in kill and primary butchering. Habitation evidence in these locations depends on whether the hunters were logistically or residentially mobile (creating, respectively, associated field camps or residential bases).

Although plant harvesting locations have relatively low visibility, those resources involving high bulk and high transport cost—such as pine nuts—produce more evidence due to the temporary storage and processing facilities required at the locus of harvesting. Plant resources procured on a low-density, encounter basis will create thin, difficult to find, non-sites.

Mineral procurement localities—streambed quarrying, collecting ochers and salt—will generally have low visibility. Only when significant byproducts are created, as when quarry material is processed at the locus of procurement, will these sites have much visibility.

The nature and visibility of the locations depend heavily on the overall mobility strategy being employed. Logistic locations are more visible because the relatively high annual predictability and high return justify energy input into construction of (archaeologically visible) facilities. Residentially mobile groups produce almost invisible locations (and archaeological recognition must center on finding the base camp rather than the location).

Other Sites and Non-sites

The *station* is where special-purpose task groups engaged in information gathering; Binford (1980, p. 12) has stressed the importance of the game monitoring station among the Nunamiut. Stations are common where logistically organized societies identify specific resource targets and where they plan future procurement.

The Great Basin Shoshoneans had a special kind of station, the *fandango,* which also functioned in the overall information exchange system. The *fandango* is a planned,

temporary festival, commonly held (although not necessarily) in conjunction with communal rabbit or antelope drives. Some such gatherings attracted up to 300 people (Harris, 1940, p. 53; Steward, 1938, p. 237), providing an unusual opportunity for social interaction beyond the traditional winter residential base camp. Although *fandangos* varied considerably from region to region, certain elements were practically universal: gambling, dancing, trading, philandering and courting, and praying for abundance of critical resources (especially rain, berries, seeds, plants, fish, and land mammals).

Here is a fairly typical description for the Reese River Shoshone (Steward, 1938, pp. 106–107): "For 5 days the men drove rabbits daily and everyone danced at night. Dances were the round dance, the horn dance, which is a variation of the round dance, and the recently borrowed back-and-forth dance. Though danced primarily for pleasure, there was and still is some belief that the round dance brings rain."

Timing of the *fandango* was variable between groups, but relatively consistent within a given locality. The Northern Paiute "Festival of the Flowers" was held in the spring (Hopkins, 1883), as was the *fandango* of the White Knife Shoshone (Harris, 1940). But groups which relied heavily on pine nuts, such as the Reese River and Kawich Mountain Shoshone, almost always held their celebrations in the fall after the piñon harvest but prior to establishing the winter residential bases. This was a time when sufficient food was on hand to feed such a large gathering of people without cutting into the food caches earmarked for winter. These events were planned and coordinated in advance, often by a specifically appointed *fandango* boss (*gwini tegwani*); in the Pahrump Valley, the ceremonies were announced at least six to eight months in advance. At Owens Valley, and occasionally near Beatty, regular piñon festivals were held at alternate sites every other year. In bumper piñon seasons, two or even three such festivals might occur in the same year.

The *fandango* is conventionally viewed as a mechanism of "social integration," an occasion during which kinship ties and group solidarity were strengthened. Marriages were often arranged and, mourning ceremonies were held for the past year's dead; clandestine sexual affairs produced a spate of illegitimate offspring, at least in historic times (Steward, 1938, p. 90; Harris, 1940, pp. 68–69). Powell noted that "at the pine nut festival, the Indians exchanged ornaments and clothing as an expression of their friendship. No person must wear away from the festival the articles in which he came" (Fowler and Fowler, 1971, p. 248). Dancing, feasting, and general visiting has generally been considered to have functioned to promote social intercourse, with essentially noneconomic motivation (Steward, 1938, p. 237). In Steward's view, the piñon festival was not directly involved in subsistence, not part of what he called "the cultural core" (Steward, 1955).

Elsewhere (Thomas, 1972a), I have argued that the *fandango* also had a critical adaptive function. Several investigators (e.g., Moore, 1957; Piddocke, 1965; Rappaport, 1967) suggest that some cultural phenomena interpreted strictly as ritual were also adaptive mechanisms. Such investigators go much further than the traditional, ideational notion that ritual operates strictly as conventionalized, stereotyped behavior, serving primarily for affective or emotive purposes (Rappaport, 1971, p. 62). The Shoshonean piñon *fandango* is surely ritual in this sense, for traditional dances were always performed, stylized prayers offered for the deceased, rites enacted to insure increase, and so forth. Latent factors probably went far beyond the economic and subsistence function of the fall *fandango,* and this is probably also true for the Northern Paiute "Festival of Flowers," the *kuyui* festival held at Pyramid Lake, and the Ute Bear Dance, held in the spring (Lowie, 1924, p. 299).

But the *fandango* was a homeostat as well, helping to regulate local abundance, serving to condition annual mobility within the extended range of the groups attending. Although scattered family clusters traditionally gathered for "ritual purposes," a critical latent function of the *fandango* was the communication of information relevant to population control. Perhaps in a manner analogous to the well-known Maring pig festivals (Rappaport, 1967), the *fandango* was directly linked to the ecological well-being of its participants.

Fandangos assisted in regulating popula-

tion density by providing an epideictic indicator to all participants regarding the exact condition of the regional ecosystem. Since productivity of piñon is partly predictable, the festival also functioned as a clearing house of ecological information: areas of potentially good (and bad) piñon crops, regions of abundant or scanty rainfall, and location of significant concentrations of jack rabbits, antelope, and bighorn. When the ecological indicators were bad, optional modes of population control (especially abstinence and abortion) might have been more stringently applied. In extremely lean years—perhaps when there were insufficient resources to hold a *fandango* at all—the more drastic controls were probably implemented: infanticide, senilicide, and abandonment of the sick and infirm. Powell knew of three old females who went voluntarily to their death, saying "they had gleaned enough" (Fowler and Fowler, 1971, p. 162; see also Frémont 1887, pp. 436–437).

But when the critical ecological variables were favorable, these regulatory means could be set aside for another year: the second twin allowed to live, the aging grandmother nursed along for a while longer, the illegitimate newborn spared.

Communal festivals also facilitated the intercept hunting strategy. Communal hunting was a particularly efficient mode of exploitation—provided that a suitable work force was on hand, *at just the right time, in just the right place.* Surprise Valley antelope hunting, for instance, involved participants from over 15 to 20 different winter residential camps—over 100 men (Kelly, 1932, p. 83). Among some other groups—including the Reese River Shoshone—the communal fall gathering provided a work force suitable for charming antelope or driving rabbits. Men often drove animals during the day, returning to the festival site during the evening. Lowie (1924, p. 305) reports that at Pyramid Lake and Fallon, rabbit drives generally took place in the fall, immediately after a festival was announced by the "boss of the *fandango.*" Communal intercept hunting was most feasible after harvest of abundant food sources; the festival itself provided the social mechanism for short-term agglomeration.

This is not to suggest that the *fandango* lacked important social functions. Marriages were commonly arranged there (Hopkins, 1883, p. 131; Steward, 1938, pp. 46, 241; Harris, 1940, p. 68), and details of the levirate and sororate worked out during these periodic gatherings.

The *fandango* also conditioned patterns of regional mobility, shuffling and reshuffling local group composition. Proper sexual balance was critical for maintaining an equitable division of labor, and local groups probably reformed themselves periodically at such gatherings. Quarrels and feuds could easily have been resolved by fission into other groups at this time (Leacock, 1969, p. 14). Local group size in Death Valley, for instance, was in part conditioned by adoption of children between local groups (Steward, 1941, p. 350); since postmarital residence was bilocal and highly flexible in this area, the *fandango* offered the newly wed couple a place to assess the sociological and ecological information necessary to choose their new residence. The site of the next festival was probably selected on the basis of pooled ecological environmental information; the local *fandango* boss might well announce where the next piñon festival would take place—subject of course to unanticipated environmental events, such as drought, early frost, insects, disease, etc.

Unfortunately, the archaeological visibility of the *fandango* is severely limited: there are no diagnostic features, dwellings, or artifact inventories associated with such temporary festivals. The archaeological record would resemble that of an antelope drive, rabbit drive, or any high-density temporary gathering. *Fandangos* were sometimes held in neutral territory, so their relative isolation might be a clue. And, like most other field camps, *fandango* locations would be less tethered to fuel, water, and shelter than would the typical base camp. To my knowledge, no archaeologist has ever recognized a *fandango* site.

ANNUAL POSITIONING STRATEGIES

So far, we have considered both the procurement strategies necessary to exploit key Great Basin resources, and the kinds of sites and non-sites that hunter-gatherers would have produced. But to transcend mere typology, it is also necessary to know how these various site types articulate in distinct regional patterns.

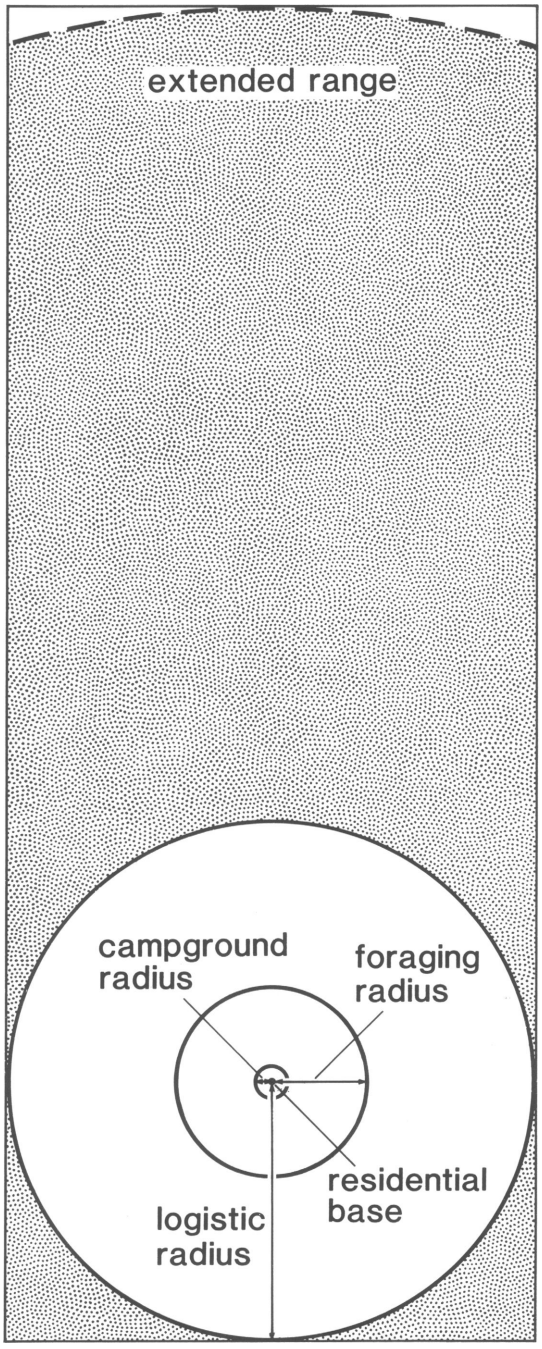

FIG. 11. Idealized model of logistic strategy exploitation of cultural geography (taken from discussion by Binford, 1982a).

Site patterning is created by the long-term processes of human positioning within physical space (Kelly, 1980; Binford, 1982a). Repositioning is another homeostatic tactic, creating overall stability within the annual sequence of various subsystems. This repositioning also creates variability in the archaeological record.

Physical characteristics of biogeography aside, a *cultural geography* is likewise imposed by the relative positioning of residential base camps. An ideal model of concentric economic zonation is shown on figure 11. To standardize the following discussion, we follow Binford's (1982a) terminology regarding the structure of the landscape radiating about the base camp.

The innermost circle on figure 11 is the *campground radius,* the zone containing the immediate workings of the residential base. The resources within this area are commonly overexploited, providing little in the way of food (Binford, 1982a). The campground radius is, however, important for the procurement of renewable or unearned resources, such as firewood and water. This area also contains lightly exploited resources, such as willow stands (for basketry), various roots and herbs for medicines, as well as a close-by hinterland for low-density encounter hunting of small game such as rodents, reptiles, and birds. The camp range extends for a kilometer or so in all directions.

The *foraging radius* extends beyond the campground radius to include the area systematically searched and exploited by task-specific work parties leaving camp to forage, but returning home each night. Binford (1982a) suggests that this foraging radius is rarely more than 10 km. or so from the residential base. Beyond this distance, it is generally more efficient to establish a field camp for overnight accommodation of work parties; in the case of high-bulk resources, the cost/benefit relationships suggest that base camps be re-established near that resource (as is commonly done by foragers). There is little need for extensive logistic mobility beyond the foraging radius in areas of uniform resource distribution (Schalk, 1978, p. 98; Kelly, 1980, p. 97).

Within this foraging radius is a wide range of procurement locations: areas for seed harvesting, fishing, encounter and limited intercept hunting, salt collection, lithic procurement, and so forth. Any intercept hunting

facilities would, quite naturally, also be available for logistic parties. The foraging radius basically defines where groups range daily during their stay at a given base camp.

Further out still is the *logistical radius,* defining the zone exploited by specialized task groups staying away from the residential camp overnight or longer. The size of this radius increases in proportion to the degree of logistic organization within the system.[2] For logistical groups, these field camps are often inhabited for two or three weeks, although some field camps were occupied up to three months (Binford, n.d.).

Because of the overnight factor, field camps must have at least minimal maintenance accommodation such as shelter, water, firewood, and perhaps also a local food supply. Tool caches are occasionally left at field camps in anticipation of future logistical use.

All these zones are within the *extended range,* the area commonly monitored relative to resource abundance and distribution. The size of the extended range varies according to the resources involved and the nature of the intergroup communication.

The various economic zones are viewed here in an ideal sense, as concentric circles about the residential base. In the real world, of course, the definition of each zone is strongly conditioned by the transport and labor costs of each resource, local topography, distribution of resource patches, and tethering effects of water availability and migration routes.

Each of these geographic zones can be seen, to one degree or another, in the three Basin Shoshonean case studies presented in chapter 3. The logistical system in protohistoric Owens Valley is characterized by a minimum of residential movements, accompanied by a large range of task-specific activities pursued elsewhere. As figure 7 indicates, the *foraging radius* of the major valley village, *Pitana patü,* is about 8 km., and similar distances are involved for the other major protohistoric districts in Owens Valley (Steward, 1933, map 2).

The *logistical radius* in Owens Valley coincides with the band territory, where nearly all food procurement occurred "except when people were invited to participate in hunts elsewhere" (Steward, 1938, p. 52). The logistical range for *Pitana patü* is about 24 km. (see fig. 7), and Steward extolled the "extraordinarily rich environment" of Owens Valley, which provided all essential resources within 24 to 32 km. of the residential base (Steward, 1933, p. 239, map 2; 1938, p. 50). This radius includes the common hunting forays to the west into the Sierra and pine nut trips into the Inyo-White Range to the east. A *wai* (a wild seed) collection area about 14 km. north of *Pitana patü,* is evidently beyond the foraging radius; Steward lists a task-specific "*wai* camp" (a classic field camp) immediately on the southeast margin of the seed plot (Steward, 1933, map 2). This distance of 14 km. was clearly beyond the foraging radius, but well within the logistic range of the *Pitana patü* villagers.

There is also intersite variability; the valley bases contrast markedly with mountain and residential bases and with a host of rather highly visible logistic sites scattered within the foraging radius. This logistical radius was extremely stable, and territorially reinforced.

Similarly, one can reconstruct the parameters of the Reese River Shoshone cultural geography from figure 6. The winter residential base was established in a traditional spot, generally named and "owned" by local family groups. Both valley and upland areas were available from these piñon woodland villages within a distance of 6 or 8 km.; this comprised the *foraging radius* for residential bases such as *Tüdüpihunupi.* Similar distances attended the summer residential bases.

The *logistical radius* for the Reese River Shoshone can be estimated at between 60 and 80 km.: "the only long trips that were necessary were for pine nuts when the local crop failed and for communal antelope and rabbit drives and festivals. These might require travel up to 40 or 50 miles, depending on the location of the village" (Steward, 1938, p. 101).

The situation is quite different for the highly mobile Kawich Mountain Shoshone. We can assume that the foraging radius—the distance ventured daily from the base camp—was probably the same as for other Basin Shoshoneans, probably 8 to 10 km. But since the Kawich Mountain groups followed a residentially mobile strategy, their "logistical range" was probably nonexistent. Even if rabbit and antelope drives were conducted on a field camp basis—rather than involving yet

another residential shift—the logistical range was probably less than 19 to 24 km. (see fig. 5). But task-specific activities within this radius were minimal.

The major contrast between the foraging Kawich Mountain Shoshone and the other Basin groups discussed here is their highly attenuated *extended range.* Kawich Mountain people commonly traveled a distance of 40 to 50 km. north into the Monitor Range for piñon nuts, and journeys to the Silver Peak Mountains (over 120 km. to the west) were not unusual.

One Western Shoshone informant knew the conditions of various seeds and roots within a 240 km. summer range (Harris, 1940, p. 45) although he noted that it was more common to camp and satisfy all one's food needs within a 40 km. radius (see also Steward, 1938, p. 232).

STRATEGIES OF LONG-TERM MOBILITY

Discussion so far has focused on how occupational and task-specific areas are arrayed across the landscape in the annual cycle. This patterning can analytically be telescoped into a single year: the Owens Valley Paiute pattern for A.D. 1800, the Reese River Shoshone pattern for A.D. 1800, the Kawich Mountain Shoshone pattern for A.D. 1800. But before defining the archaeological potential of these annual patterns for the protohistoric Monitor Valley, we must say a word about the long-term patterns of hunter-gatherer mobility. It is, after all, through long-range mobility that a given biogeographical spot is economically modified and perceived relative to a particular human procurement system (Kelly, 1980; Binford, 1982a, n.d.).

Long-term mobility also conditions the archaeological visibility of each strategy. The Kawich Mountain Shoshone, for instance, followed a *point-to-point mobility patterning,* meaning that residence was moved from one relatively low bulk location to another location, depending on the local availability of food, water, and/or fuel. In moisture-deficient areas, movement was commonly tethered to waterholes. The distance between such "camps" could be substantial, creating an annual round covering a wide area. Specific residential shifts for the Kawich Mountain Shoshone were conditioned primarily by seasonal abundance of water, pine nuts, summer-ripening seeds, and occasional high-bulk resources such as antelope and bighorn.

The point-to-point mobility pattern is also characteristic of the Nunamiut Eskimo collectors studied by Binford (1982a, p. 10), in which camps are moved to specific places "prejudged as to the degree that there is an optimal congruence among foods, fuels, and water obtainable from the chosen location." For the Nunamiut, distance between such point-to-point moves might at times be more than double the foraging radius; this probably was also the pattern with the Kawich Mountain Shoshone.

It is more difficult to assign mobility type to the other two selected Basin Shoshonean groups. The Reese River Shoshone were tethered to the "owned," traditional winter residential bases; families wintered in these spots whenever possible, moving their annual range only when forced to do so by resource scarcity. Whenever a major residential move was made, however, it was from point-to-point, relocating to another location favorable from the standpoint of food, water, fuel, and/or shelter.

The Reese River Shoshone thus employed a mixed strategy. Winter mobility was limited, relying heavily on caches near the residential base (positioned on the basis of logistical considerations); yet the Reese River groups might disperse in summer, behaving more like foragers employing a mobility strategy designed for large-scale coverage, based on resource "encounters." This strategy seasonally maximized both coverage and positioning tactics (see Binford, 1982a).

Although we lack information specific enough to pinpoint the summer strategy in Reese River, it may be similar to the *half-radius continuous pattern,* in which residences are moved to the outer perimeter of the radius previously covered. Such groups could rapidly cover an area of scattered and relatively sparse resources like the floor of the Reese River Valley.

The Owens Valley Paiute case is even more complex, since residential mobility was quite limited. Within the annual cycle, residential movement occurred only in good to excellent

piñon crop years. Whenever such moves were made, the valley villages were reoccupied during the spring. Although the form of movement seems to once again be *point-to-point,* only two points were involved: the valley village and the mountain piñon camp. More extensive residential movements during the protohistoric period were severely restricted by the system of inherited band territories.

In one way or another, all the Basin groups discussed seemed to have followed a point-to-point pattern, common to both collectors and foragers. This strategy is well-suited for the environmental specifics of the protohistoric Great Basin, requiring considerable knowledge and an *a priori* understanding of resource distributions, which often were incongruous (as for the Kawich Mountain groups). In this regard, at least, the Great Basin Shoshoneans monitored their resources more in the manner of collectors, since the strategies depended on already known resource distributions. The true foraging society emphasizes tactics designed to learn about the resources in the mobility process (Binford, 1982b); no such free-wandering Great Basin groups have been documented.

Unfortunately, so little work has been done on long-term mobility that the archaeological visibility of such patterning is presently nil (Kelly, 1980). The problem is not that the information is lacking; the problem is that we are asking insufficiently precise questions to allow us to monitor such patterning. An examination of long-range mobility patterning is a critical need in the archaeology of future years.

NOTES

[1] The topic of the "amazingly invisible female" is developed more fully in Part 2 of this series.

[2] In a sense foragers lack a logistical radius since it is isomorphic with the foraging radius. Their high degree of residential mobility obviates the use of field camps.

CHAPTER 6. PHYSICAL CONTEXTS: NATURAL HISTORY OF MONITOR VALLEY

Now we shift gears rapidly. Subsequently we restrict focus to the Monitor Valley of central Nevada. To provide a series of concrete archaeological expectations for this area, it is necessary to examine the natural and cultural history of this region in some detail (chaps. 6, 7). These data are available, and we can examine the protohistoric Monitor Valley landscape to derive the assemblage level predictions required for comparison with the archaeological record.

GEOLOGY AND GEOMORPHOLOGY OF MONITOR VALLEY

WILTON N. MELHORN AND DENNIS T. TREXLER

PHYSIOGRAPHY

The western border of Monitor Valley abuts the Toquima Range, one of the many typical "block fault" mountain masses characteristic of central Nevada. The highest point in the northern Toquima Range is Wildcat Peak (3203 m., 10,507 ft.), at the head of Mill Canyon; the average altitude of the range crest in the north is about 2900 m. (9500 ft.). The floor of adjacent Monitor Valley declines northward from an elevation of 2350 m. (7700 ft.) at the southern end to about 1905 m. (6250 ft.) at the north, where the Stoneberger Creek drainage outlet to Bean Flat crosses U.S. Highway 50 (see fig. 12).

Monitor Valley is unusual for the region in two respects. First, it is "open" at its northern end, and in historic times the surface drainage could pass through Kobeh Valley to discharge terminally into the closed sink of Diamond Valley. Second, rather than the "dry lake" or alkali sink characteristic of other internally drained basins in central Nevada, Monitor Valley retains a more or less permanent, shallow playa lake, Monitor Lake. Probable geological reasons for and the possible archaeological significance of this postglacial, perennial body of water are considered subsequently. The total relief between Monitor Lake, near the valley center, and nearby Wildcat Peak is about 850 m. (2800 ft.).

HYDROLOGY AND CLIMATE

The climate of the central Great Basin and Monitor Valley is discussed in detail in the next section by Thompson. For present purposes, it is sufficient to note that rainfall in this semiarid area increases significantly with altitude, and the temperature correspondingly declines. The regional Hydrologic Atlas (Price and Eakin, 1974) shows averages of 305.0 mm. (12 in.) precipitation at the mountain bases, 406 mm. (16 in.) at higher elevations, and 508 mm. (20 in.) on the peaks; the larger amounts come mostly as winter snow and convective showers in the late summer. Class A evaporation pan data, however, show that 70–80 percent of the available moisture is reevaporated, and relatively little water is available for stream runoff and groundwater recharge.

Most streams that drain the eastern Toquima Range are intermittent in their lower courses, and water may reach the valley floor only a few days or weeks a year. Stoneberger Creek is the only perennial stream in the north; Rush and Everett (1964) estimated base flow as 1.5 cubic ft./sec. at Monitor Ranch (see table 1). Pine Creek, Barley Creek, and Meadow Creek contribute aggregate base flow of perhaps 5 cubic ft./sec. to Monitor Lake. Most of this water sinks into alluvial valley fill before reaching the playa, but as groundwater it is under artesian pressure. Windmills and stock tanks south of the lake are evidence of a shallow water table, and some flowing wells are reported. The lake is probably recharged by these rising artesian waters.

Price and Eakin's (1974) estimate for mean annual runoff in the Toquima Range approximates a 25 mm. (10 in.) moisture equivalent at Mt. Jefferson, 127 mm. (5 in.) in the canyons, and less than 25 mm. (1 in.) at canyon mouths. Except for flash flood events associated with late summer convective storms, it is probable that surface flow rarely

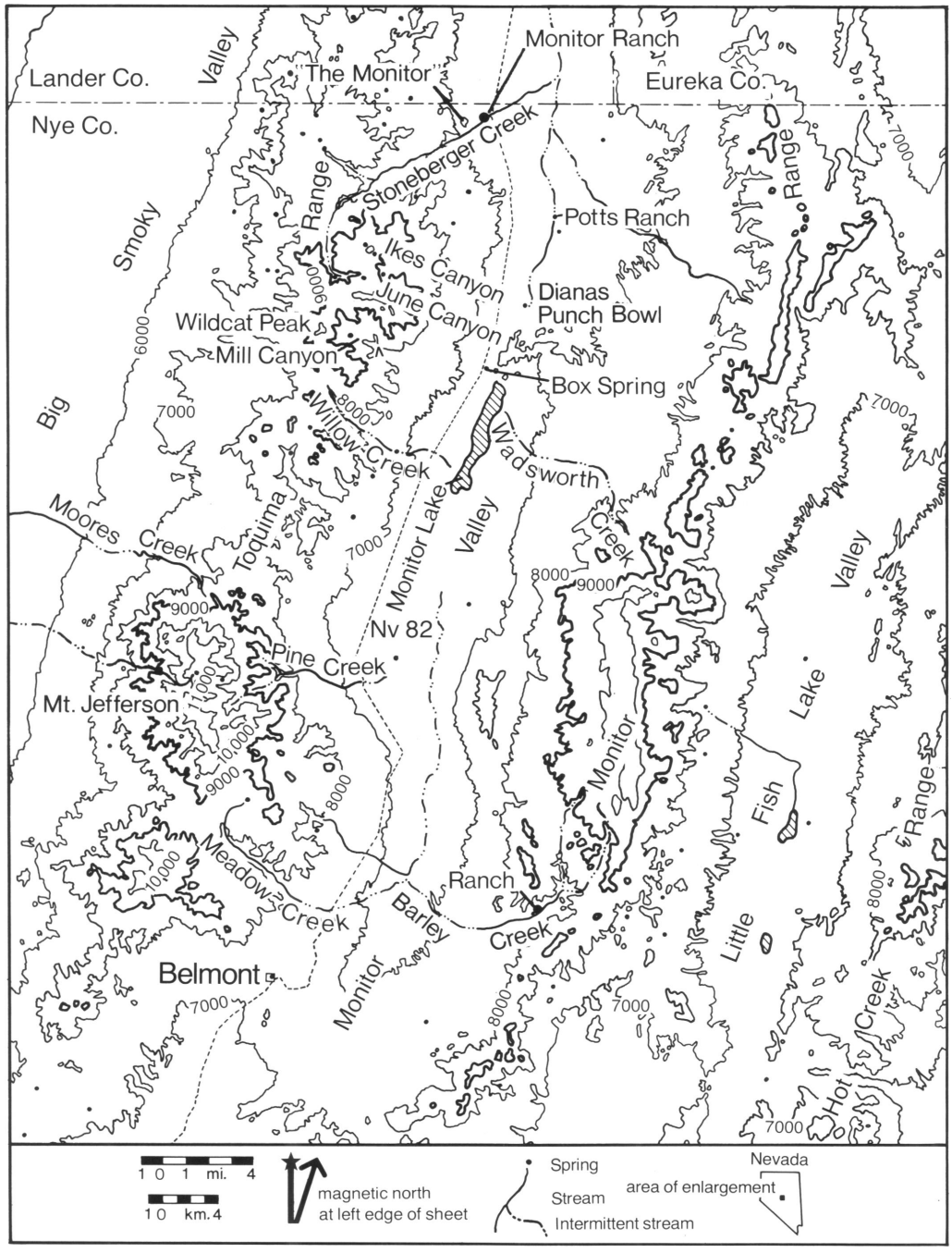

FIG. 12. Locator map of Monitor Valley, Nevada.

reaches the fan trench at the mouth of Mill Canyon and it reaches Monitor Lake even less frequently. A major flood event in mid-September 1977, caused minor debris flows and formed mud-flow levees on the valley north wall; some flood waters may have

TABLE 1
Flow Data for Selected Streams in Monitor Valley[a]

Location	Mean Flow (cu. ft./sec.)	Maximum Flow (cu. ft./sec.)	Minimum Flow (cu. ft./sec.)	Recharge Availability (acre-ft.)
Stoneberger Creek, 2 miles SW of Monitor Ranch	1.45	11.0	0.18	1050
Mosquito Creek, 17.9 miles NE of Belmont	6.03	79.0	0.11	4370
Pine Creek, 2.4 miles W of Pine Creek Ranch	9.23	92.0	0.89	6680

[a] Water-stage recorders were established by the U.S. Geological Survey on several streams in Monitor Valley in 1977, and gauge records are available for the period from October 1977 to the end of 1978. Selected data for calendar year 1978 are included in this table.

reached the edge of the shelter. However, the actual magnitude of this event is unknown.

An estimate of water budgets for the two sections of Monitor Valley presents some interesting contrasts (see table 2).

Monitor Lake is sulphurous, alkaline, and shallow and has presumably about the same form and dimensions as its ancestor, pluvial Lake Diana (fig. 13). Hubbs, Miller, and Hubbs (1974) estimate the present maximum dimensions as 9.0 km. (5.6 miles) long by 1.9 km. (1.2 miles) wide with a surface area of 11.9 sq. km. (4.6 sq. miles). The configuration of the modern lake varies annually in response to recharge, and in some years the lake is almost dry. The only outlet, at the north end, is at about 2070 m. (6790 ft.) elevation; split-spoon sampling in August 1978 showed the water table was 22.9 cm. (9 in.) below ground surface at this outlet. A rise of lake level to an elevation higher than the outlet would produce outflow through a broad, shallow, box-shaped channel about 180 m. (600 ft.) wide and 3 m. (10 ft.) deep that joins other drainages leading northward toward Dianas Punch Bowl (see fig. 13). This channel extends about 5.6 km. (3.5 mi.) and declines 37 m. (120 ft.) to an area where it shallows and disappears. The freshness of the flat-bottomed channel and the general lack of slumping of sidewall colluvium suggest that overflow occurs periodically through the appropriately named Box Spring outlet, though there is no historic record of such an event. The grassy meadow on the channel bottom is supported by minor underflow seepage from the lake and by occasional direct discharge of water from Ikes and June canyons.

Geological and Geomorphological Setting

The northern part of the Toquima Range has been geologically mapped in some detail by Kay and Crawford (1964) and McKee (1976). Although this area is not known to contain rich metallic mineral deposits, it has

TABLE 2
Estimated Water Budget for Monitor Valley[a]

	North Monitor	South Monitor
Subsurface storage (acre-feet)	1.0 million	1.0 million
Yield (acre-feet)	8000	13,000
Average annual recharge (acre-feet)	6300	15,000
Average depth to water (feet)	15–40	5–40
Spring discharge (acre-feet)	1500[b]	200
(Estimated average annual underflow of Monitor Valley = 200 acre-feet)		

[a] Data taken in part from Rush and Everett, 1964.
[b] Mostly from Dianas Punch Bowl and springs at Potts Ranch.

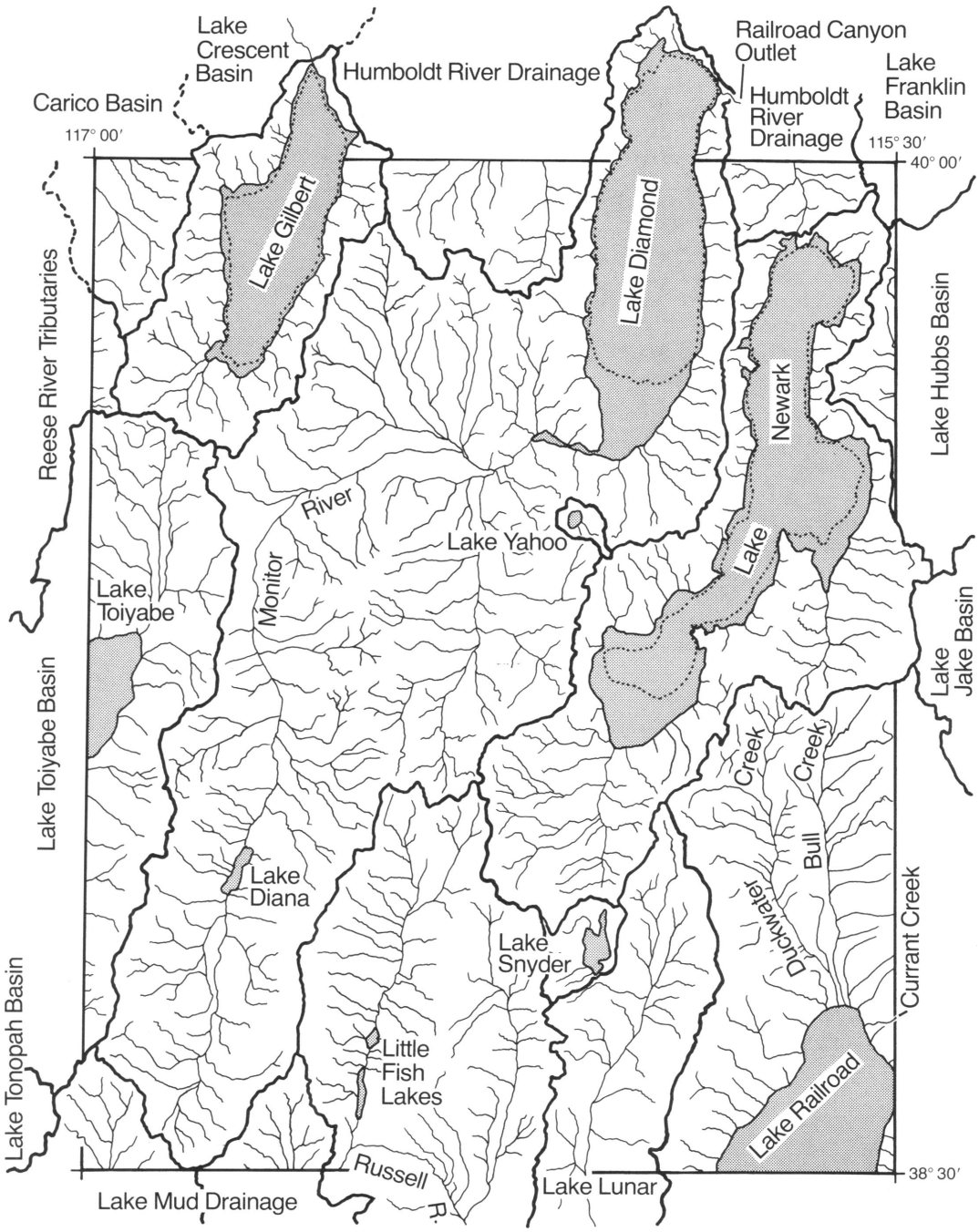

FIG. 13. Paleohydrology of Pleistocene lakes in central Nevada (after Hubbs, Miller, and Hubbs, 1974, fig. 2).

nevertheless attracted the attention of paleontologists because of the rich and varied Ordovician, Silurian, and Devonian (early Paleozoic) invertebrate fauna found in and

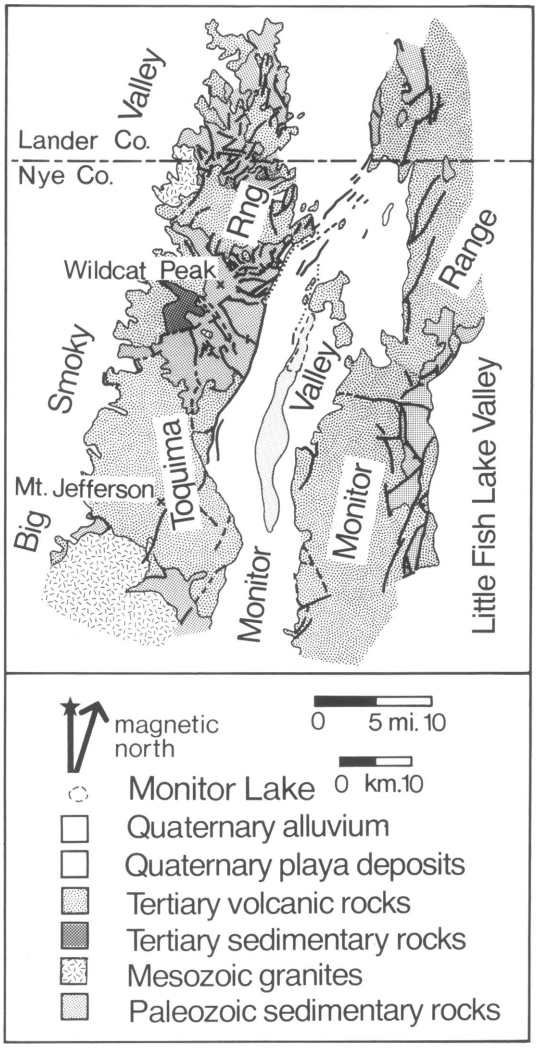

FIG. 14. Generalized geological map for the central portion of Monitor Valley, Nevada. Heavy lines indicate fault lines.

around Ikes Canyon (e.g., Bassler, 1927, 1941; Cooper, 1956; Kay, 1962; Ross, 1970). Today, the area is a favorite fossil collecting ground.

AREAL STRATIGRAPHY AND STRUCTURE: Much recent emphasis has been placed on geologic mapping of the area, an interpretation of the tectonic history and structural style shown by the Paleozoic rocks, and on a paleoenvironmental evaluation of the contained fauna. The geology was first studied by the late Marshall Kay of Columbia University and his students from 1959 to 1962. Kay proposed many informal, local stratigraphic names for rock units in order to augment the formal names used elsewhere in Nevada. A summary and interpretation of the Paleozoic rocks of the northern part of the Toquima Range is found in Kay and Crawford (1964) and a more complete analysis is contained in McKee (1976). Stratigraphic nomenclature was refined or revised by McKee and Ross (1969) and McKee (1976), and correlations extended to other ranges of central Nevada.

A simple summary of the complex geological and structural setting suffices for the purposes of the present project. In brief, early Paleozoic sedimentary rocks are surrounded by and underlie younger Cenozoic sedimentary and volcanic rocks in the area extending from the head of Stoneberger Basin and Ikes Canyon southward to Moores Creek and westward to beyond Wildcat Peak (fig. 14).

The Paleozoic rocks are an intricate succession of tectonically deformed thrust fault slices that locally lie above less deformed Paleozoic rocks of equivalent age. The slices presumably were displaced eastward some 64 km. (40 miles) from the original site of deposition to their present position by recurrent movements along the regionally extensive Roberts Mountains thrust fault. The local result therefore is seen as an in-place eastern assemblage of undeformed, predominantly light-colored carbonate rocks deposited in a shallow water shelf environment. These have been overridden and thus are overlain by a western assemblage of dark-colored carbonates, cherts, argillites, siltstones, and volcanics that were deposited in deeper water. In this geological framework, strata at Gatecliff Shelter belong to the eastern in-place group (see Part 2).

FAULTING IN MONITOR VALLEY: Although not drawn on the preliminary geological map of northern Nye County (Kleinhampl and Ziony, 1967), a fault strikes about N 45°E and cuts fan alluvium north of Mill Creek. This fault is seen on aerial photos and is traced on the ground by a zone of increased vegetative cover and trees along a shallow trough crossing the fan surface. The orientation sug-

gests that this fault connects with, extends, or parallels inferred faults shown on the geological map at Dianas Punch Bowl. In this event, the fault is probably antithetic (upthrown on the southeast side); Monitor Lake lies on the tilted dip slope of the upthrown block. This fault may figure, in part, in the history of the lake and also control the hydrologic regime by providing an impermeable barrier to groundwater flow, as is described subsequently.

The northern Nye County preliminary geological map shows also a possible fault along the axis of the outlet channel below the Box Spring outlet, but there is no supporting field evidence for this fault. It is equally likely that the channel was cut at times when Monitor Lake overflowed and trenched downward into alluvial fan or lacustrine deposits that filled a topographic low in the underlying Shingle Pass Tuff.

A small but prominent fault scarp, upthrown on the east side parallels the east shore of Monitor Lake for about 2.4 km. (1.5 miles) between the north end of the lake and the jeep road to Wadsworth Creek. The fault cuts alluvial deposits, has a throw of perhaps a few feet, and appears fresh and uneroded. This suggests that the movement is quite recent. Although the site was not visited, the fault is seen clearly on aerial photos and from some distance away on the ground. The break may have resulted from an increase in isostatic loading caused by continuous sediment flux into the playa basin rather than being a reactivation of an older, range front fault.

TERTIARY AND PLEISTOCENE LAKES: The Great Basin was the site of shifting freshwater lakes during Miocene and Pliocene times, and shorelines and other littoral features of these lakes are locally well-preserved (King, 1878; Russell, 1885). Lacustrine sediments abound in northern Monitor Valley, and between June Canyon and Stoneberger Creek they are well-exposed in a prominent series of steplike benches, in which fossiliferous silts are capped by sequences of younger alluvial fan deposits. These planar, faintly notched benches suggest that various stands of an old Tertiary lake endured long enough to create strongly marked shorelines at elevations of about 2137 m. (7010 ft.) and 2085 m. (6840 ft.), and less strongly developed features at about 2073 m. (6800 ft.), 2054 m. (6740 ft.), and 2042 m. (6700 ft.). Along Willow Creek, southeast of Potts Ranch, is an impressive exposure where 6–9 m. (20–30 ft.) of prograded, coarse-grained fan deposits rest unconformably on lacustrine silts of the 2137 m. (7010 ft.) stand, and patches of poorly cemented fan gravels rest locally in a similar relationship on the 2085 m. (6840 ft.) level.

Northern Monitor Valley was apparently part of a closed basin system when these lakes existed. The highest lacustrine bench identified is only about 9 m. (30 ft.) lower than the pass at Hickison Summit, which would have permitted overflow into Big Smoky Valley. This uppermost bench also is higher than the elevation of the gap leading to Antelope Valley and Little Fish Lake Valley farther southeastward. It is tempting to speculate (ignoring any effects of later tectonic adjustments) that a high stand of the late Tertiary lake spread as an extensive, irregularly shaped water body across much of central Nevada, analogous to the younger Glacial Lake Lahontan farther west. There are no detailed recent regional studies of these ancestral Tertiary-age lakes, though Mifflin and Wheat (1979) have established the locations and extent and developed "pluvial indices" for their Pleistocene descendants.

Sometime prior to or during the early Pleistocene, the Monitor basin must have been breached, and the Tertiary lake drained northeastward through Kobeh Valley and Devils Gate gap west of Eureka to a new and lower base level at about 1620 m. (5300 ft.) in Diamond Valley, as suggested by Hubbs and Miller (1948, p. 35). Exactly when this "basin capture" occurred is unknown, but the outlet was clearly operational prior to formation of the later Pleistocene pluvial lakes as there is no evidence of younger ponding in northern Monitor Valley. Perhaps the wave planed benches are vestiges of lake stands controlled by a succession of stabilized outlet levels that existed at different times when there were pauses in downcutting at the Devils Gate outlet.

A different scenario apparently existed in southern Monitor Valley. A Tertiary lake may

have existed and left a record of shoreline features, but these features either have been destroyed or now are concealed by the massive, compound alluvial fans which stream down from the flanks of the adjacent ranges to the playa margin. Furthermore, there seem to be no shore features representing any higher stands of pluvial Lake Diana (the predecessor of Monitor Lake). Although these also could have existed, they are overwhelmed and buried by the compound fan flanking the Toquima Range and by the alluviated pediment that sweeps down from the Monitor Range. Snyder, Hardman, and Zdenek (1964) and Hubbs, Miller, and Hubbs (1974) suggest, probably from the same evidence, that Lake Diana was little if at all larger than present Monitor Lake, However, if meltwater runoff from glaciers that advanced periodically for several miles down the valley of Pine Creek from cirques high on Mt. Jefferson maintained a stream flow stage higher than now exists, it is puzzling why Lake Diana was not larger. Assuming that surface evaporation was less, or at least no greater than at present, stabilization of Lake Diana at a uniform level could be achieved only if there was discharge into the outlet channel at Box Spring. This control could explain the lack of multiple shore features and the temporally constant area and configuration of Lake Diana.

Why then does Monitor Lake persist when elsewhere similar vestiges of the pluvial lakes have vanished? Hubbs, Miller, and Hubbs (1974, p. 21) suggest that Lake Diana and its successor have been dammed by alluvial cones of the Mill Creek and June Canyon fans, which impinged upon or merged with the "lava hill" of Shingle Pass Tuff jutting into the valley from the Monitor Range. These features do comprise a topographic barrier, but this explanation is not fully convincing. Probably a groundwater barrier or hydrological dam exists in a cross-valley orientation north of Monitor Lake and thus impedes normal groundwater underflow northward. This barrier could consist of the bosses or plugs of intruding dacite shown on the geologic map (fig. 14), an impermeable zone existing along the general line of the Mill Canyon fan fault and the Punchbowl fault zone, or some combination of these and other geological controls. Clearly some seepage does occur across this barrier, as at Box Spring, but subsurface water movement seems sufficiently retarded so as to create the excess of groundwater under hydrostatic pressure that maintains Monitor Lake as a perennial water body.

GLACIAL AND PERIGLACIAL ACTIVITY: Alpine glaciers existed in the past on the northern and eastern flanks of Mt. Jefferson, and the eastern face of Table Mountain in the Monitor Range is scarred by the remnants of at least four cirques. On Mt. Jefferson, the maximum distance of ice advance downvalley was about 4 km. (2.5 miles) along Pine Creek. However, there are only a few prominent recessional moraines left by this glacier, and cirque headwalls and flanks developed in volcanic rocks are strongly degraded and slumped, giving the appearance of considerable age. Although the precise age is unknown, Piegat (1980) has mapped deposits of two distinct glacial events, presumably belonging to the middle or late Wisconsinan glacial stage.

Superposed on the cirques, however, are at least three stages of rock glaciers. The youngest of these is either still active or movement has ceased so recently that stabilization is not completed. There are areas of patterned ground in tarn basins at the head of the South Fork of Pine Creek, and also on the flat-lying volcanic tableland above the cirques on the North Fork of Pine Creek and Buck Creek. Steep, talus-covered slopes on the valley south wall of South Fork display undistorted, unbroken stone garlands and stripes and suggest either recent or current solifluction activity. No local evidence is yet available that will permit precise age-dating of these periglacial forms. Most probably, all are of Neoglacial age; the latest rock glacier event may be as recent as the Little Ice Age (400–100 years B.P.). Upland bogs and summit-level springs suggest also that relict, deep permafrost may yet exist beneath the level crestal plateau of Mt. Jefferson. Part 4 discusses several archaeological sites associated with the

Mt. Jefferson glacial features. It seems certain that glacial or periglacial activity has persisted at elevations above 3000 m. (10,000 ft.) during much of the last 10,000 years. These events coincide with the documented time of human occupancy of Monitor Valley.

MODERN VEGETATION AND CLIMATE

ROBERT S. THOMPSON

Modern environment is the baseline against which we attempt to measure past environmental changes and predict which resources were available to prehistoric people. In this section, I review major features of the environment of Monitor Valley: climate, vegetation, and the interaction of the two.[1] It is also important to emphasize that both climate and vegetation are to some degree different than they were in even the latest of precontact times. Although I cannot assess the magnitude of these alterations in Monitor Valley, I review some of the probable historic environmental changes.

Regional Climate

To a great degree physiographic and geographic factors shape the climate of the Great Basin. The Sierra Nevada forms a major rainshadow to the west, and, to a lesser degree, the southern Rocky Mountains form an eastern rainshadow. The mountainous terrain of the Great Basin itself causes precipitation and temperature to be unevenly distributed over elevational gradients. The Great Basin Desert covers a wide range of latitudes from roughly 37°N in southern Nevada and Utah to 43°N in eastern Oregon. This latitudinal range is combined with a trend toward decreasing valley elevations toward the south. These physical factors produce a continental dry climate with large diurnal and annual temperature ranges with generally warmer conditions in the more southerly (and lower) regions.

Seasonal and Regional Distribution of Precipitation: Cool season (winter–spring) precipitation is dominant throughout most of the Great Basin and only the southeastern and eastern portions receive much summer precipitation. The westernmost region is directly in the shadow of the Sierra Nevada and, in general, receives much less precipitation than the eastern Great Basin.

During the winter months (November to April) migratory low pressure centers follow storm tracks from the Aleutian Low in the northern Pacific Ocean across the northwestern United States (Houghton, Sakamoto, and Gifford, 1975). These storm tracks follow the westerlies and shift southward as the subtropical highs weaken and contract toward the equator. The storm tracks generally are blocked from entering the Great Basin by the development of a stagnant high pressure cell (the Great Basin High) and usually follow a course north of 40°N (Mitchell, 1976). However, the Great Basin High weakens and breaks down several times during a "normal" winter and the storm tracks shift southward into the Great Basin. It is during these periods that western Nevada receives the majority of its annual precipitation (the geographic extent of this "Pacific" precipitation maximum is shown in fig. 15). Principal component analyses of historic climatic records from Nevada (Stidd, 1967) and the rest of the western United States (Sellers, 1968) indicate that this pattern has persisted throughout this century.

Springtime (April–June) and some autumn (October–November) precipitation is usually associated with the development of the Great Basin Low. The greatest frequency of cyclogenesis in North America occurs in the Great Basin because the presence of the high Sierra Nevada encourages cyclonic development in its lee (Houghton, 1969). These lows carry moisture in from the Pacific and may also receive moisture in the springtime from snowmelt (Houghton, 1969). These Great Basin Lows bring more effective moisture to most of the Great Basin than the Pacific storms because, unlike the latter, they tend to track due east across the central Great Basin, rather than farther north. The Great Basin Low ("Continental" precipitation in fig. 15) strengthens as it moves eastward, and central Nevada, eastern Nevada, and north-

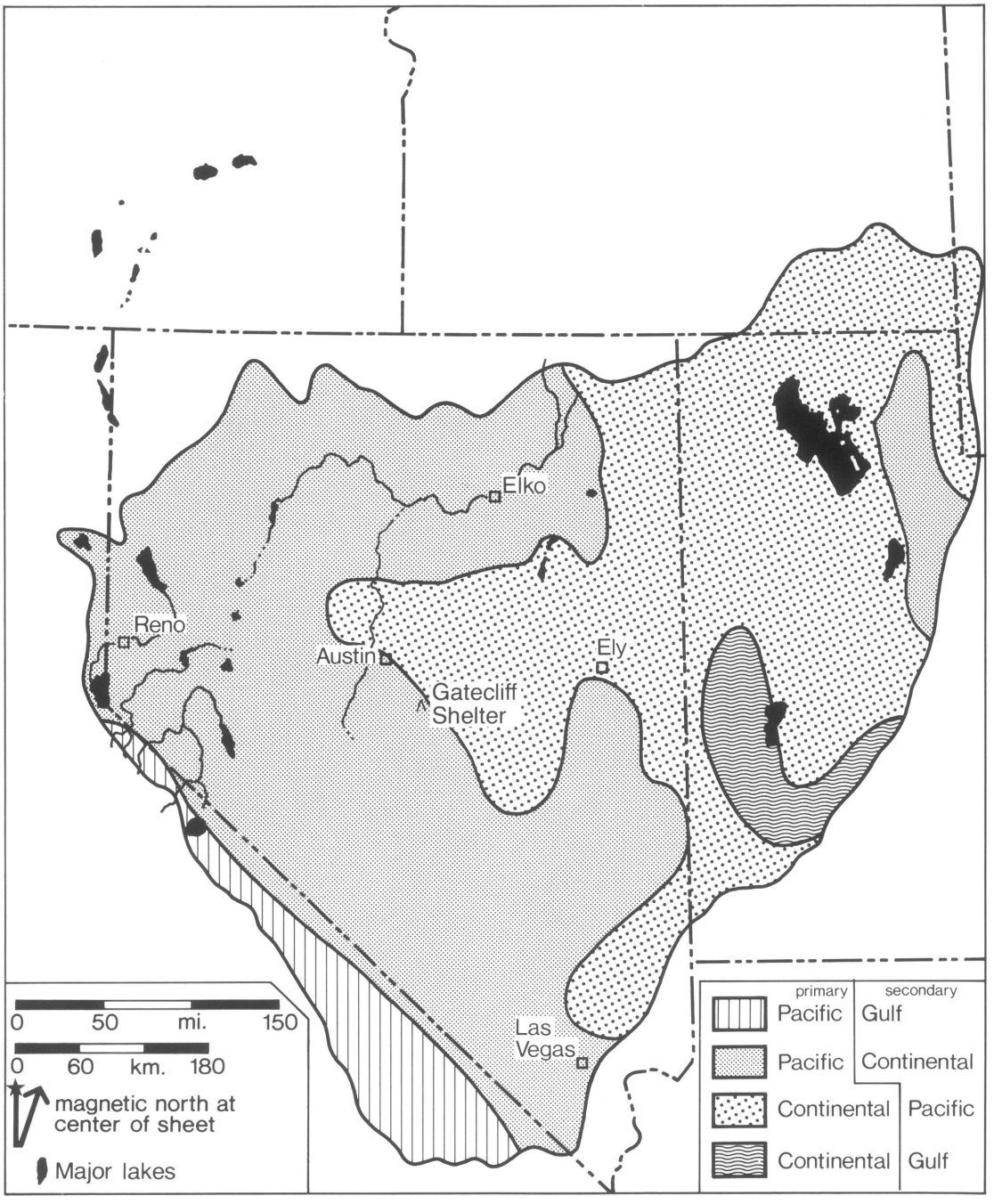

FIG. 15. Sources of precipitation in the Great Basin region. Precipitation from Pacific sources falls primarily in the winter, that from Continental sources in the spring and late autumn, and that from Gulf sources in the summer (modified from Houghton, 1969, p. 121).

western Utah have their precipitation maxima in the spring from this source (Houghton, 1969). Williams and Peck (1962) report that in northern Utah these "cold lows" bring pro-

portionally more precipitation to low elevations than to higher elevations.

During the summer months, especially July and August, the westerlies are much weaker and the Pacific storm tracks are far to the north of the Great Basin (Mitchell, 1976). The southern United States is under the influence of subtropical high pressure and the Bermuda High is shifted northward and westward. Most of the Great Basin is dry during this period for two reasons: 1) the Pacific subtropical high keeps storms from entering the area; and 2) the cold California current keeps sea surface temperatures cool and this retards the rising of moist air off the ocean. The western and central parts of the Great Basin are generally very dry during the summer, though occasionally a heavy storm will slip in from the Pacific. The eastern and southeastern Great Basin, on the other hand, may receive considerable precipitation in the form of thunderstorms during these summer months ("Gulf" precipitation in fig. 15, see also fig. 16). This "monsoonal" convective precipitation is received under conditions of meridional flow as the clockwise rotation of the Bermuda High brings unstable moist subtropical air around the southern tip of the Rocky Mountains. This subtropical moisture is derived from either the Gulf of Mexico (Bryson and Lowry, 1955) or from the Gulf of California (Hales, 1974) and is dropped when it hits the higher elevations of the eastern Great Basin. The Wasatch Front, though it is lower than many of the Great Basin mountain ranges, has much higher levels of annual precipitation than these ranges because it receives this summer convective moisture as well as springtime precipitation from cyclonic activity (Aschmann, 1958). The geographic pattern of the summer precipitation has been fairly persistent through the twentieth century and shows up well in Sellers's (1968) and Stidd's (1967) analyses.

TEMPERATURES IN THE GREAT BASIN: The Great Basin is generally at a relatively high elevation and has a continental temperature regime with cold winters and hot summers, and a large diurnal temperature range. In the western portions of the Great Basin winter temperatures are moderated by warm downslope winds off the Sierra Nevada (Houghton, Sakamoto, and Gifford, 1975). Central and eastern Nevada lie beyond the range of these winds and experience much colder winter temperatures. In this region extremely cold temperatures may result from nighttime radiative cooling under the stagnant air of the Great Basin Highs. Cold conditions may also result from the incursion of arctic air, but this is infrequent as most of this air is shunted east of the Rocky Mountains (Houghton, Sakamoto, and Gifford, 1975). Winter temperatures are milder in the lowlands of the Bonneville Basin in Utah and are moderated throughout the Great Basin when Pacific storms enter the region and dispel the Great Basin High. Summer temperatures are quite high throughout the Great Basin and reach their maximum levels in association with the incursion of subtropical air in the southern and eastern regions (Aschmann, 1958).

HISTORIC FLUCTUATIONS IN REGIONAL CLIMATE: Great interannual variations in precipitation and temperature regimes are features of climate throughout the Great Basin. Historic instrumental records of climatic variables allow us to detect longer term variations and to recognize patterns of covariance across this region. Sellers (1968) used principal component analysis to detect modes of variations in the instrumental climatic data from the western United States for the period from 1931 to 1966. His first three eigenvectors reduced 45 percent of the variance in this data. The first eigenvector placed anomalous precipitation in southern Nevada, California, and Arizona in the winter in opposition to anomalous precipitation in Washington, Idaho, and Montana in the summer. Sellers interprets this eigenvector as reflecting east–west shifts through this period in the position of the "major and mid-latitude pressure centers." Similarly, analysis by Kutzbach (1970) has demonstrated that the Aleutian Low has intensified and shifted eastward between the periods 1903–1917 and 1955–1969. At least one eigenvector in every month places precipitation anomalies of different signs in the Pacific Northwest and the Southwest, and Sellers interprets this pattern as reflecting north–south shifts in the major storm tracks. Overall this work demonstrates that there has been considerable variability in the positioning of pressure centers and storm tracks in the western United States during the historic period. This variability has caused changes in the spatial and seasonal

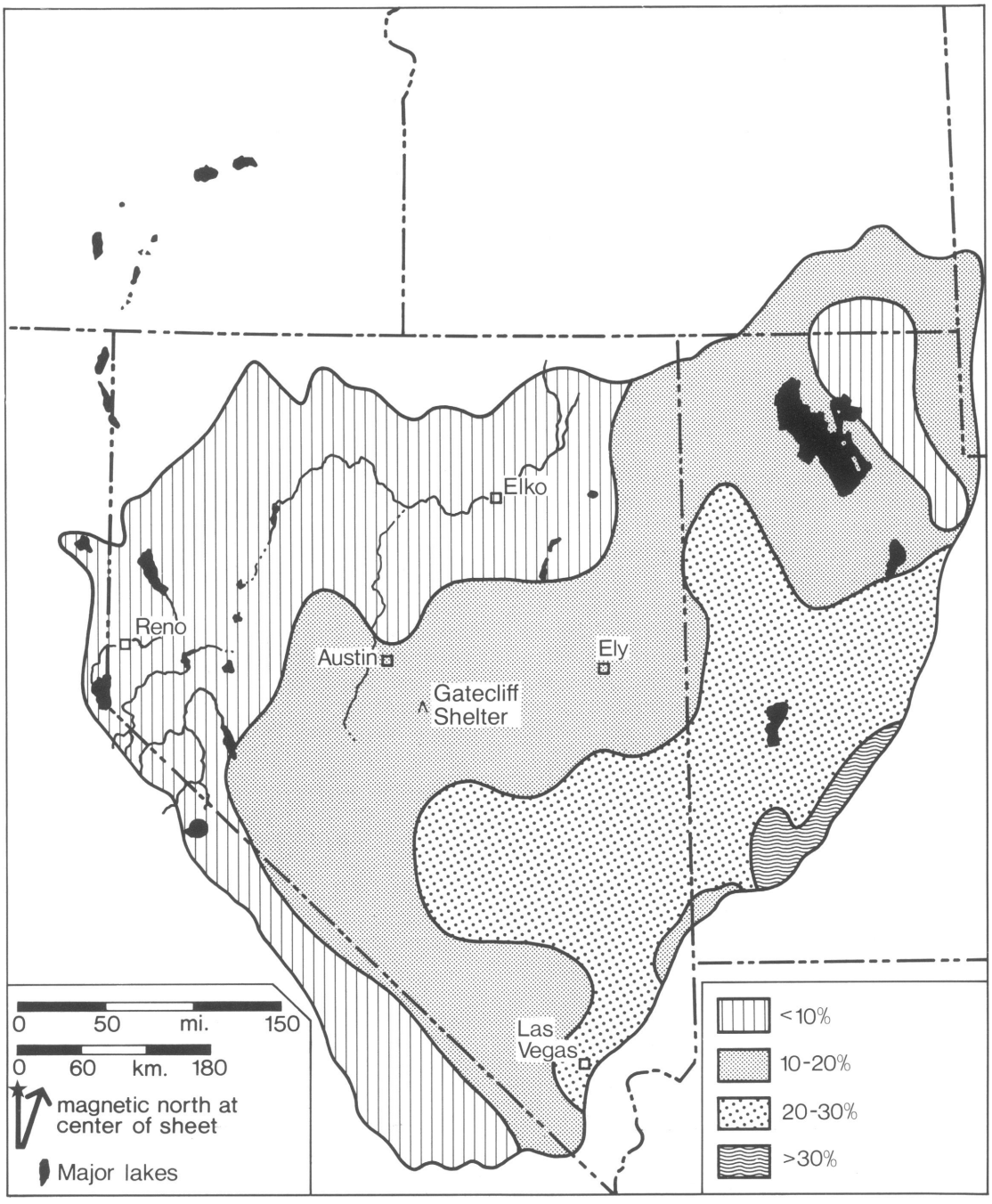

FIG. 16. Percentage of mean annual precipitation during summer months (modified from Houghton, 1969, p. 121).

distribution of precipitation in the Great Basin, with precipitation in the northern and western portions (derived from Pacific and Continental sources) being generally nega-

tively correlated with precipitation in the south and east (derived from Gulf sources).

REGIONAL VEGETATION AND CLIMATE: Many plant species in the Great Basin have geographic distributions that seem to coincide with the distribution of climatic parameters. Some northwest coast/northern Rocky Mountain conifers, such as whitebark pine (*Pinus albicaulis*) have southern extensions in the Great Basin that correspond with the path of the wintertime Pacific storm tracks (Mitchell, 1976). Other tree species, such as Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) are limited to the portions of the eastern and southern Great Basin that receive convective summer precipitation. In general, there appears to be a correspondence between the lower elevational limits of these trees and the amount of summer precipitation that the mountain range receives (Aschmann, 1958). A similar relationship has been noted in the lower elevational limits of piñon-juniper woodlands (Wells and Berger, 1967; West et al., 1978).

The Toquima Range receives less total precipitation and less summer precipitation than the mountain ranges of eastern Nevada. Probably because of this, the montane plant communities of the Toquimas are relatively depauperate compared to those of the eastern Nevada ranges, and Douglas fir, ponderosa pine, white fir (*Abies concolor*), and spruce (*Picea engelmannii*) are absent. Limber pine (*Pinus flexilis*), a relatively xerophytic species, is the only subalpine conifer known to occur in the Toquima Range. Alpine plants are also rare in this portion of Nevada (Billings, 1978), but the lower elevational communities are not similarly depauperate.

LOCAL CLIMATE

There are no long-term instrumental records of temperature and precipitation from stations near Monitor Valley. Since the predominant storm tracks come from the west, archaeological sites, such as Gatecliff Shelter and Toquima Cave, on the eastern slope of the Toquima Range are probably drier than sites at similar elevations on the western slope (such as Butler Ranch Cave). The eastern slope of the Toquima Range receives between 300 and 400 mm. (12 to 16 in.) mean annual precipitation (estimated from State of Nevada report, "Water for Nevada," 1972). Daytime summer temperatures may exceed 32°C. (90°F.), with nighttime temperatures at or near freezing. Winter temperatures frequently drop below −20°C. (−4°F.) and may remain there for long periods when stagnant high pressure cells are in place over the central Great Basin (Houghton, Sakamoto, and Gifford, 1975).

Billings (1954) has noted that the occurrence of piñon-juniper woodlands in the Great Basin is correlated with the presence of thermal belts that moderate winter temperatures. Sites located in this type of woodland may thus have warmer winter temperatures than sites at higher or lower elevations. This area may also experience warmer winter temperatures than comparable sites on the western slope of the Toquima Range, where storms from the west dispel the winter inversion layers (West et al., 1978, p. 133). However, the moderating effects of the thermal belt may be somewhat offset by the strong cold air drainage down the various canyons.

Austin, on the western slope of the Toiyabe Range, is the nearest station that has a long-term meteorological record. This station is located approximately 65 km. (40 miles) to the northwest, and is located at an elevation of 2280 m. (7500 ft.). Austin, and presumably Monitor Valley as well, receive the majority of their precipitation in the winter and spring (table 3, fig. 15) and only 15 percent of the annual total occurs during the summer months. Stations farther to the south and east of Austin (Ely and Las Vegas on table 3) receive a greater proportion of their precipitation in the summer, while stations to the north and west (Elko and Reno) receive less summer rainfall. Monitor Valley probably has a slightly higher proportion of summer precipitation than Austin, but still rarely obtains more than roughly 20 percent of its annual total during this season. As discussed in the preceding section, geographical variations in summer rainfall seem to be correlated with both the geographical and elevational distribution of plant species. Monitor Valley is today only slightly north and west of that region which has significant secondary summertime precipitation maximum in the Great Basin (figs. 15, 16). Past fluctuations in the intensity of the summer precipitation gradi-

TABLE 3
Climatic Data from Nevada[a]

Station	Elevation (m.)	Elevation (ft.)	Lat. N	Long. W	Winter %	Spring %	Summer %	Autumn %	Annual Amount (mm.)	Annual Amount (in.)	Mean Annual Temperature (C.)	Mean Annual Temperature (F.)
Austin	2042	6700	39°30′	117°10′	29.7	35.4	15.2	19.6	313.7	12.35	8.4°	47.2°
Reno	1340	4397	39°30′	119°47′	42.9	23.5	12.6	20.2	176.8	6.96	9.7°	49.5°
Elko	1547	5075	40°50′	115°47′	33.6	28.2	14.9	23.4	231.9	9.13	7.6°	45.7°
Ely	1989	6527	39°17′	114°51′	25.8	34.8	18.4	20.8	267.2	10.52	7.3°	45.2°
Las Vegas	659	2162	36°05′	115°10′	36.8	17.2	25.7	27.3	110.5	4.35	19.3°	66.8°

[a] The seasons are defined as follows: Winter = December through February; Spring = March through May; Summer = June through August; Autumn = September through November. Data from Brown, 1974.

ent from the Southwest into Nevada may be expected to have caused changes in plant distributions in this area.

Local Vegetation

Monitor Valley is situated in the south-central portion of the "Central Great Basin" floristic section (as defined by Cronquist et al., 1972, pp. 92–95). The Toquima Range is floristically similar to the nearby Toiyabe, Monitor, and southern Shoshone ranges, and to a lesser extent, to the mountains of the northern part of this floristic section (fig. 17). In the broad sense, vegetation in central Nevada is divided into a series of zones along the elevational gradient of temperature and precipitation.[2] Billings (1951) has defined a series of these vegetation zones, five of which occur in the Toquima Range. The lowest elevational community, the "Shadscale Zone" is present in the Big Smoky Valley, to the west of the Range, and in scattered pockets in the higher Monitor Valley to the east of the Toquimas. Xerophytic and halophytic shrubs dominate this zone, and common dominants include *Atriplex confertifolia* (shadscale), *Artemisia spinescens* (budsage), *Sarcobatus* spp. (greasewood), *Ephedra nevadensis* (Mormon tea), and *Eurotia lanata* (winter-fat).

The "Sagebrush-Grass Zone" occurs above the Shadscale Zone on the upper bajadas and lower mountain slopes (Billings, 1951, p. 110). Dominant shrubs include *Artemisia tridentata* (big sagebrush), *Tetradymia glabrata* (cottonthorn), *Ephedra viridis* (joint-fir), and *Chrysothamnus* spp. (rabbitbrush). But in undisturbed areas, native bunchgrasses (*Poa, Sitanion, Stipa, Elymus, Agropyron, Oryzopsis,* and *Sporobolus* [Billings, 1951, p. 111]) form more of the ground cover than the shrubs.

The "Piñon-Juniper Zone" extends from the lower mountain slopes to at least 2440 m. (8000 ft.) elevation. As discussed in the previous section, the elevational extent of this zone seems to be controlled by the limits of winter temperature inversions (thermal belts). Common understory shrubs include many of the taxa present in the Sagebrush-Grass Zone, as well as *Cercocarpus ledifolius* (mountain mahogany), *Ribes* spp. (currant), *Symphoricarpos* spp. (snowberry), and *Ephedra viridis* (joint-fir).

The "Upper Sagebrush-Grass Zone" occurs above the piñon-juniper woodland, and indeed, the latter community may be viewed as being superimposed on a continuous Sagebrush-Grass vegetation that is present from the valley to above 3050 m. (10,000 ft.) on the mountain peaks (Billings, 1951, p. 117). The common dominants include many of the species present in the lower Sagebrush-Grass Zone, as well as *Symphoricarpos* spp., *Cercocarpus ledifolius,* and *Populus tremuloides* (quaking aspen). In the mountains of eastern Nevada that receive significant amounts of summer precipitation, *Pinus ponderosa* (ponderosa pine), *Pseudotsuga menziesii* (Douglas fir), and *Abies concolor* (white fir) are present in the elevational zone occupied by the Upper Sagebrush-Grass Zone in the Toquima Range.

The highest elevational plant community present in the Toquima Range is the "Limber

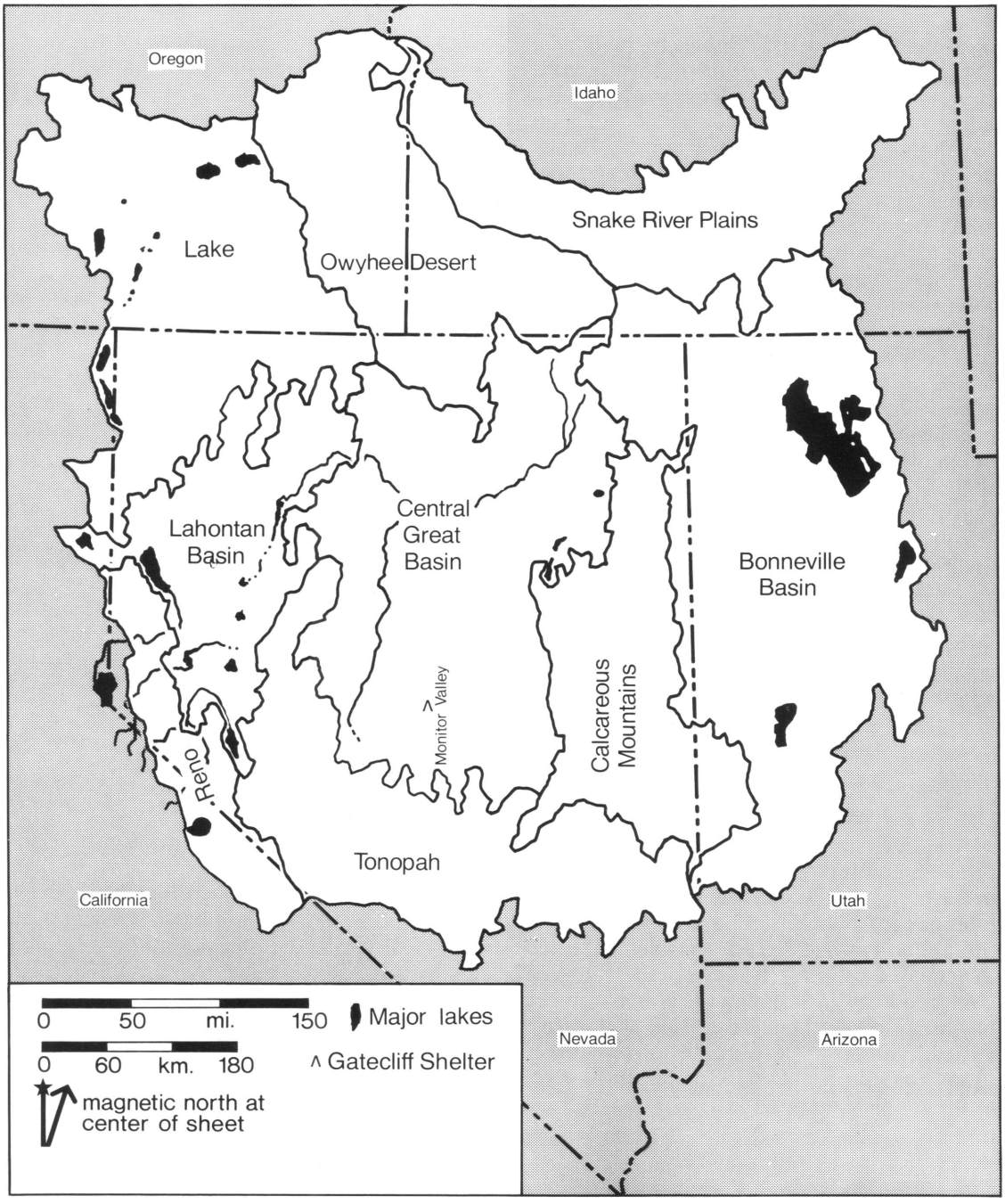

FIG. 17. Floristic zones of the Intermountain region (after Cronquist et al., 1972, fig. 54).

Pine Zone," which generally occurs above 3050 m. (10,000 ft.). Limber pine (*Pinus flexilis*), the only subalpine conifer recorded from this range, is the dominant species in that zone. Limber pine also occurs at lower elevations along streams and in cold air drain-

ages. Other common riparian elements in the Toquima Range include *Salix* spp. (willows), *Betula occidentalis* (western birch), and *Juniperus scopulorum* (Rocky Mountain juniper).

Although the plants of the Toquima Range are broadly zoned into these elevational groups, the vegetation near Gatecliff Shelter could be more accurately described as a mosaic. Although most of the plants near Gatecliff Shelter are common members of piñon-juniper woodlands (table 4), plants common to both higher and lower elevations may be found in proximity to the site. *Pinus flexilis, Juniperus scopulorum,* and *Populus tremuloides* are present in riparian settings, such as the north-facing side-canyon that enters Mill Canyon across from Gatecliff Shelter. *Atriplex confertifolia* and other xerophytic shrubs may also be found nearby on dry sites in the canyon bottoms.

HISTORIC CHANGES IN VEGETATION: Over the last century the vegetation of central Nevada has been greatly affected by the activities of miners and ranchers, and perhaps to some degree by climatic change. Limber pine was utilized for mining timbers, and piñon and juniper were used in smelting ore (Young and Budy, 1979). Overgrazing by livestock resulted in a major reduction in native bunch grasses, and their replacement by introduced Eurasian grasses, especially *Bromus* spp. (brome) (Young and Evans, 1973; Young, Evans, and Tueller, 1976). *Halogeton glomeratus* (halogeton), *Salsola kali* (Russian thistle), and other introduced xerophytes outcompeted native species and quickly spread throughout the Great Basin on disturbed sites (Young, Evans, and Major, 1972). Perhaps because of environmental changes resulting from European settlement, or, alternatively, due to climatic fluctuations, piñons and junipers have apparently invaded lower elevational communities over the last century (Blackburn and Tueller, 1970).

Historic environmental change has been well documented for parts of central Nevada (Thomas, 1971b) and other sections of the Great Basin (e.g., Rogers, 1980). Although we cannot know how great these effects have been in the immediate area surrounding Gatecliff, we can be sure that the modern environment is to some degree changed from that of precontact times.

CONTEMPORARY POLLEN RAIN IN MONITOR VALLEY

ROBERT R. KAUTZ

A surface transect of the modern pollen rain was conducted across Monitor Valley in order to provide a reasonable estimate of the relationship between extant vegetation and the pollen extracted from samples collected throughout Monitor Valley. If the range of contemporary variation in the pollen rain can be determined, then these data will prove valuable in deriving estimates of past vegetation, based on pollen extracted from local archaeological sites.

FIELD AND LABORATORY PROCEDURES

This pollen transect was designed to address the following stipulations. First, the study intended to provide a sample of ecozones, ecotones, and special communities incorporating a representative array of plant associations. Second, it was decided to use a lineal transect with regular interval sampling. Third, a qualitative rather than quantitative description of the modern plant cover was deemed adequate to accommodate project objectives. Finally, the transect orientation was chosen specifically to avoid areas of modern human disturbance except where the sampling design provided such a context.

The location of this transect is indicated on figure 22. Sampling stations were selected regularly every 500 m. beginning with Sample Number 1, located at Wildcat Spring in the Toquima Range.

During the early summer of 1975, at least five pinched subsamples were collected at each location from an area of approximately 50 sq. m. (500 sq. ft.) in order to avoid localized over-representation. These subsamples were further mixed prior to extraction and identification (Adam and Mehringer, 1975). Pollen extraction from the soil matrix was accomplished by standard methods described

TABLE 4

Vegetation Present near Gatecliff Shelter[a]

[Plant Community Code: (A) sagebrush-grass zone or lower; (B) piñon-juniper zone; (C) upper sagebrush-grass or higher; (D) riparian or wet meadows; (E) introduced.]

		Found Within						
		1 km.	5 km.	A	B	C	D	E
I.	Gymnospermae							
	Cupressaceae							
	Juniperus osteosperma (Utah juniper)	x	x	—	x	—	—	—
	J. scopulorum (Rocky Mountain juniper)	x	x	—	—	x	x	—
	Ephedraceae							
	Ephedra nevadensis (Mormon tea)	—	x	x	—	—	—	—
	E. viridis (joint-fir)	x	x	x	x	—	—	—
	Pinaceae							
	Pinus flexilis (limber pine)	x	x	—	—	x	x	—
	P. monophylla (singleleaf piñon)	x	x	—	x	—	—	—
II.	Angiospermae—Monocotyledoneae							
	Amaryllidaceae							
	Androstephium brevifolium	—	x	x	x	—	—	—
	Cyperaceae							
	Carex sp.	x	x	—	—	x	x	—
	Gramineae							
	Agrostis palustris (creeping bentgrass)	—	x	—	—	—	x	—
	Bromus tectorum (brome)	x	x	x	x	—	—	—
	Elymus cinereus (giant wild rye)	x	x	x	x	—	—	—
	Festuca octoflora (fescue)	x	x	x	x	—	—	—
	Hilaria rigida (galleta)	—	x	x	—	—	—	—
	Oryzopsis hymenoides (Indian rice-grass)	—	x	x	x	—	—	—
	Poa nevadensis (Nevada bluegrass)	—	x	—	—	—	—	—
	P. scabrella (bluegrass)	—	x	—	—	—	—	—
	Sitanion hystrix (squirreltail)	x	x	x	x	x	—	—
	Iridaceae							
	Iris missouriensis (blue flag)	—	x	—	—	—	x	—
	Liliaceae							
	Smilacina stellata (false Solomon's seal)	x	x	—	—	—	x	—
III.	Angiospermae—Dicotyledoneae							
	Aceraceae							
	Acer glabrum (Rocky Mountain maple)	x	x	—	x	x	x	—
	Betulaceae							
	Betula occidentalis (western birch)	x	x	—	—	—	x	—
	Cactaceae							
	Echinocereus mojavensis (hedgehog)	x	x	x	x	—	—	—
	Mammillaria arizonica (pincushion)	x	x	x	x	—	—	—
	Opuntia erinacea (prickly-pear)	x	x	x	x	—	—	—
	Capparidaceae							
	Heuchera sp. (alum root)	—	—	—	x	x	—	—
	Caprifoliaceae							
	Sambucus sp. (elderberry)	x	—	—	x	—	—	—

TABLE 4—(*Continued*)

	Found Within						
	1 km.	5 km.	A	B	C	D	E
Symphoricarpos longiflorus (snowberry)	—	x	—	x	x	—	—
S. rivularis	x	x	—	x	x	—	—
Chenopodiaceae							
Atriplex canescens (four-wing saltbush)	—	x	x	—	—	—	—
A. confertifolia (shadscale)	x	x	x	—	—	—	—
Grayia spinosa (hopsage)	—	x	x	—	—	—	—
Halogeton glomeratus	—	x	x	—	—	—	x
Sarcobatus vermiculatus (greasewood)	—	x	x	—	—	—	—
Compositae							
Achillea millefolium (yarrow)	—	x	—	x	x	—	—
Artemisia nova (black sagebrush)	—	x	x	x	—	—	—
A. tridentata (big sagebrush)	x	x	x	x	x	—	—
Chrysothamnus nauseosus (rabbitbrush)	x	x	x	x	—	—	—
C. viscidiflorus (sticky rabbitbrush)	x	x	x	x	—	—	—
Tetradymia glabrata (cotton-thorn)	x	x	x	—	—	—	—
Wyethia mollis (mule-ears)	—	x	—	x	x	—	—
Crassulaceae							
Sedum rosea (stonecrop)	—	x	—	x	—	—	—
Cruciferae							
Lepidium perfoliatum (shield-cress)	—	x	x	x	—	—	—
Stanleya elata (prince's plume)	—	x	x	x	—	—	—
Streptanthus longirostris	—	x	x	x	—	—	—
Elaeagnaceae							
Shepherdia argentea (buffalo berry)	—	x	—	x	x	—	—
Labiatae							
Salvia dorrii (purple sage)	—	x	x	—	—	—	—
Leguminosae							
Astragalus spp. (locoweed)	—	x	x	x	—	—	—
Lupinus sp. (lupine)	x	x	x	x	x	—	—
Loasaceae							
Mentzelia laevicaulis (blazing star)	—	x	x	—	—	—	—
Malvaceae							
Sphaeralcea coccinea (globe-mallow)	x	x	x	x	—	—	—
Onagraceae							
Oenothera sp. (evening primrose)	—	x	x	x	—	—	—
Papaveraceae							
Argemone munita (prickly poppy)	—	x	x	—	—	—	—
Polemoniaceae							
Phlox douglasii	x	x	x	x	—	—	—
P. longifolia	—	x	x	x	—	—	—
Polygonaceae							
Eriogonum spp. (wild buckwheat)	x	x	x	x	x	—	—

TABLE 4—(*Continued*)

	Found Within						
	1 km.	5 km.	A	B	C	D	E
Ranunculaceae							
Aquilegia shockleyi (columbine)	—	x	—	x	x	—	—
Delphinium depauperatum (larkspur)	—	x	x	x	—	—	—
Ranunculus sp. (buttercup)	—	x	x	x	—	—	—
Rosaceae							
Amelanchier utahensis (serviceberry)	—	x	—	x	x	—	—
Cercocarpus ledifolius (mountain mahogany)	x	x	—	x	x	—	—
Chamaebatiaria millefolium	—	x	—	x	x	—	—
Prunus virginiana (chokeberry)	x	x	—	—	—	x	—
Rosa fendleri (wild rose)	x	x	—	—	—	x	—
Salicaceae							
Populus tremuloides (quaking aspen)	x	x	—	—	x	x	—
Salix exigua (narrowleaf willow)	x	x	—	—	—	x	—
S. sp. (willow)	x	x	—	—	—	x	—
Saxifragaceae							
Ribes cereum (squaw currant)	x	x	—	x	x	x	—
R. viscosissimum (golden currant)	—	x	—	x	x	x	—
Scrophulariaceae							
Castilleja spp. (Indian paintbrush)	x	x	x	x	x	—	—
Mimulus guttatus (monkey-flower)	—	x	—	—	—	x	—
Penstemon spp.	x	x	x	x	x	—	—
Solanaceae							
Nicotiana attenuata (wild tobacco)	—	x	x	x	—	—	—
Umbelliferae							
Lomatium sp.	—	x	—	x	—	—	—

[a] Table compiled by D. Rhode and D. H. Thomas, modified by Thompson.

by Mehringer (1967, pp. 135–137). Pollen was identified by means of phase-contrast microscopy at 440×.

Modern Vegetation

The sample was collected from five major plant communities located between 2070 m. (6800 ft.) and 2920 m. (9600 ft.) in elevation. These five communities follow Billings (1951) and Cronquist et al. (1972, pp. 134–140). In addition, samples were collected from two streamside associations and a special cliff wall plant community. These communities are described as follows:

Shadscale Zone (Fig. 18): This zone is presently limited to the floor of the Monitor Valley and includes the dominant shrubs, *Atriplex* (shadscale), *Artemisia* (sagebrush), and *Chrysothamnus nauseosus.* Perennial herbs include *Castilleja, Penstemon,* and *Halogeton.* Except for a rare small juniper, these areas lack trees. Dense stands of *Distichlis* and *Elymus* occur around the occasionally flooded Monitor Lake, which was wet during the 1975 field season. The halotype *Sarcobatus* (greasewood) clusters along the lake margin (fig. 19). Other forms in the thinly distributed vegetational matrix include *Grayia spinosa* (hopsage) and other chenopods, composites, and a few *Opuntia.*

Sagebrush-Grass Zone: Dominated by *Artemisia tridentata,* with *Ephedra nevadensis* (Mormon tea), *Chrysothamnus, Castil-*

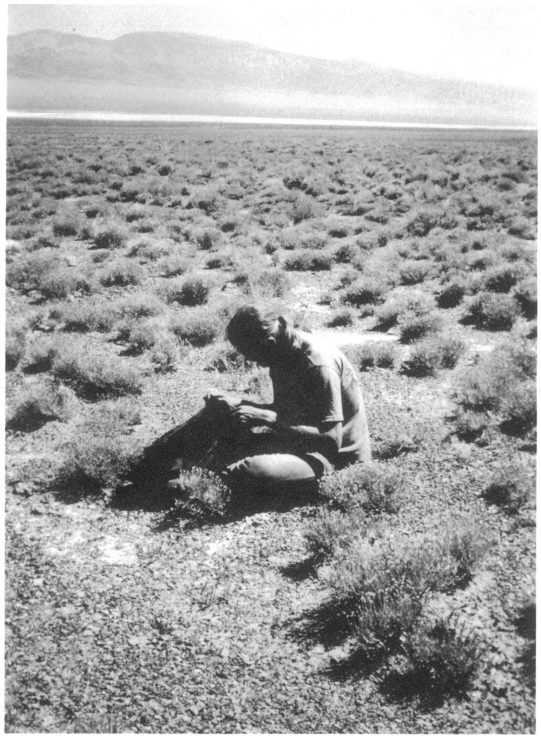

FIG. 18. Typical shadscale vegetation, looking southeast across Monitor Valley. Growing in the most arid portions of valley floors, these xerophytic plants are low and widely spaced (Pollen Station 19).

leja, cacti, *Penstemon,* grasses, composites, and occasional solitary piñon or junipers, this association is found along major canyon bottoms and on steep or rocky slopes tending to interdigitate with the shadscale community on bajadas and lower elevation valley floors.

PIÑON-JUNIPER ZONE (FIG. 20): This zone is a mountainside regime composed of an overstory of *Pinus monophylla* (singleleaf piñon) and *Juniperus osteosperma* (Utah juniper). The understory changes considerably—conforming to variables such as elevation, slope facing, and shade—between a sparse *Symphoricarpos-Shepherdia*-grass-*Phlox* vegetation in less arid shady areas, to one resembling a sagebrush-grass community at lower elevations (or where more xeric conditions prevail). This zone appears to be superimposed over the continuous sagebrush-grass zone which bounds it at its lowest and highest elevations (Billings, 1951, p. 117).

UPPER SAGEBRUSH-GRASS ZONE (FIG. 21): At its lower margins and along ridges, this zone includes *Cercocarpus ledifolius* (mountain mahogany). Otherwise, it appears quite similar to the lower sagebrush zone, although individual plants grow more densely packed due to increased precipitation. Here too, the *Symphoricarpos-Shepherdia*-grass-*Phlox* vegetation can be found where runoff is common.

LIMBER PINE ZONE: This zone is confined to cold air drainages on the highest peaks of the Toquima Range. The dominant vegetation is composed of an overstory of *Pinus flexilis* (limber pine) and *Cercocarpus,* and an understory of *Artemisia tridentata nova, Chrysothamnus,* and several kinds of annuals and grasses.

Above the lower sagebrush zone several particular associations are common, including two riparian assemblages and a cliff wall assemblage.

STREAMSIDE ASPEN FOREST: This is a three-story forest composed of *Populus tremuloides* (quaking aspen), occasionally *Betula occidentalis* (western birch), and isolated junipers and pines (including *P. flexilis* at higher elevations). The thick shrub layer is dominated by

FIG. 19. Ephemeral lake (playa) margin vegetation is dominated by the halophytes, *Sarcobatus* (greasewood), *Grayia* (hopsage), and *Distichlis* (saltgrass). Photograph taken looking east across northern end of Monitor Lake playa (Pollen Station 25).

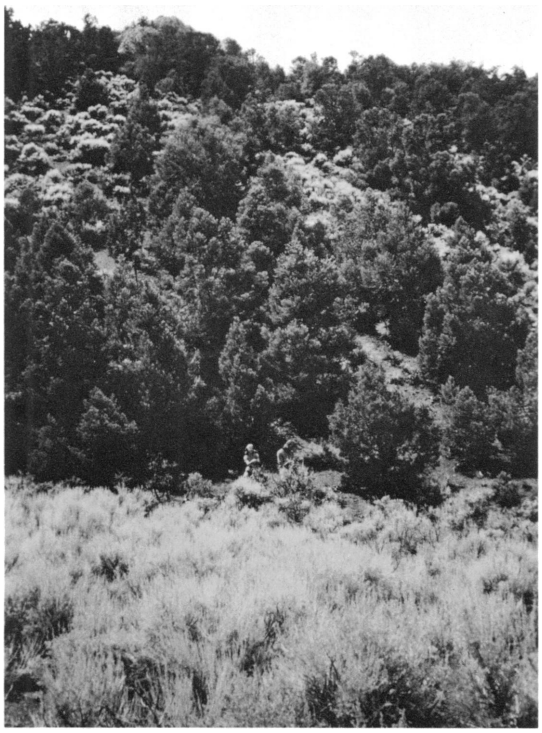

FIG. 20. Ecotone between the lower sagebrush-grass zone and the piñon-juniper zone. Photograph taken in lower Mill Canyon (Pollen Station 11).

Prunus and *Symphoricarpos,* changing to *Rosa* and *Ribes cereum* closer to the water's edge. Herbs include *Smilacina, Penstemon, Castilleja, Lupinus, Aquilegia,* and several grasses. This assemblage covers canyon floors supplied by spring-fed streams.

WILLOW THICKET ASSOCIATION: These associations are confined to isolated spring meadows and dominated by *Salix exigua* (narrow leaf willow) and *Poa nevadensis* (Nevada bluegrass). Herbaceous vegetation in the immediate vicinity includes *Oenothera, Mimulus, Iris, Delphinium, Penstemon, Castilleja,* and *Carex.* Occasionally a solitary *Prunus* or *Amelanchier* is found, but shrubs are not nearly so frequent here as alongside streams within the aspen forest.

CLIFF WALL VEGETATION: An extremely hardy type of vegetation grows on cliff walls including *Sedum, Heuchera, Chamaebatiaria, Juniperus, Phlox,* and grasses. Very few other genera are so tenacious as to hug the creviced walls of tight canyons and rocky mountain peaks. At the very base of such walls, due to cliff face runoff, *Ribes, Elymus,* and other less xerophytic plants may survive.

A plant survey was conducted in order to define the species present in Mill Canyon and associated with Gatecliff Shelter. These results are presented in table 4.

RESULTS

Regular interval sampling strategy was used to avoid an overemphasis on differences between major life zones. The results of this investigation are presented as a pollen spectrum (table 5) and zonal diagram (fig. 23). A discussion of the pollen types encountered is presented below.

Pinus: Few of the samples yielded pine pollen frequencies as low as 10 percent. Samples 4 through 5 were collected from stations between the limber pine stands present at the highest Toquima Range elevations and dense stands of piñon pine below. Sample station 28 lies immediately to the east of a small hill rising out of the floor of Monitor Valley. Higher pine pollen frequencies on the valley floor are probably derived from westerly

FIG. 21. The upper sagebrush-grass zone in upper Mill Canyon. *Cercocarpus* (mountain mahogany) is visible in the background (Pollen Station 4).

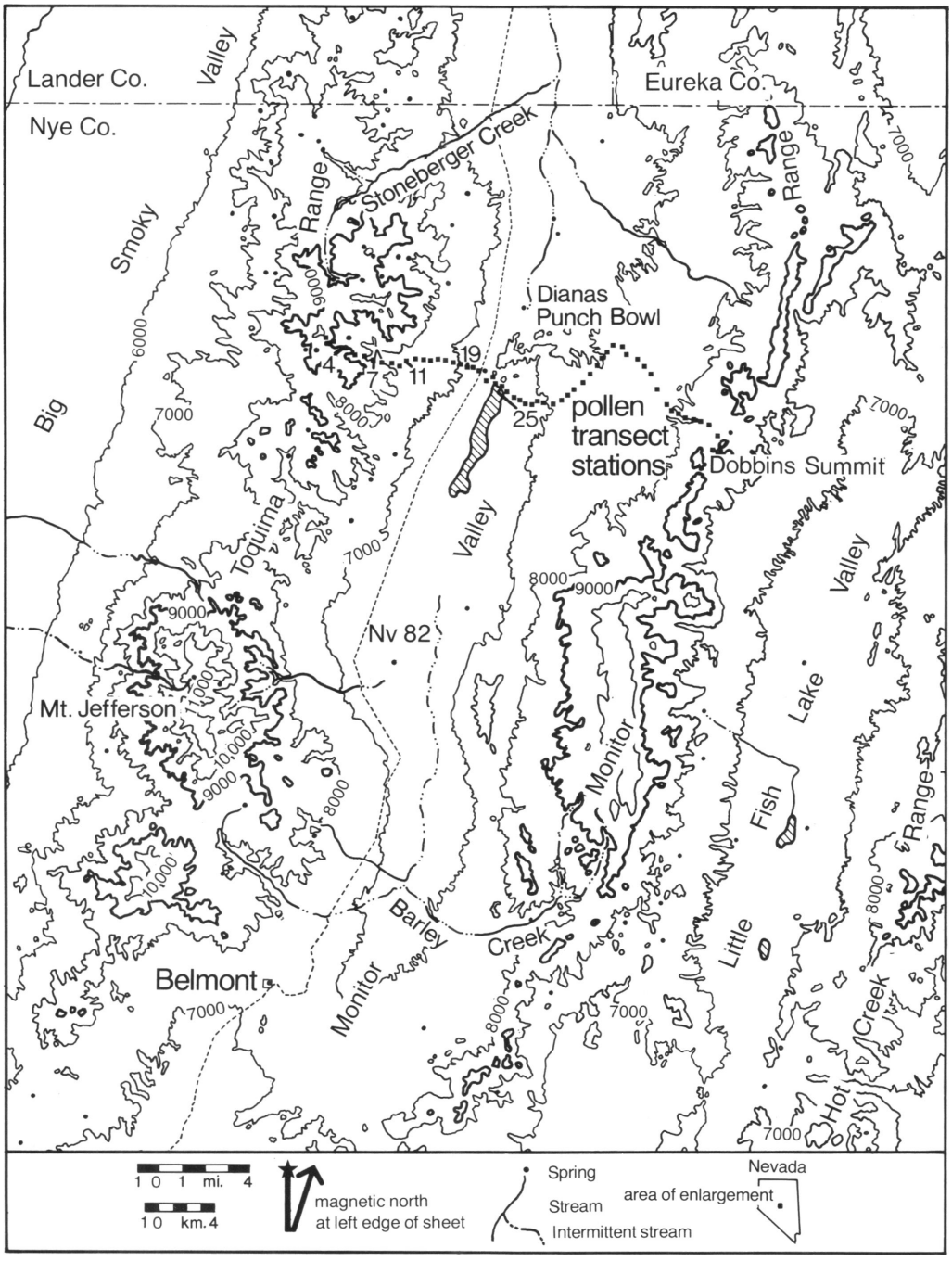

FIG. 22. Location of modern pollen transect across Monitor Valley (each point in the dotted line represents an individual pollen collection station). Selected pollen stations have been numbered, to indicate locations of vegetation photographs in this chapter.

winds most common during the summer. The decrease in relative pine pollen frequency in the sample from station 28 may be due to its location behind a hill which serves to shield

TABLE 5
Pollen Spectrum Characterizing the Major Vegetational Zones in the Monitor Valley
(Represented as percentages of the pollen sum.)

Vegetation Zone	Elevation (ft.)	Sample Numbers		Chenoam	*Sarcobatus*	Gramineae	Compositae	*Ephedra*	*Artemisia*	Rosaceae	*Juniperus*	*Pinus*
Shadscale	4600–6800	19–35	Range	6–45	+–39	+–8	1–13	+–1	21–58	+	1–5	12–42
			Mean	15	6	2	4	1	42	+	3	26
Sagebrush-Grass	6800–7400	14–18, 36–46	Range	6–24	+–1	+–3	1–11	+–3	34–70	0–1	1–5	17–34
			Mean	11	+	1	4	1	53	+	3	26
Piñon-Juniper	7400–8200	7–13, 47–49	Range	3–19	0–1	1–6	2–7	+–10	21–55	0–1	3–8	25–51
			Mean	8	+	3	4	4	37	1	6	35
Streamside	8200	1	Range	7	+	14	25	+	16	1	3	18
Upper Sagebrush-Grass	8200–9600	3–6, 50–56	Range	2–14	+–1	1–16	3–9	0–8	13–83	+–4	1–13	4–36
			Mean	6	+	7	6	2	57	1	4	13
Limber Pine	9600	2	Range	7	2	7	10	1	28	2	2	28

Note: + indicates trace.

it from a portion of wind-transported pollen. Sampling stations 51 through 56 are above the dense stand of piñon pine on the Monitor Range; limber pines are absent.

Modern surface transects in the Southwest have indicated a decrease in pine percentages with decreasing elevation and distance from pines (Hevly, 1964, 1968; Schoenwetter and Eddy, 1964, p. 68). This condition does not appear, however, to be universal either in the Southwest (Bohrer, 1972, p. 21) or in the data presented here. High pine percentages were encountered even on the valley floor indicating the interaction of several complex variables.

Juniperus: Juniper pollen was consistently encountered throughout the transect, but generally at moderate relative frequencies below 5 percent of the total sum. The one exception to the generalization occurred in Samples 5 through 13, which were taken within the modern range of juniper in the Toquima Range.

Betula: Birch pollen was recovered in quantity only from Sample 7 (12.7%), from a sampling station immediately across Mill Canyon (within 200 m. of Gatecliff Shelter). The area is dominated by a dense stand of aspen (*Populus tremuloides*) and birch, which constitutes a streamside aspen forest community associated with a small spring. As discussed in Part 2, it remains puzzling that aspen pollen is absent in the ancient archaeological samples. Aspen pollen contains little sporopollenin (and therefore deteriorates rapidly), but its absence from the modern pollen sample may indicate a problem with identification.

Alnus, Abies, Quercus, Tsuga: Alder, fir, oak, and hemlock (respectively) do not occur in the vicinity of this transect and the presence of this type of pollen appears to be due to long distance transport, in some cases, from perhaps as far away as several hundred kilometers.

COMPOSITAE: Compositae pollen of the subfamilies Liguliflorae and Tubiflorae can be morphologically distinguished in the modern samples. The latter subfamily can further be subdivided into two pollen categories determined by the length of their spines. Low-spine Compositae are those which exhibit spines less than 1.5–2.0 microns long. High-spine Compositae have spines which are longer. *Artemisia* (sagebrush), although a low-spine type of Compositae, is morphologically distinct.

Artemisia vegetation is present throughout the transect (fig. 24), except in the densest stands of piñon-juniper woodland, the most saline margins of the playa, and the dryest portions of the shadscale zone. Its frequency in the pollen record appears to be inversely related to that of pine pollen. In general, sage-

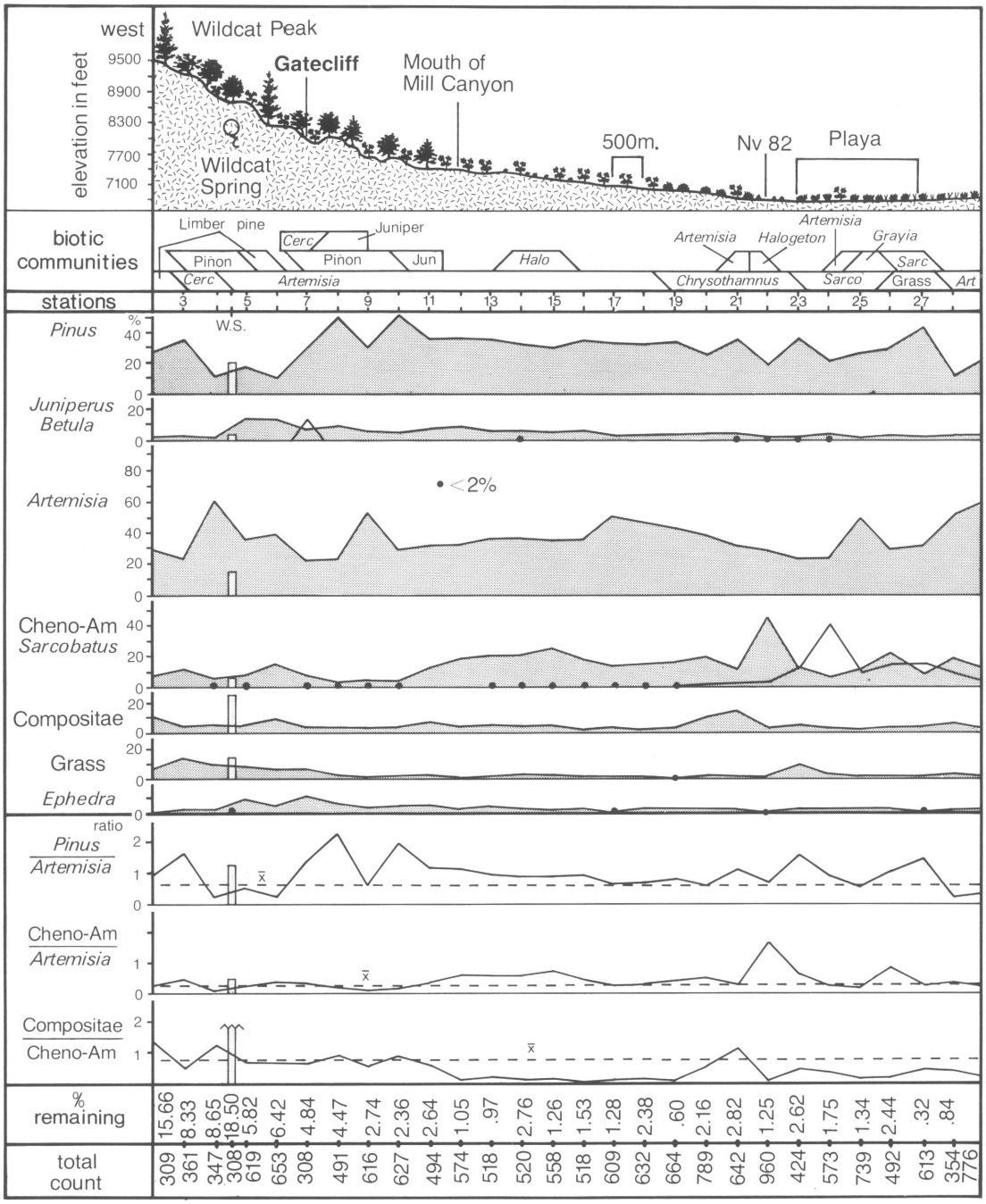

FIG. 23. Modern pollen diagram for surface deposits in Monitor Valley.

brush and piñon pollen overwhelm other varieties to the extent that a change in the relative frequency of the one will have a corresponding effect on the relative frequency of the other. Although sampling localities 4 and 9 nominally occurred within the piñon-juniper zone, they were located on south-facing slopes devoid of trees. Elsewhere, lower *Arte-*

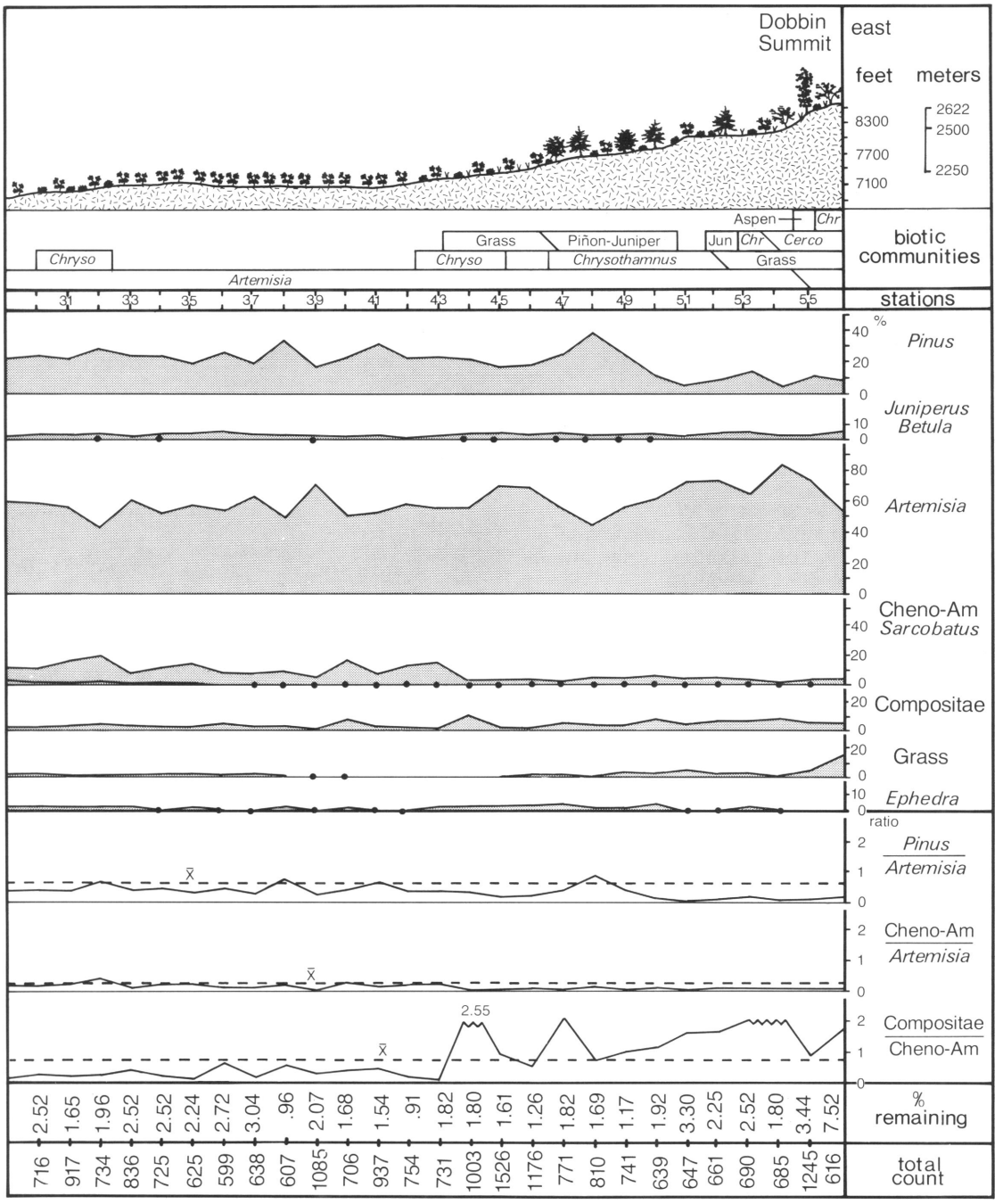

FIG. 23. Continued.

misia frequencies are probably the result of increased relative frequencies of other genera.

High- and low-spine Compositae pollen occurred in low frequencies throughout the transect (<15%). Rabbitbrush (*Chrysothamnus* spp.), a high-spine Compositae, is probably responsible for a general high-spine over

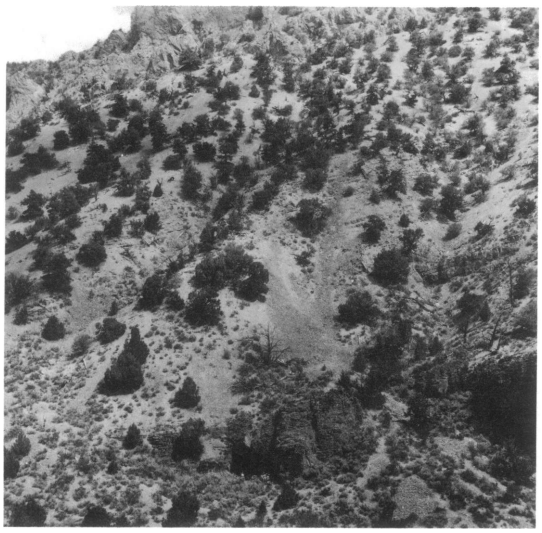

FIG. 24. The north side of Mill Canyon, covered with piñon-juniper forest. Photograph taken facing Gatecliff Shelter, at bottom of the prominent fault scarp (Pollen Station 7).

low-spine dominance. Rabbitbrush is the only major Compositae vegetational element occurring occasionally as a codominant in the Monitor Valley with sagebrush on alluvium where moister conditions and sandier soils permit.

Liguliflorae pollen was detected in the springside sample (no. 1) at a relative frequency of 10 percent. The vegetation which is specifically responsible for that situation is unknown.

GRAMINEAE: Grass is common at higher elevations where an overstory is absent and over flats and depressions on the mountain slopes. Dense stands of salt-tolerant grasses also occur along the margins of the playa on the valley floor. This distribution of vegetation is accurately reflected in the modern pollen transect. Grass pollen rarely exceeds 15 percent of the total pollen sum for any one sample.

EPHEDRACEAE: Wodehouse (1935), Andersen (1954), and Martin (1963) have divided this family into two pollen categories, *E. torreyana* and *E. nevadensis*. The local variety of Mormon tea, *Ephedra viridis*, produces the same type of pollen grain as *E. nevadensis*, which is characterized by less branched colpi than the *E. torreyana* category, whose colpi are unbranched. Occasional *E. torreyana* grains were encountered (10 grains of a total of almost 38,000), but the source is unknown.

Mormon tea in the Monitor Valley occurs most commonly in the piñon-juniper zone and near the transitional zone between the piñon-juniper and its lower, more xeric, neighboring community. Edaphic factors are also extremely important, *E. viridis* preferring loose, coarse colluvium. The results of the pollen transect reflect this preference.

CHENOPODIACEAE-*Amaranthus:* The term cheno-am refers to the morphologically similar pollen of the goosefoot family (Chenopodiaceae) and the genus *Amaranthus* (Wodehouse, 1935). Greasewood (*Sarcobatus*) is an exception which can be distinguished from other Chenopodiaceae by its aspidoporate and annulate pores.

Cheno-am pollen in the Monitor Valley shows a low relative frequency on the mountain slopes, increasing in the fine-textured alluvium of the valley floor. *Atriplex* is the most common contributor of this category, although Sample 22, with its very high frequency of cheno-am pollen (45%), probably owes that figure to *Halogeton* pollen. *Halogeton* was introduced from Asia and invades disturbed ground such as road edges. Sample 22 is at the intersection of two roads.

Greasewood grows on alkaline flats and is found in particularly dense stands along the margin of the Monitor Valley playa in soils of a silty-clay texture. It tends to exist where other plants fail because it tolerates excessive soil salts. This ability to exist under saline conditions is dependent upon the accumulation of sodium salts in the leaf and root tissue detectable in the taste of its fleshy leaves. The distribution of *Sarcobatus* pollen within the transect reflects it characteristic preference for alkaline soils. This tendency is particularly notable in Sample 24 (20 m. from the edge of the playa), where *Sarcobatus* pollen reaches a high of 38 percent of the pollen sum.

ROSACEAE: Rosaceous pollen comprises a minor constituent of the modern pollen rain in Monitor Valley. Concentrations of over 1 percent in relative frequency for any one sample are restricted to the highest aspects of the mountain slopes. This distribution conforms to the ecological tolerance of mountain mahogany (*Cercocarpus ledifolius*) which is a major vegetational component at those

higher elevations. Other possible contributors include the wild rose (*Rosa fendleri*), western serviceberry (*Amelanchier utahensis*), and western chokeberry (*Prunus virginiana*), all of which are found at lower elevations within a number of environmental contexts including riparian and dry talus habitats.

SPRING ANNUALS: Included in this category are the following forms: Umbelliferae, Cruciferae, Onagraceae, Caryophyllaceae, Liliaceae, Leguminosae, *Phlox,* and *Rumex.* Together the spring annuals comprise less than 0.25 percent of the pollen total which is not surprising given their dependence on an animal vector for pollen dispersal and the season in which this transect was conducted.

DISCUSSION

This study presents basic information relating the modern pollen rain in Monitor Valley to the floral communities that produced the pollen.

Figure 23 and table 5 summarize the average pollen distribution of selected categories of vegetation within each ecological zone.

The shadscale zone has the highest average cheno-am pollen with the widest range for that category, probably reflecting the varying density of stands of *Chrysothamnus. Sarcobatus* pollen is also limited to this zone because of drainage and salt concentrations on the valley bottom. Grass, composites, and *Ephedra* are all present in low quantities. Arboreal pollen is quite high due to the presence of wind-transported pollen.

Declining ratios of cheno-am pollen within the sagebrush-grass zone reflect the absence of dense stands of rabbitbrush and its replacement by sagebrush which averages 53 percent of the total pollen rain. Increasing slope, well-drained soils, and slightly higher elevations seem to be critical variables. Arboreal pollen is equivalent to that received within the shadscale zone.

The piñon-juniper zone is characterized by higher ratios of pine, juniper, *Ephedra,* and rosaceous pollen. Decreases in *Artemisia* may be partly due to increases in the arboreal components and partly due to the fact that the shade provided by that overstory results in a much less dense distribution of sagebrush within the forest canopy.

The next highest vegetational element occurred at a special streamside sampling location. Wildcat Spring is at 2500 m. (8200 ft.) elevation and comprises a willow thicket association in a grassy depression. *Artemisia,* pine, and *Ephedra* decrease and grass and Compositae pollen increase. The pollen of willow, Cyperaceae, and herbs such as Umbelliferae comprise about 5 percent of the pollen sum.

The upper sagebrush-grass zone is similar to its lower counterpart with the exception of slightly higher *Artemisia* frequencies and lower pine frequencies. This is probably due to the tendency for pine pollen to be transported downslope from the source vegetation especially near cold air drainages. Grass pollen becomes more common with increased elevation and precipitation.

The limber pine zone has a relatively low pine pollen frequency (28%) with the same frequency of *Artemisia* pollen. Compositae pollen at a frequency of 10 percent is probably composed of higher elevation annuals. The presence in small quantities of *Sarcobatus,* cheno-am, and other normally low elevation pollen types indicates that some upslope redistribution of pollen also occurs.

NOTES

[1] Those aspects of the modern vertebrate fauna of the Toquima Range and Monitor Valley that are pertinent to an understanding of the known prehistory of this area are discussed by Grayson and Thomas in Part 2; for general summaries of Nevada vertebrate distributions, see Linsdale (1936) and Hall (1946).

[2] Rainfall records for a 28-year period from 1892–1919 for Potts Ranch show an average of 160.7 mm./year (6.33 in.); these figures are probably typical for most of central Nevada lying below 2100 m. (7000 ft.). An irregular 16-year record (1889–1896, 1900–1905, 1915–1916) exists for Belmont located at 2100 m. (7000 ft.) at the southern end of Monitor Valley (see the next chapter for a discussion of the settlement of both Austin and Belmont). Belmont reports an average of 216.7 mm. (8.53 in.), figures which are also about typical of central Nevada (Rush and Everett, 1964).

CHAPTER 7. SOCIAL CONTEXTS: CULTURAL HISTORY OF MONITOR VALLEY

Before examining the protohistoric period in Monitor Valley, we must glean information from the historic and ethnographic accounts of the historic period. This chapter discusses first the Monitor Valley Shoshone from an ethnographic perspective, then considers the impact of white contact on these aboriginal groups.

THE WESTERN SHOSHONE PEOPLE

Western Shoshone territory extended from the arid reaches of Death Valley through the mountainous highlands of the central Great Basin (see fig. 25). The eastern lobe extended into northwestern Utah to include the Gosiute of Skull Valley and Deep Creek. The northern boundary can be rather arbitrarily taken as the divide separating the Humboldt River drainage from the area near the Snake and Salmon rivers, where the Northern Shoshone lived. This marginal territory was sparsely inhabited in historic times (Thomas and Cappannari, in press).

Western Shoshone peoples are known collectively by the linguistic term Central Numic, referring to a branch of the widespread Uto-Aztecan language family (see Lamb, 1958; Miller, 1966). Central Numic contains only two languages, Panamint and Shoshone (also spelled Shoshoni). The southern groups of Western Shoshone residing near Lone Pine, Death Valley, and Beatty, Nevada, spoke Panamint, whereas all other Western Shoshone spoke the Shoshone language, as did the Comanche of Oklahoma and the Northern Shoshone of Wind River and Fort Hall. The Numic languages are quite similar, and a native speaker of any one in particular has relatively little difficulty in learning a second Numic language (Miller, 1972, p. 3). Although there was considerable dialectic diversity within Central Numic, these dialects do not seem to have been geographically bounded.

Because of similarity between tribal and linguistic terms, a statement on nomenclature is required. *Shoshone* is a language in the Central Numic group of the Uto-Aztecan family. The term *Shoshonean,* while originally designating a linguistic family (Kroeber, 1907), now is generally devoid of linguistic connotation and remains useful only in a geographical sense. *Western Shoshone* is a tribal designation including all speakers of Panamint and the southeastern groups of Shoshone speakers. The *Gosiute* of western Utah also spoke the Shoshone language and their language has no greater distinctiveness than that which exists within the rest of Shoshone. Despite a high incidence of intermarriage with their Ute neighbors, the Gosiute remained culturally and ecologically similar to the Western Shoshone of Nevada (Steward, 1938, p. 133).

Historic Contact

Father Silvestre Valez Escalante was the first European to penetrate the Great Basin area in 1776. The first non-Spanish Caucasians to enter the Great Basin were members of a party of Wilson Price Hunt's Astoria expedition of 1811 (Cline, 1966, p. 250). Also among the early explorers were Donald MacKenzie, whose group was in the Bear River area during 1818–1820, and Peter Skene Ogden, who traveled in the northern Great Basin from 1824–1830.

In 1830–1831 Zenas Leonard (of the Bonneville-Walker party) recorded scornfully the absence of the horse among the natives near the Humboldt River and described the heavy burdens that their women had to carry. Horses, of course, would have consumed the same grasses which provided food for the Shoshone.

Around the middle of the nineteenth century, whites began settling this area with a far greater impact upon the Western Shoshone than their predecessors, the earlier explorers and trappers (see Rusco, 1976).

The Western Shoshone in aboriginal times had external relationships that were mostly friendly and involved trade and peaceful coexistence with the Paiutes to the south and the Bannock to the north. The Bannock may in fact have coexisted with the Shoshone for 200 years in the same territory (Stewart, 1966, p. 190). Relationships were less friendly between the Gosiutes (who are Western

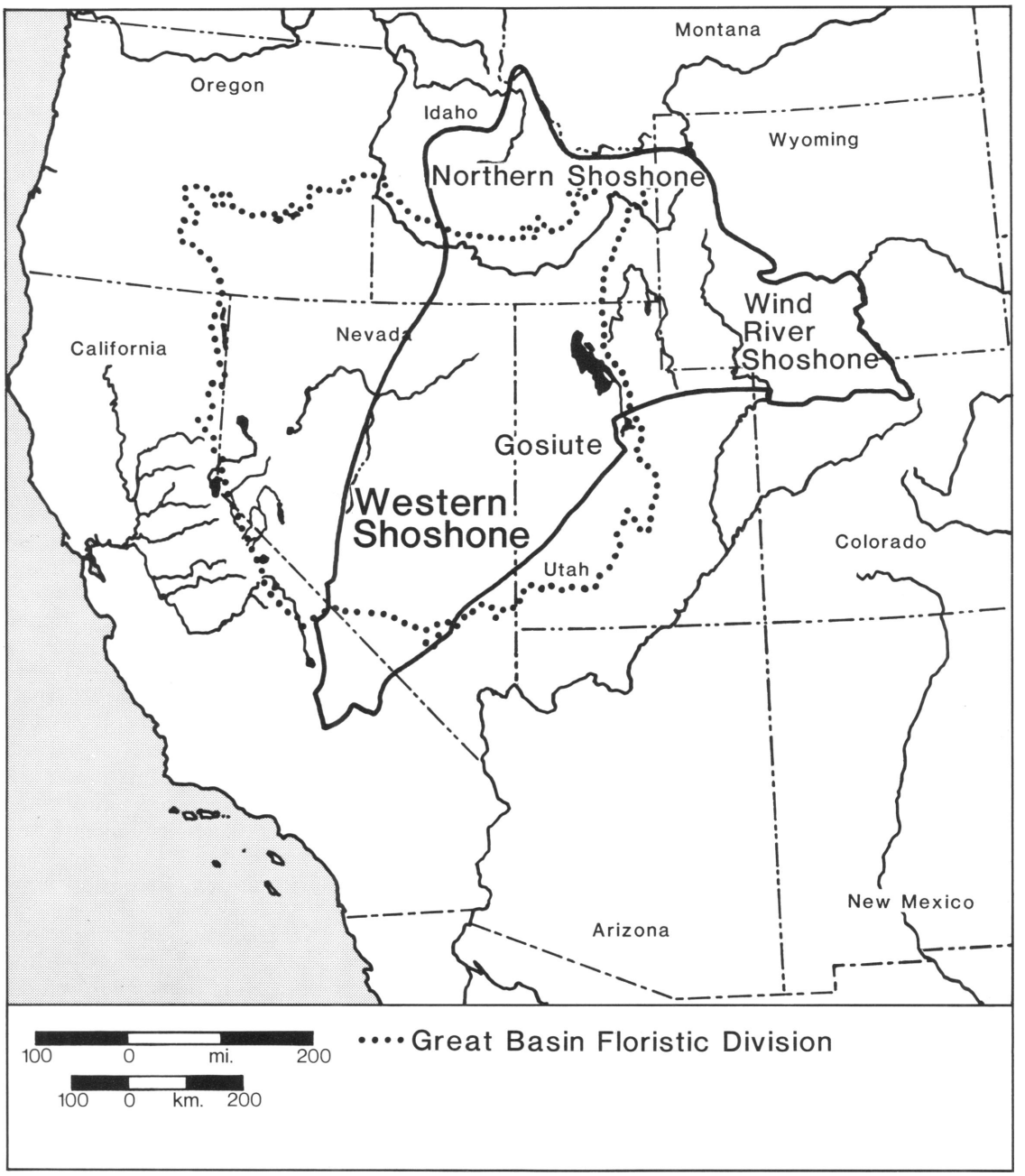

FIG. 25. Ethnographic distribution of Western Shoshone people.

Shoshone and not Utes) and the neighboring Utes who raided them often, sometimes to contribute to the slave trade. Some adult slaves were sold to Mexicans, and Utes forced Mormons to purchase captive children by threatening to kill them unless they were ransomed by the Mormons (see Malouf, 1966).

White penetration into and through Western Shoshone territory was accelerated by the discovery of gold in 1848 in California, and

in 1849 in Nevada at Gold Canyon on the Carson River. Probably the greatest single impetus for white settlements in Nevada was the discovery of the Comstock lode in 1857.

Reservation Period

There were no true reservations in the Great Basin prior to 1860, although reserves (or "farms" as they were called) had been established in Ruby and Deep valleys. During the early 1860s some Western Shoshone engaged in hostilities against the settlers moving along the Humboldt River and along the Overland Stage route. There is some evidence that local white farmers actually encouraged and even directly assisted the Shoshoneans in their raids on the emigrant caravans (Forbes, 1967, p. 48). Fort Ruby was established in part to curtail this, and the federal government began negotiating treaties with the tribes of the Great Basin.

The "Treaty of Ruby Valley" was negotiated and signed on October 1, 1863. Governor James Nye of the Nevada Territory and Agent James D. Doty represented the United States Government, and 12 "Captains" (or chiefs) represented the Indians, collectively termed the "Western Bands of Shoshone." Their territory stretched from Smith Creek Valley in the west to the Steptoe Valley and the Great Salt Lake in the east. As part of the Treaty of 1863, the Shoshone agreed to cease "depredations upon the emigrant trains, the mail and telegraph lines and upon the citizens of the United States within their country." The treaty further formalized the settlers' rights to establish new emigration routes, military posts, railway lines, mines, ranches, farms, and lumber mills. The Western Shoshone agreed to "abandon the roaming life" and live upon reservations at an unspecified time to be determined by the president of the United States. Although the captains agreed to tolerate further white incursions, at no time did the Western Shoshone actually surrender their lands. In return for these concessions, the Treaty of 1863 promised the Shoshone 20 annual payments of $5000, to be delivered in provisions, clothing, and livestock.

Within the next few years the United States Government began a new policy of "rounding up" the Indians, and in this regard, Major Henry Douglas held a series of councils with representative delegations at Pyramid Lake, Winnemucca, McDermitt, Oreana, and Walker River. He met with more than 500 Shoshone in Austin, whose representatives requested parcels of good farming land with adequate water, preferably near Grass Valley. Douglas concurred that their requests were just and promised to arrange what he could. But no reservations in Grass Valley or anywhere else were forthcoming during the 1870s, and several Shoshone joined Bannock and Northern Paiute parties in waging sporadic warfare. Forbes (1967, p. 8) estimates that in 1878, about 1000 Shoshone were living on the Carlin Farms Reserve near the Humboldt River, in Ruby Valley, and in 19 other places. About this time, the Shoshone were ordered to travel to the Idaho border to join the Duck Valley reservation. On March 24, 1879, a delegation of 16 Shoshone captains unanimously expressed strong displeasure at the order and refused to move. In an independent action, a governmental commission under Major John Wesley Powell told the Shoshone that they would not receive the payments stipulated in the Treaty of 1863 unless they took up residence on the Fort Hall reservation in Idaho.

Despite such incidents, the situation of the Western Shoshone changed little until after the turn of the century, when federal land was set aside for "Indian colonies" in Reno, Carson City, Battle Mountain, Elko, and elsewhere.

The year 1935 marked the beginning of the "Indian New Deal," when the Basin Shoshoneans were encouraged to organize into their own legally constituted tribes. In 1939 the Bureau of Indian Affairs purchased three contiguous livestock and hay ranches on the South Fork of the Humboldt River in Ruby Valley. This reserve of 9419 acres was set aside for 20 families of the "Te-Moak-Band" of the Western Shoshone in accordance with provisions of the 1863 Treaty. By 1964 these holdings had grown to 15,700 acres, administered through the agency headquarters at Owyhee, Nevada. In addition, in 1938 the federal government created the 4668 acre Yomba Indian Reservation on the upper Reese River through the purchase of three ranches by the B.I.A. In 1964 seven Shosho-

nean families were living on the Yomba Reservation and a school had been established on the reservation near Steward Creek.

Forbes (1967, p. 10) points out that the Western Shoshone have never been "reservation Indians" in the ordinary sense. Prior to 1877 less than 20 percent of the aboriginal population lived on reserves, and, by 1927, this figure had only increased to about 50 percent. Since that time, despite the addition of new reservation land, the reservation population has consistently declined.

THE MONITOR VALLEY SHOSHONE

Despite a generally adequate ethnographic record for the Western Shoshone, direct ethnographic documentation for the Monitor Valley Shoshone is almost non-existent. The earliest purely ethnographic account for this area is that of W. J. Hoffman, who served as surgeon and naturalist for the U.S. Geographical and Geological Survey (Hoffman, 1878). In 1871 Hoffman visited Belmont in the southwestern end of Monitor Valley but he remarked only briefly about the use of fire by the Shoshone and the construction of stone circles as piñon caches and game lookouts (Hoffman, 1878, pp. 467, 475).

No further ethnographic accounts were recorded in Monitor Valley until Steward's ambitious survey of Western Shoshone and Northern Paiute groups in the 1930s. Steward unfortunately could contact only a single Monitor Valley Shoshone informant. Although this full-blood Shoshone had extensive knowledge of the Belmont area, he often confused his accounts with the many practices he had observed while living at Lida (Steward, 1941, p. 214). Steward (1938, p. 110, fig. 8) contains only a fleeting reference to the Monitor Valley Shoshone, noting that recent fall festivals had been held in the Belmont area.

Steward's information about the Monitor Valley Shoshone was so sparse that he excluded them from the culture element distribution list of Nevada Shoshone (Steward, 1941), apparently believing that the Monitor Valley Shoshone differed little from the better known central Basin groups (see Steward, 1938, p. 110).

The poverty of ethnographic data prompts us to examine more closely the available ethnohistoric accounts for the Monitor Valley Shoshone. Although the evidence remains scanty, the documents relating to the white settlement of Monitor Valley provide the best data regarding the nature of the native American people of this area (see also Thomas, 1982a).

EURO-AMERICAN SETTLEMENT OF MONITOR VALLEY

Early Exploration

The first white man known to have traveled across the Great Basin is mountain man Jedediah Strong Smith, whose journey took him directly through Monitor Valley. A native New Yorker, Smith and two partners purchased in 1826 a controlling interest in the Missouri-based Rocky Mountain Fur Company. Smith set out during that summer as a company representative to explore the territory west of the Great Salt Lake (although the documentary evidence is unclear as to what, precisely, Smith's objective was; see Brooks, 1977, pp. 22–27). Smith's exact route across the Great Basin has been debated for more than 50 years, but the issue seems settled with the recent publication of his journal (Brooks, 1977). The route can also be traced from his letters and a map prepared in 1839 by David H. Burr, topographer to the United States Post Office (reprinted in Morgan and Wheat, 1954).

Smith's early explorations began near Hyrum, Utah, in August 1826. Leading a party of about a dozen men, he headed through southwestern Utah, crossed into Nevada (probably near the modern town of Bunkerville in Clark County), traveled across the Mojave Desert to the San Bernardino Mountains, and ultimately arrived at Mission San Gabriel on November 26 (see Merriam, 1923; Morgan, 1953, p. 187; Cline, 1963, p. 155; Brooks, 1977, p. 38). Because Mexican law at the time forbade entrance of unauthorized foreigners into California, Smith was ordered to return east, following the same route by which he had just arrived.

Not anxious to repeat his unpleasant Mojave Desert crossing, Smith surreptitiously explored a new route north from Mission San Gabriel. Skirting the northern edge

of the Mojave Desert, he led his party into the San Joaquin Valley, proceeded farther north, and ultimately crossed the Sierra Nevadas in May 1827. The precise location of this crossing has been debated (Mack, 1936, p. 65; Morgan, 1953, p. 207; Cline, 1963, p. 157), but the most probable route seems to have been up the Stanislaus River (through modern-day Angels Camp and Murphys) and on through Ebbetts Pass (Farquhar, 1943; see also Brooks, 1977).

It was this second Great Basin crossing which apparently took Jedediah Smith through Monitor Valley. A notation on the 1838 Burr map reads simply, "Some Isolated Mountains rise from this Plain of Sand, to the regions of Perpetual Snow, the small streams that flow from these, all soon absorbed into the sand. It contains a few miserable Indians, but little Game." Elsewhere, Smith noted that he "found some Indians who appeared the most miserable of the human race having nothing to subsist on (nor any clothing) except grass seed, grasshoppers, & c." (cited in Morgan, 1953, p. 210).

Smith's small party skirted the south of Walker Lake on June 1, 1827, and proceeded to the east approximately following the route of modern U.S. Highway 6 (Farquhar, 1943; Morgan, 1953, p. 418; Cline, 1963, p. 158; Brooks, 1977, pp. 173, 174). While at Walker Lake, Smith commented on "considerable horse sign," an interesting note since he is recorded as the first white man in the area (see Brooks, 1977, p. 174). After taking some fish from an abandoned village, he "went on a little further where there was several families encamped. They were fishing with nets verry neatly made with fine meshes .... About ten O Clock at night I was awakened by the sound of horses feet. I started up and 20 or 30 horsemen rode by at full speed to where the fishermen were encamped" (Brooks, 1977, p. 174).

Smith also observed several Indians in the vicinity of Walker Lake wearing buffalo robes and Spanish blankets. His journal notes that the Walker Lake Paiute deliberately deceived him about the availability of water to the east, in hopes of sending him "where I might perish for the want of it" (Brooks, 1977, p. 176).

The Smith party left Walker Lake, moved between Gabbs Valley and Pilot ranges, around the southern end of the Shoshone and Toiyabe ranges, and crossed Big Smoky Valley just south of Peavine Creek (see fig. 26); this portion of the journey is, incidentally, identical to the route taken two decades later by John Charles Frémont.

Smith followed a well-marked Indian trail across Big Smoky Valley on June 7, 1827, to find "water and good grass." He and his two remaining partners stopped for their midday meal just west of the modern town of Manhattan, then crossed the southern tip of the Toquima Range directly east from Manhattan along a route approximated by Highway 69 (Brooks, 1977, p. 178). They camped for two nights, June 7 and 8, near the site of Belmont.

On June 9 the Smith party traveled across Monitor Valley proper and passed into the Monitor Range via McCann Canyon. The next day Smith "found an Indian and 2 squaws who had no opportunity of running away. I endeavored to talk a little with them by signs but found them too stupid or wilful. They had a piece of a Buffalo robe and a Beaver skin which last I bought of them" (Brooks, 1977, p. 179). The trail then took them east to Hot Creek, along the base of the Pancake Range, and finally into Utah south of Gandy.

This portion of the return trip seems to have been as miserable as the earlier westward crossing of the Mojave Desert. In a letter to General William Clark (of Lewis and Clark fame), Smith noted: "After travelling twenty days from the east side of Mount Joseph, I struck the S.W. corner of the Great Salt Lake, travelling over a country completely barren and destitute of game. We frequently travelled without water sometimes for two days over sandy deserts, where there was no sign of vegetation, and when we found water in some of the rocky hills, we most generally found some Indians who appeared the most miserable of the human race" (cited in Mack, 1936, p. 66). In this letter he used the term "Mount Joseph" to refer to the entire Sierra Nevada Range (Sullivan, 1934, p. 165; see also Brooks, 1977, p. 149).

He arrived at the Salt Lake with only a single horse and one mule remaining, having eaten the rest. Ultimately he joined his part-

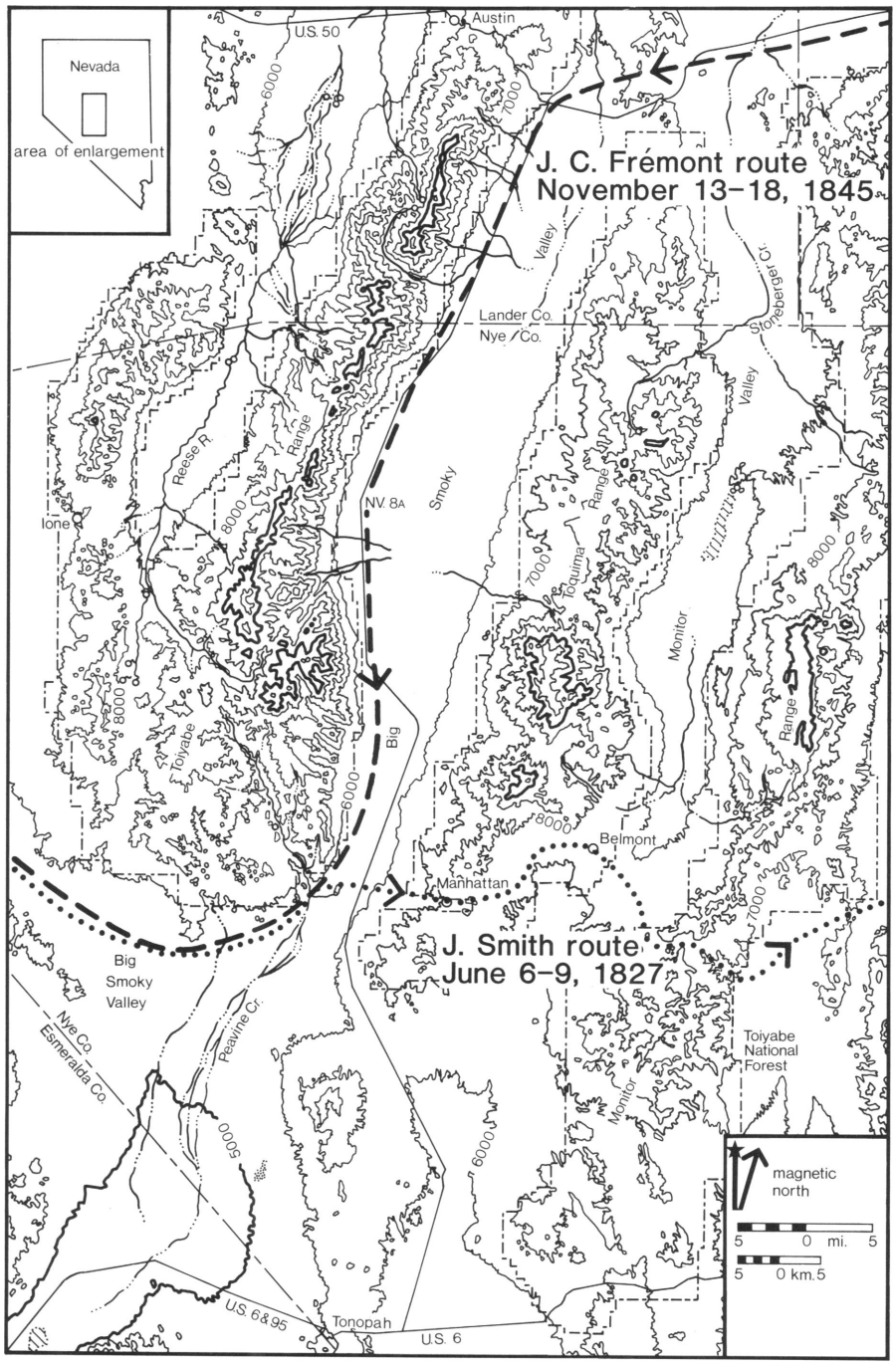

FIG. 26. Routes of Jedediah Strong Smith, summer of 1827 (after Brooks, 1977), and John C. Frémont, November 1845.

ners along the Utah-Idaho boundary at the great bend of the Bear River.

Jedediah Smith later led a second expedition across the Great Basin to San Bernardino

Valley, California. After three years of successful fur trade, he and his partners sold the Rocky Mountain Fur Company to a group of businessmen, one of whom was James Bridger.

Nearly two decades elapsed before another explorer saw the central Great Basin; this time, it was John Charles Frémont who led the expedition. The United States was pursuing a policy of Manifest Destiny in the mid-nineteenth century, and the extension of its territory as far as the Pacific Ocean seemed inevitable. Largely at the urging of Senator Thomas Hart Benton, Lieutenant Frémont—Benton's son-inlaw—led a major expedition in 1842 to explore the territory west of the Missouri River. Frémont's first expedition proceeded up the Platte River and explored the Wind River Mountain Chain. After his return, he organized a second expedition which, like the first, was under the direction of the Topographical Engineers Corps of the U.S. Army. Frémont left St. Louis in May 1843, traveled along the Oregon Trail, explored the Snake River, and ultimately arrived at Fort Vancouver. Equipped with provisions for three months, he re-entered the United States, headed through southeastern Oregon, and spent New Year's Day, 1844 camped on the western edge of the Black Rock Desert, north of Pyramid Lake. Because of the heavy snow, the party elected not to cross the Sierra Nevada there and continued south to the Walker River. Crossing through what is now known as Carson Pass, they arrived at Fort Sutter, Sacramento in March 1844.

Frémont's party remained in Sacramento only two weeks, returning to the Great Basin by way of the Old Spanish Trail, through Las Vegas, and northward to the Oregon Trail; the party then traveled east to the Missouri River, where Frémont prepared his final report. Over 100,000 copies were distributed and it had a profound effect on later emigration to the Far West (Mack, 1936, p. 97). In this report Frémont described the Great Basin as a massive land of internal drainage and his account provides the first official description: "The existence of the Great Basin is therefore an established fact in my mind; its extent and contents are yet to be better ascertained. It cannot be less than four or five hundred miles each way .... Of its interior but little is known. It is called a desert, and, from what I saw of it, sterility may be its prominent characteristic .... The contents of the Great Basin are yet to be examined" (Frémont, 1887, pp. 391–392). Even while writing his report, Frémont was making plans to examine the "contents" of the Great Basin in some detail.

Little time passed before he led a new party of 60, leaving the Missouri River in August 1845 and arriving at the Great Salt Lake in mid-October. After spending two weeks making astronomical observations, the party began their westward exploration. Frémont elected to cross the Great Salt Lake desert directly, where apparently no white man had previously ventured (Mack, 1936, p. 98). He camped at the base of Pilot Peak north of Wendover and then split his party; the larger group journeyed west to the Humboldt River, while he led a small group to the southwest.

After crossing the south fork of the Humboldt, Frémont continued a "tortuous course rendered unavoidable by the necessity of using just such passes as the mountains gave, and in searching for grass and water" (Frémont, 1887, p. 435). He and his party of 10 men generally traveled along Indian trails which skirted the foot of the ridges: "When well marked showing use, these never failed to lead to water and the larger the trail the more abundant the water" (Frémont, 1887, p. 435). Frémont made a number of ethnographic observations, some of which are discussed by Malouf (1966, p. 13); Heizer, Baumhoff, and Clewlow (1968, p. 5); Herman (1972); Johnson (1975, pp. 22–23); and the Inter-Tribal Council of Nevada (1976). Among other things, he noted that the Indians used a sinew-backed bow and arrows tipped with obsidian points. The party also happened upon an old abandoned "Digger woman," who was approximately 80 years old and left to die "because she was very old and could gather no more seeds and was no longer good for anything" (Frémont, 1887, p. 437).

Frémont's map showed that they passed through Diamond Valley, arriving at a stream he called "Basils Creek" (Kingston Creek) near the head of Big Smoky Valley. They then traveled down the west side of Big Smoky Valley until they arrived at "Boiling Sp."

(Darroughs Hot Springs), where they camped on November 16, 1845 (fig. 26). Frémont went around the southern tip of the Toiyabe Range, adding "Moores Creek" to his map (Peavine Creek). From there he led his group to the eastern shore of Walker Lake, which he named after Joe Walker, the guide of the northern party. They finally crossed into California over the Donner Pass.

As the Carson Valley and Salt Lake City areas became more densely settled, there was interest in exploring a more direct route across the Great Basin, or at least in finding better terrain through which to make the crossing (Brooks, 1965, p. 15). On September 18, 1854, Lt. Col. Edward Jenner Steptoe led a government detachment to find such a route (see Angel, 1881, p. 37; Jackson, 1965). Steptoe was accompanied by John Reese, a pioneer Mormon settler and businessman in the Carson Valley, who, practically every year since 1851, had made the crossing to Salt Lake City in order to acquire supplies and merchandise for his business (Brooks, 1965, p. 15). When the Steptoe party reached the location of modern Battle Mountain, Reese and two companions apparently followed the Reese River for some distance to the south; Reese called this the "New River," but the name was later changed in his honor (Simpson, 1876, p. 78).

The next major white incursion into the central Great Basin occurred some 14 years after Frémont had passed through Big Smoky Valley. This expedition was under the command of Captain James Hervey Simpson, commissioned by the United States Army Topographical Corps to find a suitable military route between the Mormon settlements at Camp Floyd, Utah and Genoa in the Carson Valley. Simpson set out early in May 1859, his party consisting of 64 men including several scientists, guides, and military personnel. Unlike Jedediah Smith and John Frémont, Simpson kept detailed notes of his travels. In fact, he was quite critical of Frémont's observations, complaining, "the geographic memoir of Frémont . . . does not enter into the particulars of his exploration of 1845 and 1846, but only gives a general view of the Great Basin" (1876, p. 22). Aware of his predecessor's shortcomings, Simpson attempted to record "the particulars of each day's travel across the Great Basin, as well as a minute description of country traversed" (1876, p. 27). He subsequently published both an abbreviated and a full-length account of his exploration (Simpson, 1869, 1876). Because of this care and planning, Simpson's journal provides the earliest ecologically and ethnographically relevant descriptions for the central Great Basin. A number of investigators have previously considered Simpson's observations for other areas (e.g., Heizer and Baumhoff, 1961, pp. 119–120; 1962, p. 48; Malouf, 1966, p. 20); the present discussion is confined to the immediate vicinity of Monitor Valley (see fig. 27).

While traveling down the *Pah-hun-hupe* (Diamond) Valley, Simpson noted "a couple of bush-fences or barriers converging to a narrow pass, and a large hole in this last portion. Pete [a Ute Indian] says they are to guide deer near the hole, in which the Indian hides himself, and shoots them as they pass with bow and arrows at night, a fire being used as a lure" (Simpson, 1876, p. 70).

On May 21, Simpson and his party entered the Kobah (Kobeh) Valley: "this Kobah Valley is the most extensive one we have seen, and, like the Great Salt Lake Desert, seems once to have been a lake . . . . Streams run from the sides of the mountains, toward the valleys, but sink in the alluvion at their base. They are generally grassed, particularly up in the cañons or ravines" (1876, p. 73). He established camp on May 22 at *She-o-wi-te* near the modern Roberts Creek Ranch and took this opportunity to rest, as eight of his command were ill and "unfit for duty."

Three Western Shoshone, apparently grandfather, son, and grandson, visited Simpson's camp in northern Kobeh Valley. Simpson questioned them regarding local place names and inquired about the number of their people.

> To this I could only get the answer there were very few of them. One of them is an old man of at least sixty years, and he as well as the others represent that they have always lived in this valley, and, never having gone far from it, cannot tell us of the water and mountains beyond their limited range. They say they have no chief, though they speak the Sho-sho-nee language; are clothed with the rabbit-skin cape, similar to the Go-shoots, and represent that they wear no

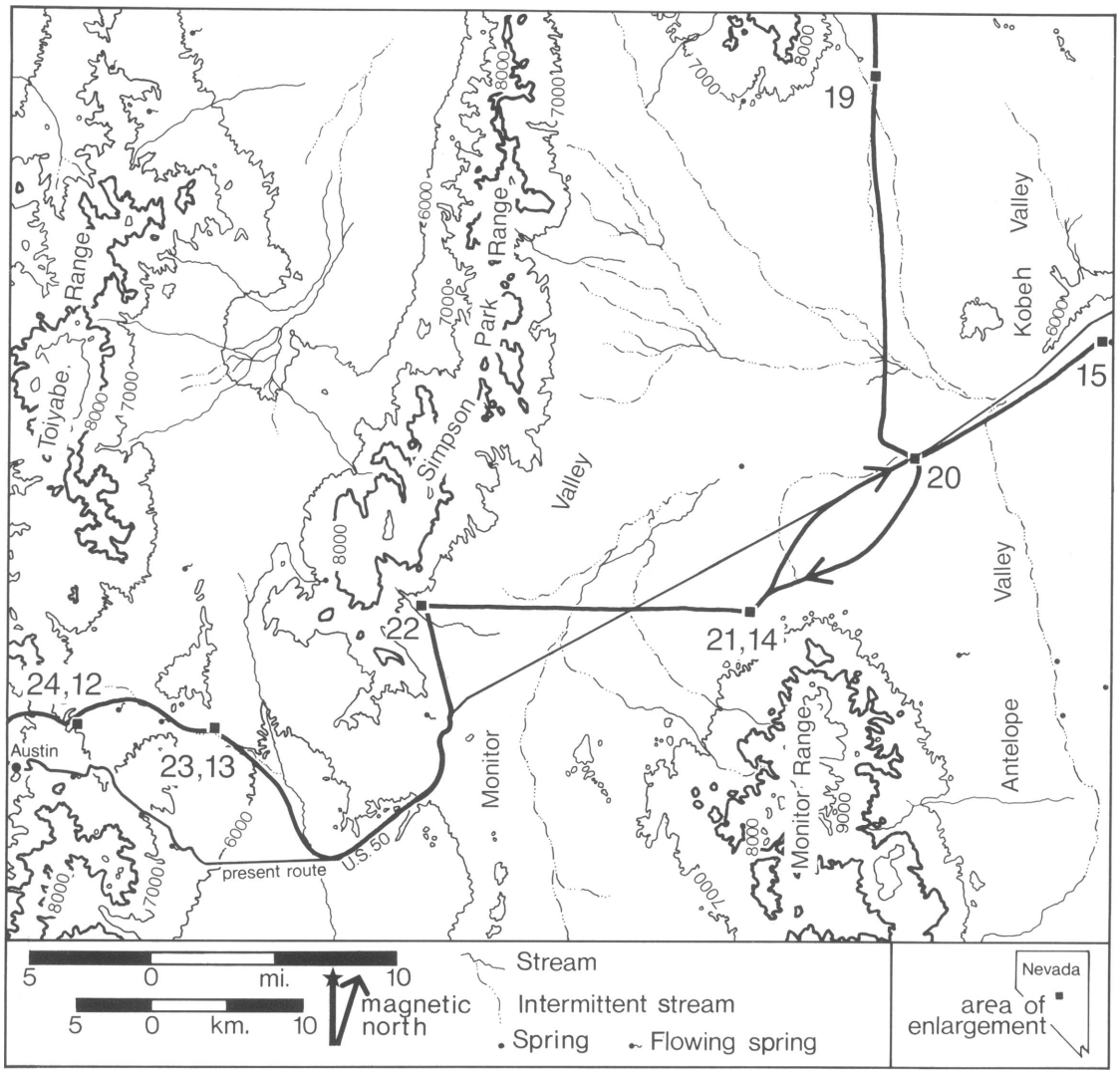

FIG. 27. Route of Capt. James Hervey Simpson. Simpson first crossed the northern end of Monitor Valley in May 1859, establishing camps 19–24. On his return from Genoa, he re-crossed Monitor Valley in July of the same year, establishing camps 12–15 (after Simpson, 1876).

leggings, even in the winter. This is scarcely credible, cold as the winter must be in this region, but it seems to be a fact. They are very talkative and lively. Eat rats, lizards, grass-seeds, & c., like the Go-shoots. The guide says he saw them, after throwing the rats in the fire, and thus roasting them, eat them, entrails and all, the children in particular being very fond of the juices, which they would lick in with their tongues and push into their mouths with their fingers. The old man represents that a number of his people died last winter from starvation and cold . . . . (Simpson, 1876, pp. 71–72).

Later that afternoon Simpson hiked up the creek to visit

a wick-e-up of the Diggers that have visited our camp. It had been reported to be but about from one-eighth to one-fourth of a mile above our camp; but, with all the search we could give for about a mile up, we could see nothing of it.

> Returning on the other side of the creek, we at last got sight of it, it being only distinguished from the sage-bushes around it by the circular form given to its development, it being made of these bushes in their still growing state, and some few loose ones thrown in. To our surprise the inmates were gone. This we conceived strange, as they had come into our camp immediately on our arrival, and seemed to be very confident of protection and safety. What makes the matter more strange, it appears that in going off they shot an arrow into one of our beeves, which looks as if they had become offended at something (Simpson, 1876, p. 72).

The next day Simpson discovered that his cook had indeed offended the visiting Shoshone by threatening them with his revolver.

On May 23 Simpson moved his group southward toward Monitor Valley. They passed the hot springs 2 miles north of the site of Bartine Ranch and made camp at what he called Shelton's Spring, named after one of his dragoons. This stop, Camp No. 20, was on modern Clover Spring, just south of Highway 50. The party found several human bones while cleaning out the spring. "This is corroborative of the statement of my guide, last fall, that the Indians of this region bury their dead frequently in springs. It may be imagined that those who had drunk of the water did not feel very comfortable after the discovery" (Simpson, 1876, p. 73).

On May 24 the expedition moved 7 miles to the southwest and stopped at *Wons-in-dam-me* or Antelope Creek (Willow Creek) at the northern end of the Monitor Range. Simpson noted that the stream was about 3 ft. wide and 1 ft. deep, in good grass and abundant cedar timber. He also recorded that the Kobeh and Monitor valleys were dominated by bunchgrass and would provide ample fodder for wagon trains.

Simpson's party then continued westward, across Monitor Valley, crossing Stoneberger Creek, also said to be 3 ft. wide and 1 ft. deep. The Journal noted the "fine grass . . . toward the mountains and many signs of sage-hen and antelope in this valley. A herd of the latter seen." To the west they observed the *Pah-re-ah* or Water Mountains (Simpson Park Range), remarking on the abundant streams which flowed into Monitor Valley.

While camped at the northern tip of the Toquima Range, they were visited by a party of 15 or 20 Shoshone: "They are the most lively, jocose Indians I have seen. Say two rats make a meal. Like rabbits better than rats, and antelope better than either, but cannot get the latter. Have no guns; use bow and arrow. They occasionally amuse us very much in their attempts to ride our mules, which are, however, so much frightened at their rabbit-skin dress as to cause them to run off with them" (Simpson, 1876, p. 75).

Skirting the southern edge of the *Pah-re-ah* Mountains, the Simpson party passed through Hickison Summit, but made no mention of the conspicuous rock art there. Big Smoky Valley, termed *Won-a-ho-nupe,* was "very thinly covered with *artemisia*" and more antelope were observed. Near his Camp No. 23, below Simpson Park Canyon, Simpson noticed "under a cedar . . . a very large willow basket of conical shape, which would contain probably a bushel and a half. Concealed under the same cedar were a number of rolls of willow peeling nicely tied together; also faggots or bundles of peeled willow—the stock in trade of some industrious Digger. Directed they should not be disturbed." Simpson also noted along the western slope of the *Pah-re-ah* range a number of "columns of stone," which he reckoned were placed there by Indians "as landmarks to guide them over this trackless region." The expedition then crossed the Toiyabe Range through what is now known as Simpson Park Canyon, a few miles northeast of the present town of Austin. Once again Simpson commented on the "luxuriant" stands of willow and grass, "the stream in the cañon is quite pure, and I think there must be trout in it . . . . There is a great deal of meadow along [the stream], and bunch-grass on the sides of the mountains."

Simpson's Camp 23 was situated on a lake "several acres in extent. Ducks frequent it . . . . Should it ever become necessary to establish a post, say near the east entrance of *Won-a-ho-nupe* [Simpson Park] Cañon, the grass, water, and timber of this mountain-range would be amply sufficient (1876, p. 77). On May 27 Simpson was visited by an old Shoshone, who

> represents that we are the first white persons he has ever seen. He says there is a large number of Indians living around, but they had run away from fear of us .... He is at least sixty years old, and says he never had a chief. I asked him if his country was a good one. He said it was. He liked it a good deal better than any other. I asked him why. Because, he said, it had a great many rats. I asked him if they ever quarreled about their rat country. He said they did. So it would appear that civilized nations are not the only people who go to war about their domains (Simpson, 1876, p. 77).

The next day Simpson led his party through a pass bearing his name to a camp on the west side of the Toiyabe Mountains. The large river in this valley was known by the Indian name of *Pang-que-o-whop-pe,* or Fish Creek. Simpson preferred to name it after his guide, Mr. John Reese, who had been there previously. During his visit the Reese River was 3 m. wide, .5 m. deep, and contained trout weighing 1 kg.

Simpson continued his journey across central Nevada, arriving in Genoa on June 12, some 41 days after he had left Camp Floyd. He lingered in the Carson Valley for a few days, then traveled across the Sierra Nevada to visit Placerville, Sacramento, and San Francisco. The return journey began from Genoa on June 24 and reached the Reese River Valley on July 6. Simpson's journal is more condensed for the return trip, but he still provides useful glimpses of both man and land in pristine central Nevada.

The lake in Simpson's Park had fallen considerably since his visit six weeks earlier (1876, p. 110), but the grass in Reese River Valley "as well as everywhere nearly on the mountains [was] very abundant; more so than when we passed before. Hundreds of acres of good hay may be cut in Simpson's Park."

Seventeen Shoshone-speaking Indians visited Simpson's camp, two of them riding horses. One of them, who spoke a little English, told Simpson that the Toiyabe Mountains comprised the "dividing boundary between the Pi-Utes and the Diggers [Shoshone] proper." That night, two of Simpson's men returned to camp with 10 brook trout caught in the Reese River, some weighing 2½ pounds.

Amidst a thunderstorm he moved his group eastward across Monitor Valley, camping on July 8 once again on the *Wons-in-dam-me* Creek, now Willow Creek. They were joined by several Shoshone, "each carrying his two rat-sticks. Several of them are entirely naked, except the breech-cloth. Quite a heavy shower of rain has been falling, but, although it came down cold and chilly, these Indians seemed to take it as if it were not an extraordinary occurrence" (1876, p. 111).

Before Simpson's party continued eastward the next day, they were "amused" with a dance performance by the visiting Shoshone: "The appearance of so many white men and wagons in their country is quite an epoch in their lives, and they are correspondingly elated." Simpson ultimately returned to Camp Floyd, Utah, on August 4, 1859 (1876, p. 111).

The Pony Express

Simpson established a workable route between Salt Lake City and the Carson Valley, cutting off almost 500 km. from the Humboldt River route, and this exploration had an immediate effect on the east–west mail system. The United States had initially attempted mail service between California and Salt Lake City using a mule train in January 1851 (Hafen, 1926); this was the so-called Jackass Express (Goodwin, 1966). This first route followed the old Emigrant Trail, which generally paralleled the Humboldt River.

The results of Simpson's survey became known shortly after he returned to Camp Floyd in August 1859, even though the official report was not published until 17 years later. The Overland Mail followed much of Simpson's Central Route from Utah to Genoa. The operator, George Chorpenning, began constructing a new series of stage stations along the Central Route west from Jacob's Well (in western White Pine County). Because of the increased cost involved in relocating the mail, passenger, and express lines, Chorpenning lost his mail contract in April 1860 (Goodwin, 1966).

The mail contract was immediately awarded to Jones, Russell and Company, which soon changed its name to Russell, Majors & Waddell. The "Pony Express," as

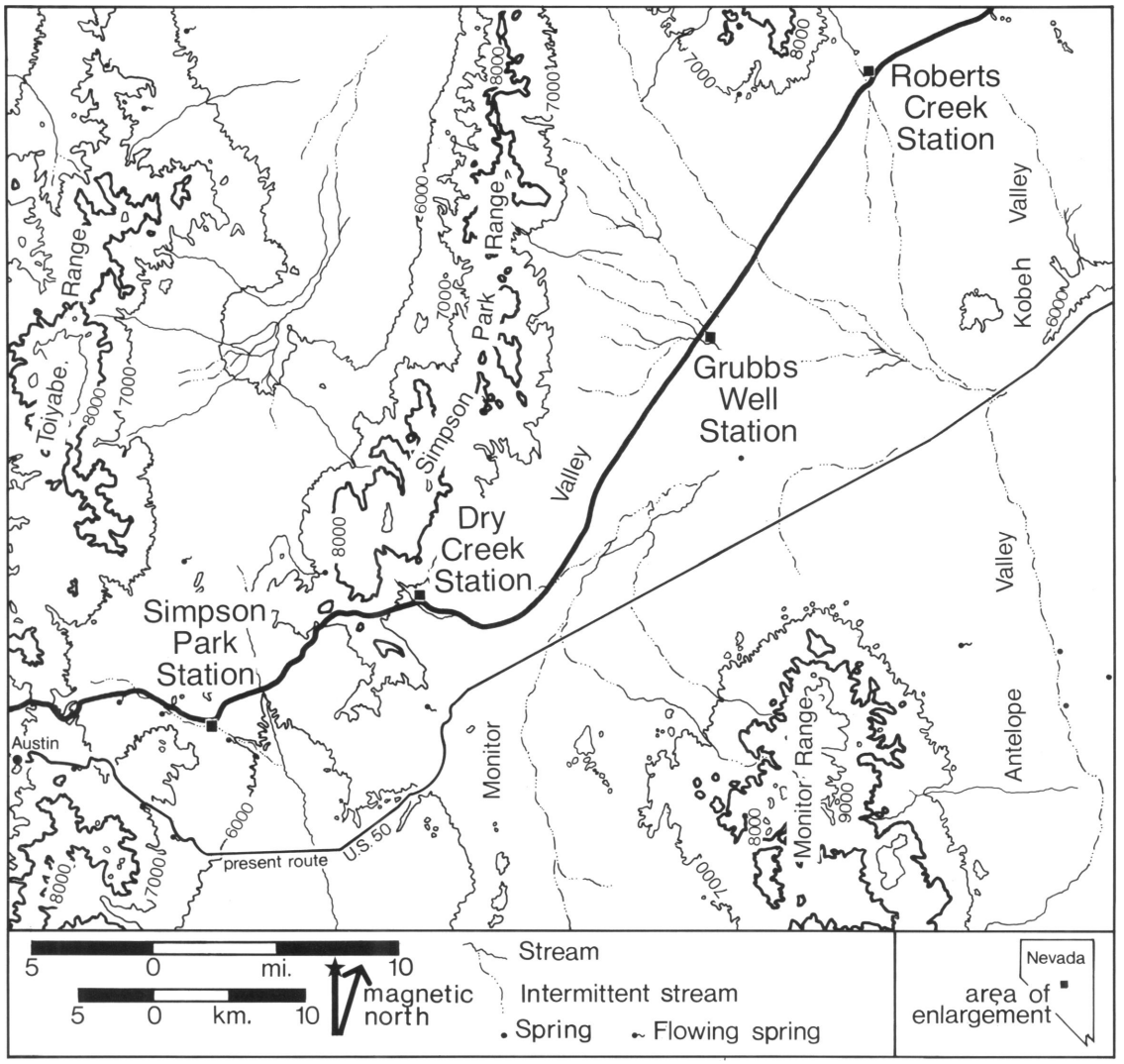

FIG. 28. Route of the Pony Express across the northern end of Monitor Valley.

it was called, operated only from April 3, 1860 to October 28, 1861, continuing Chorpenning's construction of stage stops, several of which were built in the Monitor Valley vicinity (see fig. 28).[1]

A Pony Express station was built at Simpson Park in the spring of 1860, apparently near where Simpson had camped on May 27, the previous year. Beset early on by problems, the Simpson Park station was attacked and burnt on May 20, 1860, presumably by local Indians. As part of his western travels, British scholar, explorer, and erstwhile anthropologist, Sir Richard Burton stopped at the Simpson Park station on October 12 of that year, noting that the station house had already been rebuilt: "A hideous Pa-Yuta and surly Shoshone, whom I sketched, loitered about the station: they were dressed in the usual rabbit-skin cape, and carried little horn bows, with which they missed small marks at fifteen paces" (Burton, 1862, pp. 589–590).[2] The Simpson Park station was probably also used by the Overland Mail and Stage Line

until 1862 or 1863, when the run was changed to stop in Austin.

Another Pony Express station was established farther east at Dry Creek, the site of Simpson's camp of May 26, 1859. Located at the head of Monitor Valley, the Dry Creek station was one of the last stations to be constructed. When the Simpson Park station was raided, Pony Express carrier William Streeper went to investigate. On his return to Dry Creek, he found the scalped, mutilated body of Ralph Rosier, the station keeper (Settle and Settle, 1955). At the time Si McCandless, a white man married to a Paiute, was operating a trading post in Monitor Valley, just across the road from the Dry Creek Pony Express station. According to McCandless, some of his wife's relatives may have been involved with the unpleasantries at Simpson's Park and Dry Creek. It has been estimated that the 1860 hostilities cost the Pony Express about $75,000, and may have contributed ultimately to the rapid financial failure of the enterprise (Bradley, 1913, p. 174).

Unpleasantries occurred on both sides in those early days in Monitor Valley. C. W. Brewer, a soldier who had traveled the Pony Express route in the summer of 1860 wrote: "The Pony Express & Mail Route is well stocked with Brigham's Boys who themselves have excited the Indian troubles. At Dry Creek one of them shot down an Indian ruthlessly and in cold blood saying that he would rather shoot a man than a dog" (cited in Mason, 1976, p. 30). Richard Burton also reported on his stay at Dry Creek, on October 11, 1860: ". . . we found the station on a grassy bench at the foot of low rolling hills. It was a mere shell, with a substantial stone corral behind, and the inmates were speculating upon the possibility of roofing themselves in before the winter. Water is found in tolerable quantities below the station, but the place deserved its name 'Dry Creek'" (1862, p. 587). Burton also visited the graves of those killed in the May uprising.

The Grubbs Wells station is situated to the east, in the northern end of Monitor Valley proper. Few accounts exist of this station, but it was apparently in operation as early as August 1861; it seems likely that the Grubbs Wells station was initially constructed for use in Butterfield's Overland Mail and Stage Express, and only incidentally used by the Pony Express (Mason, 1976, p. 32).

The Roberts Creek station was constructed at the spot of Simpson's May 21–22 camp, where Monitor and Antelope valleys join to form Kobeh Valley. The station was constructed in the spring of 1860, being one of the initial stops for the Pony Express. As at nearby stations, conflicts quickly arose between the Shoshone and the whites. In fact, on the second trip of the Pony Express the rider was delayed for six hours at Roberts Creek because the horses had been driven off by local Indians. Hostilities continued through May and June.

Richard Burton visited the Roberts Creek station on October 10, 1860, and made the following characteristic comments:

> From the hills rose the smokes of Indian fires: the lands belong to the Tusawichya or White-Knives, a band of the Shoshones under an independent chief. This depression is known to the Yutas as Sheawit, or Willow Creek . . . .
>
> About the station loitered several Indians of the White-Knife tribe, which boasts . . . never to have stained its weapons with the blood of a white man. They may be a respectable race, but they are an ugly: they resemble the Diggers, and the children are not a little like juvenile baboons. The dress was the usual medley of rags and rabbit furs: they were streaked with vermilion; and their hair . . . was fastened into a frontal pigtail, to prevent it falling into the eyes . . . .
>
> Mose Wright [a rider for the Pony Express] described the Indian arrow-poison. The rattlesnake . . . is caught with a forked stick planted over its neck, and is allowed to fix its fangs in an antelope's liver. The meat, which turns green, is carried upon a skewer when wanted for use; the flint head of an arrow, made purposely to break in the wound, is thrust into the poison, and when withdrawn is covered with a thin coat of glue. Ammonia is considered a cure for it, and the Indians treat snake bites with the actual cautery (Burton, 1862, pp. 584–586).

The winter of 1861 was apparently a difficult one for the Shoshone, and Pony Express station keepers occasionally supplied them with food. The *Salt Lake City Deseret News* (Feb. 20, 1861) reports that the snow was very deep in the vicinity of the Roberts Creek Station, and that the Indians were "in a destitute and starving condition. One Indian was

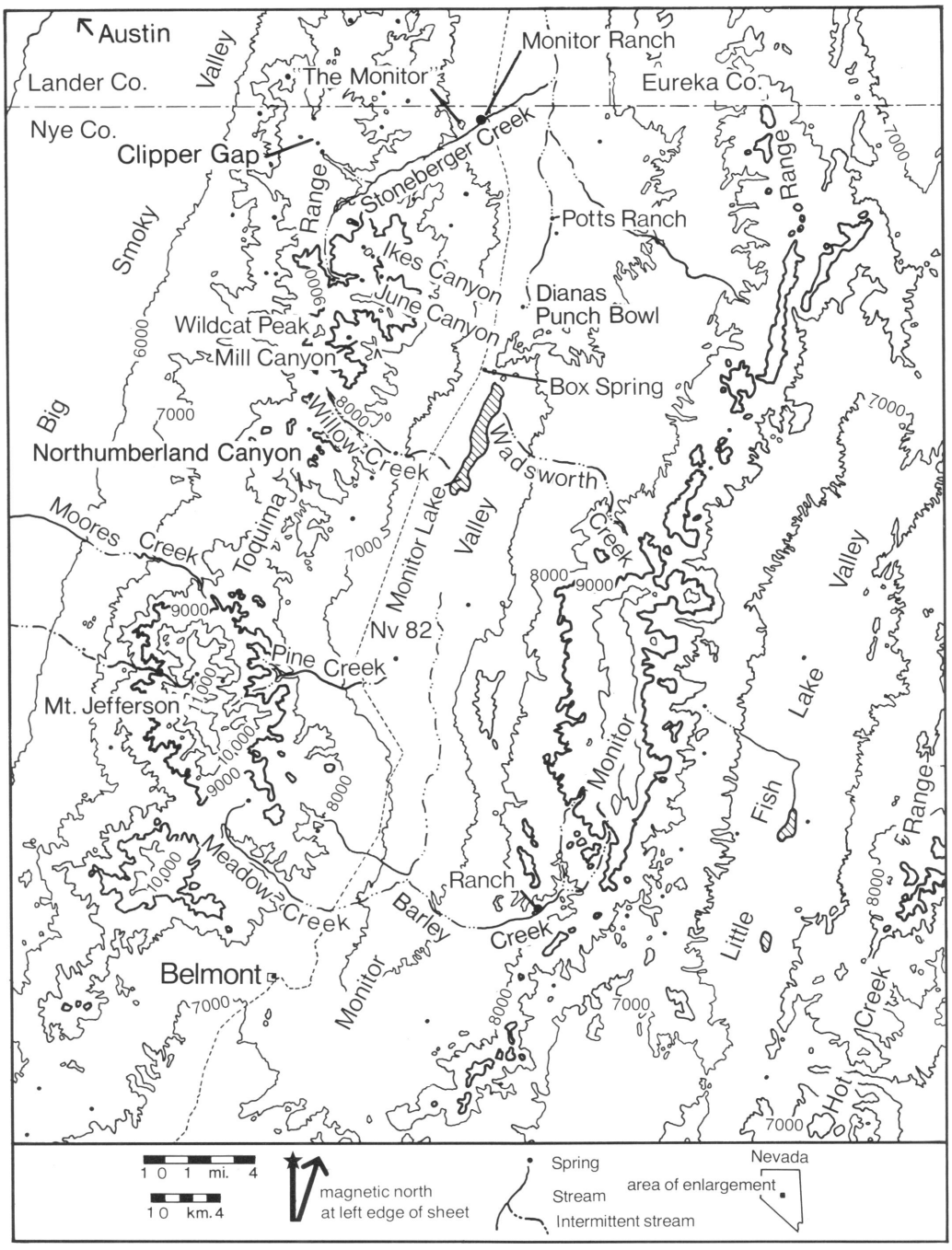

FIG. 29. Historic locations and place names in Monitor Valley.

recently found dead within a half mile of the station, who had perished of cold and starvation while on his way there for food. Another had fallen down nearby from exhaustion, badly frozen, who was seen taken to the station and resuscitated before it was

FIG. 30. The town of Belmont, capital of Nye County, looking southwest across the Toquima Range. The courthouse is the tall brick structure at the extreme right, constructed in 1874–1875. This photograph was probably taken shortly thereafter (courtesy of the Nevada State Historical Society).

too late to save his life." After the Pony Express ceased operation October 28, 1861, the Roberts Creek station continued to operate as an Overland Stage station until 1869.

THE SILVER BOOM

Myron Angel has suggested that prior to 1862 "the overland mail created all the civilized life of the central and eastern part of the Territory of Nevada" (1881, p. 461). But the character of the central Great Basin changed almost overnight when William Talcott discovered silver in Pony Canyon. Talcott, a former Pony Express rider, was hauling wood at the time for the Overland Stage station at Jacob's Well in the Reese River Valley (Elliot, 1973, p. 101). The silver ore was quickly assayed in Virginia City and proved to be extremely rich. Word spread rapidly and the Reese River Mining District was established on May 10, 1862. The response to the new boom was so great that by the fall of that year the territorial legislature was forced to create a new county, named Lander, from eastern portions of Humboldt and Churchill counties. The original county seat was established at Jacob's Well (Jacobsville). But Austin soon won the contest for survival among the small rival communities and the county seat was officially moved there on September 21, 1863.

The area reached its maximum population of 5000 to 6000 in the late 1860s (Goodwin, 1964, p. 6; see also Angel, 1881, pp. 461–468). The silver ore in Austin had been overrated and the production rate for the 1860s and 1870s was unimpressive. But Austin's true influence came not from actual silver ore production, but rather from its role as a "mother camp" to many discoveries in eastern Nevada (Elliot, 1973, p. 102).

One of these ancillary booms occurred in the Toiyabe Range to the south of Austin. Nye County was established to accommodate this mining activity, and Ione became the first county seat. But as prospecting continued, it became clear that the greatest potential for wealth, business, and population lay farther east. In May 1867, the Nye County seat was moved to Belmont, a newly established community at the edge of Monitor Valley (see figs. 29, 30).

Belmont, located on a 2400 m. (8000 ft.)

high plateau of the Toquima Range, was long favored as an area of aboriginal settlement (Steward, 1938, p. 110). The area offered the fortunate combination of abundant spring water and plentiful piñon-juniper woodland. Silver was first discovered in the area in October 1865, allegedly by a local Shoshone (Angel, 1881, p. 519). Belmont grew to almost 1500 inhabitants in 1866–1867 and during a second boom from 1873–1874, Belmont became the largest town in central Nevada. At its peak, Belmont sported a 10 stamp mill, five local sawmills, a bank, a school, telegraph service, two newspapers, and dozens of small shops.

As settlers poured into mining settlements like Belmont, the outlying valleys were rapidly explored and homesteaded as well. As one might expect, the details of the actual white settlement of Monitor Valley are incomplete. We do know that the Nye County Assessor, writing from Ione on November 4, 1865, did not mention a white settlement in Monitor Valley (State of Nevada, 1865). But one year later, on November 14, 1866, explicit reference was made to agricultural interests in the Monitor Valley area.

Myron Angel, who lived in Austin during this time, claims that the first known white settlement in Monitor Valley was in 1866 by Jacob and Samuel Stainenger, also spelled Staininger and Stininger (Angel, 1881, p. 515). Angel further reports that George and Thomas Andrews soon settled near the Stainengers and, in an ensuing confrontation, Thomas Andrews was killed by one of the Stainengers. The *Territorial Enterprise* (January 22, 1867) carried a lengthy account of the shootout, reporting that "if Mark Twain had had as many homocides to record as have occurred [in Nye County] within the last few months, he would not have been under the necessity of inventing the cruel murder of Dutch Nick's, wherewith he created a sensation, and shocked the moral sense of many readers of the ENTERPRISE." According to this account, the Stainenger brothers took up two quarter sections on Mosquito Creek sometime during the summer of 1866. After setting up several boundary stakes, they traveled to Austin for provisions, intending to return as soon as possible to improve their ranch and to cut the native hay growing nearby. Apparently there was great competition for good farm land, because when one of the Stainenger brothers returned from Austin, he found that the Andrews brothers had taken over their land and were in the process of cutting the hay. According to the *Enterprise* story, the Andrews brothers had already claimed the quarter sections entitled to them, and the new claim was made "for a friend of theirs who lived in Austin." Unable to get the Andrews brothers to give up the land, the Stainengers took possession of an adjoining tract of land "which was not considered to have much value, where they have resided ever since."

The actual shootout occurred in a dispute over the fenceline separating the Stainenger and Andrews ranches. Thomas Andrews died instantly from two shots in the back, and George Andrews was severely wounded with a buckshot immediately below the eye. No arrests were made over the incident: "the community looking on it as a free fight, in which it had no interest."

The incident points up not only the historical details of the earliest settlement of Monitor Valley, but also underscores the high value placed on obtaining rights to water and choice agricultural land located near mining settlements like Belmont.

One minor mystery remains regarding the actual naming of Monitor Valley. Local tradition recounts that the valley was named for a distinctive rock formation which closely resembles the famed Civil War vessel (see fig. 31). But despite a search for the relevant historical documents, we were unable to find any verification for this suggestion. We do know that both Monitor Valley and Monitor Range were unnamed in 1845 when John C. Frémont passed through the neighboring Big Smoky Valley. His map showed Monitor Valley as simply "unexplored." Captain Simpson's map, documenting his crossing in 1859, adopted primarily native Shoshone terms, and Monitor Valley remained unnamed.

The ironclad warship, U.S.S. *Monitor,* was commissioned in 1861, fought its historic battle with the *Merrimac* in March 1862, and sank in a hurricane off the Carolina coast on December 31 of that same year. Local west-

FIG. 31. Geological formation known locally as "The Monitor" because of its resemblance to the famed Civil War ironclad ship (looking southeast); for exact location, see figure 29.

ern newspapers of the time, such as the *Reese River Reveille,* carried whatever news was available from the eastern battlefront. It is probable that Monitor Valley was named by someone familiar with the famous warship.

Apparently the earliest published reference to Monitor Valley is in an editorial in the *Reese River Reveille* on December 3, 1864:

> For several months past the Indians of the country southeast of Smoky Valley have borne quite an enimical attitude, and occasionally made raids upon the isolated ranches in the neighborhood of the Boiling Springs, Twin Rivers [both in Big Smoky Valley] and Monitor Valley .... They do not steal because they are in need of provisions, for they commenced their robberies last spring when they still had large supplies of pine nuts and other food in plenty .... The Indians who have committed the depredations are from the third range of mountains southeast of Smoky Valley, a distance of some forty or fifty miles. Their section is entirely uninhabited by the white man.

Five months later, the *Reese River Reveille* (May 5, 1865) carried a front page story describing a band of 500 Indians massing in Monitor Valley, allegedly to attack Austin. Apparently the name was not widely known at the time, since the editor felt obliged to add that Monitor Valley "is situated south of the Smoky range."

A map is also available which records an early usage of the term "Monitor Valley." This map, on file at the Nevada Historical Society, is entitled "Map of the Reese River Mining District, showing exploration of D. E. Buel in 1864 and Joseph Todd in 1865," and includes the names "Smoky Valley," "Smoky Range" (now called the Toquima Range), "Monitor Valley," and "Monitor Mts." Published by the D. Van Nostrand Company of New York City, it contains a number of dated "endorsements": B. J. Burns (Editor of the *Reese River Reveille,* October 10, 1865), J. S. Slauson (Mayor of Austin, October 5, 1865), and M. J. Noyes (Lander County Supervisor, September 30, 1865). The map shows Monitor Valley as an empty and largely uninhabited space.

Belmont was the only significant population center in the area, and this small mountain community conditioned white settlement of the entire Monitor Valley. Because of its isolation, transportation became a major problem; not only was it necessary to freight out the silver ore, but tons of incoming supplies, lumber, and technical equipment were required to support the local population.

Additional information regarding early transportation systems in Monitor Valley is available from a manuscript collection housed at the Nevada Historical Society in Reno. The manuscripts consist of correspondence and reports written between 1864–1869 by a New York-based mining, engineering, and consulting firm. This firm, established by Rossitor W. Raymond and Dr. Justus Adelburg in 1864, expanded a year later with the addition of a western branch in Austin. Included in the collection is a series of more than 35 reports written (some in German) by Carl Stetefeldt, which detail claims, ledges, and mines throughout the Reese River Mining District and other areas in Central Nevada.

Writing in November 1866, Carl Stetefeldt describes the major toll road connecting Belmont to Austin. This road began in Austin, followed the Overland Trail, then turned down Smoky Valley, and passed through Clipper Gap in the Toquima Range (see fig. 29). After passing the site of an abandoned sawmill at Clipper Gap, the road narrowed considerably: "at the summit . . . there is a steep ascent which, however, could be reduced if the trail will be enlarged to a road. Four miles beyond the summit, one reaches Stoneburger Ranch, a considerable piece of fertile land situated in a wide canyon . . . from the ranch to Austin you have to figure on 40 miles. From the ranch to Hot Creek there is the Stoneburger Toll Road, on which loaded wagons can cross" (Stetefeldt, 1866). This toll road continued east, across the Monitor, Hot Creek, and Reveille ranges; a southward fork led down Monitor Valley and ultimately to Belmont.

This important road was further described in the *Reese River Reveille* (November 19, 1866):

> We are informed by Mr. A. Stonebarger that he will keep his road open for travel as far as Hot Creek during the coming winter. Working parties will be kept upon it constantly, and should there be at any time a fall of snow sufficient to obstruct the passage of teams, a force will be at hand to accomplish its immediate removal. Mr. Stonebarger is also engaged in building a substantial hotel and barn for the accommodation of the travelling public, at his ranch in Clipper Gap, upon the eastern slope of the Smoky Valley range of mountains, about thirty miles distant from Austin. These are movements in the right direction, as this road . . . is destined to become one of the most important thoroughfares of the State, and stations along its line where teamsters and travelers can be accommodated will be much needed, and we doubt not, most liberally patronized. Teamsters can already procure forage at several points upon the road beyond Stonebarger's ranch, and stations are in course of construction at convenient intervals. The first place at which hay can be obtained after leaving Stonebarger's is Warm Springs, in Monitor Valley [probably at Dianas Punch Bowl or perhaps near Potts Ranch].

The recently published diary of Martha Galley also discusses a crossing over the Stonebarger Toll Road, en route from Austin to Hot Creek (Lewis, 1977, pp. 87–88). After spending the night at an abandoned wood chopper's cabin near Clipper Gap, the Galley family traveled along Stonebarger's road into Monitor Valley on December 15, 1866. In her diary, Mrs. Galley observed with some pride that she "was the first white woman who had ever seen that valley which is called Monitor" (Lewis, 1977, p. 91).

Accounts such as these make it clear that Monitor Valley was settled both from the north (as a wagon route from Austin) and simultaneously from the south, as a direct outgrowth of booming Belmont.

Other toll roads were quickly established linking Belmont with Austin, and the relative merits of these routes were commonly evaluated and debated in the newspapers of the time (e.g., *Territorial Enterprise,* June 20, 1868). One could travel west from Belmont by means of the Jefferson Toll Road, a 12-mile route which crossed Jefferson summit and ultimately reached northward to Austin (*Belmont Courier,* March 14, 1874). This route also allowed coaches, sleighs, and buckboards to carry mail and passengers into Big Smoky Valley. The Alatoona Toll Road progressed eastward from Belmont across the Hot Creek Range, and another toll road also crossed Pryor Pass, to the southeast. These roads were privately owned and maintained, a tax being paid to Nye County.

Stage service was available connecting Belmont with Austin almost from the initial settlement of Monitor Valley, late in 1866. An advertisement appearing in the *Territorial*

FIG. 32. The Barley Creek Ranch, on the eastern side of Monitor Valley, as it appeared in about 1890; for exact location, see figure 29. This setting is typical of the dozens of nineteenth-century ranches which were established near virtually all permanent water sources in Monitor Valley (courtesy of the Nevada State Historical Society).

Enterprise (February 19, 1867) noted that the stage ran three times weekly, took 15 hours to travel the distance, and charged $15. The stage carried only passengers and Wells Fargo express matter. A "Fast Freight Line" operated twice weekly between Austin and Belmont. On May 1, 1868 stage service was scheduled on a daily basis from Austin, with the route passing through the center of Monitor Valley (Berg, 1941, p. 22).

The establishment of Belmont as a major mining community fostered rapid settlement of the southern Monitor Valley, primarily as an agricultural hinterland. The settlement pattern during the 1860s was in marked contrast to the aboriginal usage of the land. In prehistoric times, people lived primarily in the uplands, particularly on ridges and near high altitude springs (see Part 3). Although lowland springs and streams were exploited prehistorically, aboriginal settlements were situated at some distance from the actual water source, presumably to allow animals to water. By contrast, the historic white settlers homesteaded these lowland water sources first, using the surrounding undeeded lands for grazing purposes. By 1870, 15 homesteads appeared on the Nye County tax rolls, totaling 1680 deeded acres. These early settlements in Monitor Valley were, almost without exception, located on the flats near the mouth of one of the side canyons—at Meadow Canyon, Pine Creek, Mosquito Creek, Pryors Canyon—as well as ranches near Stoneberger Canyon and Butler Canyon, to the north in Lander County (see fig. 29).

Settlements continued to proliferate in Monitor Valley during the 1870s in direct response to the economic development of Belmont. During this period, the local papers carried repeated accounts extolling the agricultural productivity of the various Monitor Valley ranches. Meadow Canyon, for instance, produced an abundant harvest of na-

tive hay, grain, potatoes, Jerusalem artichokes, and onions, all of which were shipped to Belmont for sale (*Belmont Courier,* July 13, 1878). Approximately 3000 head of cattle and a large number of sheep were grazing in Monitor Valley in the late 1870s between the Stoneberger Ranch in the north and the Sampson Ranch, located about 29 km. (18 miles) northeast of Belmont (*Belmont Courier,* November 10, 1878).

The Nye County 1880 census records a total of 28 residents in Monitor Valley. Occupations were listed as rancher, farmer, miner, stage driver, laborer, and housekeeper. Interestingly enough, fewer than half of the 20 adults living in Monitor Valley at this time were born in the United States; countries of origin included Ireland, Italy, Sweden, England, Canada, and Germany.

A number of small-scale irrigation projects were initiated to improve the agricultural and grazing potential of the area. The 1870 Nye County Tax Rolls show, for instance, that water from Pine Creek was diverted by irrigation ditches and supplied to at least three ranches.

Monitor Valley agriculture supplemented the bland mining town diet with a number of welcome additions. Sage grouse from the Monitor Valley foothills and wild ducks from Mosquito and Barley creeks were occasionally offered for sale in Belmont (*Silver Bend Reporter,* November 16, 1867; *Belmont Courier,* December 12, 1874), and turkeys were imported from the Corcoran Canyon Ranch for sale over the Christmas holidays in 1879 (*Belmont Courier,* December 27, 1879). By this time, a number of Monitor Valley farmers were spending their winters in Belmont (*Belmont Courier,* February 1, 1879).

Timber, always in short supply, was necessary not only for construction in Belmont, but also for fuel at the silver stamp mills, for mine shoring, and for fenceposts. Local stands of piñon and juniper were rapidly exhausted (see Thomas, 1971b), and sawmills were soon established throughout the Toquima Range. One sawmill was constructed at Clipper Gap sometime in the mid-1860s, and was moved farther up into the mountains as the available timber was exhausted. Another sawmill, about 5 km. south of the Stoneberger Ranch, was built about this same time and produced some 120,000 m. of timber annually (Stetefeldt, 1866).

Sawmills such as these often used portable equipment, particularly at the higher elevations where limber pine was being timbered. One such portable sawmill was established in 1871 by Mr. J. Huey on Mt. Jefferson, at the head of Pine Creek (Nye County Tax rolls, 1871). A wagon road was then constructed to allow the sawed logs to be transported for sale in Belmont (*Belmont Courier,* November 22, 1874). This entire sawmill was moved five years later from Mt. Jefferson to the Reese River Valley (*Belmont Courier,* January 15, 1879). This type of operation generally felled and milled the timber during the summer and fall, and then transported the logs downhill on large sleds during the winter. As part of the archaeological reconnaissance on Mt. Jefferson (see Part 4), we had occasion to inspect the ruins of Huey's sawmill, located at an elevation of about 3109 m. (10,200 ft.). A massive pile of mill ends is still present and large stumps of limber pine are all about; some of these trees reached 1 m. in diameter. One of the wrecked log sleds can still be seen near the South Pine Creek trail.

The Belmont mines and mill flourished for about two decades, producing high grade silver chloride ore. But in the mid-1880s, the combination of depressed silver prices, increased costs of pumping from greater depths, and decrease in silver content of the ore, created a major decline in the Belmont mining activities (Lincoln, 1923, p. 160; Kral, 1951, p. 19). Belmont gradually lost both economic potential and population, and the county seat was moved to Tonopah in 1905. A brief redevelopment occurred in 1915 when the Monitor-Belmont Company built an electrically-powered flotation mill to treat the old mine tailings, but the mill operated only two years (Kral, 1951).

Although Belmont was Monitor Valley's major population center, a number of smaller mining communities were established in the area. Silver was discovered in East Northumberland Canyon (see fig. 29) in 1866. The ledge was 3.7 m. thick and contained very rich ore; by December of that year a 55 m. tunnel had been completed. A small village named Learville quickly arose on the slopes

overlooking Monitor Valley. A 10 stamp mill was installed and the operation continued until 1870 (*Silver Bend Reporter,* May 4, December 7, 1867; July 15, 1868; see also Lincoln, 1923). Another mining operation, centering on the Monitor and Blue Bell mines, opened in 1879 and continued until 1891 (Kral, 1951, p. 135).

Silver mining continued sporadically until gold was discovered in 1936, and a complete mining operation was begun by the Northumberland Mining Company. Established at Northumberland summit, it employed 70 men, and included an assay office and shops (*Reno Evening Gazette,* July 5, 1941; see also Berg, 1941). The large mill was moved to Northumberland from the played-out mines of the Weepah district. Gold production ceased in 1942, but there is talk of reopening a large open pit gold mine in the early 1980s; East Northumberland Canyon is currently the site of two major barite mines.

The town of Jefferson located in the Toquima Mountains about 19 km. north of Belmont was established when silver was discovered in 1873; a toll road connected Jefferson to Belmont (*Belmont Courier,* March 4, 1875). At its peak the town operated two stamp mills and contained a population of 800. Both mills ceased operation by 1878, and only four miners were living in Jefferson in 1881 (Angel, 1881, p. 525).

With the exception of these brief flurries of silver and gold mining, the white settlement of the Monitor Valley has focused on ranching and limited farming. The population of Monitor Valley declined steadily during the late nineteenth century, a trend which has continued to the present day. But once again the settlement pattern has shifted. The tendency throughout the twentieth century is toward combination of several small ranches into single large livestock operations. At present, Monitor Valley is operated by two large ranching outfits that control lands which had been homesteaded and farmed by literally dozens of small independent ranchers during the nineteenth century. During our archaeological research in Monitor Valley (which lasted from 1970 through 1981), the entire livestock industry of Monitor Valley was operated by less than one-dozen full time employees. The permanent population of Monitor Valley (including Belmont) is at present far below 100 individuals. Although ethnographic population figures are sketchy, it is safe to say that the contemporary population density of Monitor Valley is less than half that of the aboriginal population.

NOTES

[1] For a first-rate example of how documentary and archaeological evidence can be combined, see Hardesty's (1979) monograph dealing with two central Great Basin Pony Express stations.

[2] In a way, Burton's brief visit to central Nevada might be termed the first anthropological study of the area. Richard Francis Burton (1821–1890), one of the greatest British travelers of the nineteenth century wrote more than 50 books describing his journeys. Burton lived in India for seven years, and became proficient in five of the Indian vernaculars, as well as in Persian and Arabic. He achieved worldwide recognition with accounts of his pilgrimages to Medina and Mecca in 1853, and later participated in expeditions which attempted to find the source of the Nile, discovered Lake Tanganyika, and explored the Gold Coast, Dahomey, and Benin.

Burton visited the United States only briefly, describing his experiences in *The City of Saints* (1862). Unlike his predecessors, Simpson and Frémont, Burton's international travels fostered a cross-cultural perspective, although Burton's observations were by no means value-free. Burton was equally interested in observing white frontier life in the Americas, and it is this interest which enlivens the accounts of his experiences in the central Great Basin.

CHAPTER 8. PROTOHISTORIC MONITOR VALLEY: ARCHAEOLOGICAL EXPECTATIONS

A corpus of data and theory relevant to understanding the structure of the protohistoric Monitor Valley have now been presented. Before turning to a detailed examination of the archaeological record of that area, it is necessary (a) to reduce this information to a small set of strategic relationships that may be anticipated in the archaeological record and (b) to relate these anticipated strategies to the specific landscape of the Monitor Valley.

STRATEGIC MODELS FOR EXPLOITING PROTOHISTORIC MONITOR VALLEY

There is no single best way to exploit an ecosystem. This point was made emphatically in chapter 2, and need not be belabored here. Given relatively constant levels of technology and sociocultural interaction, a wide range of strategic possibilities is available to exploit a particular landscape.

But hunter-gatherers do not, and did not, behave randomly with respect to any ecosystem. Decisions of subsistence and settlement are goal oriented, with definite expectations for the future (Binford, 1979a, p. 261). Such decisions are melded into an overall long-term exploitative strategy, which may be complex and diverse. A *first priority strategy* is implemented whenever conditions allow; but there are also several *back-up strategies* to allow for social and ecological variability, and insure long-term survival (Colson, 1979). Recent studies in human ecology emphasize the importance of hazards research to supplement the more traditional attention to modal, normative ecological behavior (Vayda and McCay, 1975).

Yet despite the variety and complexity of hunter-gatherer strategies, there is a definite and finite range of behavior relevant to a given ecosystem. As Binford (1980) has emphasized, a logistical strategy tends to occur in high latitude areas, whereas a foraging strategy becomes more common near equatorial zones.

It is also worthwhile to examine how these strategic trends and tendencies impact on a single landscape—in this case, the Monitor Valley of central Nevada. Furthermore, the strategic models are targeted for the protohistoric period, operationally defined as the year A.D. 1800. This arbitrary date was selected in order to minimize both physical and social environmental variability. It is possible, with a reasonable degree of error, to stipulate what the land looked like in A.D. 1800 and also the nature of the social climate in which the "Monitor Valley people" operated. We can also define rather accurately the level of technology in which this adaptation was cast. These stipulations are essential because the regional context (population pressure, trade networks, and so forth) is critical to the strategic decisions made with regard to a single habitat.

It is possible to isolate five regional mobility strategies which *might have operated* in protohistoric Monitor Valley. These strategic options are neither independent nor mutually exclusive; they are extreme cases serving as heuristic models to approach the archaeological record of a given habitat.

I. A Strategy of High Residential Mobility

Foragers, such as the protohistoric Kawich Mountain Shoshone, could have exploited Monitor Valley as part of their extended range; this land-use pattern would be manifest as low density residential bases and locations, with a few caches constructed in areas of high bulk resources.

II. A Strategy of Seasonal Fusion and Fission: Monitored from Within the Camp/Foraging Radii

Mixed-mode forager-collectors such as the protohistoric Reese River Shoshone could have exploited Monitor Valley, establishing residential bases in several areas of relatively optimal positioning, and pursuing a local foraging and wider ranging logistic strategy throughout the rest of the valley; this land-use pattern would be manifest as a series of relatively high-visibility base camps, sur-

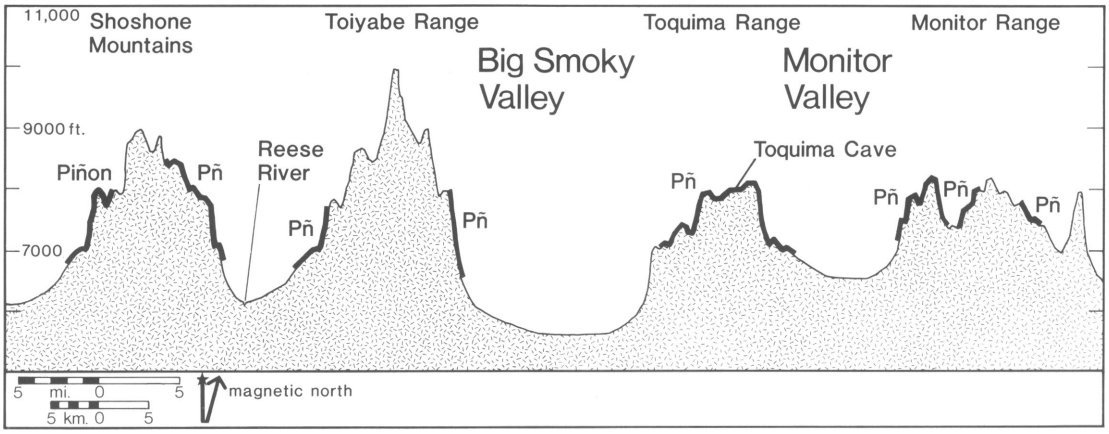

FIG. 33. Cross-section through the north end of Monitor Valley; note exaggeration in vertical scale.

rounded by locations, field camps, and extensive seasonally specific caching systems in areas of high bulk resources.

III. A Strategy of Seasonal Fusion and Fission: Monitored from Within the Logistic Radius

Mixed-mode forager-collectors such as the protohistoric Reese River Shoshone could have exploited Monitor Valley from residential bases elsewhere, visiting Monitor Valley proper only in logistic, special-purpose task groups; this land-use pattern would be manifested by a series of high visibility intercept locations, field camps, evidence of caching and the transport of high utility, low bulk resources elsewhere, and an absence of residential camps.

IV. A Strategy of Minimal Residential Mobility: Monitored from Within the Camp/Foraging Radii

Collectors such as the protohistoric Owens Valley Paiute could have exploited Monitor Valley by establishing nearly permanent optimally positioned residential bases, then pursuing foraging and logistic procurement throughout the rest of the Valley; this pattern would be manifest as relatively few highly visible residential bases showing signs of high labor and materials investment, surrounded by locations, field camps, and extensive caching, especially in areas of high bulk resources.

V. A Strategy of Minimal Residential Mobility: Monitored from Within the Logistic Radius

Collectors such as the protohistoric Owens Valley Paiute could have exploited Monitor Valley from nearly permanent residential bases elsewhere, visiting Monitor Valley proper only in logistic, special-purpose task groups. Such a pattern would be characterized by a series of highly visible intercept locations, field camps, caching spots, and evidence of transport of high utility, low bulk resources, and the absence of residential sites.

Although other strategic mixes are possible, these five models provide an adequate set to anticipate the archaeological record of Monitor Valley. But before arraying these strategic options across the protohistoric landscape, a few cautions are in order.

First of all, these five models are defined to assist in understanding both the protohistoric period *per se* and also to bridge the gap between an observable archaeological record and the now-extinct behavioral contexts. These contexts are not *ethnographic models* or *ethnographic analogies*; they are not empirical generalizations; they are not models to be tested against the archaeological record. They *are* behavioral, strategic generalizations which set out the articulations of various procurement and positioning strategies. Note, for instance, that a "strategy of high residential mobility" could theoretically operate anywhere in the world, at any time; *the strategy*

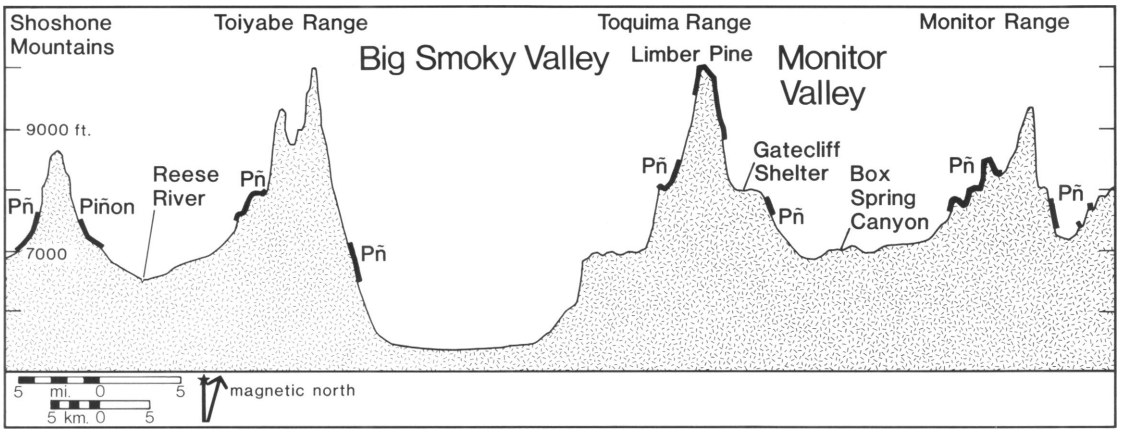

FIG. 34. Cross-section through the south end of Monitor Valley; vertical scale exaggerated.

is confined by specifics of neither time nor space. The challenge is to determine how many—if any—of these strategies were tried in the Monitor Valley landscape.

By examining the underlying strategy, rather than merely generalizing about material culture which might be found there, it is possible to address a wider range of anthropologically relevant questions:

1. *What was the dominant subsistence strategy?*
2. *Is there evidence of back-up strategies operating?*
3. *Have the various subsistence components been articulated differently in the past?*
4. *Have changing environmental conditions affected the applicability of given strategies?*
5. *Have social parameters—such as population pressure and/or intensification—influenced strategic shifts in the past?*
6. *What are the long-term effects of a given strategy (or perhaps suite of strategies)?*
7. *In an evolutionary sense, can some strategies be said to have a longer survival potential than others?*
8. *What is the feedback relationship between a given strategy and the environmental setting in which that strategy is played out?*

Questions like these proliferate once the emphasis is taken off the specifics of the archaeological record and placed on the strategies implied by that record.

Before directly confronting the archaeological record of Monitor Valley, it is necessary to take one more step: to define the operational visibility of each strategy in terms of specific environmental mosaics. *How, for instance, does one detect a residentially mobile strategy in the Monitor Valley high country? Is it possible, in a place like Monitor Valley, to tell the difference between the plant procurement locations of foragers and those of collectors? To what degree will these strategic sets appear distinct, when applied to the protohistoric Monitor Valley landscape?*

CHARACTERIZING THE PROTOHISTORIC MONITOR VALLEY LANDSCAPE

All habitats can be characterized by examining the abundance and distribution of key resources important to the well-being of the organisms participating in that ecosystem. Now it is necessary to isolate these critical ecological parameters in the protohistoric Monitor Valley landscape. The term landscape is used to denote the geomorphology, geology, soils, floristic and faunal zonation, as well as both the micro- and macro-climatology (Rowe, 1969; Winterhalder, 1980, p. 153). Of particular concern is the way in which key features of this landscape combine to create a unique mosaic replete with both resources and hazards for those who would make a living there.

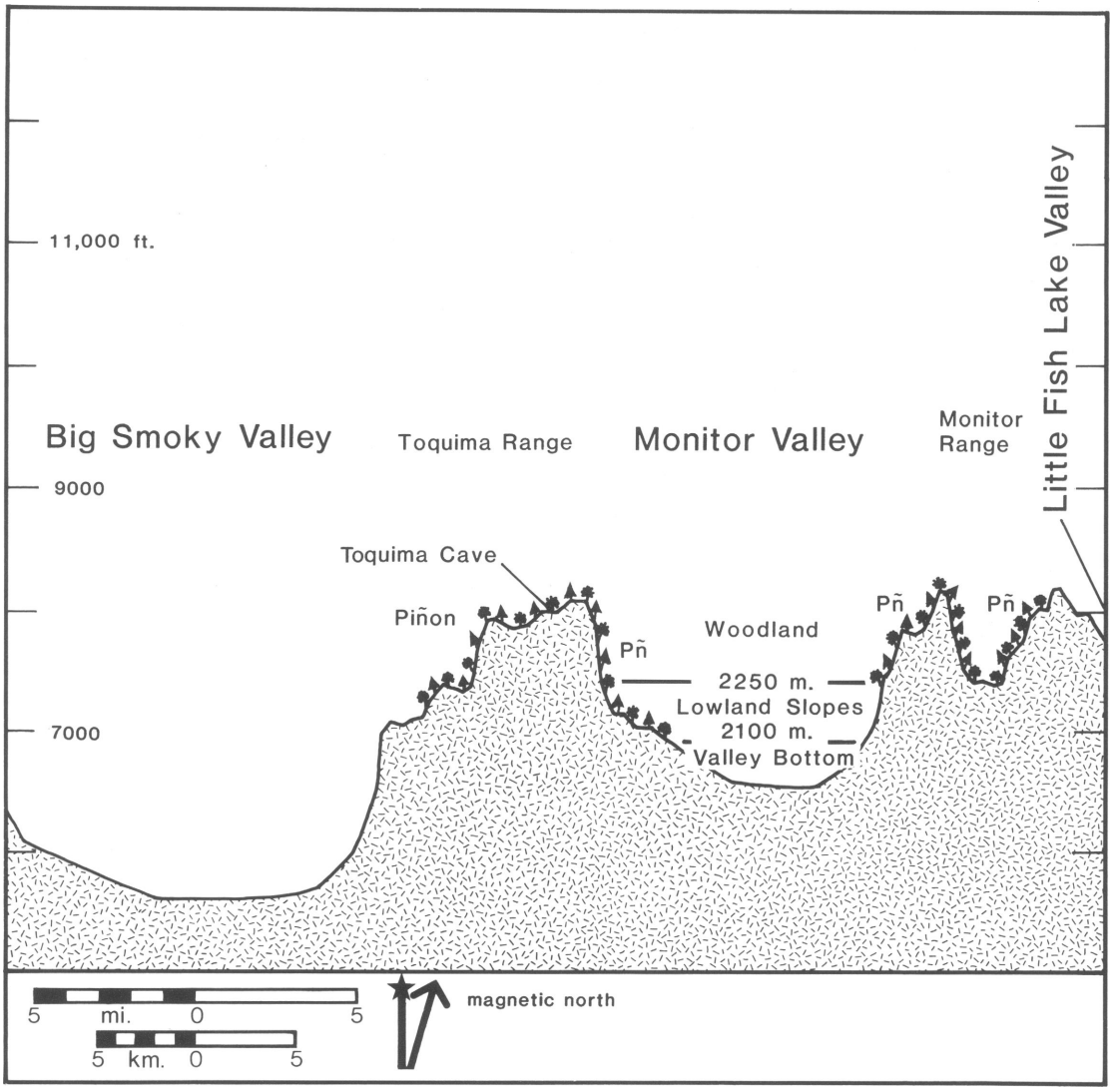

FIG. 35. Detailed cross-section through the northern end of Monitor Valley; vertical scale exaggerated. The arbitrary vertical zones have been added to the Monitor Valley portion.

Concern at present is strictly with the protohistoric period of Monitor Valley. It is possible to establish the landscape for this period, within definable limits. Thompson (chap. 6) has considered briefly how Monitor Valley vegetation changed during the historic period, emphasizing the extensive timbering of the limber pine and piñon-juniper woodlands and the overgrazing of the alluvial bottomland.

One must not make light of the floristic change that has occurred in this area over the past two centuries; but it is also a mistake to assume that the modern vegetational distribution is wholly unrepresentative of the protohistoric biogeography. More serious problems are encountered as one moves back into prehistoric time but that is not the concern at present.

Whether dealing with the protohistoric or the prehistoric period, it is better to partition landscape by absolute elevational zones than by reconstructed biotic communities. The

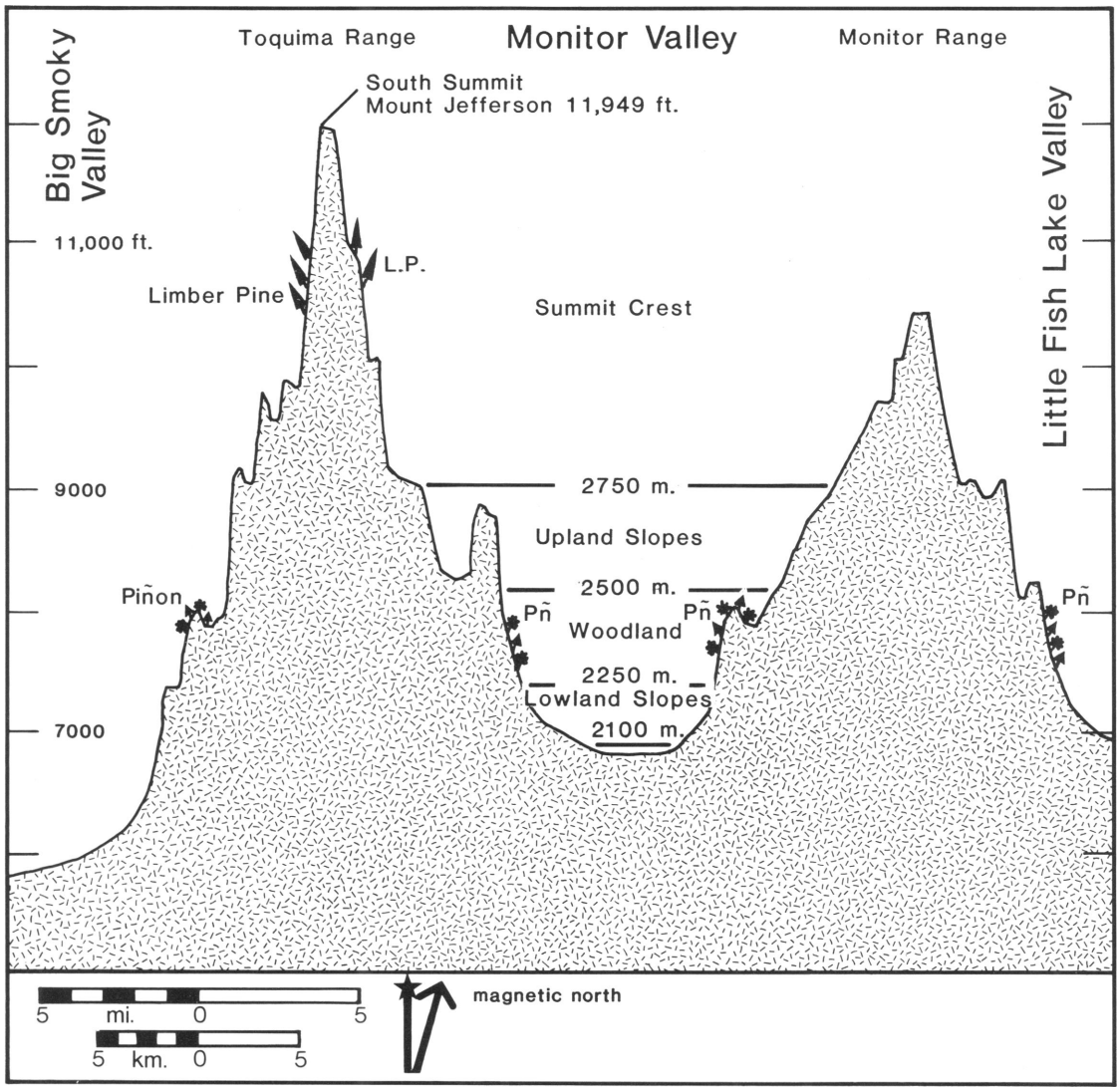

FIG. 36. Detailed cross-section through the southern end of Monitor Valley; vertical scale exaggerated. The arbitrary vertical zones have been added to the Monitor Valley portion.

archaeological and ethnographic records of the Reese River Valley, for instance, were structured by modern vegetational types (Thomas, 1969b, 1971a, 1973; Thomas and Bettinger, 1976). Although extant vegetation patterning can sometimes function as a rough indicator of the prehistoric habitat, there were some obvious discrepancies where vegetational changes had occurred. The only stratification in the Monitor Valley study is by absolute elevation; vegetational correlates are thus inferential rather than *a priori*. Objectivity and repeatability alone would recommend such a procedure.

The protohistoric Monitor Valley landscape is operationally partitioned into five elevational zones[1] (figs. 35, 36):

The Summit Crest is defined as the landscape higher than 2750 m. (9025 ft.). Modern ground cover in this high country ranges from relatively barren sagebrush-covered slopes, to a sedge and grass-dominated tundra zone

at the highest elevations. Dense stands of limber pine create distinctive forested patches throughout the southern Toquima Range.

The Upland Slope is defined as the landscape contained between 2500 m. (8200 ft.) and 2750 m. (9020 ft.). This upland community is dominated by a sagebrush-grass community, the lower margin including mountain mahogany as overstory.

The Woodland is defined as the Monitor Valley landscape contained between 2250 m. (7400 ft.) and 2500 m. (8200 ft.). This arbitrarily designated zone includes the major mountainside forest community, primarily piñon and juniper overstory, with interspersed riparian associations in the well-watered microenvironments. The understory varies, depending heavily on elevation, slope, and degree of overstory cover.

The Lowland Slope is defined as the Monitor Valley landscape contained between 2100 m. (6900 ft.) and 2250 m. (7400 ft.). This intermediate zone consists generally of the higher alluvial flats and low foothills of Toquima and Monitor ranges. The lowland slope is dominated by sagebrush-grass associations, although juniper trees occasionally finger into the upper margins of the lowland slopes. In this case, the floor of Monitor Valley is a full 460 m. (1500 ft.) above the floor of Big Smoky Valley; once again, this major elevational difference, within less than a 30 km. horizontal distance, has major significance for the seasonality of both prey and predator.

Figure 34 is notable because it passes through Monitor Lake, a rather unusual hydrological feature (see chap. 6). Taken together, figures 33 and 34 suggest how Monitor Valley articulates within the regional framework.

Figure 35 is a detail of figure 33, the northern Monitor Valley cross-section, showing the five artificially defined elevational zones superimposed. In this area neither the Toquima nor the Monitor ranges extend over 2500 m. (8200 ft.), reflecting an important topographic factor in the economic geography of Monitor Valley. Not only does this topography have hydrological ramifications, but the piñon-juniper community blankets the crests of the low mountain ranges from side to side. There is no upper sagebrush-grass zone here and the alpine communities are absent. The figure 35 cross-section passes directly through Petes Summit, the major access route to central Monitor Valley from the west, and an important game migration route in both historic and prehistoric times (chap. 7).

The Valley Bottom is defined as the Monitor Valley landscape below 2100 m. (6900 ft.). This bottomland is dominated by a shadscale association near Monitor Lake, and the sagebrush-grass association which blankets the higher portions of the valley bottom.

The character of these five elevational zones is apparent in a series of cross-sections through Monitor Valley (figs. 33–36). The first two cross-sections serve to place Monitor Valley in a regional context. Figure 33 cuts through the northern portion of Monitor Valley demonstrating the relationship of Monitor Valley to Big Smoky Valley, Reese River Valley, and Smith Creek Valley in the west, and Antelope Valley directly to the east.

The specifics of this cross-section are dealt with in subsequent chapters. But the most important aspect is the relatively high elevation of the Monitor Valley floor, particularly to the west. Monitor Valley is a full 300 m. (1000 ft.) higher than the valley floor of Big Smoky Valley. This is a major factor conditioning the seasonality of migratory game animals, and also the human foragers and collectors who hunted them.

Figure 34 is a second large scale cross-section taken through the summit of Mt. Jefferson 20 km. to the south. A rather different topographic and hydrologic structure pertains in the southern portion of Monitor Valley since the mountains are much steeper and considerably higher.

Figure 36 is a cross-section taken 45 km. south of figure 35, through Mt. Jefferson, the highest point in the Toquima Range (3642 m. [11,949 ft.]). The elevational difference between the Mt. Jefferson portion of the Monitor Valley and Big Smoky Valley to the west is even more extreme. Nearly 1980 m. (6500 ft.) of vertical elevation is compressed into a horizontal distance of only 15 km. The vegetational zonation in the southern portion of Monitor Valley is more marked, and more diverse than to the north, and both the upland slopes and summit crest plant com-

munities are well represented here. The five arbitrary vegetation zones to be used in the archaeological analysis are also superimposed on figure 36. There are obvious topographic, hydrological, and biogeographic correlates to each. These correlates can be relatively well established for the protohistoric period but require more extensive analysis and documentation for the prehistoric period.

NOTE

[1] These and subsequent descriptions of plant communities follow Billings (1951) and Cronquist et al. (1972, pp. 134–140); Thompson and Kautz (chap. 6) discuss specific plant associations in Monitor Valley.

CHAPTER 9. ANTICIPATING THE ARCHAEOLOGICAL RECORD OF THE HIGH COUNTRY

Great Basin human ecology is commonly analyzed in terms of models derived from desert ecology (e.g., Yellen, 1977). Desert environments are basically "water-controlled" ecosystems (Noy-Meir, 1973), and the flow of energy from the sun is so mediated by water availability in such ecosystems that traditional energy flow models in ecology can be replaced by a simpler water-flow model.

When applied to human ecology, this desert model focuses on availability of surface water as the key limiting factor. Too often, the protohistoric and prehistoric Great Basin has been viewed through this model of desert ecology, but the fact is that water is not the major limiting factor in large parts of the Great Basin (Thomas, 1972a, 1981b; chap. 4, this volume). Although always important, water is merely one factor conditioning mobility strategies of Great Basin people. There is no direct or significant correlation between ethnographic Great Basin population density and patterns of local precipitation (Thomas, 1972a, pp. 139–143).

This distinction alone should underscore the danger of the one-to-one uncritical analogy between the Great Basin and the Australian desert (e.g., Birdsell, 1953, 1968), the Kalahari (e.g., Lee, 1969, 1976; Yellen, 1976), or any other water-controlled ecosystem. Properly considered, the Great Basin is a steppe environment exhibiting characteristics of both semiarid desert and mountain ecosystems (Thornthwaite, 1948; Billings, 1951, p. 102). Recognizing this, Cronquist et al. (1972, p. 77) consider the Great Basin to be the major biogeographic component in the Intermountain Region of the American West:

> Even though the Intermountain Region lies wholly within the arid and semiarid parts of the United States, the many mountain ranges contain habitats humid enough to support woodland and forest vegetation. The flora, therefore, shows a great deal of diversity, ranging from alpine to subtropic, and from desert to humid .... Although the Intermountain Region is mountainous, its mountains are discontinuous and surrounded by desert.

Emphasizing the intermountain character of Great Basin ecosystems breaks away from the confining stereotype of simple desert ecology. The nature of protohistoric and prehistoric man–land relationships in the Great Basin is best viewed from a mountain, as well as from a desert perspective (e.g., Went, 1948; McGinnies et al., 1968; Noy-Meir, 1973). The mountain perspective is clearly more relevant when considering the ecology of the Monitor Valley upland slope.

THE MOUNTAIN ECOSYSTEM

The study of mountain ecology is still in its infancy, and much of the available literature on high altitude human ecology relates only to pastoral and/or agricultural adaptations (Brush, 1976, p. 125). Nevertheless, there are some principles which have relevance to the high altitude hunter-gatherer adaptations.

High mountain ecosystems are characterized by extremes of altitude and a steep environmental gradient, as well as great diurnal temperature extremes, steep and easily eroded slopes, and twin environmental stress factors of hypoxia and hypothermia. Human populations perennially living at high elevation develop a number of adaptive physiological responses (Baker, 1969): generally high rates of birth and death, maximum oxygen consumption (and thus high capacity for sustained work at reduced atmospheric pressure) and a higher rate of blood flow to the extremities during times of extreme cold. Incidentally, cardiovascular disease seems to be almost absent among high altitude populations (Baker, 1969).

Such genetic and physiological adaptations are less pronounced among transhumant groups who cope with similar stresses but only on a seasonal basis. The minimal biological means for adaptation requires that hunter-gatherers must adopt cultural methods of coping with hypoxia and hypothermia. The specifics of high-altitude adaptations result from several related factors (Rhoades

and Thompson, 1975; Brush, 1976): increased heat radiation creates lower temperatures and a wide diurnal temperature range; evaporation and insolation increase; exposure to wind increases, but differs radically on windward and leeward slopes; orographically influenced rainfall patterns exist with leeward slopes and upland valleys generally receiving less moisture than windward slopes and high valley areas. These conditions conspire to create changing climatic conditions that closely correlate with elevation, resulting in the dramatic vegetation zonation.

Considering the nature of mountain geography, Peattie (1936, p. 79) once remarked: "One of the most attractive concepts in the study of mountains is the conception of zones. Travellers among mountains delight in telling how their climb began amidst a splendor of tropical vegetation. Then in succession they went from the evergreen broad-leafed zone to that of the deciduous trees, to the evergreen conifers, to an arctic heath, and so to eternal snow. The rapid contrasts of vegetation within so small a space challenge the imagination." Mountain ecosystems are characterized by closely juxtaposed vertical seriation of vegetational communities, largely controlled by altitudinal, edaphic, and climatic vectors (Rhoades and Thompson, 1975, p. 543). Depending on latitude and altitude, mountain areas potentially share a succession of climatic zones: (a) warm valleys with attendant moisture depending on prevailing rain-bearing winds; (b) relatively temperate intermediate valley areas; (c) cool high valley areas; and (d) arctic high valleys, commonly hosting permanent snow and glaciers (Brush, 1976, p. 126).

Vegetational zones often correspond to these changing elevations, but the difficulty in defining floristic zones precisely diminishes the utility of a zonation concept based solely on biogeography (Peattie, 1936; Ellison, 1949). Further, the precise relationship between vegetational zones and areas of human adaptation is even more complex to define (Brush, 1976, p. 127). Rhoades and Thompson (1975) suggest that all mountain ecosystems can be characterized by extreme vertical biotic zonation, irregular local biogeography, and unusual geological features, especially slope, elevation, and ruggedness of terrain. Any successful human adaptive strategy must cope with these mountain universals.

Ecology of the Monitor Valley High Country

The highest point in the Toquima Range is 3642 m. (11,949 ft.). The mountain chain is about 125 km. long, much less distinct as a horst than the more commonly visited Toiyabe Range to the west. An Ordovician to Devonian sequence of carbonate and silicious rocks makes up the core of the Toquimas, partly covered by a Tertiary volcanic sequence of andesite and tuff (see chap. 6).

The central portion of the Toquima Range is dominated by an 8 by 1.6 km. flat plateau, most of which rises above 3350 m. (11,000 ft.). At least a dozen cirques contain forest associations in their central portions, and springy areas are common through the upper limit of the forested area. A clear-cut timber line occurs at about 3100 m. (10,000 ft.) with krummholz at the upper limit. The landform appears to be an old erosion surface elevated by faulting. The area has undergone paraglaciation and glaciation (Piegat, 1979), apparent in the cirques and arêtes circumventing the entire area. Although the basin and range macroclimate is characterized as arid, the U.S. Forest Service describes the climate in the uplands of the Toquima and Monitor ranges as "humid" (1969, p. 7); the annual precipitation in the Mt. Jefferson area is estimated to be 640 $\pm$ 10 mm. per year.

Surface temperature is considerably cooler in the high country than the valley bottom. The mean annual temperature in the Mt. Jefferson area has been estimated to be about 0° $\pm$ 2°C. (U.S. Forest Service, 1969). The winters are severe and snow covers the mountains during most of the season: snowfall can occur in any month of the year.

The Monitor Range flanks the eastern margin of Monitor Valley, reaching a maximum elevation of 3312 m. at Table Mountain, almost due east of Mt. Jefferson (see fig. 36). The Monitor Range extends approximately 150 km., slightly longer than the Toquima Range. The geology of this area is poorly

FIG. 37. The high country of the Toquima Range, on the western side of Monitor Valley. Photograph is taken looking southeast, across the Mount Jefferson tableland; elevation of the peak in the center of the photograph is approximately 3418 m. (11,215 ft.).

studied, due in part to the difficulty of access and the lack of permanent roads on the eastern side of Monitor Valley.

The Monitor Range is considerably more homogeneous geologically than the Toquima Range to the west, consisting of widespread Tertiary volcanics, mostly silicic tuff, rhyolite, and andesite. The Monitors also contain minimal amounts of mostly tuffaceous sedimentary rocks. Precambrian and Paleozoic deposits occur sporadically, mostly on the eastern slope facing Little Fish Lake and Antelope valleys (Stewart and Carlson, 1977).

Springs abound throughout the Monitor Valley high country. At least eight springs flow in the Mt. Jefferson area alone, and literally dozens of others are to be found throughout the uplands of the Toquima and Monitor ranges.

Because of local geological conditions, these springs tend to disappear not far from where they bubble to the surface. The overall level of surface water runoff is very low (chap. 6). At Mt. Jefferson the mean annual runoff in the upper canyons is about 13 cm., diminishing to less than 3 cm. by the time the water reaches the mouth of the canyon. Despite the number of intermittent streams flowing out of both ranges, surface water reaches the valley floor for only a few days or a couple of weeks each year. The Toquima Range forms a regional watershed, with the limited runoff occurring primarily as spring snowmelt, summer storms, and flash floods.

This means that water in the high country of Monitor Valley is almost entirely restricted to point sources, an important factor in the human ecology of the area. But there are exceptions. Bogs occur occasionally in both ranges, and there is an area—known locally as "the dry lake"—that supports an ephemeral playa at an elevation of nearly 3000 m. in the Monitor Range. Similarly, in the Mt. Jefferson area there is a vast marshy place at an elevation of 3400 m., and a small perennial lake often called "Pine Lake," with an average depth of 23 cm., covers about .4 hectares. A local rancher, who has visited Pine Lake every year since 1949, states that he has never seen this glacial tarn dry (Frantz, 1969).

FIG. 38. The high country of the Monitor Range. Photograph is taken looking to the south from Table Mountain.

This small highland lake is unique in the Monitor Valley high country.

Despite the relatively abundant water, the Monitor Valley summit crest is generally barren, harsh and extreme, and few visitors travel to these heights. In a report evaluating the economic potential of the Monitor Valley high country, the U.S. Forest Service (1969) concluded that "Mount Jefferson offers recreation only to the most hearty individual. Its remoteness, lack of roads and trails, and unfavorable climate eliminates most recreation activities." The same source describes modern access to the Toquima highlands as "almost non existent."

But this isolation may change before long. John Muir once covered this country when he worked for the United States Coast and Geodetic Survey in 1878 (McLane, 1978, p. 42) and the area is beginning to lure a new generation of campers and backpackers. A recent publication by the Sierra Club (Hart, 1981, p. 145) suggests that Big Smoky Valley, between the Toquimas and the Toiyabes, "is considered the most impressive fault-block valley in the Great Basin": Monitor Valley is surrounded by "wild ridges," and Table Mountain is a "huge green mesa . . . most astonishing are the views southeast. On most days, you can see clear to California's White Mountains and often pick up the outline of the Sierra Nevada behind them—over 100 miles away" (Hart, 1981, pp. 145, 155–156).

Traditionally, the Monitor Valley high country has been used as ranch land, and was once heavily overgrazed. Between 1908 and 1929, the number of cattle on Mt. Jefferson alone varied between 1250 and 1800 head; there was also a massive herd of sheep, 1500 to 4000 head, 50 to 100 horses, plus an undetermined number of mustangs (Hanks, 1969). This stock drifted into the high country early in the spring, staying until the snow pushed them out in the fall. The United States Forest

Service estimates that during this period, the highest portions of the Toquima Range were grazed by sheep between about August 1 and September 30.

More strict grazing controls were established in 1929. As of about 1970, only 30 to 50 head of cattle graze in this area, for a period of about two and a half months each year (Hanks, 1969, p. 40).

The impact of grazing is obvious from the character of the low shrub vegetation in the high country today. But even before the introduction of sheep—which John Muir (1894) derisively termed "hoofed locusts"—the Toquima and Monitor ranges had been severely impacted by lumbering activities (chap. 7, this volume) largely in response to the swelling population in Belmont. The lower stands of piñon and juniper woodland were lumbered first, as fuel for silver stamp mills, for mine shoring, and for fence posts. Sawmills were soon established throughout the Toquima Range (Stetefeldt, 1866; Thomas, 1982a). A portable sawmill was established in 1871 on Mt. Jefferson, at approximately 3109 m. (10,200 ft.), and a wagon road was constructed to transport the logs for sale in Belmont. Operating for about five years, this sawmill devastated the local limber pine community. Evidence of both the sawmill and its environmental impact, in the form of innumerable massive stumps of limber pine, are obvious in the high country today.

The summit crest proved a mixed blessing to the earliest Euro-American explorers who preceded the miners and ranchers. Although water is never abundant in the central Great Basin, oases are created here and there by high country topography. Passing through the Monitor Valley area in June 1827, Jedediah Smith complained that: "the general Character and appearance of the country I have passed is extremely Barren. High Rocky hills afford the only relief to the desolate waste .... But for these snowy Peaks the country would be utterly impassible [*sic*] as they furnish almost the only grass or water of this inhospitable land. They are to this plain like the islands of the Ocean" (in Brooks, 1977, pp. 178, 184).

Smith and his small party bisected Monitor Valley passing close enough to the vertical ranges to avail themselves of the grass and water available during the arid mid-summer, but they avoided the high country itself by following the well-defined canyon systems near present-day Manhattan, Belmont, and McCann Canyon. Smith kept his party below 2400 m. while in Monitor Valley (fig. 26).

Similarly, when Frémont moved through the area two decades later, he skirted the northern end of Monitor Valley, never traveling higher than about 1920 m., as he passed to the south in Big Smoky Valley. Captain Simpson essentially followed Frémont's route across the northern Monitor Valley in 1859 (see fig. 27). The extreme topographic relief of Monitor Valley was thus both a resource and a hazard to the early Euro-American explorer.

But to the endemic game animals, this verticality provided a way of life for millennia. Wintering in the lowlands and summering in the high country, the bighorn sheep of protohistoric Monitor Valley exploited two very different ecosystems. Their migration routes between those two worlds were circumscribed, as traditional as winter and summer range, as predictable as the first winter snowfall (chap. 4).

Monitor Valley in a sense is an isolate, connected east and west by only a few mountain passes (figs. 33–36): Hickison Summit, Petes Summit, Clipper Gap, Ikes Canyon, Mill Canyon, Northumberland Canyon, Moores Creek, Meadow Canyon, Manhattan Canyon. Unlike the endless, seemingly undifferentiated plain—what Jedediah Smith condemned as "desolate waste"—the Monitor Valley high country topography is structured by geological history. The few passable canyons funnel both the two-legged and the four-legged into undeniable, incontrovertible modes of movement. In chapter 4 we emphasized the importance of the traditional migration routes through the Toquima, and to a lesser extent, the Monitor ranges. Although the vegetation zones have evolved and fluctuated through the millennia, the topography is intractable.

A final consequence of Monitor Valley verticality is the seasonality it imposes. Desert flowers begin to appear in the lowlands by April. In May and early June, they blossom on the slopes. The canyons begin to bloom in June and "from then on, it is simply a

matter of following spring up the mountainsides" (DeDecker, 1969, p. 132).

Spring comes late to the high country, in late June or so; it is summer only in July, and fall has arrived by August. By September, one must retreat to lesser altitudes or be willing to brave the icy blasts of winter. By November, such retreat may be often impossible, because routes of access to the canyon-bottom are commonly clogged with snow. The seasonality of the summit crest is compressed, rapid, marked, and unforgiving. In the idiom of this volume, the high country of Monitor Valley manifests extreme *temporal incongruity* in this area. Plants and animals are available only for the shortest of times, and then they are gone.

But the high country offers predictability and stability to those who plan ahead. Where else can one camp for two months and experience the full range of spring through fall resources *in that one spot*? The high country provided a magnificent short-term window to those willing to front the transportation and logistic costs.

SPECIFIC ARCHAEOLOGICAL EXPECTATIONS

People lived in the Monitor Valley high country long before the shepherd, the rancher, the backpacker, the lumberman, the topographic surveyor, and the fur trapper arrived. But how many people lived there, and what they did for a living is today unknown. Although the ethnographic and ethnohistoric literature provides a few vague hints about the aboriginal exploitation of the summit crest there is little direct evidence for exploitation of the high country anywhere in the Great Basin; there are no data available on high altitude human ecology in the prehistoric central Great Basin.

And yet the record of human presence is out there in this stark region, daring one to discover the clues and read their significance. The challenge for the archaeologist is to use the available empirical and mid-range theoretical information to anticipate, then locate the physical remains of those activities wherever they might exist. The anticipation is set out in the remaining chapters of this volume; the finds are described in subsequent volumes dealing with the archaeology of Monitor Valley.

Simply stated, what is the biogeographic potential for the Monitor Valley high country? The summit crest unquestionably provided first-rate summer range for bighorn sheep during the protohistoric period and mule deer living there now. These game animals live at such heights only during the summer months. Similarly, high altitude plant communities provide potential food—nuts of the limber pine, seeds of summer-ripening grasses and sedges, fruits of *Opuntia* and *Ribes*—but their availability is restricted to the summer months.

It is difficult to escape the conclusion that for human beings the potential of the summit crest is confined to the period between late spring and early fall. Theoretically it is possible to overwinter in the heights of the Toquima and Monitor ranges, particularly during mild winters; but one must still be willing to negotiate a snowpack that can virtually cut off access between the high country and the lowlands from November through April. Overwintering is extremely difficult to detect archaeologically, since no winter-diagnostic plants or animals exist. At best, one could perhaps hope to identify ecofacts diagnostic of the early spring period (assuming that an early spring occupation could only result from an overwintering strategy). But the overwintering hypothesis, it seems to me, is a remote possibility.

The historic, ethnographic, and even archaeological literature is unfortunately silent about the nature of an aboriginal high country adaptation. Julian Steward provides a hint of what could be expected. Citing a report from a professor at California Institute of Technology, Steward (1941) tells of apparent house remains high in the White Mountains (to the east of Owens Valley), at an elevation between about 2900 m. and 4000 m. Steward was puzzled at this: "it is difficult to see why houses were so often built above the piñon zone, in places which must have been intensely cold in the winter. It may be that summer seeds in this high, well-watered zone induced them to live in the mountains also in other seasons. It is also possible that these were occupied by hunters pursuing mountain sheep" (1941, pp. 334–335). In the modern

idiom, Steward was proposing that the high elevation of the White Mountains could have been exploited by two alternate strategies: residential or logistic mobility. Summer-ripening seeds would seem to be the key factor to a residential strategy; a logistic strategy would have established task-specific field camps occupied by all-male hunting parties.

High Country Base Camps

One or both options may have been pursued in the Monitor Valley high country. Suppose, for instance, that this area had been occupied by a residentially mobile group like the Kawich Mountain Shoshone. The archaeological record produced would contain both residential bases and procurement locations. Temporary resource caches might have been constructed occasionally for high-bulk resources, and tool caches built in areas of seasonally specialized resources.

Foragers must live in high country base camps for a mapping-on strategy to work; the difficulty of access effectively places the entire summit crest out of the foraging radius of base camps located anywhere in the lower zones.

The high altitude base camp is relatively visible archaeologically. These base camps, if present, will evidence the standard base camp diagnostics (discussed in chap. 5). But, in addition, the houses must be relatively well constructed, perhaps resembling those common to more northerly latitudes. To provide protection from wind chill, they may be built on the leeward slopes, away from prevailing winds. This factor can be critical, perhaps outweighing conventional concerns of fuel, food, and water—resources that can be transported, if necessary. But in the extremely high elevation areas, shelter is where you find it.

High altitude base camps, should be spatially restricted to those few microenvironments providing adequate resources for life-space. Thus the summer camp will be reoccupied more frequently, perhaps showing signs of greater labor investment than would be common in lowland forager base camps. Even a foraging society, for instance, may build a number of different house types at the high altitude sites because these few locations would commonly be reoccupied.

Because of the overriding importance of shelter, the high altitude summer residential base may superficially resemble the more permanent lowland winter camp. Such camps will differ little between foraging and collecting societies, since the resource constraints are nearly identical for both procurement strategies.

Fire must be used somewhat differently in the high country. In the Nuñoa area of the Andes, for instances, bonfires are avoided because of the wind problems and because limited fire is better expended indoors (Baker, 1969, p. 1153). If planned incorrectly, a bonfire could quickly incinerate an entire village. High altitude sites should have distinct evidence of hearths located inside the houses; the hearths should also more closely resemble those of winter villages than the outdoor cooking areas commonly associated with summer lowland camps.

The high country is so inaccessible, and the transport costs between the valley floor and the upland settlements are so great that *ad hoc* caches were probably established in residential bases and elsewhere. Such caches would not necessarily involve physical features (although they might). The primary function of the *ad hoc* tool cache is simply to leave items where they were used last, in anticipation of some future use. In the high country of Monitor Valley, I have cached freeze-dried food and some specialized tools necessary for my work at such elevations, as well as non-essential boredom reducers—a folding chair, playing cards, a couple of paperback books, a little brandy, and some dog food. Such caches reflect reduction of transport costs as well as an anticipation of returning.

Similar caches may have been constructed during protohistoric times. One does not transport grinding stones to the valley floor from a high country residence; they would be left in place, provided that raw materials were available. Milling stones made of local stone may be relatively unworn, since they could be easily replaced.

But transporting raw materials such as milling stones to high country is expensive and these items would probably be heavily reused. The same is true for chipped tools: if adequate raw materials were available in the

area, tools could be commonly refashioned as the need arose. But when local raw materials were limited, usable artifacts may have been left as caches (perhaps merely on the house floors so that they could be retrieved the following season, or even 10 seasons hence). There should also be a high degree of reuse and multipurpose wear on artifacts cached in this way. It is even possible that exotic materials may be more common in the high country. Exotic materials tend to be highly desirable, and if desirable equates to reliable, then this is precisely the kind of implement needed in the high country. One need look no further than the contemporary cowboy, forest ranger, or occasional archaeologist, to recognize that some of the most expensive implements—down vests and sheepskin jackets, ripstop tents, vibram boots, gore-tex raingear—are necessary to work in the high country. The distances are too far, and the consequences too unpleasant to bring anything less than the best gear into extreme environments such as this. A parallel to the protohistoric archaeological record is clear.

Because occupation is limited to the summer, the seasonal game cache was probably ineffective: meat would have to be carefully dried beforehand, and the foraging radius at such elevations is restricted. Caches may, however, have been employed for storage of summer-ripening seeds, as well as berries, roots, rodents, and lagomorphs that could have been procured locally. But such food caches, important for a month or two, were probably not of long-term significance because of the seasonal imperative always operative in the high country.

To summarize, there is little reason to suspect that the high country offered great residential potential during the protohistoric period. Steward (1941) has provided hints of such a pattern in the heights of the White Mountains, and some archaeologists have proposed limited residential activities for sites in the Rocky Mountain and Colorado Plateau areas (Benedict and Olson, 1978; Benedict, 1981; Gooding, 1981). But at present, there are no satisfactory explanations as to why people would establish base camps in the heights, and pay such high transport costs for such seemingly limited gains (see Simms, 1979 for an informative exception).

If present, a residentially mobile strategy would also produce a number of procurement locations within the foraging radius of such base camps.

High Country Procurement Strategies

There is much evidence to support logistic use of the summit crest. Game procurement was restricted primarily to low-density hunting of bighorn and perhaps the occasional deer ambush.

The Toquima Range provided prime bighorn territory—the species surviving there until at least the turn of the century, and perhaps much later (Glade Quilter and Robert McQuivey, personal commun.; see also Hall, 1946, pp. 638–642). As discussed in chapter 4, a primary factor limiting the distribution of bighorn is the availability of adequate escape cover, particularly precipitous terrain; the relative scarcity of such rugged landscape in central Nevada may have been the major factor controlling their population density and distribution, perhaps overshadowing seasonal migration patterns. In considering the possibilities for prehistoric bighorn procurement in the Monitor Valley area, McQuivey (personal commun.) has offered the following observation:

> I would suspect that early tribes would naturally be able to concentrate their efforts for bighorn in those areas where precipitous terrain is present, whether it be on the summer or winter range or on the intermediate range. Based on the habitat requirements for the species, I would suspect that portions of Mount Jefferson and Wildcat Peak [in the Toquima Range] were the stronghold for the population with little if any use in areas like Stoneberger Basin and Shoshone Mountain. While Mill and Ike's Canyons provide marginally adequate habitat characteristics for use by sheep, areas such as lower Pine and Meadow Canyons were probably used very little if at all. The importance of terrain as a necessary habitat feature is often overlooked by researchers even though it is a critical requirement of the species.

Moreover, whatever patterned migration did occur almost certainly followed a few, well-defined and traditional migration routes.

Linsdale (1938, p. 199) has documented the importance of one such route between the

TABLE 6
Archaeological Expectations as a Consequence of Bighorn Procurement in Monitor Valley

Zone	Elevation (m.)	Activity	Features	Artifacts	
				Density	Distribution
Summit Crest	Over 2750	Low density intercept strategy hunting	Many low-cost hunting facilities	Relatively high	Clumped
Woodland & upland slopes	2250–2750	Fall–winter: Intercept hunting	A few high-cost hunting facilities	Relatively high	Clumped
Lowland slopes	2100–2250	Occasional encounter strategy hunting	Few	Moderate to low	Random
Valley bottom	Below 2100	Extremely rare encounter strategy hunting	None	Very low	Random

Big Smoky Valley and the Toiyabe Range to the West. A second important route has been documented going into the Monitor Valley area across the Simpson Park Range immediately to the north; in this case, contemporary deer herds winter in the relatively low Big Smoky Valley, and live in a summer range in the high country at the north end of Monitor Valley (described in Heizer and Baumhoff, 1962, p. 40).

Bighorn behavior is rather more complex than that of deer or antelope, and the archaeological expectations for bighorn procurement in the Monitor Valley area is summarized on table 6. In this chapter, we consider only the implications for the summit crest area; the lower landscapes are discussed in subsequent chapters.

The Monitor Valley summit crest should contain evidence of low-density intercept hunting above, say, about 3000 m.: archaeological features such as rock walls, rock blinds, rock cairns, and alignments in areas exhibiting either natural "change of pace" or natural "funneling" environments.

Deer occur throughout contemporary Monitor Valley, and relatively large numbers of them are common during the summer on Mt. Jefferson, up to an elevation of almost 3700 m. Most protohistoric deer hunting was probably conducted only in the summer on an encounter basis. If deer was a significant item in protohistoric Monitor Valley—an unlikely proposition—then the archaeological record will involve losses from both hunting and kill-butchering, scattered yet clustered from the lower slopes up to the summit crest. Although existing ambush and drive features may have assisted such encounter hunting, these facilities would probably have been constructed for hunting the more common bighorn, and only incidentally reused for deer.

In other words, deer hunting would be almost invisible archaeologically anywhere in protohistoric Monitor Valley (chap. 4). Artifacts and features are similar to those used for bighorn, and should be distributed in roughly similar fashion across the landscape. The key will be found in the faunal remains.

Antelope occur today in other parts of Monitor Valley, but they do not venture into the summit crest area.

Any logistic usage of the summit crest would almost certainly require that field camps be established nearby. High altitude field camps would have the standard all-male, limited habitation diagnostics expected for Great Basin field camps in general (chap. 5). In addition, a number of characteristics should distinguish summit crest field camps from residential bases in the high country: field camps should lack substantial houses, milling stones, female-specific fabrication items, domestic equipment and any evidence of child rearing. High altitude base camps were probably located on the leeward side of the summit crest; natural protection from wind and storm is even more critical in a field camp because the short-term occupation would rarely justify the cost of constructing substantial housing. Caves and rock-shelters,

if any, might be temporarily occupied by such groups. In contrast to the base camp, field camps will not necessarily be tethered to water supply, since the water sources are also the primary loci of game procurement: don't camp where you hunt.

To summarize, a residentially mobile procurement strategy will be manifest in the high country as both residential and foraging evidence, biased heavily toward summer-ripening seeds and ambush of artiodactyls in summer range. Although seed procurement is virtually invisible, milling equipment at base camps should indicate whether such activity had occurred locally. Large mammal procurement is highly visible in both surface features and artifacts, as well as from faunal elements in base camps. The base camp is also characterized by the presence of relatively high utility faunal elements.

It is much easier to envision a logistic use for the Monitor Valley high country. Such logistic exploitation was almost certainly centered about game procurement, since available summer crops in this area would not seem to justify transport to the lowland area. The archaeological visibility of game procurement features has been elaborated above: low-density intercept features, including blinds, walls, highly clumped artifact distributions, and artifact assemblages restricted to kill-butchering artifacts. Any field camps established during this time would presumably use primarily low-utility faunal elements, perhaps as a "snacking" food (in the sense of Binford, 1978a). High utility items were probably dried for transport to the residential base.

Summary of Archaeological Expectations for the High Country

Archaeological expectations for the summit crest are not complex. Residential bases are highly visible and although there is little reason to suggest their presence there, one cannot assume their absence. If the area had been used logistically, then this exploitative network should also be visible, in terms of facilities, artifact density, as well as the remains of field camps (and absence of base camps).

The following strategic probabilities can be assigned to the summit crest area of Monitor Valley:

Strategy I. High Residential Mobility: Not likely, based on the available ethnographic evidence; but mid-range theoretical considerations suggest the possibility for integrating yields from summer-ripening seeds and bighorn procurement into a single summer residential strategy in the high country.

Strategy II. Seasonal Fusion-Fission, Monitored from Within the Camp/Foraging Radii: Fusion camps in this area are improbable, but summer dispersal camps are a possibility; these camps would be identical to those resulting from the high mobility residential pattern (Strategy I).

Strategy III. Seasonal Fusion-Fission, Monitored from Within the Logistic Radius: Together with Strategy V, the most likely possibility; evidence from this activity would be highly visible because of the large number of game procurement facilities expected and the absence of residential camps.

Strategy IV. Minimal Residential Mobility, Monitored from Within the Camp/Foraging Radii: Virtually impossible; establishing nearly sedentary residential bases near the peaks of 3700 m. (12,000 ft.) mountains not only flies in the face of all cost/benefit considerations, but would almost seem to be in defiance of gravity.

Strategy V. Minimal Residential Mobility, Monitored from Within the Logistic Radius: Highly likely; the bighorn procurement localities produced by these activities would be identical with those of Strategy III.

CHAPTER 10. ANTICIPATING THE ARCHAEOLOGICAL RECORD OF THE PIÑON-JUNIPER WOODLAND

The *Monitor Valley woodland zone* is that portion of landscape contained between 2250 and 2500 m. This arbitrarily defined elevational zone is dominated by the piñon-juniper vegetational type, with interspersed riparian associations in the well-watered microenvironments. This chapter considers the ecological structure of the Monitor Valley piñon-juniper woodland, and establishes a series of archaeological expectations for this area during the protohistoric period.[1]

ECOLOGY OF THE PIÑON-JUNIPER WOODLAND

The elevation of the piñon-juniper woodland varies somewhat throughout the Great Basin, but it is usually between 1500 m. and 2100 m. The lower limit is determined by available moisture, the association generally occurring in areas where the annual precipitation is more than 305 mm. (12 in.) (Billings, 1951; Cronquist et al., 1972, p. 127). Although superficially rather uniform in appearance, the piñon-juniper woodland varies considerably with both elevation and geography. Juniper is found in pure stands at the lower elevational limits of the zone, commonly extending into the sagebrush-grass zone, particularly along the sides of ephemeral streams and draws. Piñon enters at slightly higher elevations, occurring in nearly pure stands near the top of the zone (Woodbury, 1947; Merkle, 1952; Woodin and Lindsey, 1954; Critchfield and Allenbaugh, 1969; Cronquist et al., 1972, pp. 127, 232; West et al., 1978; Madsen, n.d.)

The piñon-juniper zone of the central Great Basin comprises mixed stands of singleleaf piñon (*Pinus monophylla*), Utah juniper (*Juniperus osteosperma*), and Rocky Mountain juniper (*J. scopulorum*; see, chap. 6). Singleleaf piñon—the Nevada state tree—tends to grow on rocky slopes throughout the desert mountains, generally at elevations ranging between 1500 m. to 2100 m. although extreme ranges can be as high as 3000 m. and as low as 980 m. (Cronquist et al., 1972, p. 232; Beeson, 1974; Lanner, 1981).

The Utah juniper is the most common tree in the Great Basin, codominant with *P. monophylla* in the piñon-juniper woodland of the central Basin area. Utah juniper grows on alluvial fans and dry rocky hillsides between about 1370–2590 m. (Cronquist et al., 1972, p. 241). Rocky Mountain juniper is much less common in the central Great Basin, generally growing along streams, often on the northern slopes of canyons, between 150 m. to 1980 m.

The piñon-juniper woodland of Monitor Valley, is less "belt-like" than, for instance, that of the Reese River Valley (see below). Although a fairly discrete piñon-juniper belt today occurs in the southern portion of Monitor Valley (see for instance, fig. 36), the piñon-juniper woodland extends over the entire crest of both the Toquima and Monitor ranges in northern Monitor Valley (see fig. 35). Such variability is due largely to topographic and hydrological differences within Monitor Valley itself, and has a marked effect on the distribution of both flora and fauna.

Billings (1954) suggests that the distribution of the contemporary piñon-juniper zone correlates with *thermal belts* that moderate the local winter temperatures. If true, this phytogeographic structuring would mean that any residential bases located within the piñon-juniper belt would have warmer winter temperatures than those located either farther upslope or downslope. Additionally, Thompson (chap. 6) points out that the western side of Monitor Valley may also be slightly warmer during the winter, since storms moving from the west would tend to dispel winter inversion layers in this area.

Historic Period Changes in the Piñon-Juniper Woodland

Although the existence of junipers was well known at the time, John C. Frémont is credited with bringing the piñon pine to the attention of the scientific community (Cronquist et al., 1972, p. 47; Lanner, 1981, p. 107). Frémont saw his first pine nut in January 1844, as he attempted to traverse the Sierra

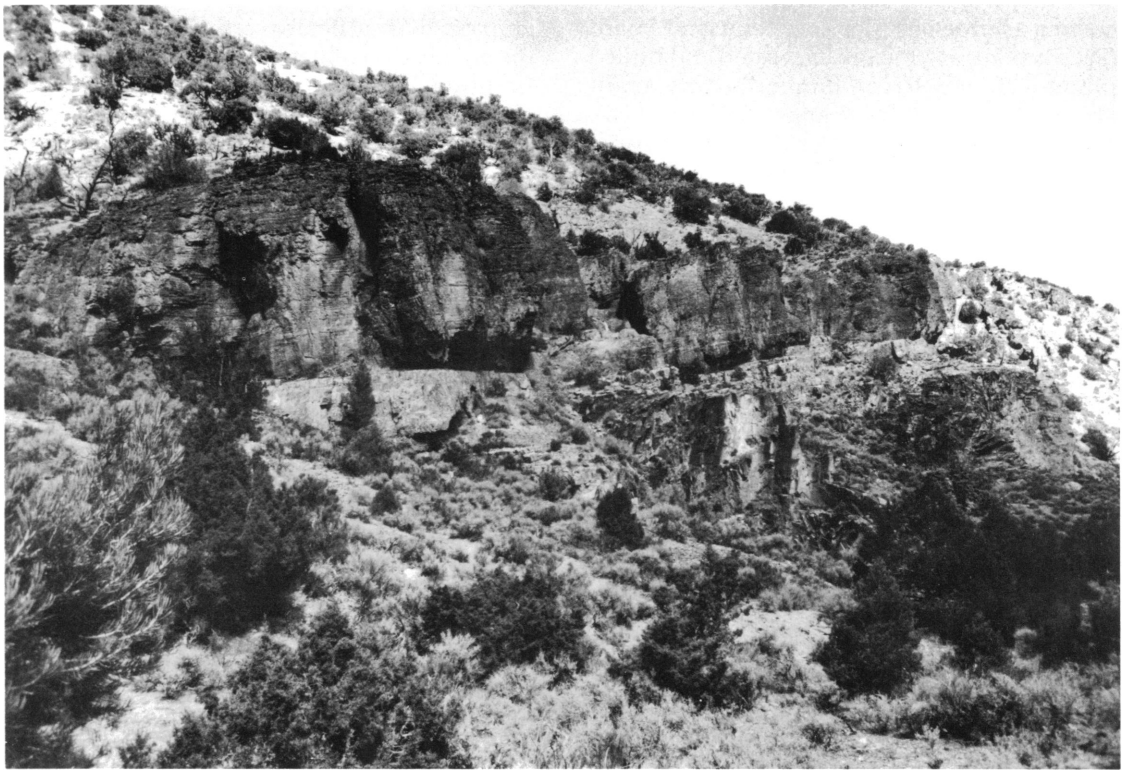

FIG. 39. The lower piñon-juniper woodland, looking northeast across the head of Mill Canyon, Toquima Range. The prominent chert and dolomite scarp is the Gatecliff Formation.

Nevada during the dead of winter; he purchased a small skin bag containing a few pounds of pine nuts from local Indians, noting that "when roasted, their pleasant flavor made them an agreeable addition to our now scanty store of provisions" (Frémont, 1845, quoted in Lanner, 1981, p. 95). From this time on, Frémont was "almost obsessed" with his new botanical discovery (Lanner, 1981, p. 107). After an extensive correspondence with John Torrey of Columbia University (the nation's leading botanist at the time), *Pinus monophylla* was formally named by Frémont in his journal (1845). In November of that same year, he skirted the northern periphery of Monitor Valley, but made no specific mention of the piñon-juniper zone encountered there.

Silver was discovered in Monitor Valley 20 years later, an event that was to have a drastic impact on the piñon-juniper woodland (Sargent, 1879; Thomas, 1971b, 1982a; Young and Budy, 1979). By May 1867, Monitor Valley was such a booming area that the Nye County seat was moved to Belmont, a traditional *fandango* area located in the piñon-juniper woodland at the southern end of Monitor Valley (see chap. 7). By 1869, Belmont had more than 1500 inhabitants.

This rapid growth drastically changed not only the demography of central Nevada, but the specific impact on the piñon-juniper woodland was staggering. As Lanner (1981, p. 117) aptly puts it, "The great Nevada silver boom ran on wood"; although piñon makes poor lumber because it is knotty and available in only short lengths, both piñon and juniper provided cheap construction materials, as well as fence posts, firewood, and fuel for the stamp mills. High quality lumber was imported at this time into the central Nevada area from the forests of the Sierra Nevada,

costing as much as $250 per thousand board feet. By contrast, locally harvested and milled piñon—"Reese River lumber"—was available for half that price (Lanner, 1981, p. 118). Young and Budy (1979) provide figures documenting the enormous quantities of piñon and juniper trees consumed for fencing, cooking, and construction throughout the rural mining country of nineteenth century Nevada (see also Howell, 1941; Reveal, 1944; Billings, 1951, p. 117; Thomas, 1971b).

Deforestation was commonplace even around minor settlements during the 1860s and 1870s (Sargent, 1879). The piñon slopes of Monitor Valley were undoubtedly quickly and severely affected by the white occupation of Belmont, the communities in Northumberland Canyon, and the ranchers scattered throughout the valley. Although we have no direct assessment of the impact in the Monitor area, comparative photographic studies published by Thomas (1971b), Lanner (1981) and Rogers (1982) document similar contemporary events in neighboring areas (see also Goodwin, 1966).

Wildfire, another direct consequence of the Nevada silver boom, also impacted the piñon-juniper woodland of Monitor Valley and elsewhere (Young, Evans, and Tueller, 1976). Although wildfire needlessly wasted valuable timber, it was an unavoidable consequence of white settlement.

There is little question that the piñon-juniper zone was decimated during the early Nevada silver boom, and the impact on the aboriginal inhabitants was disastrous. Elsewhere (Thomas, 1971b), I have described a positive feedback cycle which operated during this time near Austin, Nevada. As a direct result of mining and urban activities around Austin, the local piñon-juniper woodland quickly disappeared. The burgeoning appetites of these settlers also required large herds of cattle, which rapidly overgrazed the surrounding lowlands. Local Shoshone nucleated around settlements such as Austin and, as habitat destruction continued and the native foodstuffs became scarcer, this nucleation accelerated. Local Indians were increasingly employed as lumberjacks and ranch hands. Ironically, those forced into wage labor further destroyed the source of their traditional winter food, the pine nuts; Shoshone employed as cattle drovers aided and abetted the eradication of native grasses that had been traditional summer fare. The more these food sources were destroyed, the more the Shoshone came to depend on wage labor, thereby engaging in more lumbering and ranching for the white man, destroying the food resources even further. When the mines collapsed in the 1880s and 1890s, the piñon groves were gone and the valley grasslands were fenced for cattle grazing. The westward expansion of the United States had unwittingly trapped the Western Shoshone, through no fault of their own, in a positive feedback cycle from which there was no escape.

The mines and mills of Belmont flourished for only about two decades, and by the mid-1880s, depressed silver prices and increased mining costs had caused the Belmont mines to shut down; the Nye County seat was moved to Tonopah in 1905 (see chap. 7). Even with an occasional flurry in gold and silver mining in Monitor Valley since then, the major ecological pressure on the piñon-juniper woodland disappeared with the nineteenth-century silver boom.

Despite the devastation, the trees grew back but an interesting controversy has arisen about that reforestation. A number of investigators (e.g., Phillips, 1909; Emerson, 1932; Cottam and Stewart, 1940; Blackburn and Tueller, 1970; Tausch, West, and Nabi, 1981) suggest an extensive piñon-juniper *invasion* into the black sagebrush lowland communities. Juniper tends to invade the sagebrush flats first, followed eventually by piñon (Blackburn and Tueller, 1970, p. 841). An accelerated invasion by both species has occurred, throughout east-central Nevada, starting in the 1920s. Blackburn and Tueller (1970, p. 846) argue that several factors have conspired to produce the piñon-juniper downslope invasion: overgrazing, fire suppression, and microclimatic change (see also Beeson, 1974; Young, Evans, and Tueller, 1976).

Lanner (1977, 1981, pp. 131–140) questions the *invasion hypothesis,* suggesting that the "invasion" may be little more than reforestation of areas previously stripped for lumber, posts, firewood, etc. The historical evidence is clear that the piñon-juniper zone was devastated during the last half of the

nineteenth century, and the real question is whether we are seeing an *invasion* or merely successional reforestation.[2]

Specific Archaeological Expectations: Residential Potential

The piñon-juniper woodland holds great potential for residential usage, more so than any other landscape in protohistoric Monitor Valley. Simply stated, this zone most adequately satisfies the requirements of life-space for a non-agricultural group for many reasons (enumerated in no particular order):

1. *The piñon-juniper zone tends to have more moderate winter temperatures;* furthermore, this area is subjected to neither the high daily temperatures of the valley flats nor the diurnal temperature extremes of the high country.
2. *Summer lightning does not pose much of a problem in the woodlands;* lightning is, however, a major hazard in both the high country and on the valley flats.
3. *Water is relatively abundant in the woodlands;* water is severely deficient on the valley flats, and available in only patchy distribution in the summit crest area.
4. *The woodland contains an inexhaustible, year-round fuel supply;* a condition found neither in the high country nor the valley floor.
5. *The woodland usually contains snow-free areas, even during the winter;* although snowdrifts pile up in the piñon-juniper woodland during the winter, there are almost always snow-free ridges, relatively warmer than surrounding areas.
6. *The piñon-juniper woodland contains a number of important resources;* the woodland is the source of pine nuts, the major protohistoric food resource, as well as a number of other seeds, roots, berries, and greens.
7. *Resources of both upland slope and valley bottom are available within the woodland village foraging radius;* specifically, every valley floor resource can be obtained within 9 km. of the woodland camp and every part of the summit crest is at most 7 km. away (of course, the difficulty of access to the high country argues for occasionally establishing upland residential bases if the resource harvest in the uplands is sufficient to justify the transport costs in moving base camp).
8. *The woodland offers ample ancillary resources;* willows (for basketry and constructions), *Apocynum* for cordage and twine, streambed chert cobbles, turquoise sources, ocher deposits, limestone and other suitable materials for milling equipment.
9. *The woodland provides naturally sheltered areas;* although caves and rock-shelters rarely provide good residential sites, they are excellent temporary shelter and first-rate caching facilities; naturally occurring caves are particularly common in the dissected stream margins of the woodland; caves and rock-shelters are totally absent from the alluvial flats and very rare in the high country.

All of these factors endow the piñon-juniper zone with the highest residential potential in Monitor Valley. As Colson (1979, p 22) emphasizes, diversification of activity is probably the most effective coping device available to the hunter-gatherer. In this case, strategic residential positioning allows for diversification of seasonal activities from a central location. Although the piñon-juniper woodland does not necessarily foster sedentism, the mosaic of resources that can be exploited from a woodland camp is diverse and rich, richer and more diverse than the suite available from any other single spot in Monitor Valley. Stated another way, residential positioning to cope with potential adversity is a reasonable method not merely to provide maximal returns under optimal conditions, but also to provide reasonable returns under a wide variety of environmental conditions (Colson, 1979, p. 23).

Consideration of Niche Breadth: This argument clearly appeals to the concept of niche breadth, but in a manner rather different from the conventional approach (see Flannery, 1968; Hardesty, 1972, 1975, 1977, 1979; Harpending and Davis, 1977; Cohen, 1981; Hayden, 1981a, 1981b). Niche breadth conventionally refers to the diversity of resources used or conditions tolerated by a population *throughout the year.* In this sense, niche breadth is defined by the *variety* of

environmental conditions for which the organism is best suited (Hardesty, 1975, pp. 71–72).

Niche breadth theory further suggests that each organism occupies a more or less *distinctive space* in order to minimize competition between organisms.

There is no single best way to measure niche breadth. One method examines the total annual resource variety, then tabulates *how many* resources are exploited and *how much* of each resource is harvested; Hardesty (1975, table 1) has calculated niche width in this manner for the Mistassini Cree of Canada. It is also possible to estimate niche width by measuring the amount of subsistence variety which is due to spatial distribution of resources. Human groups do not necessarily encounter identical resource distributions, both because of the way in which resources are distributed across the landscape and also due to differences in technology and perception. If resources are obtained equally from a number of microenvironments, then niche width is said to be wide; if resources are obtained disproportionately, then niche width diminishes (Hardesty, 1975, p. 77). It is also possible to characterize niche width in terms of the temporal variability experienced in specific resource sets.

But regardless of how specific indices of niche breadth are derived, all such measures attempt to characterize the *overall ecological diversity manifest in a single human procurement system in an average year.*

Once these estimates are available, they can be used to compare "environmental uncertainty" across different human adaptations. Wide niches provide certain buffers against unpredictable resource loss, whereas narrow niches lack such buffers. Winterhalder (1980, p. 161) however, cautions that a direct relationship between niche breadth and long-term ecological stability has yet to be established (e.g., Flannery, 1968; Hardesty, 1972; Harpending and Davis, 1977). Nevertheless, niche breadth studies have significance for long-term evolutionary studies, as well as for considerations of competition and population pressure.

Niche breadth is also a useful typological mechanism. Human societies occupying niches of similar breadth are commonly "postulated to have negotiated similar settlements with the environment and therefore can be grouped together as ecological compadres" (Hardesty, 1975, p. 83). It would be useful, for instance, to compare the *overall niche* breadth of the Reese River Shoshone with that of, say, the Mistassini Cree, the San, and perhaps some prehistoric groups. At the very least, such generalizing, overall characterizations provide a useful classificatory device of human ecology (Hardesty, 1975, p. 83).

But this approach suffers from just this generalized, overall characterization. In this study, I am not interested in pursuing what Winterhalder (1980, p. 138) has termed *normative environmental analysis.* It is more useful, at this stage, to investigate the diversity of adaptations within a given system, and to compare such varying strategies between systems. The Reese River Shoshone follow a fusion-fission pattern of seasonal mobility. The niche breadth of the large and relatively stable winter encampment is quite different from the niche exploited in the smaller, dispersed summer settlements. Similarly, the niche breadth of a lowland village at Owens Valley is rather different from that of a Reese River winter base camp. But this distinction is lost when one computes an overall, year-round niche breadth estimate. Similarly, how does the niche breadth of a Kawich Mountain Shoshone base camp compare with the small, summer settlements established by the Reese River Shoshone?

Niche breadth can be an extremely useful tool for examining adaptive variability. The foraging base camp is where procurement parties originate, and also where most processing, manufacturing, and maintenance activities take place. The richer and more diverse the procurement localities included within the foraging radius, the better is the overall positioning of that camp.

Collectors make similar positioning decisions, except that their base camp serves as the activity hub for both foraging and logistic parties: the better positioned base camps allow for easier access to both foraging and logistic locations, at lower transport costs.

Residential positioning strategies are conditioned by both resource quality and resource quantity, as well as by timing relative to other

resources (Hardesty, 1977, p. 112); but the conventional niche breadth concept tends to gloss over the within-system positioning alternatives. Niche breadth can be considered to be site-specific merely by computing breadth conditions for each residential base, rather than summing across the entire season and averaging for an entire year. This is yet another aspect of the microevolutionary process requiring emphasis on edaphic as well as global variability.

Returning to the specifics at hand, the piñon-juniper woodland provided the highest potential (i.e., widest niche breadth) within protohistoric Monitor Valley. Furthermore, all other major resource patches fall within the foraging radius of woodland base camps. Although we will not presently pursue a full-blown discussion of settlement location models, it is clear that the piñon-juniper zone provides excellent settlement positioning (what Bettinger, 1980, p. 225 terms a *polythetic-satisficer* model). Piñon-juniper settlements are important both because critical resource thresholds are reached, and also because no single locational variable is essential to site placement. This polythetic set emphasizes the *range of variables* employed in settlements of the piñon-juniper woodland (Williams, Thomas, and Bettinger, 1973; Thomas and Bettinger, 1976).

But Monitor Valley is not Reese River Valley. We have argued that—given the protohistoric Basin Shoshonean level of technology—the piñon-juniper zone has the greatest niche breadth and hence the greatest residential potential of all the Monitor Valley microenvironments. But the settlement potential for the piñon-juniper woodland in Monitor Valley is not nearly so high as that for the corresponding area in the Reese River Valley (Thomas, 1973; Thomas and Bettinger, 1976).

The Reese River Valley is, of course, a more mesic environment than Monitor Valley, but mere availability of water is only a part of the answer. Recent research into the structure of Great Basin climatic patterns and vegetational distribution provides additional information regarding the differences between the two areas (especially West et al., 1978; Tueller et al., 1979).

High moisture levels of the Reese River Valley result from both a unique topographic situation, and the effects of local weather systems. Precipitation in the central Great Basin results from two types of major storm systems, the continental and the Pacific frontal (Houghton, 1969; Houghton, Sakamoto, and Gifford, 1975; Tueller et al., 1979; chap. 6, this volume). Continental storm systems, commonly known as Tonopah lows, form in place over a region, with the effect of pulling upper level moisture into an area. Topographic elevation has only a minor influence on precipitation levels from these storms and levels of precipitation are approximately uniform over the entire central Great Basin.

Particularly appropriate to this discussion are the recent comments by Robin J. Tausch, who has extensive field experience in the Toiyabe, Monitor, and Shoshone ranges, particularly with respect to the differences in distribution of the piñon-juniper woodland among these ranges (see West et al., 1978; Tueller et al., 1979; Tausch, West, and Nabi, 1982):

> Differential moisture levels between the Reese River and Monitor Valleys comes from Pacific frontal storm systems. These systems track from the west-northwest to the east-southeast and are strongly influenced by topographic features. In general, higher elevations receive more precipitation, but the extent and exposure of the higher elevation is also important. A single high peak does not receive as much moisture as a long ridgeline of equal elevation and exposure because a storm system can simply move around the single mountain. The longer the ridgeline, the greater the resistance to lateral movement by storms and the greater the orographic uplift.
>
> The Toiyabe Mountains are not only high, the major ridgeline is many miles long. In addition, the Reese River Valley has a strong increase in elevation from north to south and is closed off to the south by a substantial mountain mass linking the Toiyabe and Shoshone Mountains. As a result, a portion of a Pacific frontal ridgeline is also orographically uplifted, further increasing the precipitation levels. The Toiyabe Mountains also have a high exposure to Pacific frontal systems because of the small size and short ridgelines of the mountain ranges to the west and northwest.
>
> Because of their height and length, the Toiyabe Mountains effectively rainshadow the Toquima and Monitor Ranges from Pacific frontal systems and their exposure is thereby reduced. The

higher elevations of Mount Jefferson on the Toquima and Table Mountain on the Monitor Range offset this to some extent. However, at an equal elevation the average precipitation on Mount Jefferson or Table Mountain is less than it is on the Toiyabe Mountains. The overall moisture differences are relatively small in magnitude, around 2 to 4 inches, but important.

Increased moisture results in more productive and more diverse (more species) plant communities in Reese River Valley, particularly upper Reese River Valley, and the Toiyabe Mountains. It also means a greater productivity of important root crops and small game; more sage grouse, more rabbits, and more ground squirrels, for example.

Interestingly, the increased moisture in the Reese River Valley-Toiyabe Mountains area results in a reduced extent of pinyon-juniper woodlands . . . Landsat imagery . . . demonstrates this difference. There are two primary causes for this. One is that the increased moisture increases the other plant species' ability to resist encroachment of pinyon and juniper. More important are the climatic effects of the Toiyabe Mountains' high exposure to the Pacific frontal systems. Pinyon-juniper woodlands in this region are largely dependent on inversion layers for protection from late winter and early spring freezes. The high impact of Pacific frontal systems on the Toiyabe Mountains reduces both the elevational extent and the intensity of the inversion layers. In some areas, particularly north slopes and very exposed mountain peaks, inversion layers are eliminated during storm passage and so are pinyon-juniper woodlands . . . I suspect that the increased understory density may have also increased the frequency of fire in the past contributing to the reduction of pinyon-juniper abundance.

Pine nut production by pinyon seems generally controlled by successional status with very young and old stands having low levels of production. Young-mature, but still vigorous stands (100 to maybe 300 years old) appear to have the highest production levels for pinyon nuts. The distribution and frequency of these intermediate age stands might have been enhanced by an increased fire frequency as well as their production by the higher available moisture.

In summary, it is my impression that the overall higher productive potential of the Toiyabe-Reese River area increased the food supplies from many sources, not only pinyon nuts (Robin J. Tausch, personal commun.).

These varying hydrological and phytographic factors between the Reese River and Monitor Valleys are also evident in other ways.

Consider the differences in surface distribution of water between the two areas. Most of the surface water in the Reese River Valley is distributed across relatively permanent streams. Although springs do occur throughout the Reese River high country, surface flow is usually sufficient to support a stream or creek, at least for some distance. This means that most of the surface water in the Reese River areas is structured as a linear resource, which, all else being equal, generally creates a higher residential potential than other water distribution patterns (see Thomas and Bettinger, 1976; Thomas, 1979a, 1982a; chap. 9 this volume).

By contrast, the surface water in the Monitor Valley woodland consists largely of point resources, with their self-limiting potential. There are exceptions, but overall, water tends to be a limiting—rather than a facilitating—factor in aboriginal settlements in most of the Monitor Valley woodland.

The phytographic differences mentioned above also influence aboriginal settlement pattern. The more restricted piñon-juniper woodland in Reese River occurs as a "belt," but in Monitor Valley, the trees tend to blanket the entire mountain slope, extending over larger geographic areas (see fig. 35). The Monitor Valley woodland thus lacks the well defined upper and lower margins ("edges") characteristic of the Reese River area.

Previously (Thomas and Bettinger, 1976) we have stressed the importance of the ridgetop base camp in Reese River Valley, particularly as a winter residential location. Ethnographic ridgetop villages are common throughout the Reese River area, but they should be considerably less common in Monitor Valley. This is due to the combination of topography and hydrology that results in point sources rather than a flowing, linear distribution of surface water. In the Monitor Range, surface water has been insufficient to create the eroded, relatively flat-top ridges that characterize the Reese River woodland. Thus topography conducive to winter residence—areas with snow-free ridges, warmer winter temperatures, relatively flat places for living, access to an established ecotone and

the rest—is common in the Reese River woodland, but relatively rare in Monitor Valley.

This is not to say that Monitor Valley lacks suitable places for winter residence; optimal base camp locations can be found in the Monitor Valley woodland. But the abundance of such areas in the Reese River Valley is simply not duplicated in Monitor Valley. Accordingly, those places which are optimally suited for such residence in the Toquima and Monitor ranges should contain more nucleated, tightly structured, localized settlements than at Reese River where literally hundreds of potential winter village locations can be found.

To summarize: the piñon-juniper community provides the broadest niche for residential usage in Monitor Valley, but when compared to the Reese River Valley, that potential is limited. The protohistoric Reese River Shoshone positioned their winter villages so that the total range of annual resources was accessible within a reasonable foraging radius. Although such locations exist in the Monitor Valley area, they are scarce (judging from the resource abundance, distribution, and overall biogeographic proximity).

Resource structuring would suggest that a residentially more mobile strategy is required in Monitor Valley than that known for the Reese River Valley during the protohistoric period. All else being equal, hunter-gatherers employing the protohistoric Shoshonean technology would probably use Monitor Valley as a backup resource zone from a more residentially stable area such as the Reese River Valley. This projection presumes, of course, that adequate life-space existed within the central Great Basin to permit such a large extended range. Any regional effect, such as population pressure or environmental stress, would alter this projection, requiring groups in both the Reese River and Monitor valleys to either out-migrate or intensify resource procurement and restrict residential mobility.

Specific Archaeological Expectations: Resource Procurement Potential

The Monitor Valley woodland provides a number of dense patches of plants and animals, as well as a wide range of resources suitable for tool manufacture and trade.

Deer and bighorn used the entire area for summer range, but they could be profitably exploited only by encounter hunting. This activity, if visible at all, should appear as somewhat clumped distributions of kill-primary butchering implements near ambush spots, in areas of diurnal movement and near water holes.

If this hunting was conducted on a logistical basis, then field camps would have been established nearby. Based on our Reese River experience we would expect to find these field camps located some distance from the water sources, so as not to prevent game from coming to water. The artifact assemblage at such camps should, of course, be limited to the tools and weapons required for kill and primary butchering. It is also possible that these temporary field camps were occasionally established at abandoned base camps; if so, these field camps would become virtually invisible in the archaeological record.

The winter downward migration of bighorn is predictable to some degree and involves fairly aggregated prey. It is also likely that some of the side canyons in the Toquima Range provided traditional wintering grounds for bighorn. As discussed in chapter 4, such conditions could, in some years, provide near-ideal hunting potential. Intermediate elevations should contain evidence of hunting facilities, some perhaps involving significant expenditures of labor.

The high bulk kill is visible archaeologically. These locations should have characteristically high labor cost facilities, such as rock walls, cairns, blinds, and perhaps even corrals. These should be directly associated with game migration trails (that is, on ridges along steep-sided canyons connecting the relatively high Monitor Valley with the lower valleys on either side, particularly the Big Smoky Valley). The artifact assemblages associated with these high density kills should be tightly clustered and restricted to kill-butchering implements.

One such hunting facility has been previously reported by Thomas and McKee (1974). Two prehistoric rock walls were discovered in end-to-end alignment southeast of Austin, Lander County in a major pass at an eleva-

tion of about 2320 m. The Bob Scott Summit walls are ideally suited for intercept strategy hunt timed with the first snowfall.

The high density kill raises an interesting transportation problem. If the kill had been made within the foraging radius of an established residential base, then the game animals could be transported directly to that base camp, with only minimal field butchering. If the kill was made within the logistic radius however, implying that the base camp is some distance off, then there would have been immediate transport and storage considerations.

The field camps associated with such high bulk kills hold the clues to determining residential base location. The farther away the base camp, the more primary butchering is required prior to transport. Because of this, logistic field camps contain a relatively great amount of low utility faunal material. The high utility field-butchered cuts were either transported immediately back to the residential area, or cached for more leisurely transport at a later time; perhaps this transport could be embedded in other procurement activities.

The faunal inventory at a given site thus depends upon which part of the system is being monitored. If a large number of low utility items are found, the site was probably located in the logistic radius; the more common the low utility elements, the farther away the base camp. By contrast, finding a high proportion of high utility items (such as ribs, vertebrae, and bones associated with the haunches) denotes a locus of consumption or storage. Such a faunal inventory could indicate either an unused meat cache (an unlikely event) or, more probably, a residential base camp. The context of the find should make that distinction clear.

The lower portion of the piñon-juniper woodland is also the location of encounter hunting for both bighorn and deer, predominantly during winter and spring months. As with all encounter hunting, the visibility of this activity is relatively low, the archaeological assemblages generally forming non-sites with low clustering of kill-butchering implements. Limited point water resources tend to tether such activities to springs, which might also have evidence of ambush facilities.

Bighorn populations probably wintered in Monitor Valley near the heads of the various side canyons, and these herds could have been hunted most profitably by an encounter strategy. Few permanent hunting facilities should occur in such areas, and evidence of such encounter hunting would be restricted primarily to relatively dispersed, low density hunting losses. The archaeological visibility of bighorn hunting in the winter range is quite low, unless kill-butchering stations can be located.

Logistic plant procurement leaves little evidence, in the piñon-juniper zone or anywhere else. Harvesting pine nuts, for instance, leaves almost no evidence as such at the locations. Pine nut procurement is visible mostly through the caches required by a high bulk harvest and perhaps an occasional roasting feature. Similarly, procurement of grasses, berries, roots, and greens is basically invisible, except for the occasional tool cache expected within the logistic radius.

Raw material procurement depends heavily on the nature of the resource being exploited. Chert outcrops occur throughout the piñon-juniper zone, and lithic procurement tends to be highly visible as quarry debris. In such cases, the nature of the production stage biface provides clues as to positioning strategy. A high proportion of roughouts, cores, and few finished products suggests relatively high-bulk transport, implying that procurement took place within the foraging radius. If, on the other hand, quarrying debris is indicative of finished tool manufacture, either the base camp is immediately at hand, or else the activity took place near the end of the foraging radius, with only finished tools being transported back to the base camp. The context of such procurement sites should assist in positioning that activity within the overall mobility framework.

Summary of Archaeological Expectations for the Woodland

The piñon-juniper woodland holds the highest potential for residential evidence in Monitor Valley (although that potential is not considered to be as high as for the Reese River Valley). Conditions in the piñon-juniper woodland are about as good as they get in

terms of adequate life-space. Base camps for each of the five strategies are relatively visible in the archaeological record.

If, on the other hand, the Monitor Valley woodland was used predominantly for logistic purposes, then several procurement activities conducted there also have relatively high visibility: game procurement and possible meat caching, raw material procurement for tool manufacture, and plant procurement—visible predominantely as pine nut caches.

This area provides a number of natural caves and rock-shelters which would hold more potential for caches and temporary field camps than for residential bases.

Encounter strategy hunting occurs as a relatively low-density mosaic, predominantly tethered to point water sources.

In terms of the five procurement strategies isolated in chapter 8, we assign the following probabilities to the woodland of Monitor Valley:

STRATEGY I. HIGH RESIDENTIAL MOBILITY: Quite likely; foraging base camps can be expected to occur at certain spots in the woodland, located in situations similar to those encountered in the Reese River Valley (Thomas and Bettinger, 1976), although the density of such camps should be considerably lower in Monitor Valley. Evidence of satellite procurement locations should also be present.

STRATEGY II. SEASONAL FUSION-FISSION, MONITORED FROM WITHIN THE CAMP/FORAGING RADII: Dispersed residences are a possibility, but the resource distribution makes large settlements (fusion camps) unlikely; these base camps would be almost identical with those resulting from the high mobility residential pattern (Strategy I), and extraction locations would be similar as well.

STRATEGY III. SEASONAL FUSION-FISSION, MONITORED FROM WITHIN THE LOGISTICAL RADIUS: Together with Strategies I and V, this is the most likely possibility; evidence of logistic activity is quite visible, primarily as field camps and game procurement activities, and the absence of base camps.

STRATEGY IV. MINIMAL RESIDENTIAL MOBILITY, MONITORED FROM WITHIN THE CAMP/FORAGING RADII: Quite unlikely; any nearly sedentary base camps established in Monitor Valley should occur in the piñon-juniper zone, but the resource densities and topography make this possibility a long shot.

STRATEGY V. MINIMAL RESIDENTIAL MOBILITY, MONITORED FROM WITHIN THE LOGISTIC RADIUS: Highly likely; game and plant procurement locations and temporary field camps would be identical with those of Strategy III. The major limiting factor in such usage would be whether any set of microenvironments is productive and diverse enough to allow a nearly sedentary base camp to be located so that Monitor Valley would fall within its logistical radius.

NOTES

[1] Chapter 8 defined the *upland slope* as that portion of the Monitor Valley landscape between 2500 and 2750 m. elevation. Although it is important to keep this area distinct for the archaeological research discussed in the next three volumes of this series, the *upland slope* will be informally combined into the present chapter in order to reduce descriptive redundancy.

[2] This question is of more than academic significance because of the extensive "chaining" of piñon-juniper woodland currently being conducted throughout the Desert West. The government program of woodland eradication—using massive machinery to uproot piñon and juniper stands and turning woodland into pastures the hard way (Lanner, 1981, p. 131)—is a charged issue (see also Young and Budy, 1979).

We note in passing that such chaining, quite obviously, has a disastrous impact on the archaeological record of the woodland.

CHAPTER 11. ANTICIPATING THE ARCHAEOLOGICAL RECORD OF THE VALLEY BOTTOM

In chapter 9, I emphasized the dangers of slavishly adhering to models of water-controlled desert ecology when analyzing the adaptations in the Great Basin. The perspectives from mountain ecology are much more useful in determining the constraints on human adaptation to the summit crest. Similarly in the piñon-juniper woodland, water was only one of several key factors determining the niche breadth available to the protohistoric hunter-gatherers.

And yet, because Nevada is the most arid state in the Union (Brown, 1974; Houghton, Sakamoto, and Gifford, 1975), desert models are not wholly irrelevant. Desert precipitation varies from a low of about 60 mm. average per year in extremely arid areas, to as much as 500 mm. per year in areas termed semiarid by McGinnies et al. (1968). Today, Monitor Valley falls into this range, receiving between 300 and 400 mm. average precipitation per year (see chap. 6). Despite the relevance of other ecological models to the Monitor Valley case, we cannot afford to ignore the arid nature of this system, especially when examining the valley bottom, the most water-deficient of its microenvironments. The Monitor Valley is, without question, a semiarid desert which we must view, at least in part, from the perspective of desert ecology and the critical importance of "water-control" (e.g., Noy-Meir, 1973; see also Yellen, 1977, p. 266).

THE LOWLAND ECOSYSTEM

The contemporary landscape of the Monitor Valley lowlands is described in chapter 6. Before proceeding directly to the archaeological expectations for this area, however, it is necessary to highlight and underscore certain salient characteristics of the Monitor Valley lowland; in particular, there are certain similarities and differences between the lower sagebrush-grass areas of Monitor Valley and valley bottoms in surrounding areas that directly conditioned the aboriginal strategies for exploiting this area.

The key factor is the relatively high overall elevation of Monitor Valley. As figures 33 and 34 illustrate, the Monitor Valley ecosystem operates at a significantly higher elevational gradient than do the valleys on either side. All else being equal, this elevational difference makes Monitor Valley a more favorable habitat in summer than in winter, at least relative to the surrounding valley systems. This is especially important for grazing ruminants and also has definite implications for protohistoric forager-collectors.

The surface water distribution of Monitor Valley is distinctive in two ways. Monitor Valley lacks both the large dry alkali sink characteristic of many such internally drained basins and the central bisecting stream, as it occurs in the Reese River Valley. Instead Monitor Valley retains only a relatively permanent shallow playa lake. This sulphurous and alkaline body of water is unusual in that it survives in approximately the same form and dimensions as its ancestor, pluvial Lake Diana (fig. 13).

Hubbs, Miller, and Hubbs (1974, p. 21) suggest that Monitor Lake persists because it has been dammed by the extensive alluvial cones extending from Mill Creek and June Canyon. Melhorn and Trexler (chap. 6) agree that such a surface topographic barrier does indeed exist, but suggest that other factors are probably responsible for the unusual persistence of Monitor Lake. It may be that a ground water barrier or hydrological dam exists with a cross-valley orientation somewhere north of Monitor Lake, impeding normal ground water flow to the north. Some surface seepage does occur at Box Spring, for instance, suggesting the presence of a subterranean dam nearby. Subsurface water movement is probably sufficiently retarded in this area to create enough hydrostatic pressure to maintain Monitor Lake as a perennial body of water.

The Monitor Valley floor lacks linear sources of flowing surface water, since the intermittent streams draining the Toquima and Monitor ranges only rarely reach the valley floor. Taken together the aggregate flow of all of these intermittent streams is less than

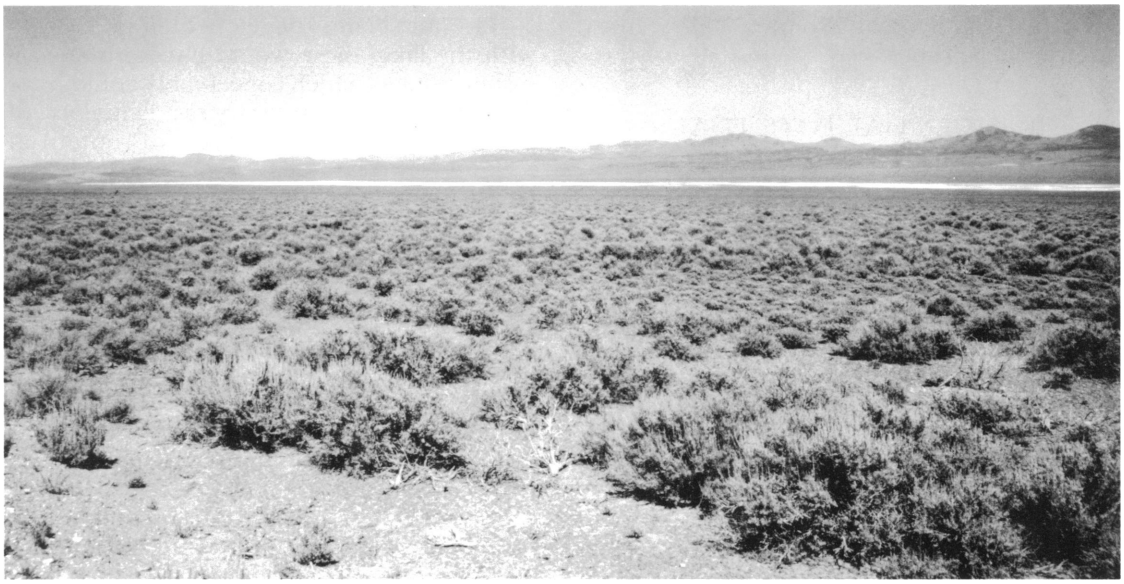

FIG. 40. View of the Monitor Valley lowland environment, looking northeast across the Monitor Lake playa.

.2 cu. m. per second (7 cu. ft. per sec.) (Rush and Everett, 1964). Most of this surface water sinks into the alluvial fill well before reaching the valley bottom.

Artesian ground water pressure beneath Monitor Valley creates restricted point water sources on the valley floor. Three of these—Box Spring, Potts Ranch Spring, and White Sage Spring—all bubble to the surface and disappear a short distance away. Geothermal activity is evident both at Potts Ranch, and also at Dianas Punch Bowl (fig. 29). In recent times, a ditch has been excavated to connect the Dianas Punch Bowl and Potts Ranch Spring areas; but before this canal was excavated a couple of decades ago, both sources flowed into a small and shallow ephemeral sink.

The overall hydrological configuration in Monitor Valley, is thus distinctive, contrasting markedly with surface water distributions in both Big Smoky and Reese River valleys to the west and Little Fish Lake Valley to the east.

The vegetational cover of the Monitor Valley bottomland, however, is characteristic of most central Nevada areas, consisting of both shadscale and sagebrush-grass associations. The composition and structure of these floristic associations prior to European colonization has been obscured in this area, as throughout the Great Basin, by a century of intensive grazing pressure. According to the model proposed by Young, Evans, and Tueller (1976, p. 187) Monitor Valley experienced a number of floristic changes: an increase in native shrubs undesirable for browsing ruminants, a reduction in native grasses and forbs, and the exploitation of these voids by alien annual weeds which are highly adapted to intensive grazing by domestic animals.

Monitor Valley was impacted beginning in the late 1860s when it became the major agricultural hinterland for Belmont, the silver boom town located in southern Monitor Valley. Historic white settlers initially homesteaded near the lowland water sources presumably using the surrounding, undeeded lands as rangeland. Contemporary newspapers extolled the agricultural virtues of these new Monitor Valley ranches, which harvested native hay, grains, potatoes, and onions. The 1870 Nye County Tax Rolls record that three ranches had developed at least rudimentary irrigation systems on Pine Creek. All of these activities, of course, mod-

ified the character of Monitor Valley from protohistoric times.

RESIDENTIAL POTENTIAL OF THE LOWLANDS

The residential potential of the Monitor Valley bottom is severely limited. Potable water is nowhere abundant, and that which is available is restricted to a few point sources. The valley generally lacks the base camp requirements of fuel and adequate food supply as well. Extreme cold due to air inversion probably precluded the use of the bottomland during the winter months. Although the valley floor is habitable from spring through fall, the niche is considerably more constricted than that of residential settlement on the woodland slopes, only a few kilometers to the east and west.

The key to residential usage, if any, of the lowlands is Monitor Lake itself. In our experience over the past decade or so, Monitor Lake can be expected to be dry at least two years in every five (unfortunately, we did not keep exact records). Even when standing water is available in Monitor Lake, it is commonly stagnant and scummy, and hardly potable. Had hydrological conditions been sufficiently different to allow a relatively constant stand of potable water, Monitor Lake would have provided a linear resource, allowing for great flexibility in residential positioning along the lake margin. Given present information this seems unlikely.

An adequate source of potable water is available at Box Spring (less than 2 km. to the north) and at Dianas Punch Bowl (only 5 km. to the north). Although these sources are also limited in terms of residential potential, they do provide better sources of potable water than does Monitor Lake.

The potential of Monitor Lake as a residential focus lay not in the availability of water, but rather in the presence of any marsh vegetation that might have once existed around its margins. Historic accounts dating back to the 1860s provide no evidence that marsh vegetation was present around Monitor Lake at the time of white contact, and at present we lack sufficient paleoenvironmental detail to allow reconstruction of this lacustrine community.

Had marshlands developed in association with the lake, these would have provided a resource focus which conceivably could have triggered at least temporary residential use of Monitor Lake. A number of potential resources would have appeared with the lacustrine biotic association: cattails, bullrush, migratory waterfowl, marsh rodents, and perhaps also fish.

There is an argument that the presence of such lacustrine resources would *a priori* provide Monitor Valley with a residential potential, perhaps approaching sedentism. Some investigators suggest that lacustrine and marsh resources in the Great Basin were so abundant, plentiful, and continually renewable that they provided tethering influence stable enough to support sedentary, or nearly sedentary populations (e.g., Rozaire, 1963; Napton, 1969; Heizer and Napton, 1970; Madsen and Lindsay, 1977; Aikens, 1978; Madsen, 1979, 1982).

Recently, however, mid-range theoretical considerations have led to criticism of this Garden of Eden approach to limnosedentism. Marshes may not provide such nutritious resources after all, and the procurement costs of these resources are excessively high (Jones, 1981; Kelly, n.d.). There is also reason to think that marsh resources—fish, waterfowl, and the various plant species—greatly fluctuate through time (Kelly, n.d.; see also Mason, 1957; Correll and Correll, 1972; Weide, 1976). This fluctuation appears to occur in even the more extensive marsh areas, such as the Carson and Humboldt sinks. As Wheat (1967, p. 3) has noted: "In the Great Basin the marshes ... were intermittent affairs, always at the mercy of dry cycles and shifting dunes and channels. In a half dozen years a marsh could change into a dust bowl." There is at present no evidence that the Monitor Valley ever contained much in the way of marshlands; but even if wetlands did exist during protohistoric times, they may have provided very little residential potential.

This does not mean, however, that the Monitor Lake area lacks extractive potential. Ephemeral marshes provide useful sources of food, both for human consumers, and animal populations. In just a few moist years, a dry playa can be transformed into a relatively

luxuriant nesting ground for water birds. Newspaper accounts mention that wild ducks, presumably collected in the Monitor Valley wetlands, were offered for sale in Belmont during the 1860s and 1870s.

Although no data are available regarding the avifauna of Monitor Valley, Linsdale (1936, 1938) made an extensive study of the Toiyabe Mountains, less than 40 km. to the west of Monitor Valley: Whenever bodies of water occurred, whether large or small, they served as feeding or resting places for an assortment of waterfowl including mallards pintail, green-winged teal, cinnamon teal, ruddy duck, herons and coots (Linsdale, 1938, pp. 4–6). But in areas that are periodically dry—such as playa lakes—the lack of aquatic vegetation means that "attractions offered to birds are so meager that only small numbers can be expected . . . but whenever sufficient moisture occurs to keep even small basins filled for sufficient time to establish marshes, a large population of water birds would doubtless occur."

A high proportion of these wetland birds are migratory because of the severe winter climate. Linsdale noted that migratory species would congregate in marshy areas of Big Smoky Valley to feed on *Scirpus* in the shallow water at the margin of the ponds between mid-April and mid-September (1938, p. 34).

This migratory bird population provides an erratic, but worthwhile food resource that could be procured in the manner discussed in chapter 4. If Monitor Lake had water at all, it was during the spring runoff. The early spring was the most likely time for congregation of migratory birds which could have remained at Monitor Lake as long as standing water was available (even in the absence of significant marshland vegetation). If water persisted into the fall, limited bird populations would be available then as well; but migratory birds would have to leave on or before the date of the first freeze of Monitor Lake.

Monitor Lake provides an extremely valuable food resource, insect larvae. Despite the probable lack of marsh vegetation, Monitor Lake generally contains more water than most of the playa lakes in central Nevada and in some years, we have encountered an extremely dense concentration of flies and larvae along the lake margin. The flies swarmed and buzzed as we conducted the archaeological survey of the lakebed area, often filling eyes, ears, nose, and mouth. These insects also created a loud din, distracting to all; I can remember only two years when such fly swarms were a noticeable hazard (regrettably, we collected no samples, so we cannot be certain of the specific identification).

But it seems likely that these larvae and flies were *Ephydra,* or a similar species that could have been harvested and utilized like *kutsavi,* as described in chapter 4. The creatures certainly had all the characteristics of *kutsavi*: small size, available only during the warm summer months, year-to-year variability, and density. But in years when they were present, the larvae would have provided quite a sizable concentration of potential foodstuffs.

As mentioned above, even when Monitor Lake periodically fills, such water is of questionable value for drinking. But the presence of *kutsavi*-like larval forms would have markedly increased the temporary resource potential of Monitor Lake and, even though they did not afford residential potential, *kutsavi* procurement may have proceeded as a foraging activity, or a field camp might have been established nearby, depending on where the residential base was located.

Speaking of residential and logistic positioning, one must keep in mind that the Monitor Valley area is a relatively circumscribed geographic entity. Nowhere is the valley lowland more than 10 km. from the piñon-juniper woodland. That is, considering the niche breadth argument (chap. 10), the piñon-juniper woodland has a much greater residential potential than the lowlands. It is also important to note that all the resources of the valley bottomland would be available from any piñon-juniper base camp within a 10 km. foraging radius. This biogeographical fact vastly diminishes the residential desirability of the lowlands of Monitor Valley.

But if this notion is incorrect, and residential bases were indeed established in the lowland, where would they occur? A winter occupation is eliminated for climatic reasons as well as low winter resource potential. Because water would rarely be available as snow and ice, virtually all lowland residential bases

would have had to be tethered to the few available point water sources. Moreover, because water supply at any such valley village is limited, there should be a rather high proportion of water storage vessels: ceramics, pottery, stone bowls, etc.

Valley floor residential areas would, of course, be expected to contain the archaeology of base camps in general (chap. 5). The dwellings should be of relatively low visibility since we postulate mostly warm-weather occupation. Dwellings constructed in such sites are usually restricted to brush wickiups, ramadas, and sun shades. In addition, because of the predominantly alluvial substrate, stones for building foundations and features are limited, further lowering the archaeological visibility of any such base camps.

The lack of suitable local lithics would also mean that grinding stones must be transported from the mountains. Although this distance is not great, roughly 10 km., the occurrence of such non-native rock would be a conspicuous feature of the archaeological record, perhaps in part offsetting the inconspicuous nature of dwellings constructed there.

ADDITIONAL RESOURCE POTENTIAL OF THE LOWLANDS

Because the potential for base camps in the valley bottom is low, the area was more likely exploited as discrete resource procurement locations within a foraging or logistical radius from base camps established elsewhere. Although patches of economically important grasses do not today occur with any frequency in the lowlands, these would have been heavily impacted by nineteenth- and twentieth-century grazing known to have occurred here. The archaeological visibility of such plant procurement is low, creating mainly low-density non-site scatters. No plant or tool caches are expected to occur in conjunction with lowland plant procurement.

This area does, however, provide potential for both intercept and encounter strategy hunting. Pronghorn survive today in Monitor Valley and they were available—if not plentiful—during protohistoric times. Although antelope venture occasionally into mountainous areas, their characteristic annual round is confined to the valley bottoms and lower alluvial slopes. All evidence of antelope procurement in Monitor Valley should thus be found below 2250 m.

As detailed in chapter 4, antelope can be hunted in two ways, and each strategy implies distinctive archaeological consequences. The very low-density encounter/ambush strategy is most profitably pursued near point water sources, such as those located on the valley floor and lower slopes of Monitor Valley.

To be effective, this strategy requires that hunting be conducted some distance away from both residential and logistic camps, a major reason for such camps to be located away from major water sources. Small individual blinds may have been constructed in such ambush spots with an artifact inventory restricted to low-density, isolated kill-butchering losses.

Communal hunting is more productive, and more archaeologically visible. Large, communal pronghorn driving facilities were probably constructed on the valley floor of Monitor Valley (below 2250 m.), consisting of "wings" and a corral; cairns might also have been constructed to attract the attention of the pronghorn. Although such facilities were probably constructed of brush and branches—and hence did not enter the long-term archaeological records—well-constructed pronghorn features were sometimes made of heavy beams and rocks.

Except when an antelope trap was continually reused the artifact assemblage associated with pronghorn procurement is sparse, although highly clumped and generally restricted to kill-primary butchering and general-purpose implements. Since most pronghorn hunting facilities are perishable, such clumped scatters can be found—in seeming isolation—almost anywhere on the valley floor. Rabbit drives would produce a similar assemblage.

The valley floor provides a few unique opportunities for non-food resource procurement. Salt could have been collected from Monitor Lake, if the area had been sufficiently dry to create a playa of long standing. Similarly, McKee and Thomas (1973) in reporting results of X-ray diffraction analysis of pigments from Toquima Cave (Monitor Valley), noted that gypsum, the primary con-

stituent of modern wall plaster, was a common element, as well as aragonite and alum (halotrichite-pickeringite). Aragonite in association with gypsum and alum and the absence of more stable calcite suggested to Koski, McKee, and Thomas (1973, p. 8) that pigment raw materials probably came from "rather restricted physical and chemical conditions characteristic of deposits from hydrothermal waters." Such hot springs occur in almost every valley in the Great Basin, and an especially large one, Dianas Punch Bowl, lies in the center of Monitor Valley. The actual procurement of pigments for body adornment or perhaps pictographs would be of extremely low visibility in the archaeological record.

A relatively minor obsidian source occurs between the northern end of Monitor Lake and Box Spring (see fig. 29). This relatively low-grade obsidian occurs as Apache tears; the source is quite diffuse, most of the small nodules occurring as float in dry washes and along the alluvial surface. Therefore, no intensive quarry activities would be expected. Most likely, procurement would be embedded in other foraging or logistical activities in the area. The small chunks were probably simply gathered up, and fabrication took place elsewhere, either at residential bases or field camps (depending on whether the procurement party was operating within a foraging or logistic radius).

SUMMARY OF ARCHAEOLOGICAL EXPECTATIONS FOR THE VALLEY BOTTOM

Archaeological expectations for the valley bottom are not complex. Base camps are not expected, but if they occur, they should be tightly tethered to the few available point sources of water and should contain a large variety of materials imported from the upland microenvironments. Monitor Lake is a significant residential factor only if water levels were sufficiently high for several years to allow for a significant marshlike vegetation to develop (an unlikely prospect).

But these lowlands would fall into the foraging radius of any base camp established in the woodland zone, and several procurement opportunities for game, plant, and minerals are available on the valley bottom. None of these procurement activities should produce a very substantial archaeological record.

Field camps were probably established occasionally on the valley floor, in times when base camps were outside Monitor Valley. These field camps should be water-tethered, low-density affairs.

In terms of the five aboriginal procurement strategies identified in chapter 8, we assign the following probabilities to the bottomland of Monitor Valley:

STRATEGY I. HIGH RESIDENTIAL MOBILITY: Possible; base camps were probably established in the woodland, with foraging groups ranging throughout the lowlands. Even short-term base camps are a possibility if Monitor Lake remained sufficiently full over several years, allowing for the development of a lacustrine plant association.

STRATEGY II. SEASONAL FUSION-FISSION, MONITORED WITHIN THE CAMP/FORAGING RADII: Fusion camps in the lowlands are extremely improbable, but summer dispersal camps are a remote possibility. The niche breadth of the nearby woodland probably eliminates the lowlands from base camp consideration, but foraging activities from these camps could easily occur on the valley bottom.

STRATEGY III. SEASONAL FUSION-FISSION, MONITORED FROM WITHIN THE LOGISTICAL RADIUS: This, together with strategy V, is the most likely possibility. Evidence from logistic use of the lowlands should appear largely as low-density non-sites, although field camps were probably established occasionally on the flats.

STRATEGY IV. MINIMAL RESIDENTIAL MOBILITY, MONITORED FROM WITHIN THE CAMP/FORAGING RADII: This is the most unlikely possibility of all; Monitor Valley lacks the high bulk, seasonally stable resources necessary to support nearly sedentary base camps and, if such camps were established, the valley floor would be a poor choice indeed. If nearly sedentary base camps were established in the woodlands, foraging, and perhaps even logistic activities could be conducted on the flats, but this is also a low probability count.

STRATEGY V. MINIMAL RESIDENTIAL MOBILITY, MONITORED FROM WITHIN THE LOGISTIC RADIUS: This is most likely; game and plant procurement, together with the occasional field camps, would be identical with those of Strategy III. The only factor limiting this possibility is whether any set of microenvironments was sufficiently productive and diverse to allow a nearly sedentary base camp to be established sufficiently close so that Monitor Valley would fall within the logistical radius of that camp.

CHAPTER 12. PREHISTORIC MONITOR VALLEY: ARCHAEOLOGICAL EXPECTATIONS

This volume has engaged in model building—constructing the mid-range strategic models necessary to examine the protohistoric archaeological record of Monitor Valley, Nevada. But the five strategies so defined operate strictly as synchronic models, since they are directed at a single point in time (in this case, A.D. 1800). In chapter 2 we argued that if archaeology is relevant to human ecology in general, then the models and explanations must be diachronic in nature, capable of dealing with change as well as stasis.

The archaeological potential of places like Monitor Valley lies not in the examination of single points in time: the chronology through which we perceive the past is simply too coarse grained to allow for adequate point level resolution. While the protohistoric models and strategies serve as a beginning point for inquiry, the success of the Monitor Valley project rests on how well one can deal with the diachronic, long-term aspects of the archaeological record. This final chapter provides the background necessary for the examination of the prehistoric archaeological record of Monitor Valley (which is presented in subsequent parts of this series).

CHRONOLOGY OF THE CENTRAL GREAT BASIN

Most archaeologists would agree that chronology forms the basic framework for any archaeological inquiry, regardless of one's final objectives (Thomas, 1979a). The cultural chronology currently employed in the central Great Basin was proposed over a decade ago (Thomas, 1971a, table 3.3). This sequence is reproduced on table 7.

The key structural element in this chronology is the concept of the *cultural phase,* what Willey and Phillips (1958) called "the practicable and intelligible unit of archaeological study." Phases, used in this sense, are defined as follows: "*an archaeological unit possessing traits sufficiently characteristic to distinguish it from all other units similarly conceived, whether of the same or other cultures or civilizations, spatially limited to the order of magnitude of a locality or region and chronologically limited to a relatively brief interval of time*" (Willey and Phillips, 1958, p. 22). Keep in mind that because this definition was proposed for use in the New World at large, it works better in some areas than others.

Chronological control is minimal in the Great Basin, at least when compared with areas such as the American Southwest or the Basin of Mexico. In the 1971 definition for the central Great Basin, the briefest phase was 559 years, and the longest duration—the Willey and Phillips "brief interval of time"—was two millennia. These divisions, as initially defined, were relatively coarse grained, and time-markers supporting them were poorly defined.

The cultural phase also has a spatial dimension, what the Willey and Phillips definition denotes as "the order of magnitude of a locality or region." A decade ago, we could not deal with spatial variability very adequately either: "the phase sequence for central Nevada . . . is here considered in the restricted sense of the Reese River Valley, plus one or two valley systems to either side. The central Nevada region, as defined here, is only perhaps 10,000 square miles or so" (Thomas, 1971a, p. 98). This chronology was based largely on work conducted by University of California at Berkeley, Archaeological Research Facility, under the direction of R. F. Heizer, his students and colleagues (see Thomas, 1982b). Several other institutions—notably the Desert Research Institute, Nevada State Museum, and Peabody Museum (Harvard)—contributed to the chronology of western Nevada as it was then known; but only about two dozen radiocarbon dates were available to support the chronology. As I pointed out at the time, "The refining of local chronologies can be similar to approaching a mathematical asymptote; no matter how fine the time scale, one can never reach perfection. There comes a time to accept the situation at hand, allow for future refinements, and move on to other more advanced aims in archaeology" (Thomas, 1971a, p. 88).

TABLE 7
Cultural Phases Proposed by Thomas (1971a, table 3.3) for the Central Great Basin
(See also Thomas, 1981a)

Geologic-Climatic Periods	Phase	Age	Diagnostics
Late Holocene	Yankee Blade phase	A.D. 1300–1859	Desert Side-notched points, Cottonwood Triangular points, Shoshonean ceramics
Late Holocene	Underdown phase	A.D. 500–1300	Eastgate series points, Rose Spring series points
Late Holocene	Reveille phase	1000 B.C.–A.D. 500	Elko series points
Middle Holocene	Devils Gate phase	*ca.* 3000 B.C.–1000 B.C.	Pinto series points, Humboldt Concave Base A points
Early and Middle Holocene	—	pre-3000 B.C.	Northern Side-notched points, Various stemmed and concave base point forms

Except for the Monitor Valley excavations (to be described in subsequent volumes) little additional chronological information has become available in this area to refine the temporal ranges or to more satisfactorily circumscribe the spatial dimension in the decade since this definition was proposed. The 1971 sequence was used as a point of departure in the Monitor Valley prehistory project.[1]

In truth, part of the justification for the Monitor Valley prehistory project was a dissatisfaction with the Thomas (1971a) chronology. Although it was the best chronology available at the time, stratified verification was lacking, and the search for adequately stratified sites provided a major impetus for initiating archaeological fieldwork in Monitor Valley (see chap. 2).

PREVIOUS ARCHAEOLOGICAL RESEARCH IN MONITOR VALLEY

The history and genesis of archaeology in the central Great Basin has been discussed elsewhere (Thomas, 1982b; see also Elston, 1980). We confine our scope, at present to previous archaeological investigation within the Monitor Valley proper.

Although virtually no archaeology had been conducted in this relatively remote upland area prior to our own work in 1970, we were hardly the first archaeologists to set foot in Monitor Valley.

To my knowledge, this distinction goes to M. R. Harrington. R. F. Heizer's field notes from 1937—now deposited at the Lowie Museum of Anthropology, Berkeley—mention that Harrington had sometime previously surveyed the extensive cavern system known as Northumberland Cave, but we have no details about that early archaeological exploration. Our own excavations at Northumberland Cave (discussed in Part 3 of this series) showed no human occupation of the cave.

Toquima Cave (then known as Potts Cave) was visited by R. F. Heizer and R. K. Beardsley during their 1937 cave survey, which ranged throughout much of the central Great Basin (Thomas, 1982b). Heizer's field notes describe very limited test excavations conducted at Toquima Cave on May 20, 1937. A few artifacts were recovered in this excavation, and these are now stored at the Lowie Museum of Anthropology. We include descriptions of these artifacts in discussion of our own excavations at Toquima Cave (Part 3 of this series).

The rock art of Monitor Valley has attracted periodic attention from anthropologists. In his classic synthesis of North American picture writing, Mallery (1893, p. 94) described the massive petroglyph boulder in East Bald Mountain Wash, at the extreme southern end of Monitor Valley; Steward (1929) recorded this same boulder as his "rock art site 215,"

and Heizer and Baumhoff (1962, p. 57) designate this site Nyl. None of these investigators actually visited the site, and a confusing nomenclature has arisen as a result (discussed in Part 3 of this series).

Steward (1929, p. 145) and Heizer and Baumhoff (1962, pp. 57–58) also briefly describe petroglyphs located in White Rock Canyon, on the southeastern margin of Monitor Valley. This site was apparently never investigated firsthand.

Heizer and Baumhoff (1962, p. 38, figs. 79b–g, pl. 16a) discuss the pictographs in Toquima Cave (see Potts Cave), but this description was taken from a black and white snapshot taken by Heizer during his 1937 visit (Baumhoff, personal commun.); less than one-quarter of the elements were recorded in that report.

However, the Hickison Summit rock art site was both visited and recorded by Heizer and Baumhoff (1962, pp. 38–40) and this site provided a major portion of the argument developed by them, namely that rock art localities are associated with prehistoric hunting/ambush areas.

The archaeology of Monitor Valley has also been briefly mentioned by Dick Shutler. While conducting an archaeological reconnaissance in southern Nevada in 1955, Shutler met Albert Hooper, a Paiute Indian then living in southern Monitor Valley. Hooper took Shutler to a historic piñon cache located in a small natural rock outcrop in the Toquima Range; the cache is described in detail by Shutler (1956).

Such was the state of knowledge regarding the archaeology of Monitor Valley prior to the beginning of our research project there in 1970. Over the past decade, there have been a few archaeological studies which operated concurrently and independently of our own work (e.g., McGonagle and Waski, 1978; Busby and Kobori, 1980; Crew, 1981). Their findings will be integrated, when possible and where appropriate, with the presentation and analysis of American Museum research in this area.

THE ARCHAEOLOGY OF MONITOR VALLEY

As discussed in the Introduction of this volume, we began working on the archaeology of Monitor Valley in 1970, and eight field seasons were involved in this investigation. The purpose of this volume—the first of five—has been to provide the epistemological background for the fieldwork and the analysis. That framework has now been presented. Part 2 of this series presents the archaeology of Gatecliff Shelter, a major site excavated in the Monitor Valley project. Part 3 details woodland and valley floor areas, discussing probabilistic and non-probabilistic survey strategies, the intensive collecting and mapping which took place on hundreds of surface sites, as well as stratigraphic excavations conducted at over one dozen additional sites in Monitor Valley. Part 4 presents data for the Monitor Valley high country. The final volume considers the overall findings of the Monitor Valley project in terms of regional and theoretical significance.

NOTES

[1] An alternative chronology has been proposed for the central Great Basin area by McGonagle and Waski (1978); that scheme is not employed here.

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