HOVENWEEP 1976

by JOSEPH C. WINTER

ARCHEOLOGICAL REPORT No. 3



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SAN JOSE STATE UNIVERSITY
SAN JOSE, CA.

Hovenweep vessels in squash garden

HOVENWEEP 1976

by

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July 1977

with sections by

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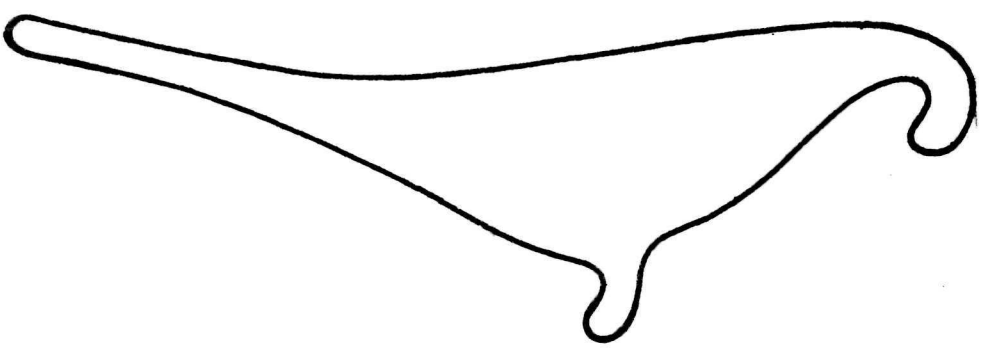
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ARCHEOLOGICAL REPORT No. 3



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TABLE OF CONTENTS

		Page
	Acknowledgements	i
	Table of Contents	ii
	List of Figures	iv
	List of Tables	viii
I.	OBJECTIVES	1
II.	PROCEDURES	2
	1. Resource Baseline Studies	2
	2. Site Testing Program	3
	3. Gardening And Water Control Experimentation	8
III.	DATA	10
	1. Site Descriptions, by Joe Winter, Laurel Casjens, Pat Hogan and Brad Noisat	10
	A. Possible Habitation/Storage Sites	10
	B. Possible Habitation/Farm Sites	30
	C. Simple Water Control Sites	52
	D. Miscellaneous Sites	57
	2. Analysis of 1976 Ceramic Collection, by Julia Hammett	63
	3. Comparative Analysis of the Surface Treatment of Pueblo II-III Corrugated Wares from Hovenweep National Monument, 1975 Survey, by Michael Pendleton and Dorothy Washburn	79
	4. A Study of Lithic Materials Found in the 1976 Field Season of the Hovenweep Archeological Project, by Anita B. Hornback	93
	5. Projectile Points Hovenweep 1976, by Patricia A. Hicks	114
	6. Ground Stone Tool Analysis 1976	119
	7. Worked Bone Tools 1976 by Thomas D. White	125
	8. Miscellaneous Artifacts	130
	9. Farm Field Location Through Palynology, by Anne I. Woosley	133

Page

10. Soil Chemistry Studies of Hov 24, by Allan McIntyre 151

11. Sampling Procedures, 1974-1975: Physiographic Analysis of Hovenweep Survey Quadrats, by Gail Del Pero 159

12. Hovenweep Lithic Sources, by Marilyn Swift 170

13. Further Studies of the Potential Faunal Resources on Cajon Mesa, by Thomas D. White 183

IV. INTERPRETATIONS . . . . . .

1. Farm Fields and Water Control 188
   A. Floodwater Fields 188
   B.-C. Sand Dunes and Seepage Fields 198
   D. Springside Gardens 201
   E. River Irrigation 204
   F. Dry Fields 204
   G. Reservoirs and Tanks 206
   H. Mesa Top Terraces 208

2. Other Types of Sites 210
   A. Towers 210
   B. Pithouses and Kivas 215
   C. Storerooms, Shelters and Other Sites 218

3. Economy 230
   A. General 230
   B. Hovenweep Maize 1974-1976, by Dorothy Reaves 232
   C. An Analyses of the 1976 Faunal Remains, by Thomas D. White 237

4. Paleoenvironment 243
   A. General 243
   B. Pollen Evidence For Environmental Change at Hovenweep National Monument AD900-AD1300, by Glendon H. Weir 246

5. Hovenweep Rock Art and Agriculture, by Nancy Hulbert Olsen 279

REFERENCES 293

LIST OF FIGURES

Figure		Page
1.	Location of 1976 Test Excavations on Cajon Mesa	12
2.	Map of Hov 648	14
3.	Map of Hov 691	16
4.	Map of Hov 626	18
5.	Map of Hov 24	19
6.	Map of Hov 520	21
7.	Map of Hov 597	23
8.	Map of Hov 623	25
9.	Map of Hov 709	26
10.	Map of Hov 685	28
11.	Map of Hov 15	29
12.	Map of Hov 707	31
13.	Map of Hov 708	32
14.	Map of Hov 64	33
15.	Map of Hov 12	35
16.	Map of Hov 3	37
17.	Map of Hov 53	38
18.	Map of Hov 714 Reservoir	40
19.	Map of Hov 714 Tower Complex	42
20.	Map of Hov 94	43
21.	Map of Hov 643	45
22.	Map of Hov 571	47

Figure		Page
23.	Map of Hov 656	49
24.	Map of Hov 47	51
25.	Map of Hov 49	53
26.	Map of Hov 456	55
27.	Map of Hov 665	56
28.	Map of Hov 539	58
29.	Map of Hov 644	59
30.	Map of Hov 652	61
31.	Mesa Verde Corrugated and Hovenweep Corrugated (lower right) vessels from Hovenweep	72
32.	Chapin Gray (upper left), Hovenweep Gray (upper right) and Piedra Black-on-white (bottom) vessels from Hovenweep	72
33.	McElmo Black-on-white (upper left and right, middle left), Mesa Verde Black-on-white (middle right and lower left), and plain white (lower right) vessels from Hovenweep	75
34.	Model Drawing of Attributes on Corrugated Sherds	81
35.	Distribution of Coil Width on Hovenweep and Mancos-Mesa Verde Corrugated Sherds	81
36.	Distribution of Sherd Thickness on Hovenweep and Mancos-Mesa Verde Corrugated Sherds	84
37.	Distribution of Hovenweep and Mancos-Mesa Verde Corrugated in the Seven Drainage Systems on Cajon Mesa	92
38.	Examples of Bifacial (upper row) and Unifacial (bottom row) Tools From Hovenweep	110
39.	Jar Lids From Hovenweep	110
40.	Examples of Axes and Mauls From Hovenweep	113

Figure		Page
41.	Hoes From Hov 49	113
42.	Examples of 1976 Hovenweep Projectile Points. Upper left - Armijo; upper middle and right- Late En Medio; middle row- BMIII-PIII corner notched; lower row- PII-III side notched	115
43.	Pendants From Hovenweep	132
44.	Miscellaneous Artifacts From Hovenweep . .	132
45.	Cross-Section of Hov 94 Akchin Dams and Terraces	194
46.	Hov 94 Akchin Dams During Tests.	194
47.	Floodplain Test Locations in Little Ruin Canyon Below Square Tower Ruin Group	195
48.	Floodplain Field Test Locations in Canyon Below Hackberry House Ruin Group	195
49.	Arroyo Dam at Hov 644	197
50.	Cross-Section of Arroyo Dams and Terrace at Hov 644	197
51.	Upright Slab "Ditch"(?) at Hov 49	199
52.	"Floodplain Terrace"(?) Wall at Hov 49 . .	199
53.	Cobble Wall at Hov 12	200
54.	Cistern Wall and Ditch at Hov 64	202
55.	Cross-Section of Cistern Wall and Ditch at Hov 64	202
56.	Map of Cobble Walls, Pithouse (?) Slab Wall and Ventilator Shaft (?) at Hov 64	203
57.	Transect Map of Presence/Absence Pollen Distribution of Corn, Beans and Squash at Hov 47 . . .	205
58.	Cross-Section of Reservoir Wall at Hov 714	207
59.	Tower Wall at Hov 571	207

Figure		Page
60.	Grinding Bins and Wall at Hov 685 Tower . . .	214
61.	Walls, Plaster Floor and Footprints in Tower at Hov 12 (Twin Towers)	214
62.	Room Wall at Hov 714 Tower	216
63.	Kiva at Hov 623 (Aneth Trading Post)	216
64.	Work In Progress at Hov 12 Kiva	219
65.	Cross-Section of Kiva at Hov 94	219
66.	Modern and Fossil Pollen Diagram	258-260
67.	Cajon Mesa Vegetation Zones	261-262
68.	Lalakonta Ceremony Figures (after Fewkes and Owens 1892, Plates I-II)	282
69.	Symbols Recorded at Each Site	286
70.	Detail of Petroglyph at 5MT312 (Ismays) Showing Anthropomorphic Figures With Headdresses Arranged in a Spatial Structure	289

LIST OF TABLES

Table		Page
1.	Chronology of 1976 Sites	13
2.	1976 Ceramic Types By Site	64-67
3.	1976 Ceramic Vessel Counts	68-70
4.	1974-1975 Survey Data	76-77
5.	Distribution of Crest--Crest Measurements on Hovenweep and Mancos-Mesa Verde Corrugated . .	85
6.	Distribution of Crest--Trough Measurements on Hovenweep and Mancos-Mesa Verde Corrugated . .	86
7.	Distribution of Coil Heights on Hovenweep and Mancos-Mesa Verde Corrugated	87
8.	Distribution of Primary Angles on Hovenweep and Mancos-Mesa Verde Corrugated	88
9.	Distribution of Vessel Condition Types on Hovenweep and Mancos-Mesa Verde Corrugated	90
10.	Distribution of Surface Treatments on Hovenweep and Mancos-Mesa Verde Corrugated	91
11.	Identification of Stone Types of Experimental Tools	94
12.	Experimental Material and Action	94
13.	Edge Angles	95
14.	Tool Types by Site	99-109
15.	Revised Means and Ranges of Various Attibutes of Hovenweep Projectile Points	116
16.	Hovenweep 1976 Projectile Points By Site . .	118
17.	Ground Stone Tools By Type and Site 1976 . .	120
18.	Beveled Manos	122
19.	Flat or Parallel Manos	123

Table		Page
20.	Other Ground Stone Tools	124
21.	Worked Bone Artifacts	126
22.	Miscellaneous Artifacts From Hovenweep 1976 Tests	131
23.	Major Pollen Types at Hovenweep 1976	136-144
24.	Hov 47 Pollen Transect Data	145-147
25.	Soil Chemical Tests at Hov 24	153-158
26.	1974-1975 Survey Samples Stratified by Botanical Zone	162
27.	Pinyon-Juniper Mesa Top Quadrats	163
28.	Sage Mesa Top Quadrats	166
29.	Mann-Whitney U Test	167-168
30.	1975 Tool Material By Site	171-180
31.	1976 Mammal Trapping Data and Population Estimates	185
32.	Hopi and Zuni Water Control Device Correlated With Field Type	189
33.	1976 Sites Correlated With Possible Farm Field Type and Cultigan/Weedy Pollen Found at Each Site .	190-192
34.	1976 Tower Data	212-213
35.	Features Recorded at 1976 Site Tests	220-229
36.	Maize Attribute Data, 1976 Hovenweep Material	233
37.	Percentages of 8-Rowed Cobs Across Northern Southwest	235
38.	Frequency (%) of Taxa Identified From Faunal Remains from Nineteen Sites	238-240
39.	Location and Provenience of Pollen Samples .	247-252
40.	Modern Pollen Sample Counts	253-257
41.	Fossil Pollen Sample Counts	267-273
42.	Specific Symbol Occurrence With Site Features	287



OBJECTIVES

Detail of petroglyph panel at Ismays

I. OBJECTIVES

As described in the Hovenweep 1974 and 1975 reports (Winter 1975, 1976), the goals of the three year old Hovenweep Project are to reconstruct the Anasazi agricultural system at Hovenweep and the surrounding ruins on Cajon Mesa. This report summarizes the test excavations and related environmental activities which were run at Hovenweep during the summer of 1976. The two preceding years of survey located the various types of ancient farm fields which were used on Cajon Mesa and determined to some degree their spatial distributions. A considerable amount of research remains before the goals of the Project are realized, however, since we still need to know how the sites worked, why they were built in their respective locations, when they were constructed and abandoned, and how they were integrated into a functioning agricultural system built around mesa top and canyon head habitation centers. Many basic temporal and explanatory questions cannot be answered, in fact, without subsurface information. Determining the relations of economic change and growth, or environmental disturbance and regional abandonment, or the effects of altered resource base on population dynamics, for example, can only be accomplished with controlled data from middens, storage rooms and farm fields. For this reason the 1976 season was organized around the testing of thirty archeological sites on Cajon Mesa. The experimental and environmental research which was initiated in 1974 was also continued, so several approaches which cross-cut archeology and environmental studies were involved. Brief descriptions of each of these approaches form the basis of this report.

II. PROCEDURES

1. Resource Baseline Studies

To understand the ancient Hovenweep environment and economy it is essential that the full range of existing resources is identified. Glen Weir's study (1976; chapter IV.4.B) of the survey pollen samples from the 400 sites examined during the 1974 and 1975 seasons is an excellent example of the value of this approach. By comparing modern plant community boundaries with pollen rain variations across Cajon Mesa, and then analyzing the pollen content of samples from archeological sites in each of the plant communities, Weir was able to determine that several fluctuations in plant community boundaries had occurred during the Anasazi use of the Mesa. To understand how and why these environmental changes took place, and to discover similar variations in faunal, soil and lithic raw material utilization patterns, environmental baseline studies were continued through the 1976 season.

A. Floral Studies - Bill Litzinger's analysis of plant community boundaries and species composition were continued through the winter of 1975 and on into the spring and summer of 1976 (cf. Litzinger 1975,1976a, 1976b). Over 300 species have been found growing on the mesa in dozens of communities in six major floristic zones. Litzinger also completed a detailed reference herbarium which is available for study at the Hovenweep Museum.

Glen Weir continued his surface pollen collecting to obtain a more accurate picture of the relations of modern flora with its pollen distribution. Several deep arroyo cuts were sampled for pre and post occupational environmental data, while extensive pollen samples were taken from each of the thirty sites tested during the summer. Weir has analyzed the environmental samples and the economic pollen from the middens, granaries, towers and storerooms, while Anne Woosley has examined the agricultural pollen from the farm sites.

B. Zoological Studies - Ted Rado's faunal analysis (Rado 1975, 1976) was taken over by Tom White. Although Rado's study gave us a general view of mammal resources across much of the Mesa, several micro-zones which are rich in archeological and mammal resources remained to be trapped. White therefore concentrated his trapping activities around an active sand dune on the Navajo Reservation, a

juniper-sage ecotone, a spring near Cutthroat Castle (Hov.70), and the broad alluvial floodplain of Hovenweep Canyon below Painted Hand (Hov.600). Several of Rado's original trapping zones (narrow canyon bottom, canyon edge and sage flat) were also retrapped to obtain an estimate of resource turnover.

C. Geological Resources - Marilyn Swift's (1976) study of geological resource patterning on Cajon Mesa has demonstrated the potential of lithic source analysis for tracing trade networks and community relations. Unlike Mesa Verde to the east, the canyons of Cajon Mesa are extremely rich in cherts, chalcedonys, shales and other source materials. Since the 1974-1975 surveys have already yielded a large collection of tools of numerous materials from 400 sites, Swift continued her study in 1976 by surveying several of the major canyons to locate possible quarries.

D. Soils - Allan McIntyre resumed Bradley Noisat's (1976a) investigation of the Hovenweep soils by concentrating on chemical and ph variations at one site. Samples from the occupational and post-occupational fills of several features at Hov. 24 have been analyzed by McIntyre to determine if soil chemistry varies as a result of cultural and natural depositional activities (Hov. 24 is a possible late Basketmaker III through Pueblo III Prudden Unit).

2. Site Testing Program

The Hovenweep Archeological Project was initiated in 1974 to investigate the Anasazi economic system as it functioned on Cajon Mesa. Three broad archeological field stages are involved: 1) two years of survey to obtain an overall view of the environmental zones and site distributions; 2) two years of limited testing of 50-60 sites to collect background economic and environmental data; and 3) two or more years of excavation at one of the larger tower complexes to obtain a detailed understanding of a single farming community.

The testing phase of the past summer entailed the recovery of four levels of information. First, we needed to know more about the places where farming and water control occurred, and where produce was prepared, stored, distributed and consumed. Second, we also wanted to know more about variations in the foods, including the domesticated and weedy crops, the wild products and competing pests.

The seasonal patterns of availability, the fluctuations in resource zones, the patterns of post-abandonment succession, and the types of ceremonial-medicinal-construction plants are relevant to this search. Third, we needed to learn about the behavior responsible for the fields and harvests. How were the crops grown? How were farm fields prepared, maintained and abandoned? How were storehouses built? How was food distributed within the social unit? How was it ritually used? Finally, we wanted to know about the changes which took place in all three of these economic spheres, how the system emerged and declined, how the environment was affected by, and in turn affected the farming system, and how the economy functioned over time and was linked with the religious, social and political customs of the Anasazi.

A. Types of Data - To facilitate this search, the testing phase was oriented around the collecting of information relating to economic features and economic/environmental data.

Economic features are all meaningful phenomena which apparently resulted from, or were associated with farming and related economic activities; thus granaries, store rooms, grinding bins, plazas, terraces, reservoirs, alluvial laminae in fields, roof fall, post occupational layers in rooms, trash lenses and many other things have been trenched and analyzed. Features generally cannot be brought back to the lab intact, so careful and detailed description in the field was essential. We already know that many of the Hovenweep sites, such as terraces and granaries, were probably associated with agriculture, as demonstrated by the pollen and floral data collected in 1974-1975. For this reason we intentionally chose certain of them to test since we needed data concerning the crops and weeds which grew on them and the construction techniques and maintenance behavior. Other sites, such as kiva/pithouse depressions and middens, yielded information concerning broader aspects of the economy and environment. Still others, such as lithic scatters, were tested precisely because we do not know what kinds of economic data they contain. In each instance all of the features we encountered were fully described and examined, within the time limits of our program, whether they appeared to have resulted from agricultural activities or not. Even when direct economic information was lacking, for example in kivas, data about social distribution of food, post-occupational climate and economically related rituals was still revealed.

Economic/environmental data are composed of artifacts, pollen, botanical specimens, flotation samples, animal bones, coprolites, ash and other items associated with or making up the features. This material can be brought from the field and analyzed, and it was collected in immense quantities. Much of the excavation routine was spent, in fact, in the collecting and proveniencing of economic and environmental information.

B. Types of Sites - Two general types of sites were tested during the summer. Brief descriptions and maps of each site can be found in the following chapter; testing methods and sampling procedures are discussed below.

At possible habitation/storage sites, three basic trenches were generally established:

a. One trench was normally placed in possible storage or work rooms to find crops and evidence of processing, habitation, and related activities. Features which were encountered included walls, fill layers, floors, grinding areas, storage bins or pits, metates, manos and hearths. Pollen scrapings and washings, botanical specimens, flotation samples, dating samples, vessel contents and soil samples were collected.

b. Trash mounds or middens were also usually trenched, since the daily accumulation of refuse, the occasional cleaning of rooms and the natural buildup of background environmental data during and after site use resulted in an enormous amount of information. Middens also provided controlled ceramic sequences, sometimes in stratified form. Structural features were seldom encountered, except when earlier features were covered by the refuse, but in one instance a burial was uncovered. Burials can be especially important sources about ritual plant use.

c. Finally, kiva/pithouse depressions and towers were usually investigated. Layers of post-occupational fill and roof fall were usually dug through, exposing floors, hearths, vessels, grind stones, lithic tools, beams and sipapus. All layers and features were sampled for pollen, flotation and soil, including sterile layers. Deep structures should be especially valuable sources of successional patterns, since rain water and snow melt apparently pooled up in the depressions, catching seeds and pollen. Kivas, pithouses and towers were also probably the locations of economically related rituals, processing activities and perhaps even storage and consumption activities, so the roof fall, floors, bins and other features were often rich in burned crops, bones, ash and pollen, as well as vessels, sherds, grind stones, projectile points and beams.

When time permitted, other features as well were trenched at the large sites. Rows of upright slabs were sometimes examined, since they often denote the remains of jacal structures, early surface rooms or pithouses. Wing walls were also tested, which are low rock walls forming gridworks around a site and which may have been agricultural terraces, jacal ramadas or habitation structures. Possible water control features at large sites were almost always tested; when present,

four trenches were sometimes placed at water control/habitation sites: one across the water control structure, one in a tower, one in a kiva depression, and one in a roomblock or midden.

At water control sites, whether they were simple check dams in an arroyo or complex tower clusters with a variety of water control structures, a number of different tests were utilized. A variety of different types of water control sites were noted locally during the survey, so test pits were usually set up to bisect the walls and sediments of each type of site, thereby exposing the stratigraphy all across the structure along with the sterile material at both ends and beneath it. Since the material in water control sites was usually sterile and non-artifactual, they were fairly easy to test. In fact, aside from the masonry walls and a few sherds or lithics, the features were generally composed of alluvial laminae made up of soil and gravel. We wanted to identify old field surfaces, along with the rates and processes of soil buildup and construction techniques, and great care was used in examining the layers and following them out. The strata and their pollen-flotation-soil samples also yielded information concerning crops, weeds, weather, moisture retention, nutrient content and sedimentation dynamics. All of the layers of the sites were defined, down to bedrock or subsoil, and when more than one dam or terrace was present, several dams were trenched. Area excavations were sometimes run along the most productive looking layers, stripping back the soil across a portion of the terrace. Theoretically the remains of old field surfaces, rows, hills, waffles, ditches and dams should have been revealed by area excavations, as demonstrated by Fowler (1969) and others in the Southeast and Midwest. Although no visually obvious field surfaces were found, the pollen associations did allow us to identify the locations of dry fields, floodplain fields and several types of terraced farms.

C. Types of Sampling Procedures - Ethnobotanical studies were at the core of our research. Data relating to plant remains and their distributions within a site, as well as their changes within the natural and culturally modified environment around a site, are essential to an understanding of the prehistoric Hovenweep economy. They can be the key to the relations of a human society and its resource base, they provide a measure of the socioeconomic energy necessary for subsistence maintenance and growth, and they serve as sensitive indicators of the complex, reciprocal relationships between cultural modifications and environmental alterations. For this reason much of the past summer's collecting activities were organized around the controlled retrieval of botanical data. A variety of sampling techniques were used.

a. Botanical samples included all plant remains except pollen and dating specimens, including flotation samples and bulk feature specimens (i.e., obvious plant remains such as corn

cobs, beans, and large charcoal pieces). In contrast to Bohrer (1976) we retrieved all kernels, seeds, cobs, stems, and other botanical materials encountered, not just subsamples, since we believe that inter and intra-site variations in crops and weeds can be revealed by analyzing the morphological characteristics of plants. Corn can be especially important, so if a bushel or more of cobs and kernels was uncovered, all of it was collected (cf. Winter 1976: 302-303).

Flotation samples are particularly important types of botanical samples, and sampling by flotation can increase the efficiency of botanical collecting to an amazing degree. Studies by Munson et al (1971) at Scoville, for example, suggested that flotation was at least 50 times more effective than ¼ inch screening! All Hovenweep samples were broken down in the lab using the water technique of Bohrer (1976). Two types of flotation samples were taken at each site:

- general samples - Unscreened general flotation samples from obvious features, such as ash lenses, fire pits, storage bins, etc. in which economic data could be expected. Bags of soil were taken from all features, in fact, whether we noted obvious botanical materials or not.

- screen samples - Ideally, all soil removed from a site should be screened through ¼ inch mesh or smaller screen to retrieve tiny beads, bones and seeds. Screening also reduces the weight of flotation sampling, if proper techniques are utilized. Time never permits us to screen everything, but in a project such as ours where quantification is essential, screening is absolutely necessary. Therefore portions of all provenience units and features were screened and flotation sampled, using several mesh sizes. First, one bucketful of each 10 cm. deep by one meter square unit was screened through a ¼ inch mesh shaker screen. All of the botanical and zoological remains caught by the screen were collected. Next, the residue passing through the ¼ inch screen was then passed through a one mill screen, and again the tiny organic matter caught by the screen was collected. Finally, a large flotation sample was taken from the fine residue which passed through the one mill screen. In this manner three already screened and separated flotation samples were taken from each provenience unit, along with general flotation samples and bulk botanical samples from each feature.

b. Pollen Samples were also taken from all features and provenience units. The surfaces of whole or partial grind stones were also sampled, as were vessel interiors and the plaster in walls and floors. Grind stones were immediately wrapped up in foil when uncovered and transported back to the lab, where pollen washings and at times flotation samples were taken from their surfaces. If a vessel was too fragmented to transport intact, samples were taken in the field.

c. Zoological Samples were also saved whenever encountered. Fine bones which are normally missed, even when screening, have emerged from the flotation samples. Most of the bones were from fill layers, but an intact Hovenweep Corrugated vessel from a tower at Holly House (Hov.53) on the canyon rim yielded the skeletons of a rabbit, three lizards, a toad, a mouse, and two birds.

d. Dating Samples involved dendrochronological specimens and C14 materials. Dendro samples are by far the more reliable and inexpensive of the two, but C14 are more common, due to the immense amount of botanical materials we recovered. Dendro samples were taken whenever available; if large number of burned logs were found, for example in a kiva or pithouse, the largest and most intact were saved. C14 samples were always collected, even when dendro materials were present, since many of the tree species at Hovenweep are not datable by dendrochronology.

e. Soil Samples were taken from all layers and features at water control sites, and when time permitted, from all features at other sites as well. Soil samples were also taken from sterile control pits near each site, and from nearly 100 locations in a possible dry field near Hov. 47.

f. Artifacts were collected, whenever uncovered. These included four whole vessels, a dozen partial vessels, over 6000 sherds, several thousand lithics, and dozens of grind stones, bone tools, beads, pendants and other materials.

3. Gardening and Water Control Experimentation

Three of the gardens started by Bill Litzinger in 1975 (Litzinger 1976c) were continued this summer, while two were left fallow to study weed succession. Hopi and other traditional Indian crops were raised at the two gardens near the project camp and at Lowry Ruin. Although

the results were poor in terms of harvest size, valuable data on weed succession, weed competition and herbivore predation were obtained.

Water control experimentation was similarly continued and expanded. Chris Pierce took over Bradley Noisat's (1976b) study of springs by comparing the volume of several modified and unmodified springs and by incorporating excavation data from the Hov. 3 and Hov. 64 seep sites. A study of possible dry farm field locations and unmodified floodplain fields was also initiated by taking long pollen transects around the Hov. 47 mesa top pueblo and in the canyons below Hackberry House and Square Tower Ruin.



DATA

Twin Towers (Hov 12) from Little Ruin Canyon

III. DATA

1. Site Descriptions

By
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Thirty archeological sites were tested during the 1976 field season. Eight of these were clustered in and around the Square Tower Ruin complex at the head of Little Ruin Canyon (Fig. 1), while eleven were located in and around Big Ruin Canyon. The remaining sites were scattered across Cajon Mesa in or near Negro, Hovenweep, Cross, Bridge, Keeley, Allen and McElmo Canyons. All sites were chosen on the basis of the economic and environmental data they might yield; two thirds of them were clustered around the two canyon systems in order to test certain of the proposals presented in the Projected Research section of the Hovenweep 1975 Report. Individual site descriptions are presented in this section, organized around type of site.

A. Possible Habitation/Storage Sites

Twenty of the thirty sites appear to have been living sites where a variety of processing, storage, consumption and ceremonial actions took place. Eight of these additionally yielded evidence of water control activities, so they are discussed in the next section. Possible habitation sites were generally composed of rubble mounds, surface rooms, middens and apparent kiva or pithouse depressions. Three much smaller sites organized around rock overhangs were probably used as storage units associated with the larger living sites. The chronological positions of many of the sites have been determined by dendrochronology and C14 (Table 1). The other sites' dates have been approximately determined using ceramics.

Hov 648 - 5MT4090 -

Hov 648 is a possible Archaic shelter and Pueblo II-III special use site located on the floor of Big Ruin Canyon several miles below the Hov 707/708/709 complex. Three trenches and an isolated test pit were used at the site, which was composed of several rock overhangs and an apparent kiln or roasting pit (Fig. 2).

Figure 1. Location of 1976 Test Excavations

Location:

1. Hov 623 (Aneth Trading Post)
2. Hov 456/359/458 (Cajon Spring)
3. Hov 520/597 (twin pueblos above Little Ruin Canyon)
4. Hov 3/12/15/24 (Little Ruin Canyon complex at Square Tower)
5. Hov 94/539 (farming sites above Little Ruin Canyon)
6. Hov 53 (Holly House)
7. Hov 64 (Hackberry House)
8. Hov 47/49 (pueblo and farm site above Horseshoe House)
9. Hov 656 (large unit pueblo and farm site above Hovenweep Canyon)
10. Hov 648/652 (shelter/kiln? and farming site in Big Ruin Canyon)
11. Hov 665 (reservoir in Cross Canyon)
12. Hov 707/708/709 (unit pueblo and storage sites above Big Ruin Canyon)
13. Hov 691 (pithouse above Hovenweep Canyon)
14. Hov 626 (pithouse above Negro Canyon)
15. Hov 714/571 (pueblo, reservoir and tower complex on Cow Mesa above Big Ruin Canyon)
16. Hov 643/644/615/685 (pueblo, check dams, and tower cluster above northern reaches of Big Ruin Canyon)

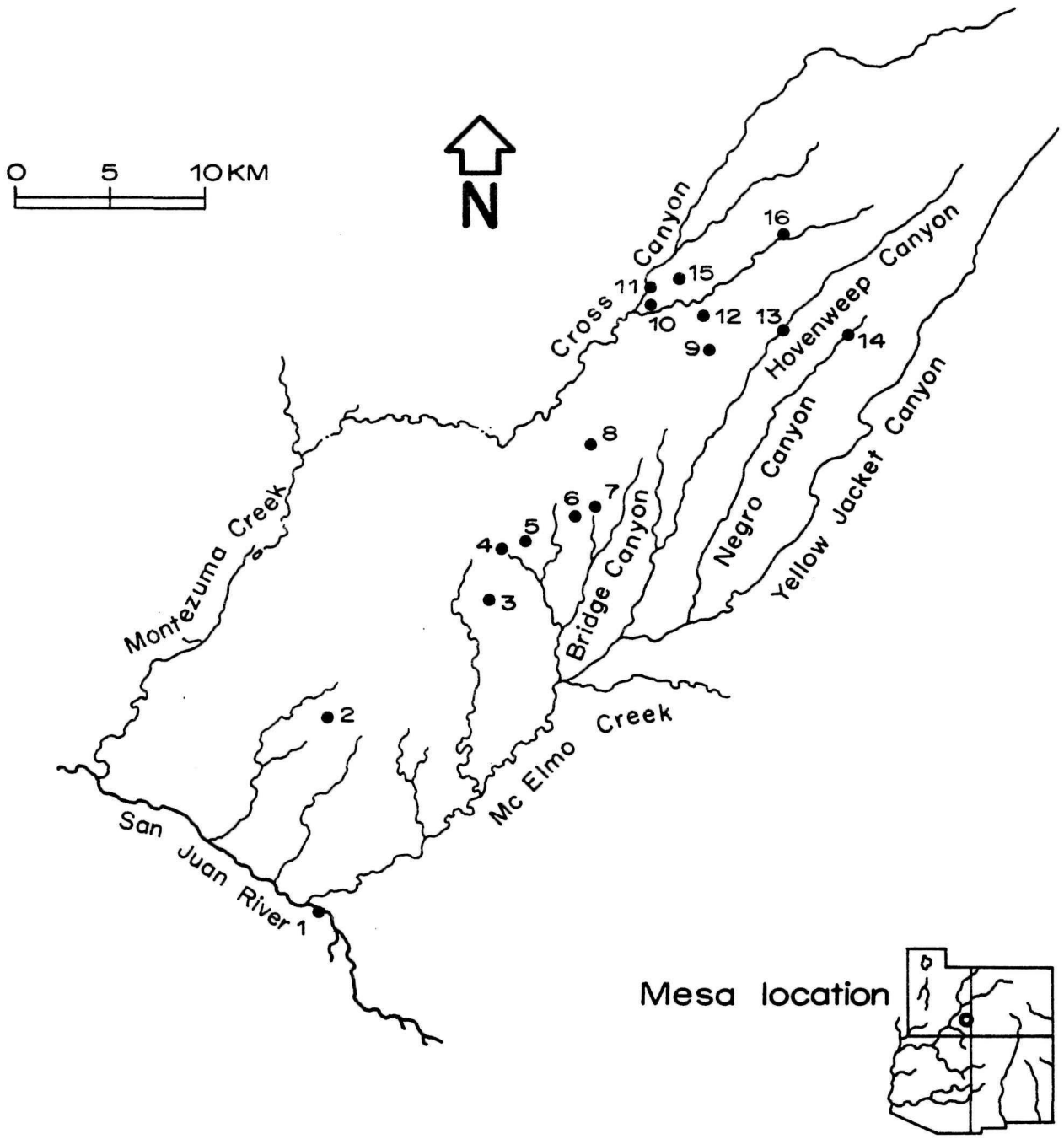


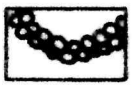
FIGURE 1 Location of 1976 Test Excavations

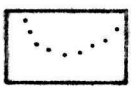
TABLE 1 - Chronology of 1976 Sites

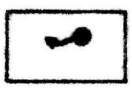
Site		C14 Date	Dendrochronological Date
Hov 648	- shelter	445BC±145	
	- kiln?		AD1151+vv
Hov 691	-pithouse	AD660±100	
Hov 709	-slab cist	AD695±100	
Hov 15	-pithouse/kiva	AD920±130	AD1188vv
Hov 626	-pithouse		AD973+vv AD1023vv
Hov 24	-kiva	AD1080±120	
Hov 520	-kiva	AD1120±120	AD1173+v
Hov 597	-storeroom	AD1190±100	
Hov 53	-Boulder House		AD1201+vv
	-Holly House		
	-north room		AD1236+B
	-south room		AD1246+L AD1267+B
Hov 12	-Twin Towers		
	-west tower		AD1232+v
	-kiva	AD1240±130	
Hov 64	-Hackberry Ruin		
	-midden	AD1260±120	
Hov 94	-kiva	AD1380±120	
Hov 47	-storeroom	AD1615±120	

Key to Figures 2 – 30

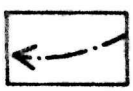

Cliff edge

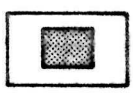

Standing wall


Rubble area

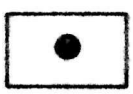

Seep

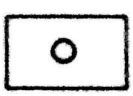

Cliff overhang

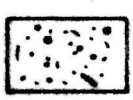

Drainage pattern

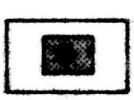

Test pit

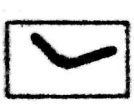

Depression


Charred post


Pollen test pit


Midden


Burial or storage pit


Earth wall

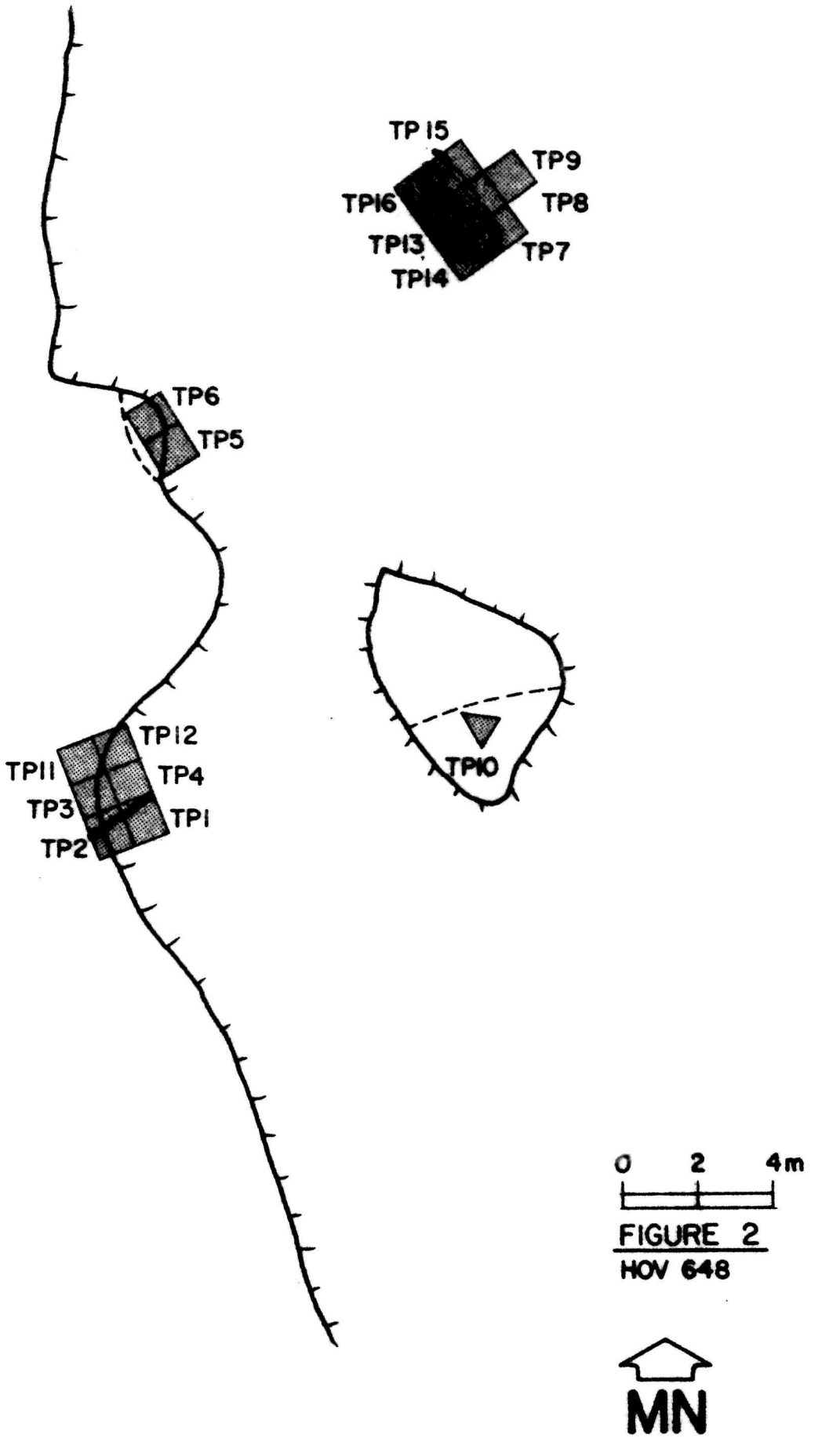


FIGURE 2
HOV 648

T.P. 1-4 and 11-12 investigated a wall in one shelter, while T.P. 5-6 examined a smaller shelter to the north. Aside from the one wall, a few artifacts and charcoal, no cultural features were uncovered. A C14 date of 445BC±145 from one of the shelters, however, suggests that the site was used by archaic hunters and gatherers.

T.P. 7-9, and 13-16 recovered rich cultural material. A heavily burned room or cist was surrounded by upright stone slabs and an adobe collar. The floor was formed of horizontal sandstone slabs, with the remains of several smashed Mesa Verde and McElmo Black-on-white bowls resting on its surface. The structure may have been used as a room, but it is also possible that it functioned as a pottery kiln or large cooking feature. A dendrochronological sample of AD1151+vv was obtained from a log in the fill.

The final pit at the site was T.P. 10, located in a shallow crack between two large boulders. Charred plant materials, charcoal lenses, and alluvial laminae apparently represented slope wash and midden.

Hov 691 - 5MT----

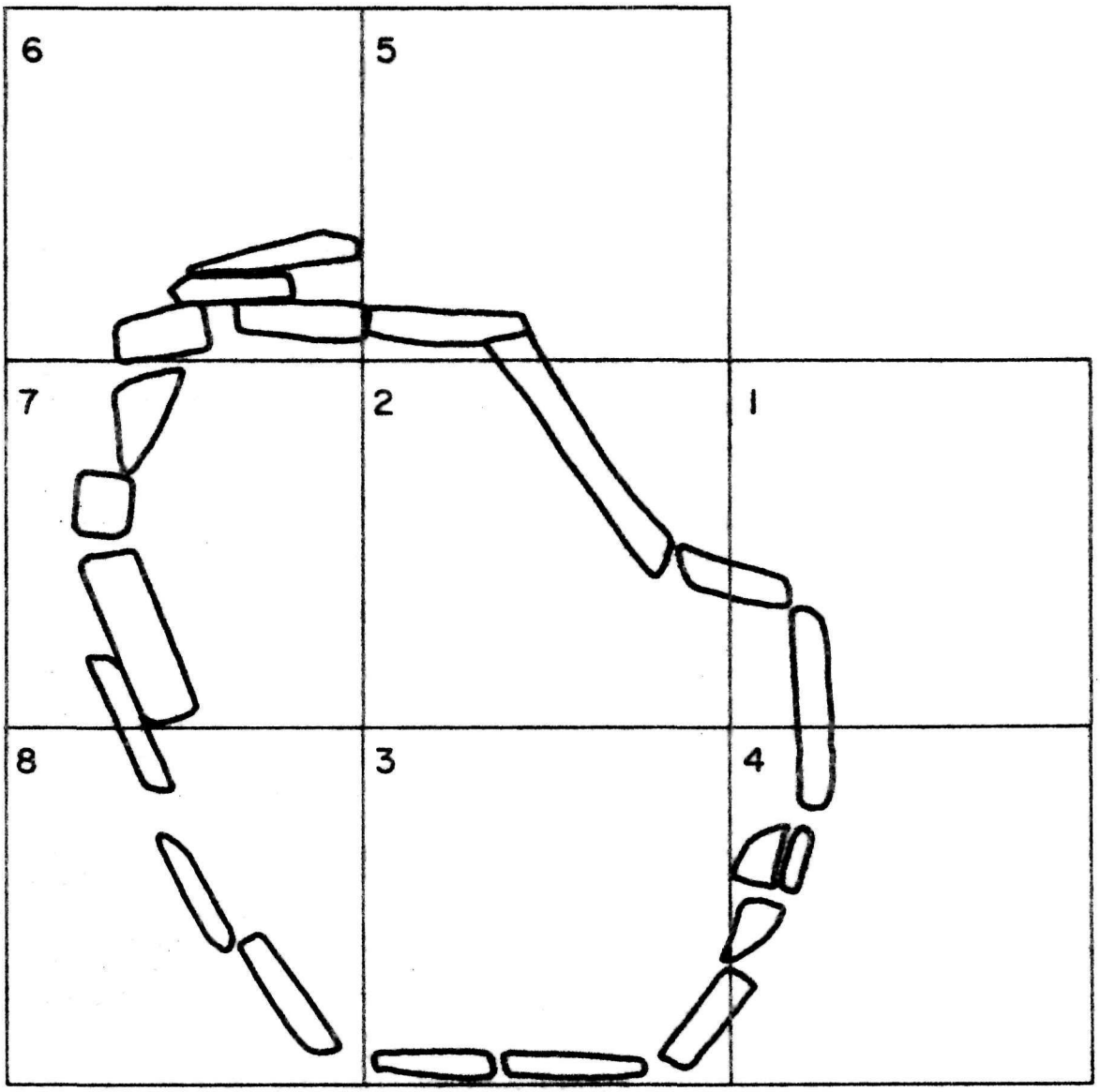
The only definite Basketmaker site tested during the summer was Hov 691, located in the general vicinity of the Hov VII survey Quad (see Winter 1976 for survey quad locations). We had originally intended to test a possible pithouse at Hov 542, but were unable to relocate the isolated site in the dense, homogeneous pinyon-juniper forests above Hovenweep Canyon. The upright stone slab structure at the nearby Hov 691 site was discovered and tested instead (Fig. 3). Eight 1 x 1 meter pits exposed the feature, which seems to have been a surface cist or small rectangular pithouse. A rough use surface was noted at 35-40 cm. below surface, immediately above bedrock. A partial Chapin Gray jar and a smashed apparent Piedra Black-on-white ladle were found in the burned roof fall in a layer of ash, cracked rock and reddened soil.

No other test pits were established at the site, but the absence of surface debris outside of the slabs probably indicates a limited, special use room or isolated pithouse hamlet, of the Basketmaker III period. The one C14 date from the site was AD660±100.

Hov 626 - 5MT4-68 -

Hov 626 is a probable late Pueblo I-early Pueblo II pithouse site located above Negro Canyon. It occurs in an open knoll, with numerous unit pueblos and ceramic/lithic scatters in the surrounding pinyon-juniper forests and sage thickets. Although no obvious depressions were noted on the surface, concentrations of sherds, lithics, burned rocks and discolored soil indicated an early Pueblo occupation.

Two trenches were used in separate artifact scatters to determine



0 .5 1m

FIGURE 3
HOV-691

MN

if subsurface structures existed at the site (Fig. 4). Test pits (T.P.) 1-2 examined the largest scatter, while the 4 meter square T.P. 3 investigated a cluster immediately to the south. Two burned earth walls forming the corner of a semi-subterranean room were exposed at 25 cm. below surface in T.P. 1-2, with a probable adobe floor occurring at 85 cm. below surface. Charred stubs of posts were encased in the wall, and a partition of upright stone slabs set in an adobe collar was found near the corner of the walls. A much cruder earthen wall was found in T.P. 3, but it is unclear if it represents a pithouse wall or a former surface feature. The walls, posts, floor and partition in the nearby trench, however, undoubtedly indicate a semi-subterranean pithouse, similar to those found by Martin (1938, 1939), Wheat (1955) and Rohn (1975) on Cajon Mesa, Matheny (personal communication) in Montezuma Canyon and Brew (1946) on Alkali Ridge. The dense surface concentrations of rubble and sherds probably indicate a rather sizable early Pueblo village, which has been dated to the late 900s and early 1000s by dendrochronology (Table 1).

Hov 24 - 42SA1924 -

Hov 24 is an apparent late Basketmaker III or early Pueblo I through Pueblo III Prudden Unit located on a ridge above the Square Tower complex in Little Ruin Canyon. Two other nearby ridgetop pueblos and the Hov 94 farming community in an adjacent arroyo suggest that a rather sizable mesa top population of farmers once lived on Cajon Mesa prior to the development of the canyonhead towers in the thirteenth century A.D.

Five small trenches were set up at the pueblo (Fig. 5). T.P. 1-2 investigated the large central depression, which apparently represents the remains of a Pueblo II-III period kiva. Features exposed within it included a bench composed of thick plaster laid over pecked stones, a possible wall niche, and a plastered floor. A C14 date of AD1080±120 was obtained from wood in the roof fall.

T.P. 3-4 and 11 trenched two of the contiguous rooms which formed a U-shaped unit around the depression. A single course of well-shaped masonry blocks formed a wall separating the rooms, and floors made of plaster and sandstone slabs set horizontally in mortar were found in the northern and southern rooms, respectively.

T.P. 5-6 investigated a small three sided masonry room to the south of the roomblock. The two walls which were uncovered were only four courses high but were formed of well-shaped, pecked masonry blocks. The floor seems to have been a natural caliche use surface.

The final two trenches at the site included T.P. 9-10 in a low rubble mound a few meters to the north of the room block, and T.P. 7-8 in the midden to the southeast of the depression. The midden lacked

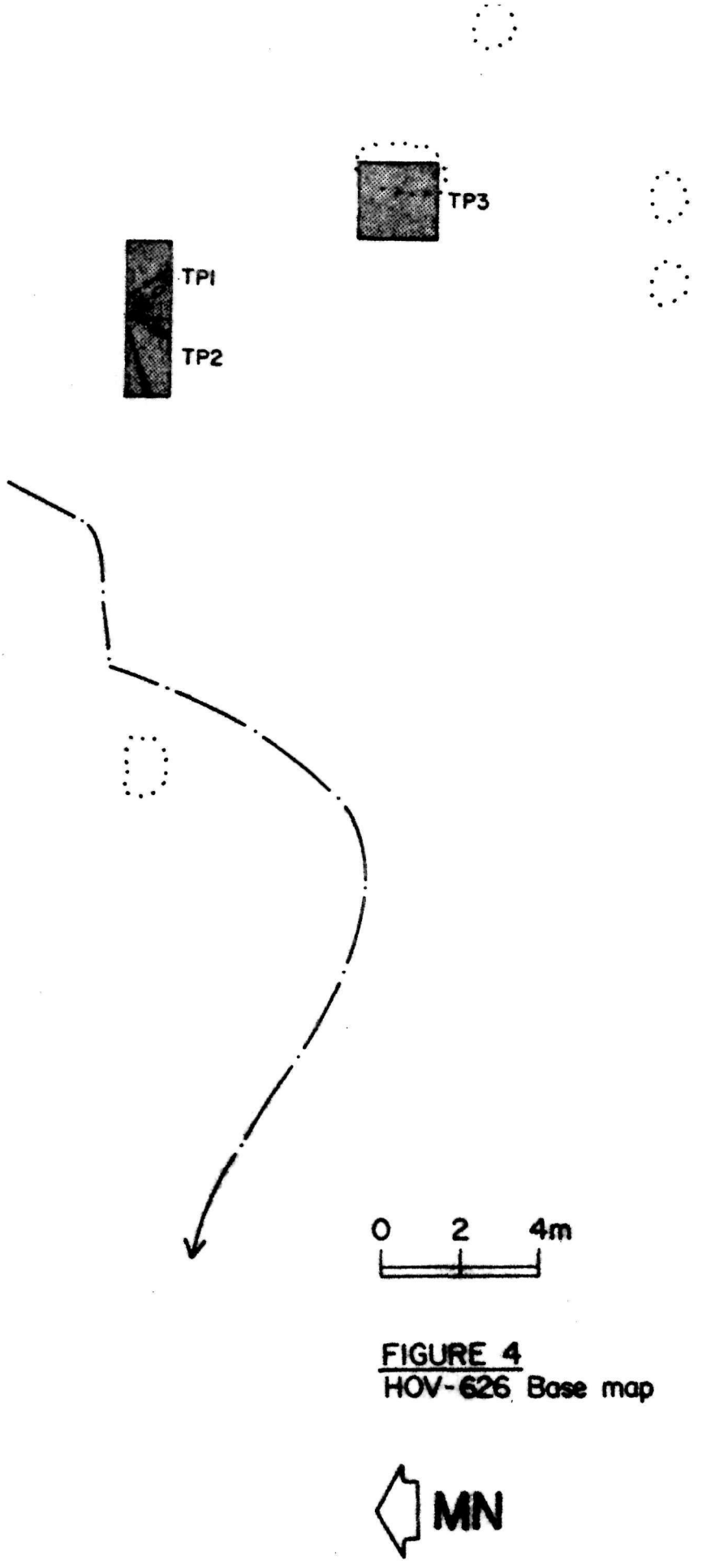


FIGURE 4
HOV-626 Base map

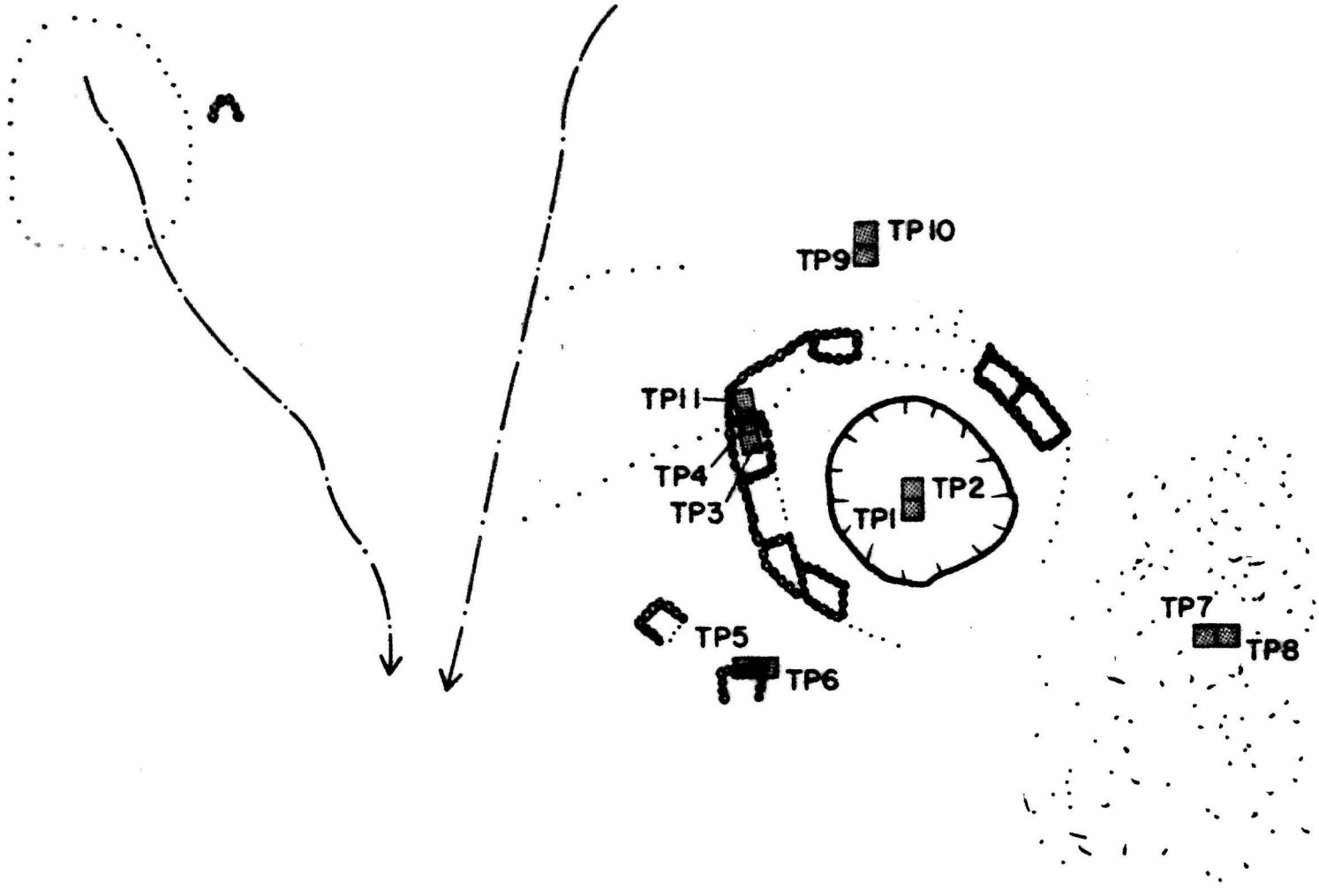


FIGURE 5
HOV-24

architectural features, and its ashy soil graded into sterile subsoil by 60 cm. below surface. The mound, in contrast, probably represents the remains of a surface jacal structure or perhaps an earlier pithouse. The features exposed in it included a thick basin shaped lens of burned logs resting on a rough use surface of burned sterile soil at 75 cm. below surface, and several layers of burned jacal and rubble above the logs.

Hov 520/597 - 42SA4890 and 42SA4892

Hov 520 and 597 are twin unit pueblos located on a ridge above the southern edge of Little Ruin Canyon, across the canyon from Hov 24. Both ruins are similar to Hov 24 and the other unit pueblos tested this summer (e.g., Hov 643, 656, 94, 709 and 751) in that the sites are composed of a central depression surrounded on several sides by rows of masonry rooms.

At Hov 520, the large pithouse or kiva depression was associated with a roomblock to the north, midden to the southeast, a possible tower mound to the northeast, a square room of upright stone slabs to the northwest, and a possible pithouse or jacal room depression to the south. Chapin, Piedra, and Cortez Black-on-white and later ceramics indicated a Basketmaker through Pueblo III use of the site. Trenches were therefore established to obtain diachronic economic data.

T.P. 1-2, 7-8 and 11 investigated the southern depression, which was surrounded by upright stone slabs and extensive wall fall (Fig. 6). A basin shaped floor was uncovered at the bottom of the depression, but the tests demonstrated that the original room had probably been rebuilt into a masonry walled unit room with a puddled clay floor during Pueblo times. The later room may have been contemporaneous with the row of rooms to the north of the central depression, which was tested by T.P. 9-10 and 12. A room surrounded by a double coursed masonry wall was defined in the latter trench. The outer wall course was of pecked, well-shaped sandstone blocks, while the inner course was composed of upright slabs set in a thick adobe matrix. A room dividing wall was also uncovered, along with a clay floor at the base of the slabs.

The central depression appears to have been a Pueblo II-III kiva, and thus contemporaneous with the masonry lined, Mesa Verde style kivas at Hov 12, 94 and 643. The walls of the semi-subterranean structure were formed of thick, one meter high upright stone slabs, covered by a hard 15cm. thick layer of clay. The tops of the slabs began at 80cm. below surface, while the bottoms rested on a clay floor. Burned roof material occurred on the floor, which was devoid of features. Logs from the structure were dated at AD1173+v by dendrochronology, and AD1120±120 by C14.

The final trench at the ruin was in the "midden." T.P. 5-6

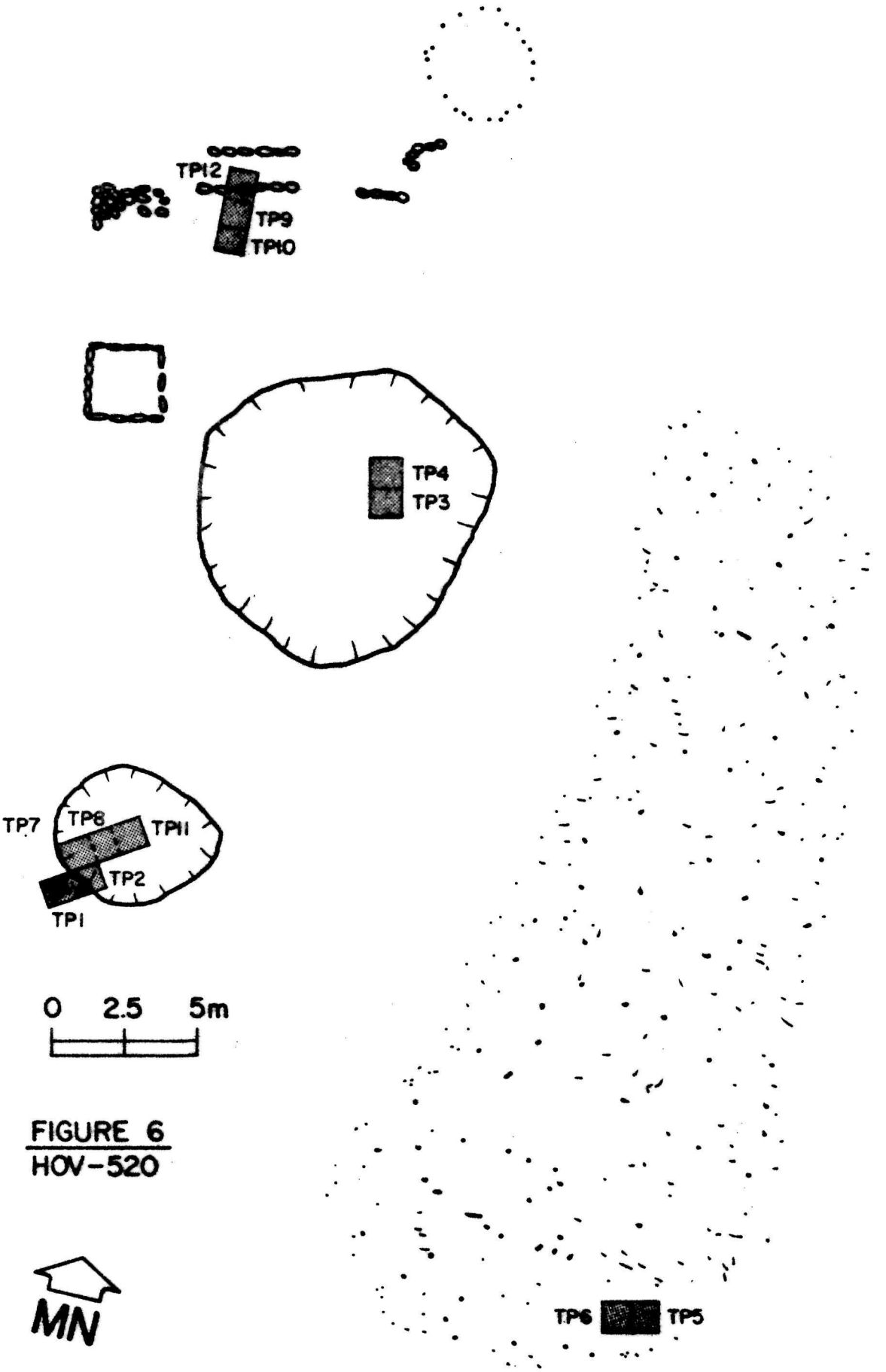


FIGURE 6
HOV-520

revealed that the artifact scatter occurred only within the upper 10cms. of soil, and probably had resulted from slope wash from the pueblo rather than from dumping activities.

Hov 597 is on the same ridge approximately 100 meters to the east of Hov 520. Surface ceramics had indicated a Pueblo II-III period occupation (Winter 1976, Appendix IV). Four trenches at the ruin corroborated this general time period by uncovering the remains of a Mesa Verde style Prudden Unit (Fig. 7). The total 520/597 complex could therefore represent the development of a single community, with the western mound occupied from Basketmaker III through Pueblo III times, and the eastern mound occupied only during Pueblo II and III times. Whether the later mound's inhabitants budded off from Hov 520 or moved in from elsewhere and joined the early group is not yet known, but whichever occurred it probably represents a period of population growth.

Hov 597 is an L-shaped roomblock surrounding a central depression, with an attached tower mound and a large midden to the southeast. T.P. 1 and 6 investigated the depression. Rubble and probable roof fall were encountered to 160cms. below surface, but the tests ended before any walls, floors or other features were detected.

The apparent tower mound yielded somewhat more positive results. Although no walls were defined, the 3 test pits (T.P. 7-9) uncovered a thick layer of rubble overlaying a lens of sherds and lithics which ended at sterile subsoil. No floor features were noted on this crude use surface.

T.P. 2-3 in the midden revealed a rich layer of sherds, ash, charcoal and lithics which graded into sterile soil by 35 cm. below surface. Grind stone fragments, animal bones, burned seeds, a pendant and a bead were mixed in with the sherds and waste flakes.

T.P. 4-5 in the roomblock were the most productive units at the site. A coursed masonry wall and two superimposed, burned floors were uncovered, with fill layers separating the floors. Only a few artifacts occurred in association with the lower floor, but the ashy fill above the upper floor yielded several liters of charred corn cobs and kernels, along with the remains of a smashed Mancos Corrugated vessel. The corn yielded a C14 date of AD1190±100.

Hov 623 - 42SA----

Hov 623 is the remnant of a large Pueblo I through Pueblo III period village located on a terrace above the confluence of McElmo Creek with the San Juan River. The pueblo is also the location of the Aneth Trading Post, so years of recent grading, construction, and road building activities have seriously impacted the ruin. The most

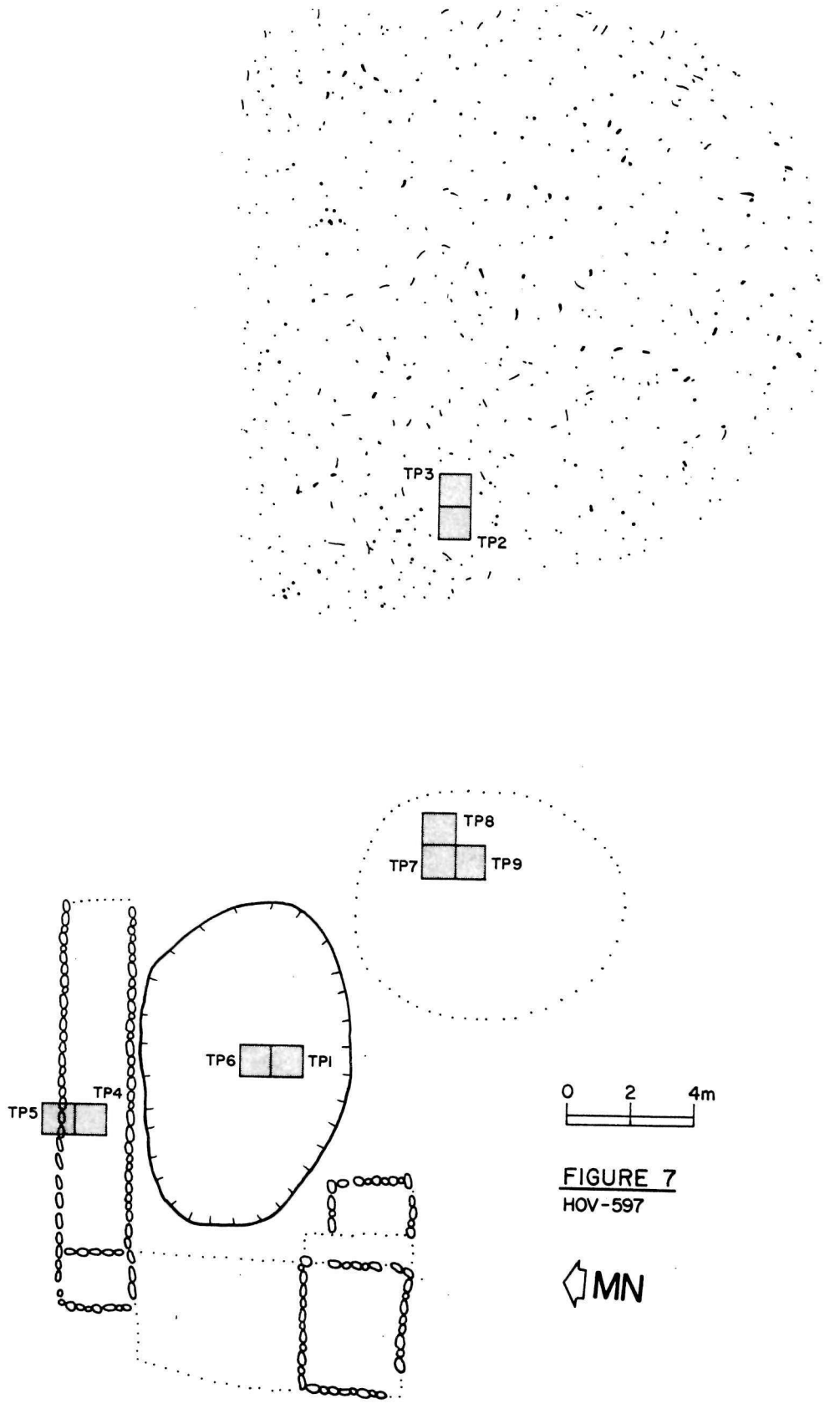


FIGURE 7
HOV-597

recent disturbance occurred during the winter of 1975, when a pipeline trench uncovered the remains of several burials and a circular kiva. After Navajo Tribal Museum archeologists salvaged the burials, Dwight McGee (the property's owner) fenced off the kiva and asked us to examine the site.

Four trenches were placed within the open kiva and the disturbed midden (Fig. 8). T.P. 5-10 and 13 widened the trench through the kiva, revealing two parallel masonry walls, several superimposed floors, a possible tunnel or ventilator shaft, and dense burned roof fall. One intact Mesa Verde Corrugated vessel, numerous redware sherds, and Basketmaker through Pueblo III black-on-white sherds suggest that the Anasazi farmed the broad floodplain of the San Juan Valley for nearly 1000 years.

Three smaller trenches were placed in the graded midden, which is at the edge of a cliff overlooking the McElmo Valley. T.P. 1-2 and 3-4 investigated several sections, revealing rich fill which was at least 100 cm. deep. The third trench (T.P. 11-12) recovered a partial burial which had been exposed and crushed by the grading. The remains of a gray ladle were found with the skeleton.

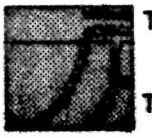
Hov. 709 - 5MT711 -

Hov 709 is a large vandalized mesa top unit pueblo in the pinyon-juniper forests above Big Ruin Canyon. Four trenches and an isolated test pit were established at the ruin (Fig. 9). A circular depression, a potted midden, a large rubble mound and smaller rubble scatters to the west, southeast and southwest of the depression occur on the surface. Testing focused on the mound and associated rubble scatters.

Both trenches in the rubble mound uncovered the remains of rooms with masonry walls, rubble fill and rough use surface floors. No other features were noted, but the rooms were probably used for storage, habitation or processing purposes.

Walls and possible rooms revealed by two of the other trenches indicate that the pueblo was U- or L-shaped. T.P. 6-7 uncovered two parallel masonry walls, but since no floors or use surfaces were encountered, it appears that the structure may have been an open sided ramada shade or work area. Similar structures may also have stood on the opposite side of the depression, as revealed by T.P. 8 and 11-13. An ash filled slab cist, a Hovenweep Gray vessel, a rough use surface with the remains of a smashed corrugated vessel on it, and a crude masonry wall were uncovered in the trench. A C14 date of AD695±100 was obtained from charcoal in the cist. The Hovenweep Gray vessel was also found in it, so it is possible that the sample dates an earlier occupation.

The final feature tested at the site was a surface alignment of







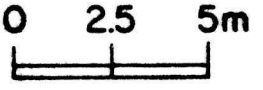


FIGURE 8
HOV-623





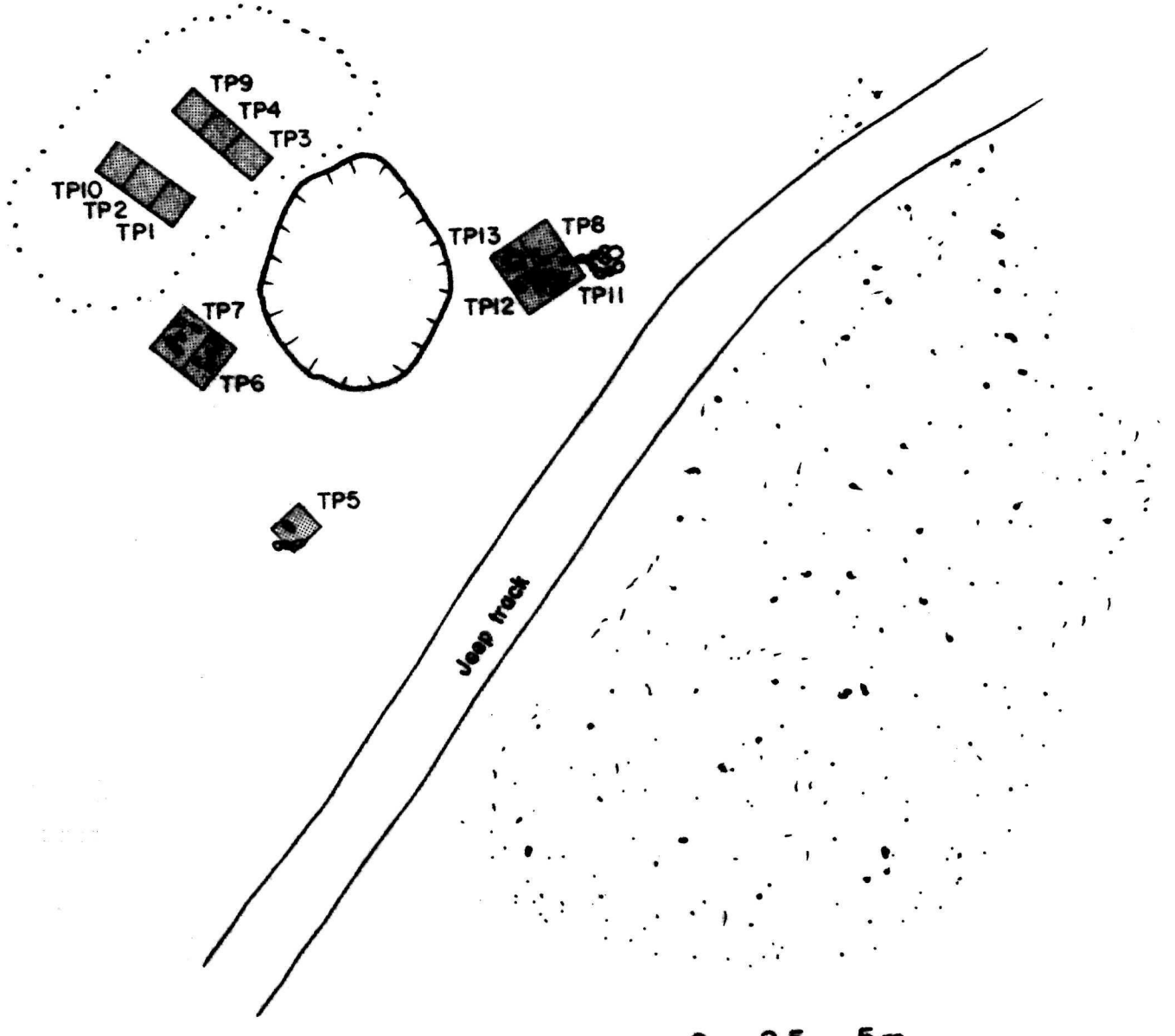


FIGURE 9
HOV-709

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rubble located to the southwest of the depression. No walls, floors or burned fill were discovered, so the rubble probably represents wall fall from adjacent structures.

Hov 685/615 - 5MT---/4079

Hov 685 is an impressive rubble mound with probable kiva depressions, talus walls and a standing tower located at the edge of Big Ruin Canyon. Tests were initially set up at the adjacent PI-III ceramic scatter (Hov 615), but when no subsurface materials were uncovered the testing shifted to the rubble mound, which also contained PI-III ceramics. Three trenches were established at the ruin, which is composed of at least four probable kiva depressions, one standing tower, a possible plaza or rim dam, and numerous talus walls.

T.P. 1 in the tower (Fig. 10) uncovered a circular or D shaped double coursed wall made of finely pecked sandstone blocks. The walls were several meters high on two sides, and were built on bedrock. The rough floor was cluttered with three slab grinding bins, two metates and three manos.

A series of three parallel walls were suggestive of rows of room-blocks or terraces on the talus slope below the tower. No definite walls, terraces or interior room features were noted by the two meter long T.P. 2, so the purpose of the midden covered slope is unclear.

The final trench at the ruin (T.P. 3-4) investigated a possible plaza or rim dam near the tower, represented by a long masonry wall and a flat open area. Three sterile layers were identified above bedrock, but the wall was not investigated and the nature of the feature is still unknown.

Hov 15 - 42SA1915 -

Hov 15 is a series of shelter rooms, talus walls, midden and petroglyphs in Little Ruin Canyon below Stronghold House (Hov 13) in the Square Tower complex. The tests indicated that the ruin is probably a small outlying hamlet. One of the shelters and a possible pithouse/kiva were tested.

Three trenches were used at the site (Fig. 11). T.P. 1-2 investigated a probable granary or storeroom, represented by ten courses of mortared masonry wall and a well-plastered, slab floor. A second contiguous room was examined by T.P. 5, where a circular, three sided masonry wall abutted onto the natural rear wall of the shelter. No definite floor was found in this structure.

A four meter long trench outside of the shelter investigated a wall and depression at the top of the talus slope. The remains of a large square kiva or pithouse were uncovered, with a possible

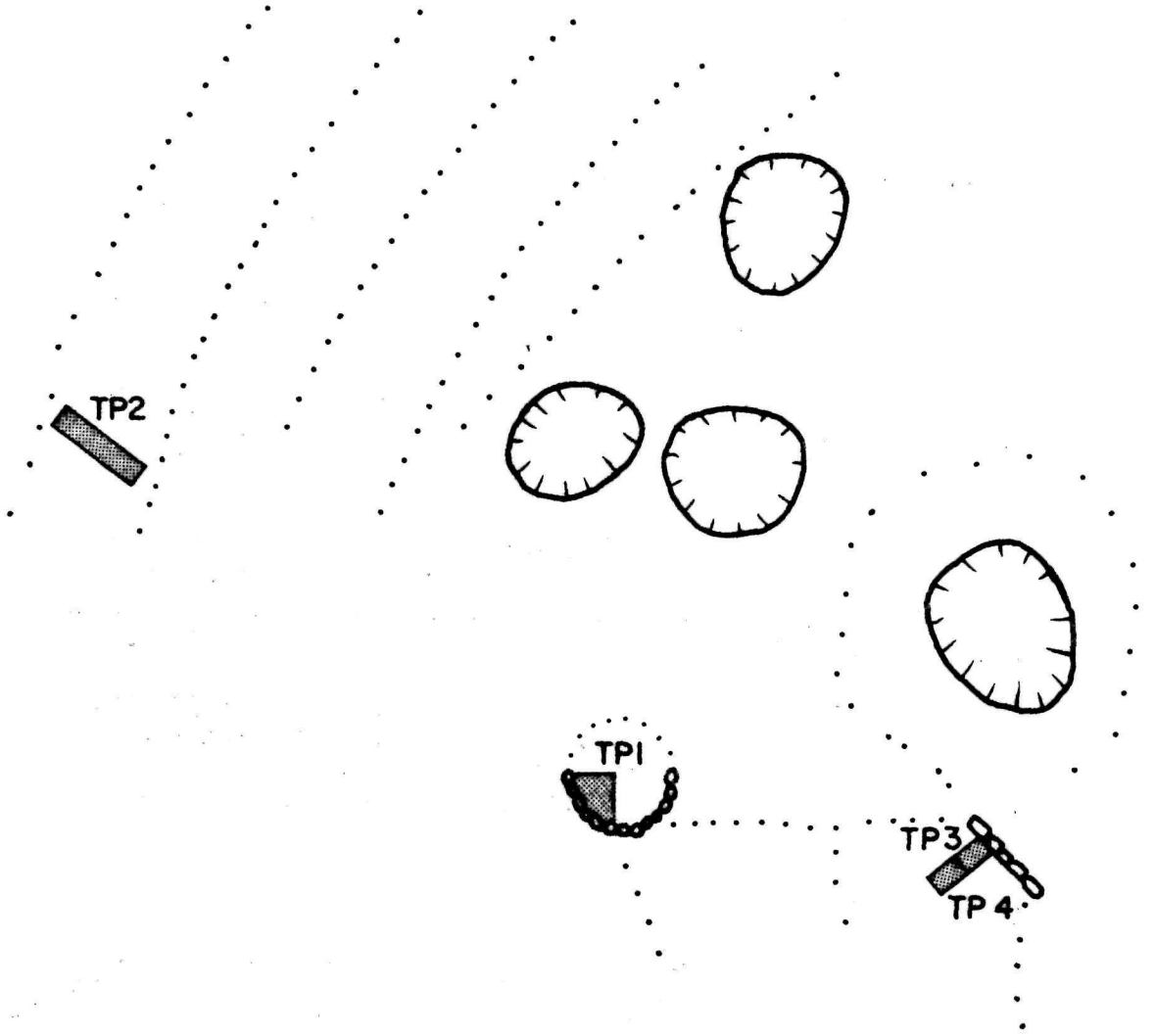


FIGURE 10
HOV-685

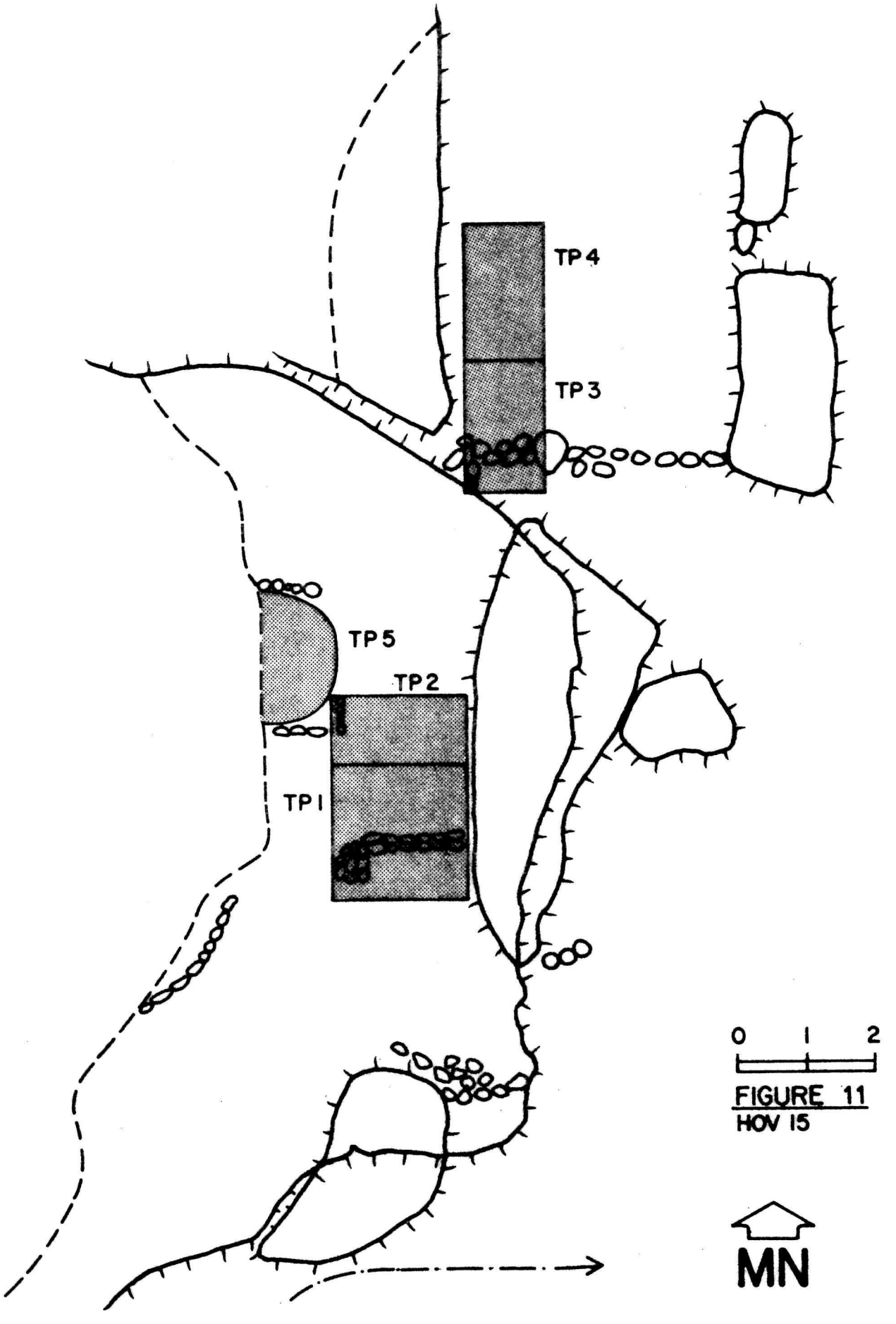


FIGURE 11
HOV 15

ventilator shaft, a cobble wall with an inner face of upright stone slabs, a probable masonry bench, a plaster floor and Pueblo I-III period sherds. A C14 sample from the kiva yielded a date of AD920±130, while a dendrochronological specimen yielded a date of AD1188vv.

Hov 707/708 - 5MT4282/4283

This series of four small rock overhangs along the cliff edge of Big Ruin Canyon was probably associated with the nearby Hov 709 Prudden Unit. All four overhangs contained thin layers of fill above bedrock or clay. A few sherds, lithics and corn cobs or kernels were usually found in the fill.

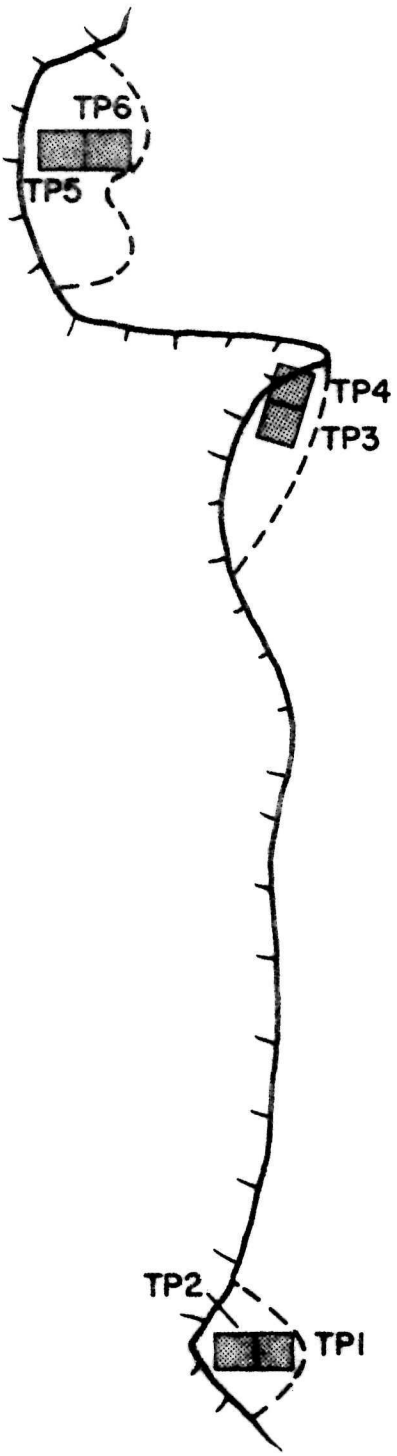
The best preserved of the shelters was at Hov 708, where a masonry wall abutting onto the cliff edge and a boulder was tested by T.P. 2 (Fig. 12-13). The wall and thin fill ended by 35 cm. below surface, and it is likely that the crude rooms functioned as temporary storage shelters, probably for crops raised both on the mesa and in the canyon.

B. Possible Habitation/Farm Sites

The most complex ruins on Cajon Mesa are the sites where multiple activities most likely occurred, including both habitation and farming. Most of these are tower and roomblock clusters at canyonheads or canyon edges, with associated talus terraces, rim dams or reservoirs, and arroyo check dams. Similar ruins were also tested on the mesa top, where large Prudden Units were sometimes attached to terraces.

Hov 64 - 5Mt601 -

Hackberry House is one of the largest clusters of towers, rubble mounds, roomblocks, probable kiva depressions and talus terraces on Cajon Mesa, and like most tower ruins it is organized around several large seeps in a canyonhead shelter. Three trenches were oriented around the shelter (Fig. 14). T.P. 1-3 and 6-7 concentrated on the larger seep, T.P. 4-5 investigated a room in the shelter and the sediments below it, and T.P. 8-12 examined several talus walls below the shelter. The extensive linear walls along the talus slopes at Hackberry House and the seeps are reminiscent of springfed Hopi terraced gardens (cf. Winter 1976: Sec III), so the Hackberry trenches were set up to determine if the walls represented the remains of terraces which had been linked by ditches to the springs. The shelter trench was added to obtain environmental information, under the



0 2.5 5m

FIGURE 12
HOV 707

MN

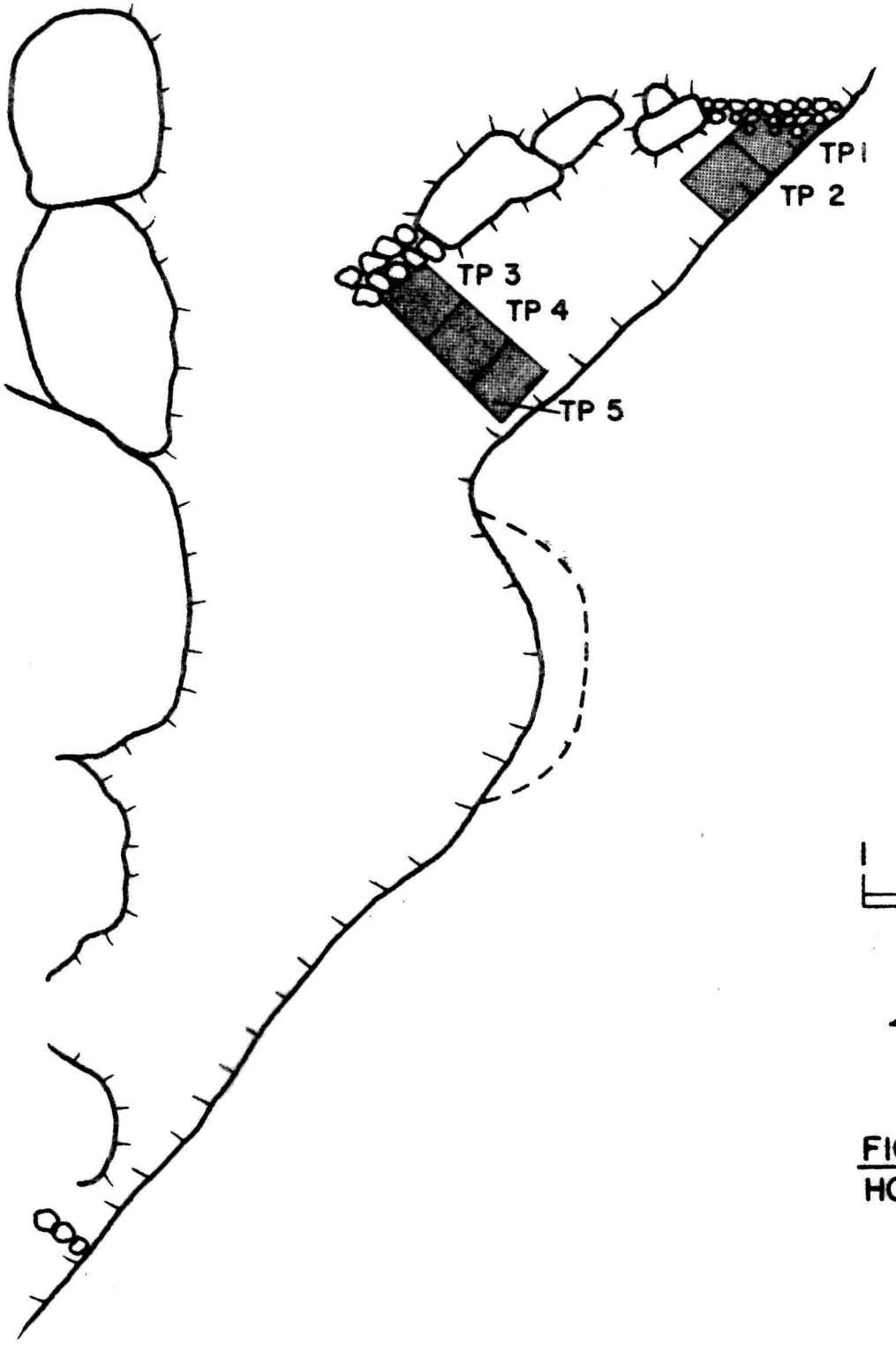


FIGURE 13
HOV - 708

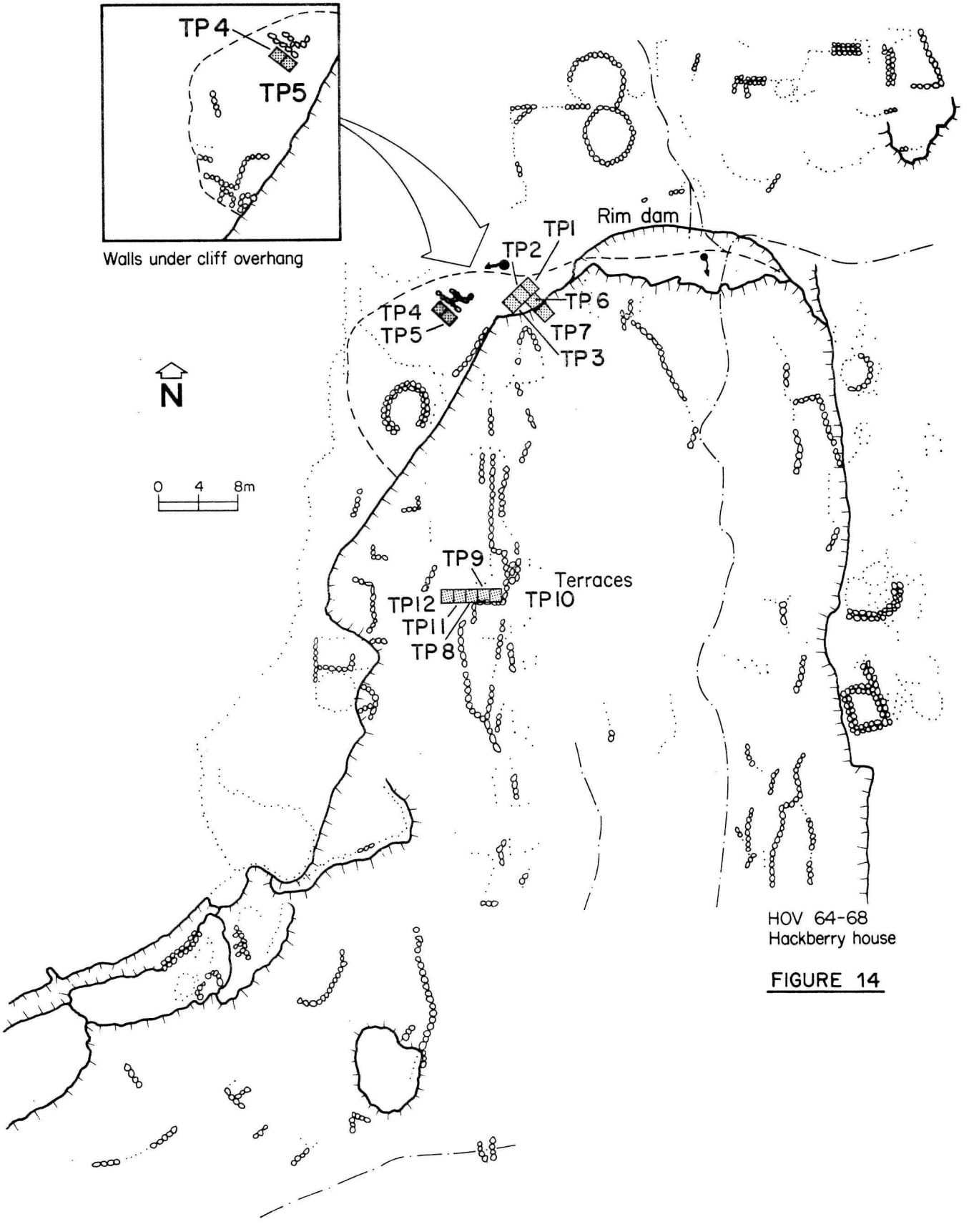

TP4
TP5
Walls under cliff overhang
Rim dam
TP1
TP2
TP6
TP4
TP5
TP7
TP3
N
0 4 8m
TP9
Terraces
TP12
TP10
TP11
TP8
HOV 64-68
Hackberry house

FIGURE 14

assumption that the deep shelter would have provided optimal preservation conditions.

The results of the Hackberry tests were better than expected. A probable irrigation ditch and cistern were uncovered in front of the seep, while two crude cobbled walls in the talus trench apparently represent the remains of terrace retaining walls. A possible pithouse wall formed of one meter high upright slabs and a probable kiva ventilator shaft were also found in the trench. The shelter test yielded over two meters of nearly sterile fill below a plaster floor associated with a firepit and a masonry wall. A C14 date of AD1260±120 was obtained from the midden above the possible pithouse.

Hov 12 - 42SA1955 -

Another immense cluster of towers, roomblocks, possible kivas, middens and apparent dams is the Twin Towers site, located on the canyon edge and talus slopes above a spring near the head of Little Ruin Canyon. Long linear talus walls, arroyo check dams and a probable rim dam were probably important components of the ruin's water control system. Four trenches were used to recover economic data (Fig. 15). T.P. 1-2 investigated the northern room of the westernmost twin tower, T.P. 3-4 examined a kiva depression, T.P. 7-8 tested the rim dam, and T.P. 5-6 and 9-13 bisected three parallel talus walls.

The tower room yielded several meters of collapsed wall and floor rubble containing seven whole and partial Pueblo III period vessels. The finely chinked wall of well-shaped, pecked blocks was two stories tall, and the floor was made of thick plaster set on fill. Floor features included several smashed vessels and scores of human footprints molded into the plaster. Dendro dates placed the tower's construction at no earlier than A.D.1232.

The large circular depression on the talus slope below the boulder top tower contained the wall, possible pilaster, bench, plaster floor and firepit of a finely constructed Mesa Verde style kiva. Smashed vessels were found in the fill and on the bench. A C14 date of AD1240±130 was obtained from a log in the fill.

The rimdam test uncovered a low masonry wall of dressed blocks set on bedrock, backed up by a pile of gravel and cobbles. The alluvial fill behind the dam was very rocky, but it formed an arable plot of soil on otherwise barren slickrock.

The linear walls along the talus slope were buried in a mixture of midden, ash, shale and colluvial materials. Three parallel walls were uncovered in a series of seven test pits. The upslope pair of walls appear to have outlined a room, as evidenced by two superimposed

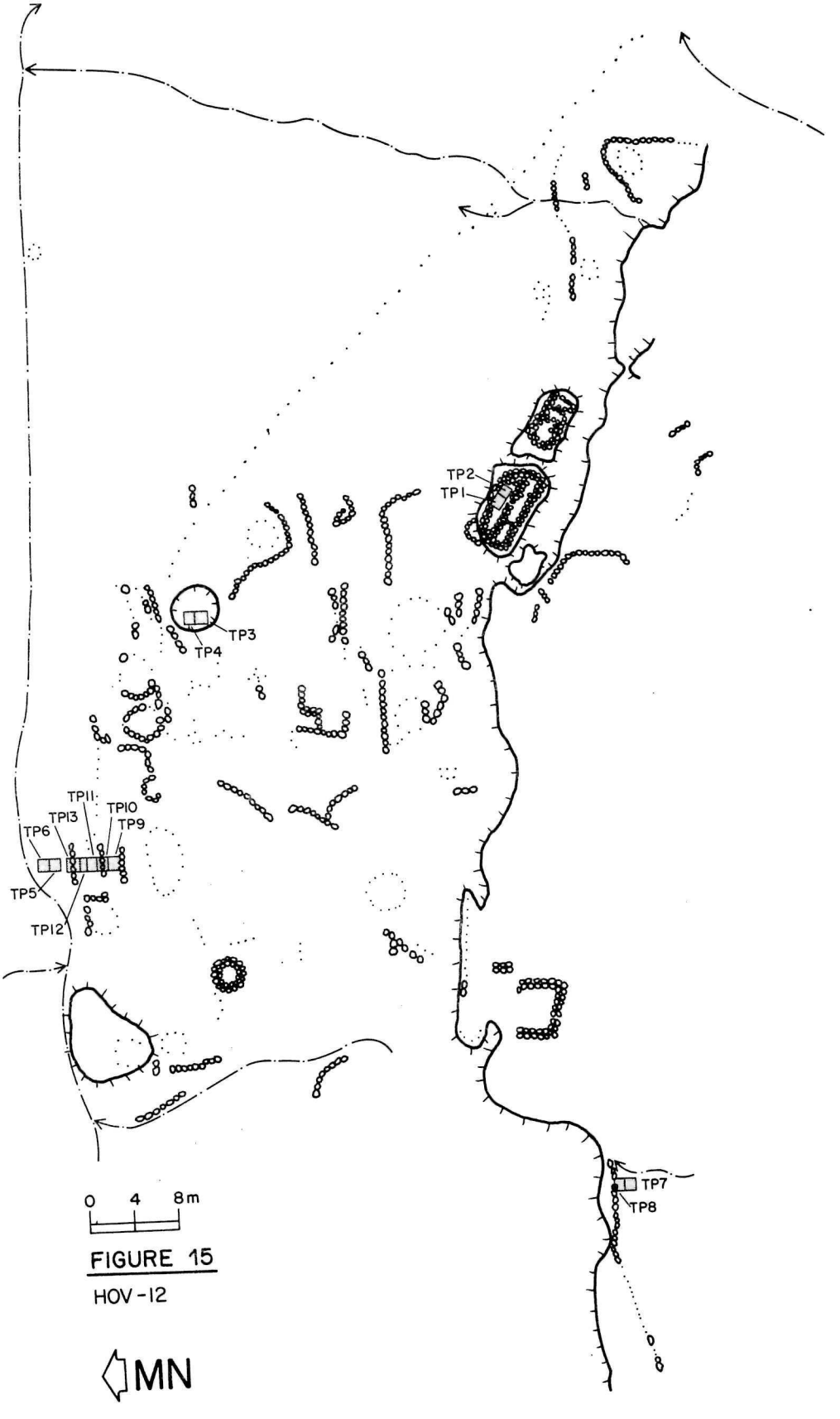


FIGURE 15

HOV-12

use surfaces, grind stones and solid, well-built walls constructed on fill. Close inspection of the nearby slope revealed a string of probable rooms associated with apparent kiva depressions immediately to the south. The downslope wall, in contrast, was constructed of rough unshaped cobbles backed up by midden and eroded soil. Similar cobble piles were uncovered on the talus slopes at Hov 64 (Hackberry House) and Hov 53 (Holly House), and most likely represent the remains of ancient talus farming terraces which were watered by slope run-off and/or spring-fed irrigation ditches.

Hov 3 - 42SA1903 -

Hov 3 is a cluster of shelter rooms and a modified spring associated with the Hov 1 (Hovenweep House), Hov 2 (Square Tower) and Hov 4 (Hovenweep Castle) tower complexes. The seep forms a standing pool of water surrounded by two masonry walls (see cover Chapter IV), while wall stubs set on bedrock represent former rooms on a ledge above the spring. Since the fill in the rooms was never more than a few centimeters deep, eight locations were tested before undisturbed economic data was recovered (Fig. 16). T.P. 1,2,5,6 and 12 trenched the larger of the room groups, in which several sherds, three manos and dried corn appeared. Food processing could have taken place in this area, but the much smaller rooms tested by T.P. 7-9 probably represent granary areas.

T.P. 3-4 examined the pool and the sediments around it while T.P. 10-11 and 13 investigated a nearby depression which appears to have been an historic stock tank. Great care was taken in testing the pool, since we wanted to trace the construction sequence, find out if ritual and irrigation activities occurred nearby, and protect the Tiger salamanders which live in the pool. Although the historic disturbance in the nearby depression raised questions about the seep's antiquity, no historic materials were found in or around it and it was probably used, and walled in, aboriginally. It was periodically dredged, and over time a high mound of dark clay built up around the pool. No dendro or carbon samples were recovered, but the nearby towers at Hov 4 and Hov 2 were constructed at A.D.1166, 1277 and 1239, respectively (see Winter 1976: Table 45), while BMIII-PIII ceramics were recovered from the tests.

Hov 53 - 5Mt602 -

Holly House is another one of the canyonhead tower complexes which was tested for its farming terraces and evidence of economic activity in the towers. Four trenches were used at the ruin, in two of the towers and at two probable farm terraces.

T.P. 1-3 and 11 (Fig. 17) examined a series of dams on the rim, where a pollen pit in 1974 yielded evidence of corn, beans, Cleome, Lycium and Typha. The tests revealed two low masonry walls of well

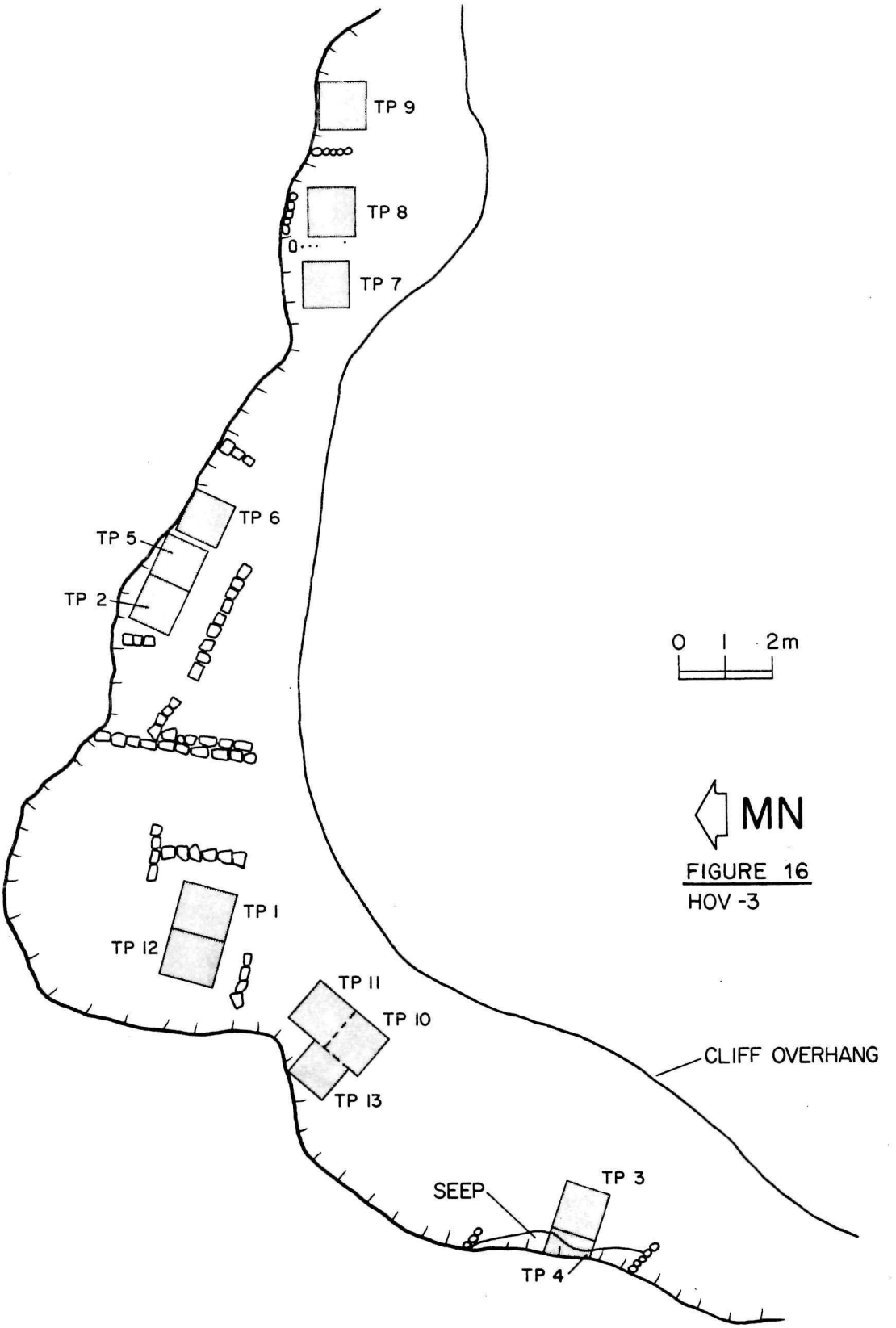
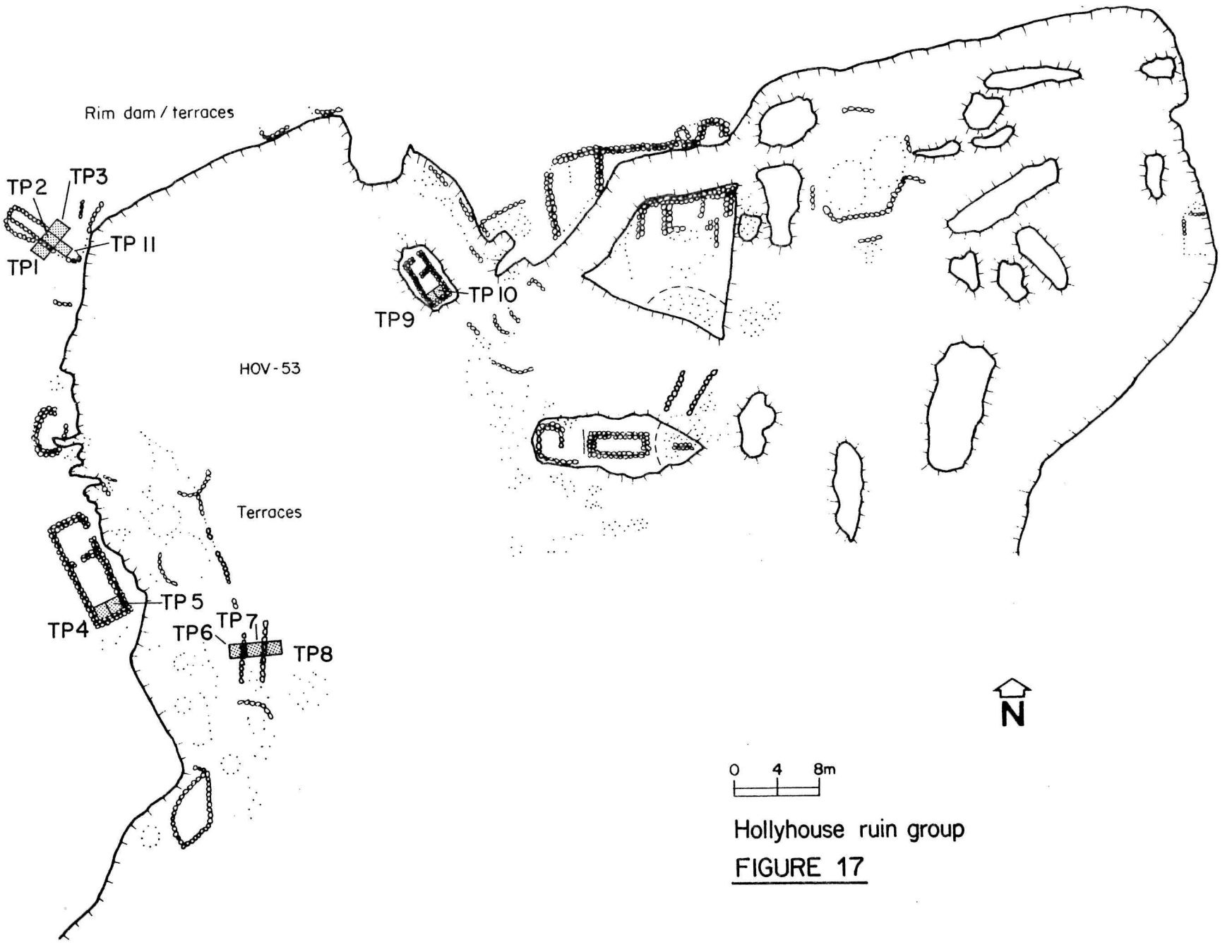


FIGURE 16
HOV -3



Hollyhouse ruin group

FIGURE 17

shaped, mortared blocks, sterile sediments, a thin layer of adobe coating the bedrock, no artifacts, and large amounts of cultigen pollen. T.P. 6-8 on the talus slope uncovered two crude walls of unshaped cobbles, associated with midden. No other distinct cultural features were discovered, so it is possible that the walls served to retain farm terraces, in much the same way as the dams on the rim.

The towers, however, yielded very rich cultural materials. T.P. 4-5 along the south wall of a rim rock tower uncovered one partial McElmo Black-on-white kiva jar, one partial Mesa Verde Corrugated vessel, and one whole Hovenweep Corrugated jar, complete with contents which included the skeletons of a rabbit, three lizards, two birds, a mouse and a toad. Grind stones, a large serrated biface and a fire-pit were also found on the floor along with the vessels. Dendro dates from the room range from A.D.1246 to A.D.1267.

The Boulder House tower tested by T.P. 9-10 also yielded cultural materials. A firepit was found on the floor of the structure, along with two delicately shaped bifacial projectile points or drills, several bone awls and a bone scraper, and one partial Mesa Verde Corrugated jar. This tower was probably built no earlier than A.D. 1201, as suggested by dendro dates from a beam (Winter 1976).

Hov 714 - 5Mt751 -

Hov 714 is a canyon edge cluster of towers, rubble mounds, talus rooms, kiva depressions and probable terraces, midden, shelters and an apparent reservoir on Cow Mesa across Big Ruin Canyon from the Hov 707-709 complex. The well preserved reservoir, which was originally described by Winter (1976: Fig 31), was the center of the testing program; trenches were also placed in a tower unit and in the midden.

The reservoir was trenched in two places with five pits (T.P. 1-2, 5 and 10-11), thereby bisecting both the inner and outer walls (Fig. 18). Both were built of well shaped sandstone blocks, backed up by piles of cobbles, gravel and sediments. The inner wall was set on bedrock, while the outer, which was located five meters southeast, was built on a 10cm. thick layer of gravel immediately above bedrock. Twenty centimeters in from the wall the gravel was replaced by a compact layer of charcoal or peat. The reservoir is still functional, and only half filled with sediments. It is located below a small area of slickrock which probably serves to flood the reservoir after storms. Cultigen pollen suggests that it probably served as a farming area, but domestic water was undoubtedly taken from it as well. It may also have functioned to increase percolation to a filled-in seep in a shelter immediately below the cliff. The reservoir's construction is generally similar to that of Mummy Lake on Chapin Mesa (Rohn 1963), and the inner wall may have functioned to slow down the slickrock floods and divert water into an outlet formed by the two walls.

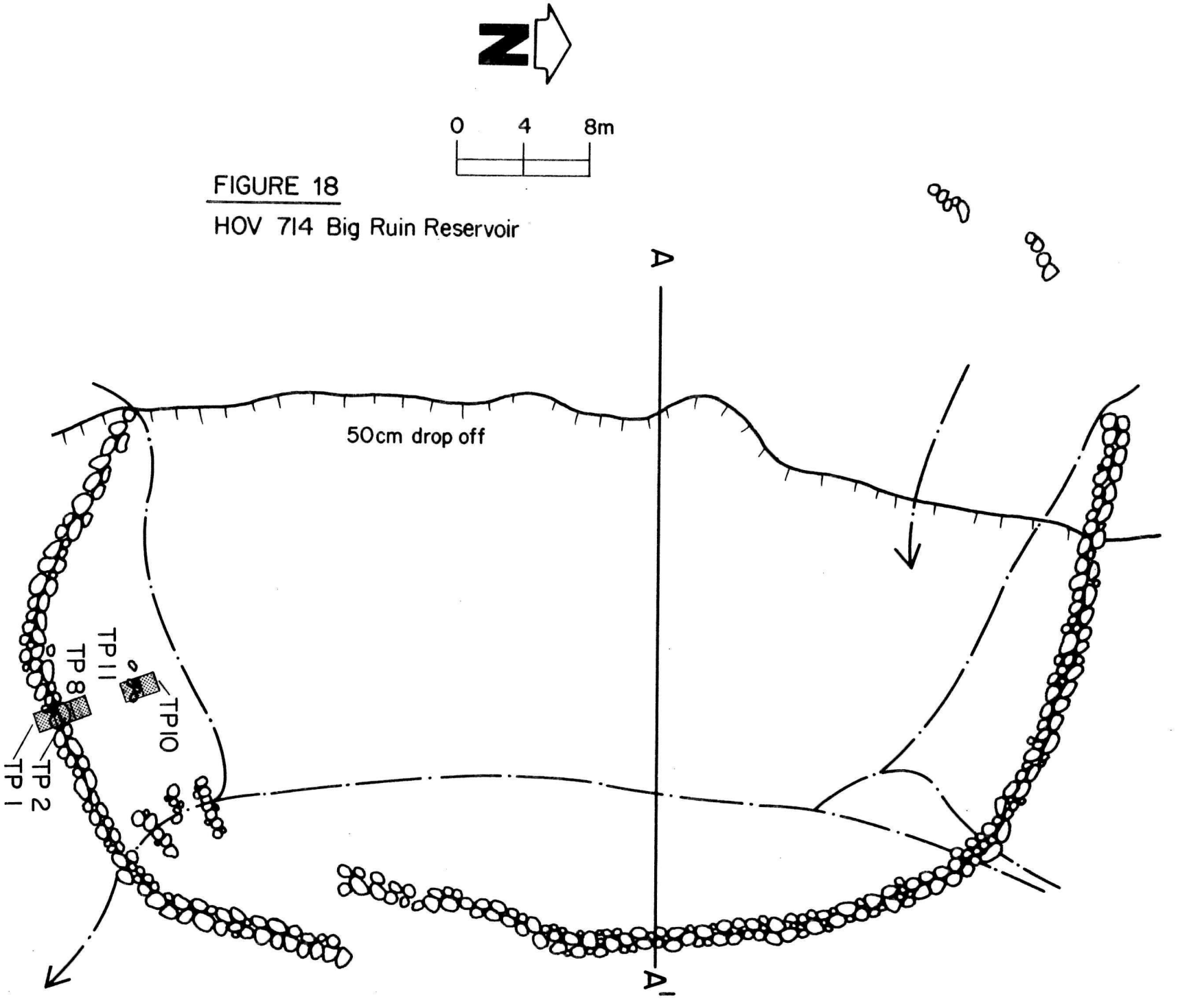


FIGURE 18

HOV 714 Big Ruin Reservoir

The tower cluster which was tested is composed of a large rectangular unit fronting on one side with an open plaza and on the other with the cliff edge (Fig. 19). Although eroded in places, the unit appears to have been a rectangular version of Horseshoe House (Hov 57), with a series of outer rooms built around a kiva. T.P. 7 and 9 in one of the outer rooms uncovered three walls and a floor built on a layer of fill above the uneven bedrock. T.P. 3-4 in the central room uncovered a probable kiva, represented by a plastered floor, the corner of a firepit, and an apparent sipapu to the north of the hearth. The sipapu was actually the neck of a large black-on-white olla sunk down into the floor; the neck and a 13cm. deep hole below it were then filled with fine sand. Similar sipapus in kivas at Mug House are described by Rohn (1971).

The final trench at the site involved two test pits (T.P. 5-6) in the talus midden below the tower and reservoir. Numerous probable kiva depressions, rooms and apparent terraces littered the slope, but the test units were placed in an area of pure midden. Twenty to thirty centimeters of sherds, bones, flakes, ash and charcoal covered the colluvial clays of the slope.

Hov 94 - 42SA1894 -

Hov 94 is a mesa top cluster of akchin terraces associated with a roomblock, kiva depression, midden and shelter. The ruin is located in a large arroyo draining into Little Ruin Canyon (cf. Winter 1976: Fig. 20), and it appears to have been an outlying hamlet of the Square Tower complex of canyonhead villages. Originally described as an akchin farm with possible talus terraces and storerooms, the tests this summer revealed a much more complex farming village with probable habitation, ceremonial, storage and agricultural structures.

Two of the ten akchin terraces on an arroyo fan were examined by a nine meter long trench (Fig. 20). The well shaped sandstone blocks in the dams were set on streambed gravels, with a mixture of cobbles, gravels and small boulders piled up behind them. Several fine sandy and gravelly layers were then deposited naturally between the dams, and there is no evidence of intentional filling on the part of the builders. Total depth of the alluvial fill varied from 75cm. immediately behind the dams to 30cm. thick between them. The terrace thus built up was over eight meters long, and its top reached midway up the higher dam.

The other features tested at the site include a series of shelter storerooms with a bedrock tunnel linking them (T.P. 5,6 and 9-10), a unit pueblo composed of a string of masonry rooms (T.P. 7-8, 11 and 14) and a probable kiva (T.P. 12-13), and a midden (T.P. 19 and 21). Talus terraces do not seem to have been present, unless the uphill wall of the pueblo functioned as a gardening retaining wall.

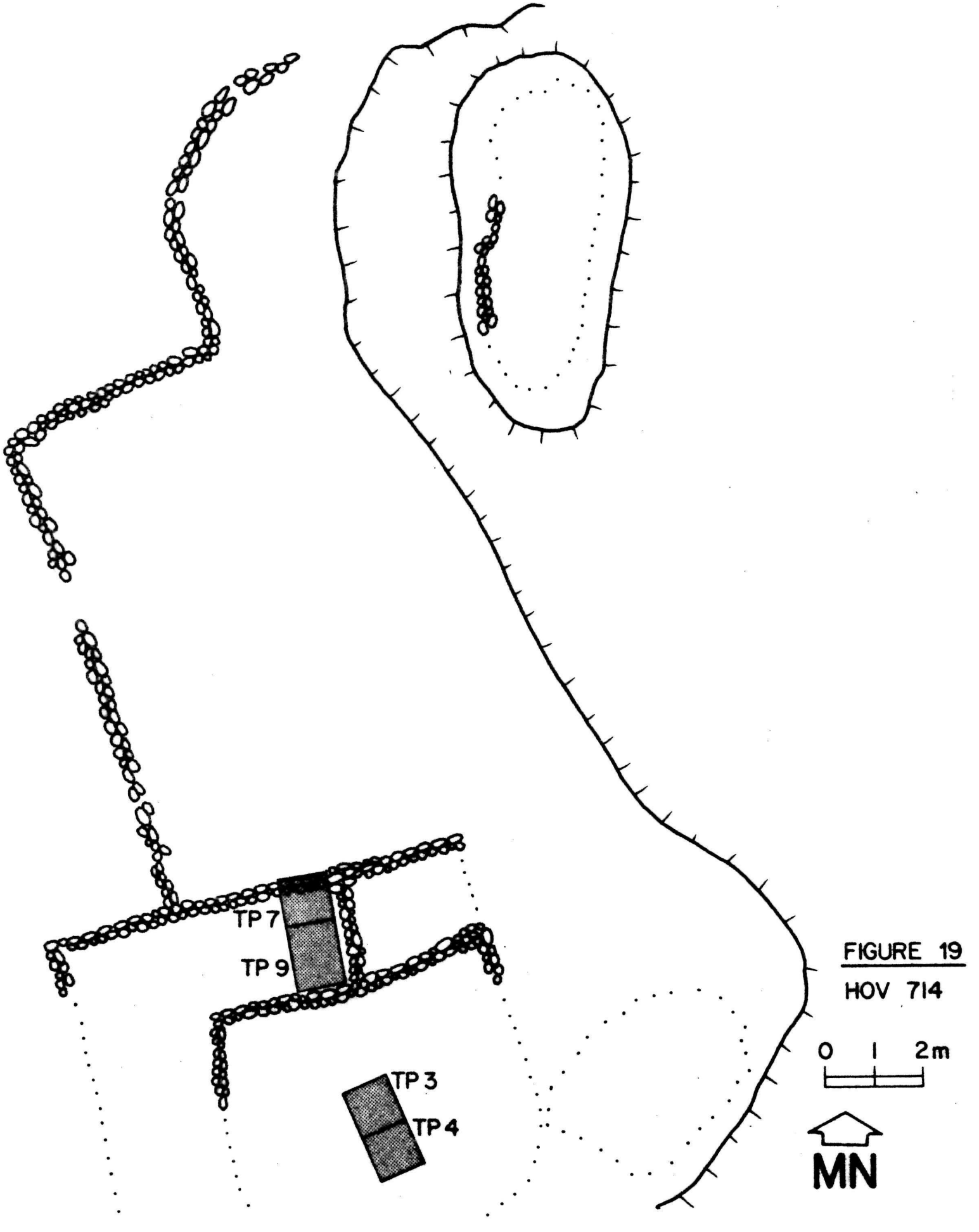
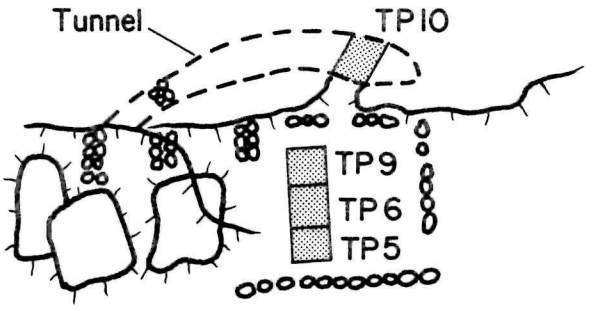
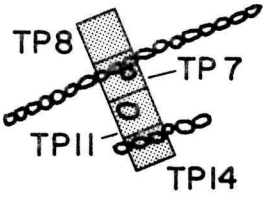
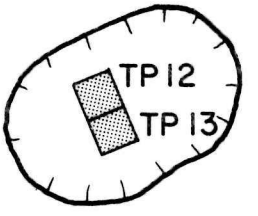


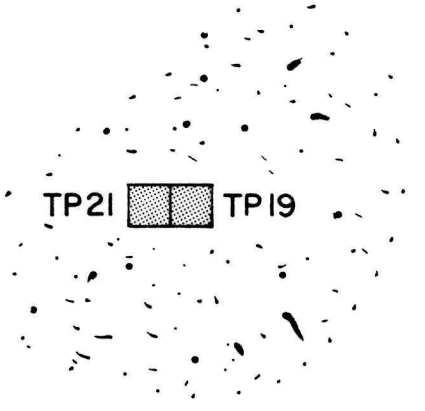
FIGURE 19

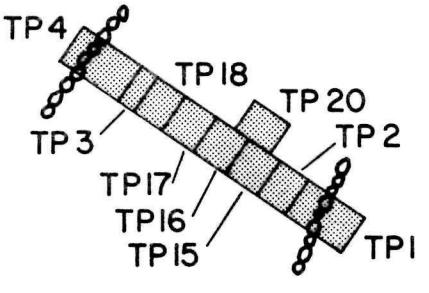
HOV 714











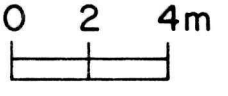


FIGURE 20 HOV 94



Two walls and a floor in one of the pueblo rooms were uncovered, along with a rock covered cist and a metate on the floor. The kiva trench revealed a finely built masonry wall and bench, and a clay or plaster floor. The test pits in the shelter examined one of the walled-in rooms and a portion of the tunnel. One wall in the room and a partial McElmo Black-on-white olla in the tunnel were uncovered. The midden stratigraphy was quite complex; several lenses or pits were discovered which might represent an earlier Pueblo I period component.

Although Hov 94 appears to have been a moderately sized hamlet, it should not be concluded that the inhabitants of the site lived in isolation and had no relations with the nearby Square Tower complex. The towers, roomblocks, terraces and kivas at the various canyonhead villages, such as Hov 12, may actually have been the focal point for a number of outlying hamlets and villages, including Hov 94. It is also possible that there may have been a developmental sequence around Little Ruin Canyon, with Hov 94 and the ridge top pueblos (Hov 24, 520 and 597) inhabited primarily during the eleventh, twelfth and early thirteenth centuries, and abandoned in favor of the canyonhead springs during the middle and later parts of the 1200s. Charcoal from the kiva yielded a C14 date of AD1380±120.

Hov 643 - 5Mt4085 -

This large complex of roomblocks, midden, a kiva depression and apparent farm terraces which is located approximately 100 meters south of the edge of Big Ruin Canyon is probably associated with the Hov 685 tower village (see preceding section) and the series of arroyo check dams at Hov 644 (see following section). Ceramics date the ruin at BMIII-PIII times. It was chosen for testing because of its location along Big Ruin Canyon and its proximity with the other sites, as well as the possibility of its having mesa top terraces. Five trenches were established at the site.

T.P. 1-2 examined the central depression, revealing a well made masonry wall and bench, a plaster floor, and over two meters of rubble fill and roof fall (Fig. 21). An apparent recess was built into the bench, and the masonry was of the Mesa Verde style.

T.P. 5-6 and 12 were placed in the roomblock immediately to the north of the kiva depression. Three low walls of a room were uncovered, along with a crude firepit and a rough use surface.

T.P. 7-9 and 10-16 investigated the possible terraces attached to the northern and western edges of the room block. The northern "terrace" was composed of a low, one course high masonry wall with very cobbly soil. No post holes, use surfaces, pits or other room or work area features were noted, so the feature may well have been

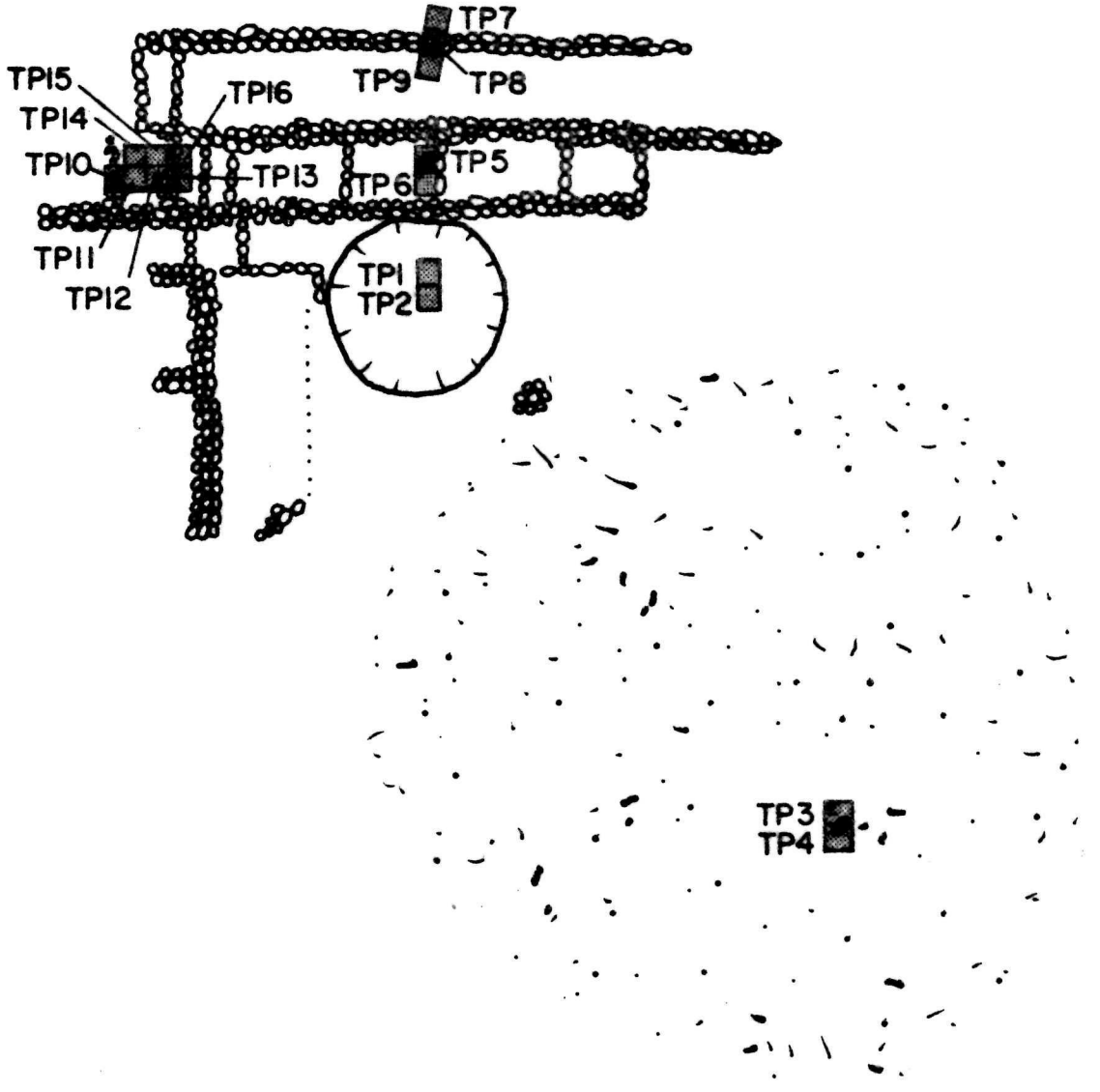


FIGURE 21

HOV 643

a farm plot rather than a ramada or jacal structure. Beneath the wall and sterile soil, however, was a thick lens of adobe, which could represent an area where mortar had earlier been prepared or discarded.

The second possible terrace was much more complex. Two of the nine walls which form a gridwork attached to the pueblo were examined. Again, the walls were only one course high, and associated with many small cobbles. No post holes were found, but a rough use surface associated with a charcoal lens was discovered in one of the test pits. A number of different activities may have taken place around the walls, perhaps at different times of the year. The use surface and adjacent wall, for example, could have served as a work area, while the outer walls could have been retaining walls for farm plots.

The final feature tested at the site was a large vandalized midden to the southeast of the depression. A use surface with a slab lined cist was discovered beneath the mixture of BMIII-PIII period sherds, lithics and bones, so it is possible that a BMIII or Pueblo I period component exists somewhere at the site. Redware and early black-on-white sherds were scattered across the ruin, but aside from the cist and use surface below the midden no obvious early features, such as circular rows of upright slabs or pithouse depressions were discovered.

Hov 571 - 5Mt771 -

Hov 571 is a large unit pueblo in the pinyon-juniper forests of Cow Mesa, located several kilometers north of the Hov 714 tower/reservoir complex. Numerous immense pueblos fill the sage glens of the mesa, and at Hov 571 several rubble mounds, a tower mound, two large middens and three probable kiva depressions occur in association with several possible farm terraces. Eight small trenches were set up at the site.

T.P. 3-6 examined the circular "tower" (Fig. 22). Rubbly fill and a crude, 90cm. high double coursed wall were uncovered, but no definite floor, use surface or other cultural features were discovered.

Two trenches in the room block encountered the remains of several rooms. T.P. 13-14 revealed the corner of one room and a floor, while T.P. 18-19 and 22-23 yielded the remains of a room wall which separated several of the kiva depressions. One of these depressions was trenched by T.P. 9-10. Over 170cm. of rubble was uncovered, but no walls, floors or other architectural features were discovered. Two other trenches (T.P. 15-17 and 20-21) in a rubble scatter to the west of the roomblock also failed to uncover walls or floors, as did T.P. 1 in the disturbed midden. Redware and black-on-white sherds demonstrate

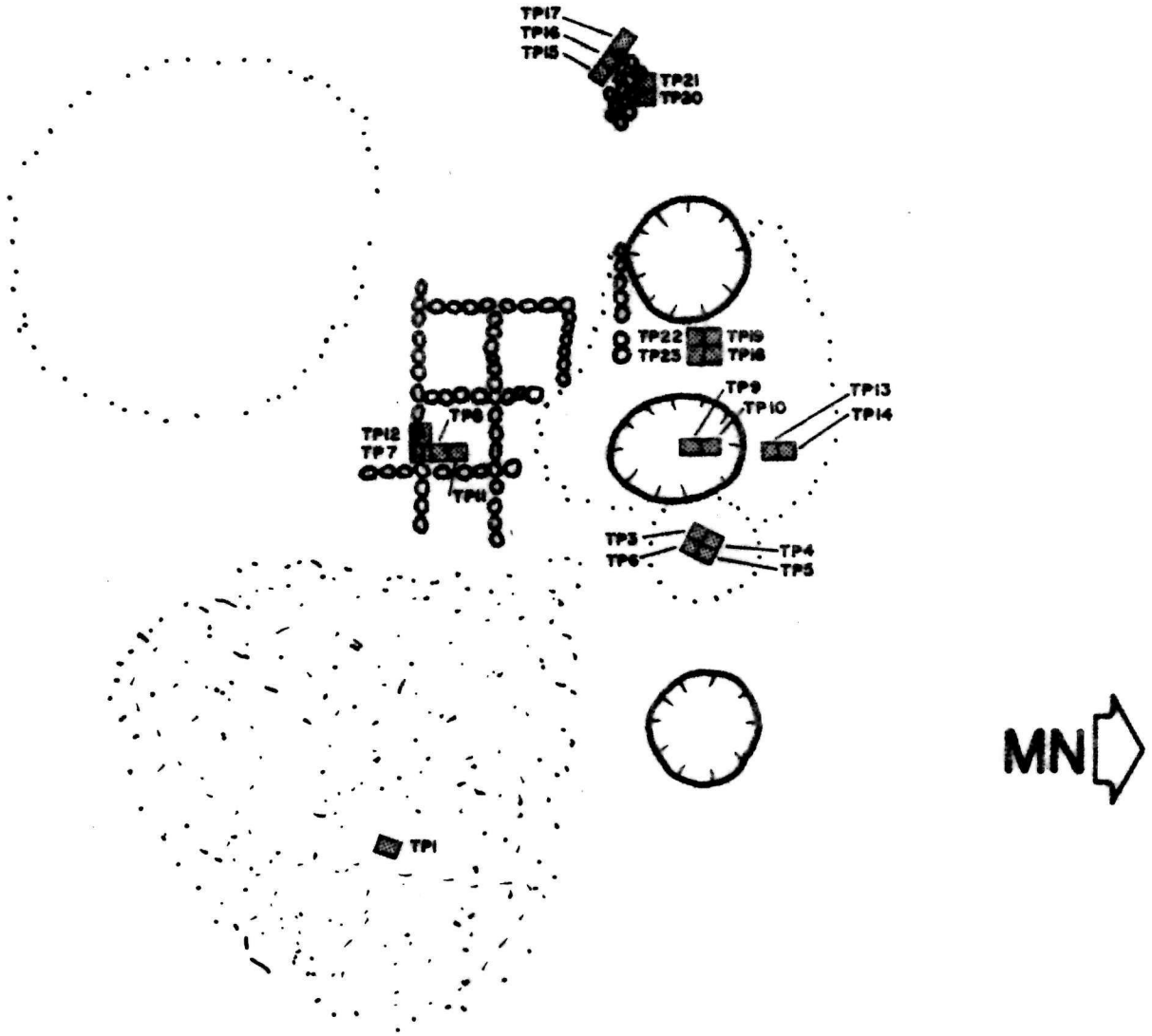


FIGURE 22

HOV-571

that the ruin was occupied from Pueblo I or earlier times through Pueblo III times.

The final feature sampled at the site was a gridwork of low walls located to the south of the roomblock and depressions. At least six stone walls form a checkerboard of small squares; T.P. 7-8 and 11-12 examined two of the low walls and the area around them. The walls were built on sterile sand and were only one course high, while the ground around them was almost totally devoid of artifacts and rubble. The gridwork could therefore have been a series of farm plots, similar to those at Hov 643 and Hov 656.

Hov 656 - 5Mt 532

The third possible mesa top farm terrace site tested during the summer was Hov 656, located on private land in the pinyon-juniper forests at the north end of the mesa. The ruin is one of the largest unit pueblos yet discovered at Hovenweep, and like many pueblos in the north it occurs in an immense sage glen in a dense pine forest (cf. Winter 1976: Figs. 34-35). Six probable kiva depressions, three apparent tower mounds, three or more roomblocks, a gridwork of low masonry walls, and two heavily vandalized middens with human burials in them make up the site. Tests were limited to the masonry gridwork attached to the northwest corner of the roomblock, where pollen tests in 1975 had yielded evidence of corn, beans, milkweed (Asclepias) and an unidentified Solanaceous species (Winter 1976: Table 27).

T.P. 1-3 bisected one of the walls forming the grid and investigated the soils around and beneath it (Fig. 23). No distinct cultural features and only a few sherds were found in the sterile sediments. The wall was only one course high and three to five blocks wide, and built on sterile sand. Since no use surfaces, pits, post holes or other features were found, it is probable that the squares once served as farm plots, as suggested by the pollen evidence.

Hov 47 - 5MT116 -

Another late Basketmaker or early Pueblo through Pueblo III unit pueblo tested during the summer was Hov 47, which contained seven obvious surface rooms, a large midden overgrown with Lycium (wolfberry), a probable kiva depression and an apparent tower mound. Since charred corn was collected from a vandal's pit during the 1974 survey, and the pollen of maize, Cleome, Lycium, Typha and unidentified Solanaceae and Cyperaceae species was retrieved from the survey pollen pit, the 1976 tests were set up to obtain as much data as possible about the types of maize and other crops grown near the site, along with evidence of food production techniques. Extensive pollen and flotation samples were therefore taken from the hearths and floors exposed during the trenching, while the surrounding sage

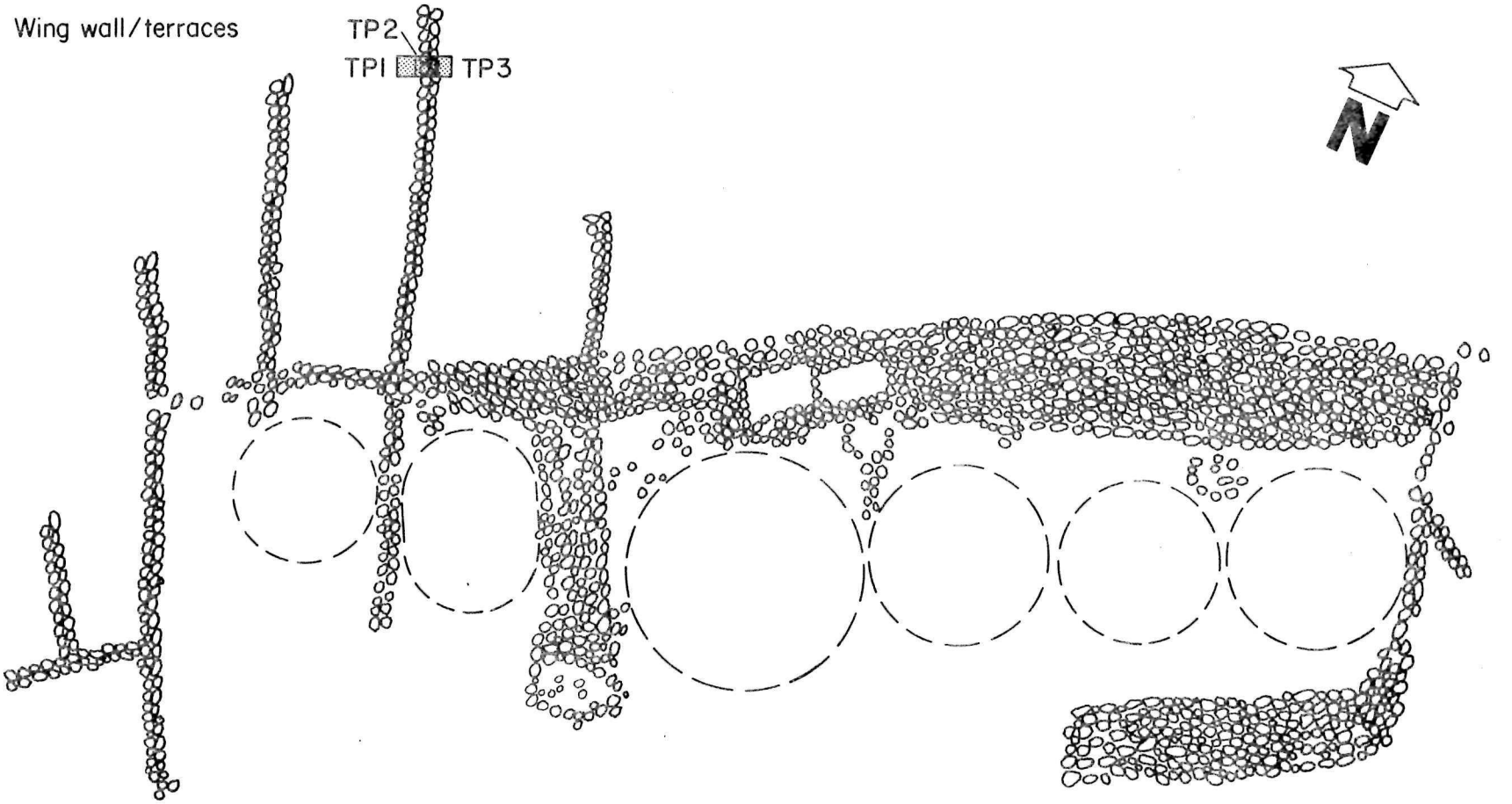


FIGURE 23
HOV 656 Prudden Unit Terrace site

0 3 6m

flats were systematically sampled for evidence of dry fields.

Five trenches were used at the site (Fig. 24). T.P. 1-4 and 6 formed the most extensive trench, which uncovered most of a cooking or habitation room. Two probable hearths occurred on the floor, along with hundreds of burned corn cobs and kernels. Three well made, mortared masonry walls were uncovered.

The probable tower mound which was trenched by the five meter long T.P. 5 was poorly made relative to the room block. No evidence of roof fall was found in the fill, and the wall consisted of very crude sandstone blocks which bottomed out at 120cm. below surface. A rough use surface was noted at the base of the wall, but the absence of distinct floor features does not allow us to speculate about the tower's function.

Three other trenches were established at the ruin. The rich midden was investigated with T.P. 8, revealing cultural material to a depth of 25-30 cm. A rubbly area of loose rock and burned jacal to the north of the room block was tested by two trenches to determine if early structures were present, as suggested by the ceramics, but aside from a row of upright slabs on the surface no distinct architectural features were encountered.

The final test at the site involved the collecting of nearly 200 pollen and soil samples from four 500 meter long transects in the flats around the site. Although no stone terraces were present, the soil was apparently excellent for farming as discussed in later chapters. A C14 date of AD1615±120 obtained from corn from the site appears much too late to be a realistic date.

Hov 49 - 5Mt426 -

The most complex "water control" site tested during the summer was Hov 49, located in a shallow canyon on the mesa top several kilometers north of Horseshoe House (Hov 57) and approximately half a kilometer south of Hov 47. Schroeder (1967-1968) first recognized its unique combination of features and hypothesized that the curving, double row of upright slabs on a small fan represented the remains of an irrigation canal. Other walls on the floodplain and talus slopes were thought to be farm terraces.

The site was revisited in 1975, when pollen sampling demonstrated that maize, Cleome, Typha and an unidentified Solanaceous species were grown at or near the site. Our surface sample and pollen test pit also suggested, however, that the curving wall was most likely the remains of a pithouse, rather than an irrigation canal.

As a result of the six trenches used to test the ruin this past

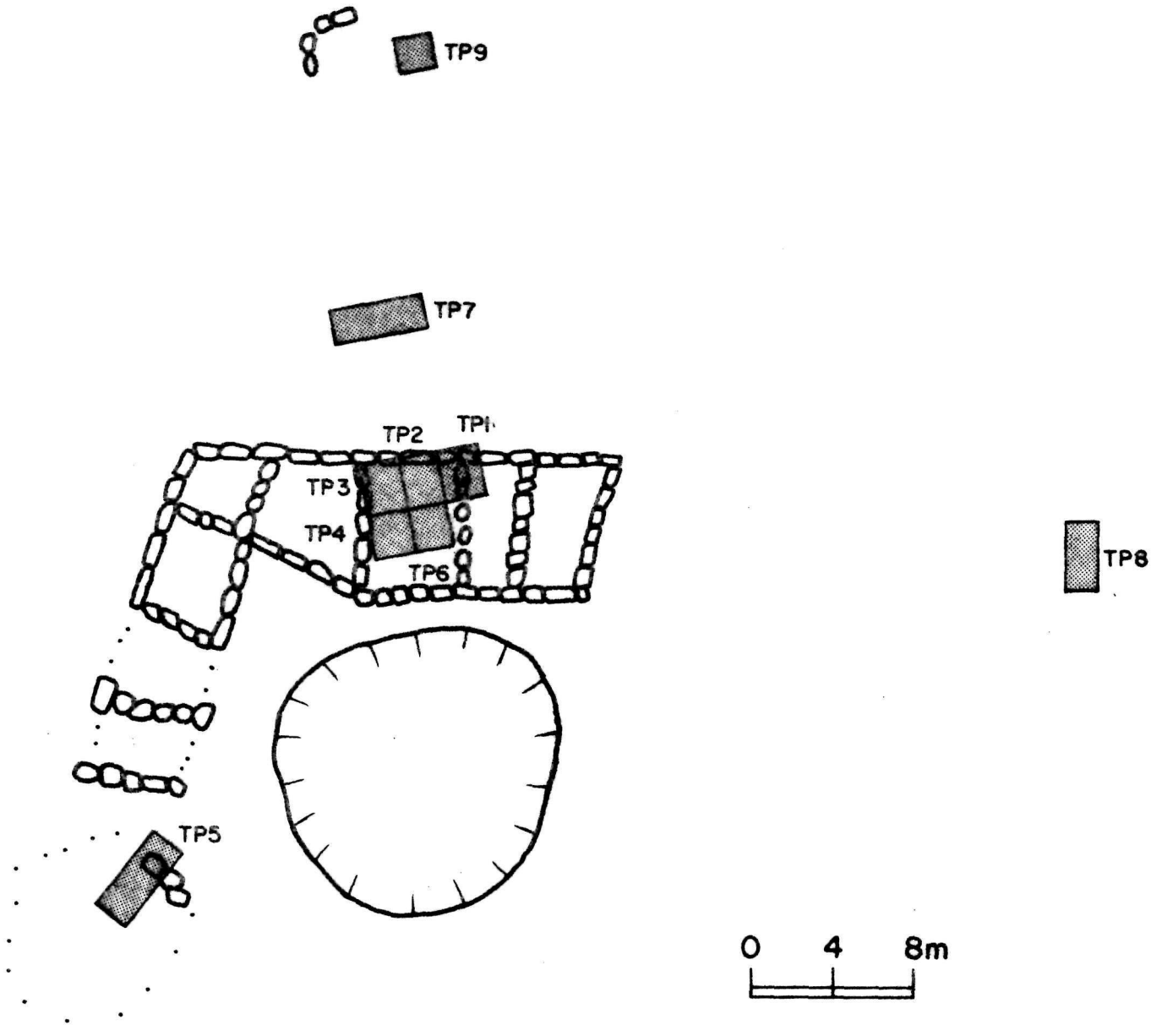


FIGURE 24
HOV-47

summer we now realize that the site is more complex than suggested by either Schroeder's or our survey data. The "ditch vs. pithouse" unit trenched by T.P. 1-3, 7-8 and 12-15, (Fig 25) for example, is still very unclear and could actually represent the remains of any number of different kinds of structures. The upright slab walls, two crude superimposed use surfaces and fill which ended at approximately 50 cms. below surface could have resulted from an agricultural retaining wall, a work area, or an eroded Great Kiva, as well as from an irrigation ditch or an ancient pithouse.

The floodplain terrace system also proved difficult to interpret on the basis of our limited tests. Instead of finding a low single coursed wall with sediments behind it, as expected, the wall tested by T.P. 4-5 continued to 120cm. below surface, with three to four rough use surfaces present in the fill. Whether this represents a series of superimposed fields and paths, a large room interior, a pithouse, or whatever is not yet known.

The talus walls, in contrast, were much simpler. T.P. 6 and 9 revealed a single rock course built along the hillside on sterile sand. The midden tested by T.P. 10-11 was also fairly easy to interpret: most of it is actually slope wash, with a rough use surface at 30cm. below surface.

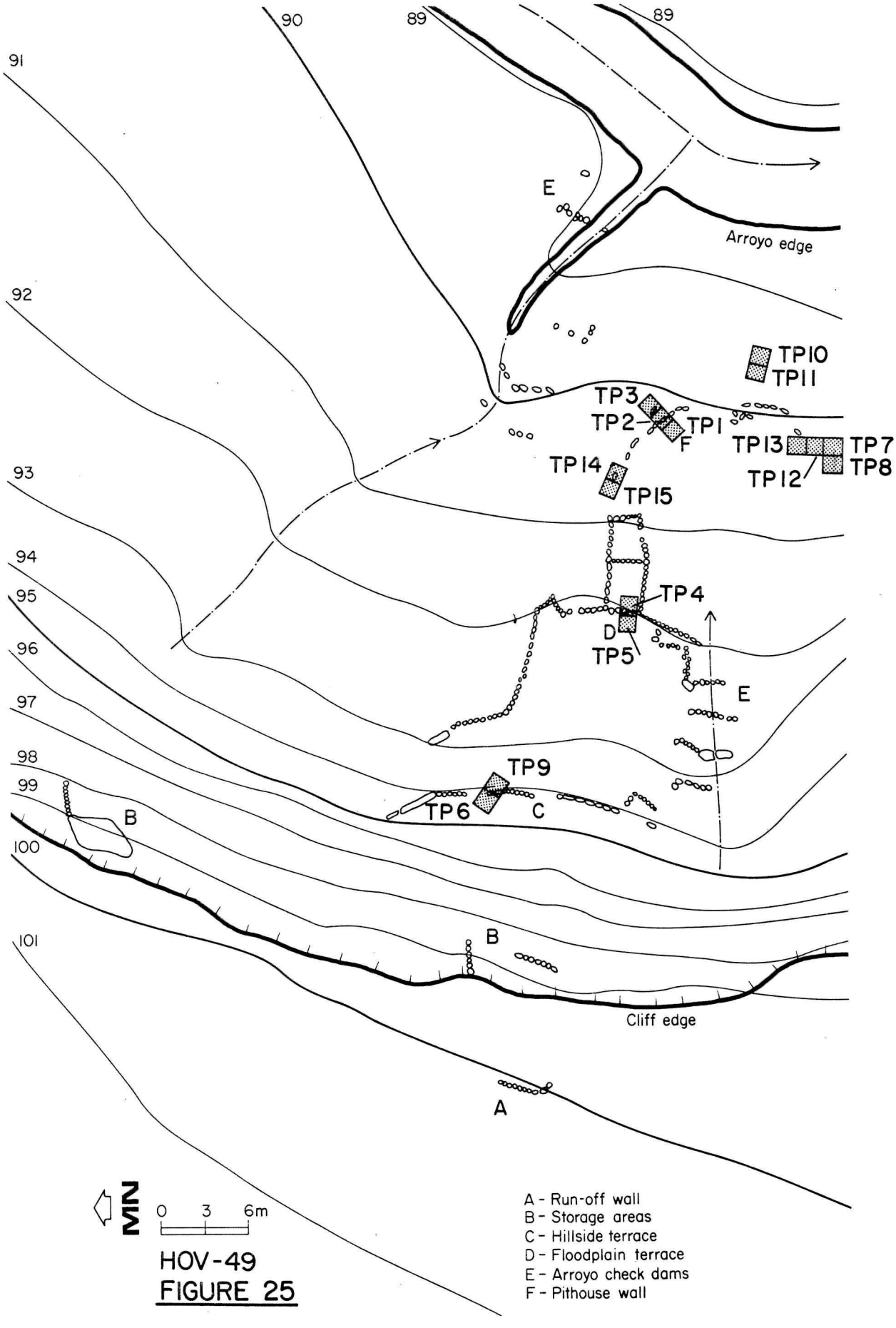
Hov 49 is an extremely complicated site which may never be understood until it is totally excavated. It may have been a terraced agricultural area, but if so the farming activities spanned a considerable length of time and were probably associated or alternated with habitation and other activities as well.

C. Simple Water Control Sites

Simple water control sites are probable farming areas which lack evidence of habitation, storage and related activities. Numerous small check dams occur in the arroyos of Cajon Mesa, along with isolated slickrock reservoirs. Five sites were tested. Two rock tank reservoirs were examined, along with three check dam series.

Hov 456/359/458 complex - 42SA3915/3893/3917

Hov 456 is part of an extensive site scattered across more than twenty acres of ridges, blowouts and arroyos above the Cajon Ruin springside tower complex at the head of Allen Canyon. A number of different components make up the "site." Hov 359, for example, is the large lithic scatter on the ridges and in the blowouts, which



HOV-49
FIGURE 25

has possible Paleo Indian and Archaic through Pueblo III materials. A much later Navajo component is represented by a burned hogan at Hov 458 on one of the ridges, while a probable reservoir occurs in the major arroyo at Hov 456. Hov 359 and 458 are discussed in the following section.

The earth and rock reservoir at Hov 456 was tested by facing off a 4.75 meter long section of the arroyo bank where it cut through the dam (Fig. 26). Although a possible Archaic point and Pueblo III sherds were found on the surface of the terrace behind the dam during the survey (Winter 1975), no artifacts were noted within the dam itself or in its sediments. It is possible, however, that the reservoir is associated with the nearby Pueblo III tower complex, which was dated by dendrochronology to A.D.1168 or later (Winter 1976: Table 45).

The sequence of construction at the dam entailed the building of a highly compacted mound of sand over bedrock, over which was piled a layer of rocky sand mixed with charcoal flecks. Several lenses of alluvial sediments then backed up behind the dam, forming a broad terrace. A row of rocks occur at the surface near the west end of the dam, but no rock walls were discovered during the tests in the center of the structure. When in use it probably measured one meter high and several meters thick; after abandonment an additional 25-50cms. of aeolian topsoil drifted in and covered the dam and its terrace.

Hov 665 - 5Mt4291 -

Hov 665 is a probable talus slope rock tank composed of several masonry walls attached to a cliff near the confluence of Cross Canyon with Big Ruin Canyon (Fig. 27). A much cruder wall of rough cobbles links the masonry wall with a large boulder, thereby forming a twenty meter long, crescent shaped dam. Three test pits investigated the northern section of the masonry wall, revealing rubble backing and lenses of sterile gravels and clay. No artifacts, floors, hearths or other cultural features were noted in the fill behind the dam, but the outline of an apparent bear's paw was cut into the cliff face above the structure. The large tank probably served to impound run-off from the cliff and talus slope for agricultural purposes, as suggested by cultigen pollen. Corrugated sherds found during the 1975 survey suggest a Pueblo II-III period use.

Hov 539 - 42SA4880 -

Hov 539 is a series of sixteen check dams and floodplain terraces located in an arroyo immediately above the cluster of akchin dams and rooms at Hov 94. Two probable floodplain terrace dams and one check dam were tested by two trenches and an isolated test pit to determine the construction and maintenance sequence, and if possible, to trace

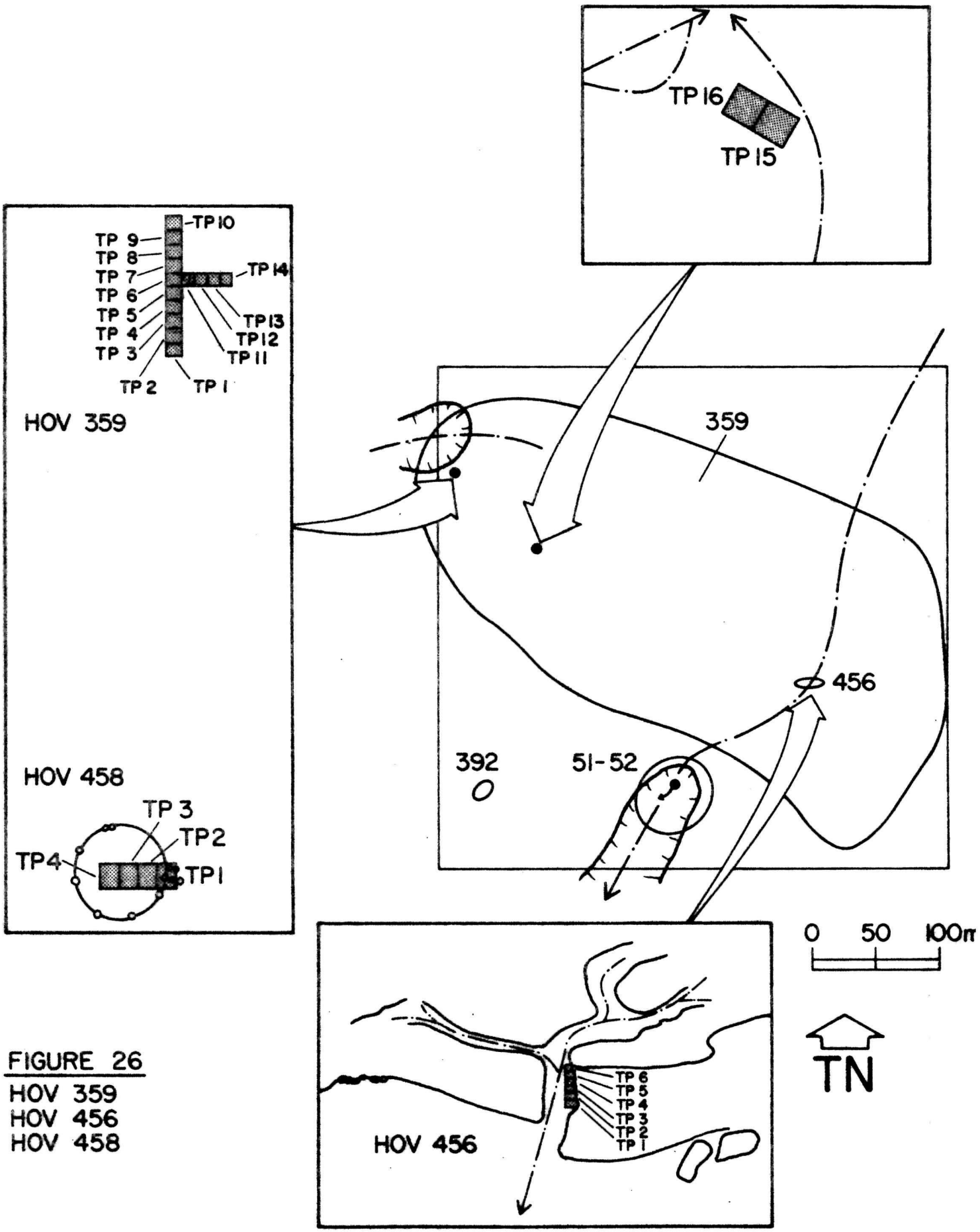
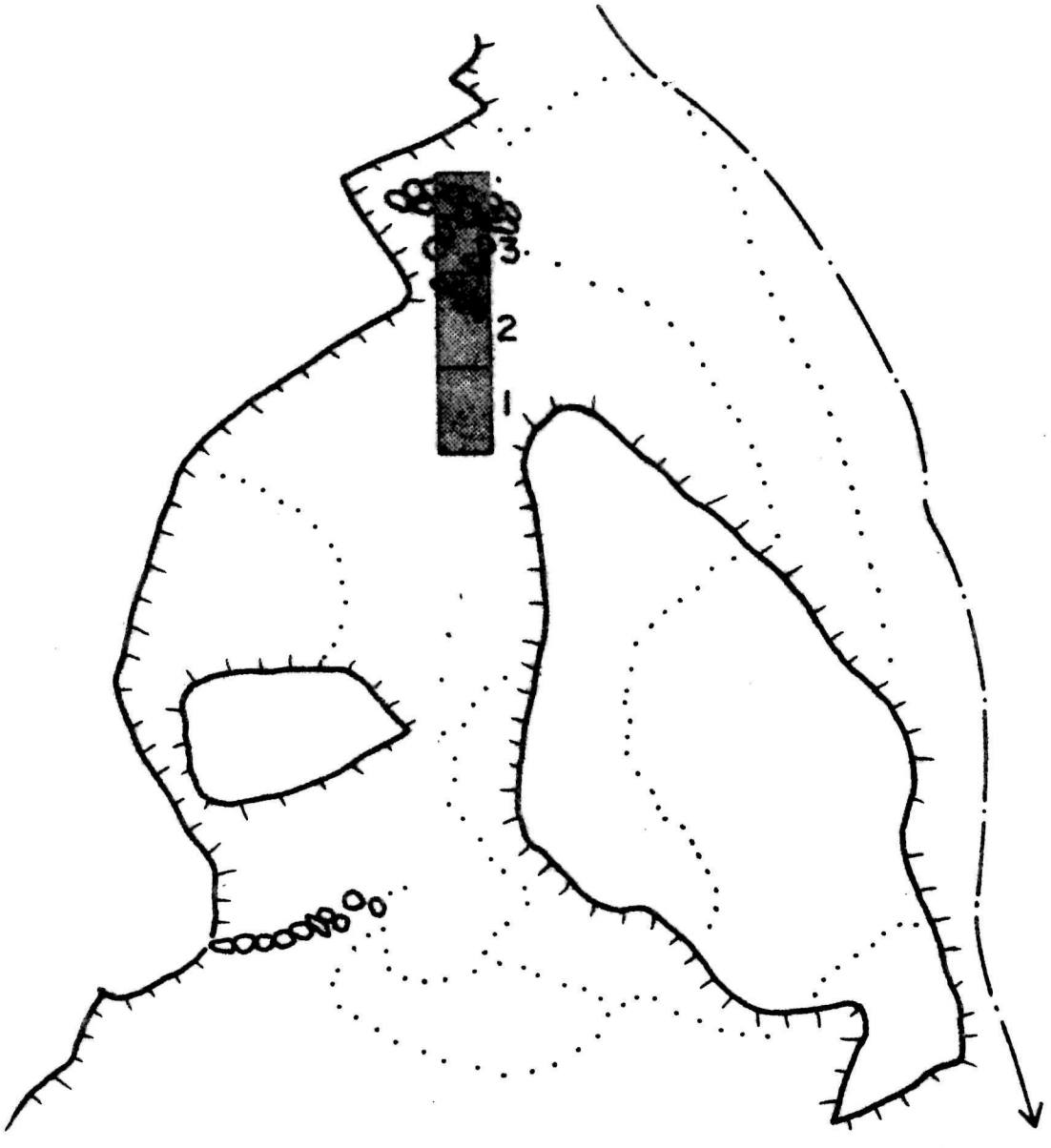


FIGURE 26
HOV 359
HOV 456
HOV 458



0 2 4m

FIGURE 27

HOV-665 Base map

MN

out field surfaces and obtain datable artifacts (Fig. 28). Although no sherds were found within the chinking of the dams, several PI-II sherds were discovered within the terrace sediments.

Stratigraphic profiles in the trenches indicate that the floodplain dams were once linked up with the check dam, and that water impoundment, rather than soil conservation and management, was probably the primary purpose of the retaining walls. In fact, the sediments behind the dams were actually no different than natural strata elsewhere in the arroyo system, so the dams could not have provided very much additional soil for gardening. Rather, the dams' positions and the sediments suggest that temporary water retention was their main function. The linking of the floodplain dams with the check dam in the arroyo would have insured the impoundment of a considerable amount of water during floods, thereby providing a relatively moist series of garden plots. Typha and maize pollen obtained during the pollen tests at the site suggest that the small reservoirs which formed during floods probably provided several months of moisture for the hardy drought resistant crops.

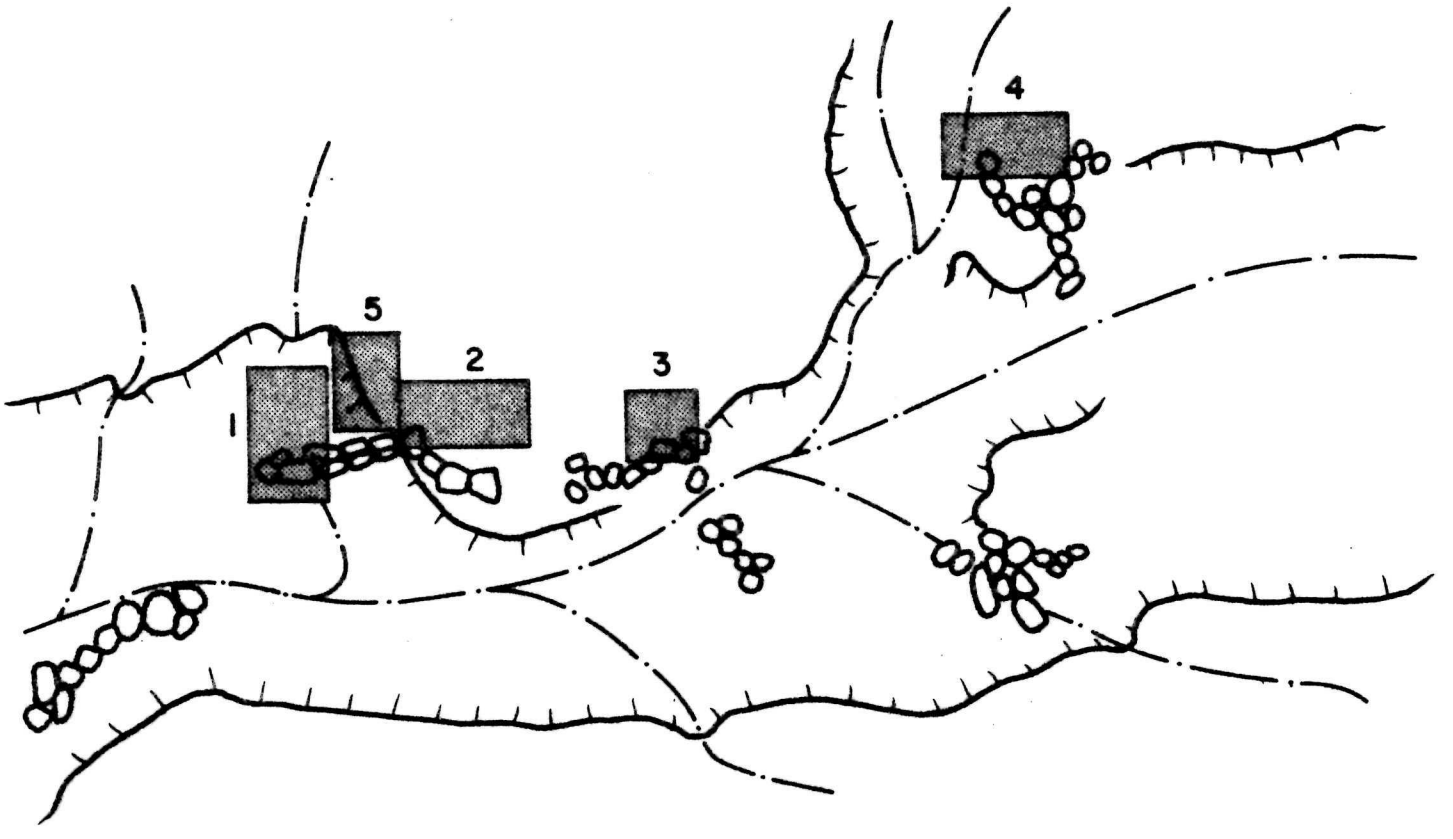
Hov 644 - 5Mt4086 -

Hov 644 is a series of seven low masonry check dams scattered along a wash immediately above Big Ruin Canyon. Two types of tests were run at the site (Fig. 29). First, an eight meter long trench was placed across two of the best preserved dams to investigate dam construction techniques and soil sedimentation. Similar 1 x 2 meter long trenches were also placed along two of the smaller dams. In all four instances careful records of soil depth, texture and composition were taken, along with pollen and soil samples.

The second testing phase involved the collecting of twelve pollen columns from three transects which ran along the two long dams and the terrace between them. Forde (1931) and Beaglehole (1937) note that the average Hopi field rarely exceeds one acre in size, and that small hillocks are cropped in evenly spaced rows. If similar maize fields were once grown behind the Hov 644 dams, pollen transect sampling could be useful in delineating the borders of the cultivated areas.

Hov 652 - 5Mt4093 -

The final water control site tested during the summer is Hov 652, located on the south side of Big Ruin Canyon, one mile northeast of the confluence of Big Ruin with Cross Canyon. The site is situated on a high alluvial terrace within the canyon, approximately 300 meters from the present channel. Fifteen small check dams and hillside terraces occur at the site; twelve are check dams scattered along several small washes, while three are linear walls running along several gentle slopes.



0 1.5 3m

FIGURE 28
HOV-539 Base map

MN

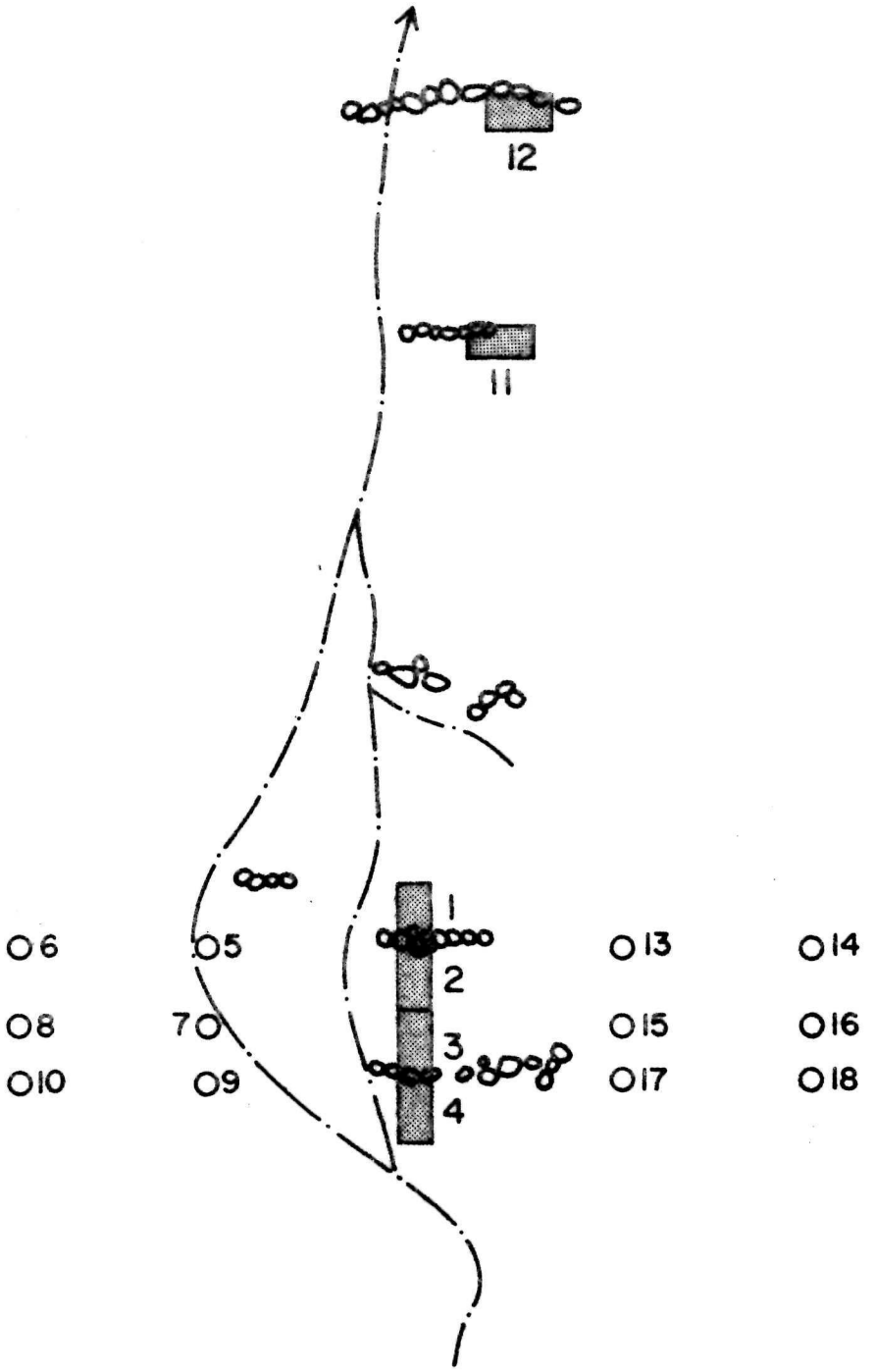


FIGURE 29
HOV-644 Base map

Five trenches were used at the site (Fig. 30). T.P. 1-8 bisected two of the best preserved dams and the terrace between them. Greatest soil depth in the terrace was 50 cm., but in general the soil was very shallow and eroded. Caliche usually began at 35 - 40 cm. below surface. T.P. 9-10, 13-14 and 15-19 obtained similar results at three other check dams.

The final trench at the site was placed in one of the linear hillside dams. Although running parallel to the arroyo rather than across it, the stratigraphy behind the dam was generally the same as that in the check dams, with shallow, eroded alluvial laminations.

D. Miscellaneous Sites

Hov 359/458 - 42SA3893/3917

Hov 359 is an extremely large scatter of projectile points, scrapers, flakes and a few sherds on the ridges around Cajon Ruin. The Hov 456 reservoir (preceding section) and the Hov 458 hogan (see next page) occur within the scatter, which is formed of numerous surface lithic concentrations on the ridges and in blowouts. Since apparent Paleo Indian and Archaic points were collected during the 1974 survey (cf. Winter 1975, 1976), two of the densest artifact scatters were tested this summer to determine if stratified, datable economic deposits were present below the surface.

Fourteen very shallow test pits investigated the heaviest lithic concentration, while two pits examined another (see Fig. 26). All artifacts were carefully mapped both vertically and horizontally. The unstratified aeolian sands bottomed out on bedrock at 10 - 25cm. deep in both trenches, and subsurface artifacts were very rare. No diagnostic tools or features were recovered, so the thin artifact scatters probably represent several thousand years of occasional tool manufacture by visitors from nearby habitation sites. Continuous erosion has mixed the tools into a 10 - 25cm. thick layer of flakes, bifaces and scrapers which probably represents the complete span of occupation at Cajon Mesa, from possible Paleo Indian and Archaic times through Anasazi and Navajo times.

Hov 458 is a good example of the most recent (and current) occupation of Cajon Mesa, since it is composed of a burned Navajo hogan and artifact scatter which probably dates from early and mid portions of the twentieth century. In fact, Navajos still use the nearby spring and shrubzone immediately outside of the Monument boundaries as a stock tank and grazing area. A large homestead occurs just over an adjacent ridge, and the site probably represents

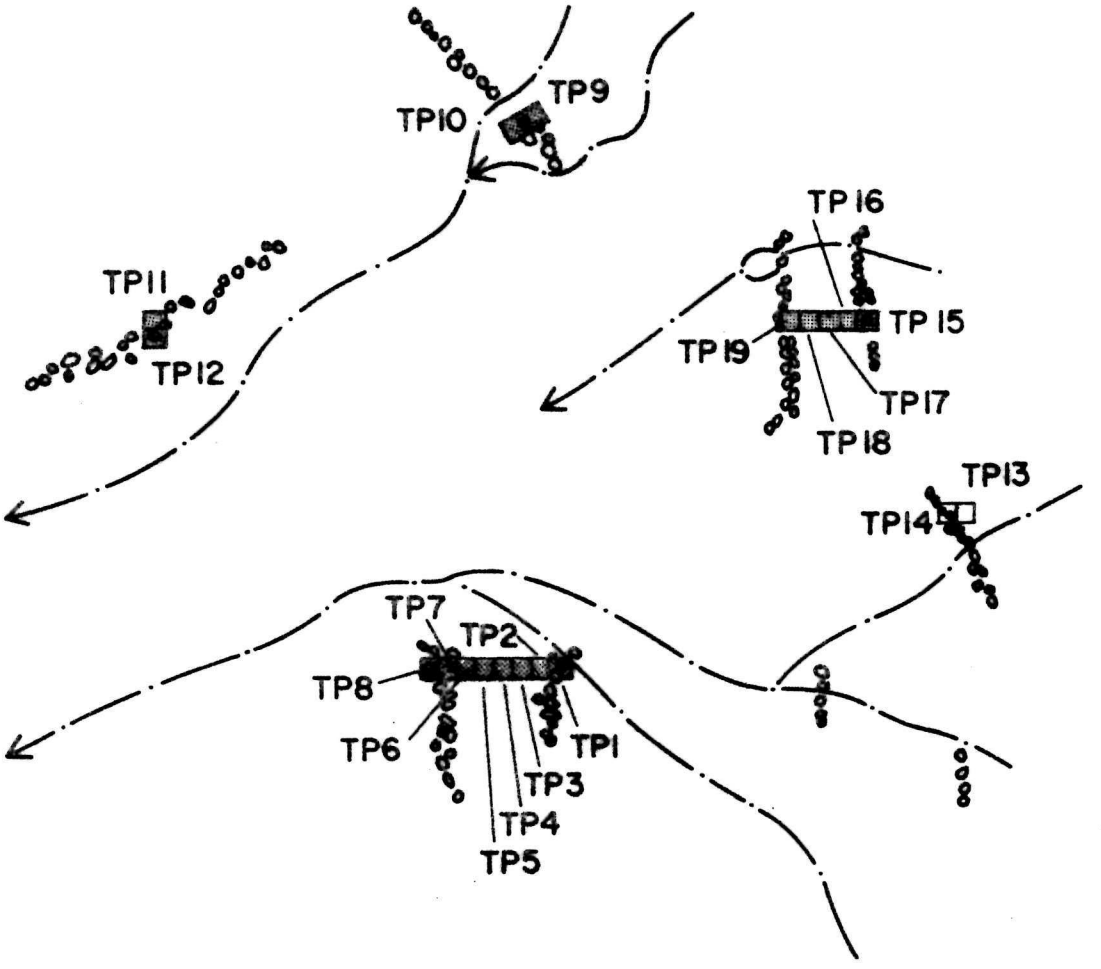


FIGURE 30
HOV 652

a former habitation of the current occupants of the neighborhood.

One four meter long trench was used at the hogan, running east-west from the doorway through the center of the structure (see Fig. 26). A burned use surface formed the floor, over which lay a 20cm. thick layer of ash, broken china, and galvanized nails and hinges.

Hov 388 - 5Mt4109 -

Hov 388 is a small lithic scatter located on a pinyon-juniper covered ridge above Cutthroat Castle (Hov 70). Upright slabs noted during the 1974 survey were suggestive of an isolated Basketmaker II pithouse, but shallow testing demonstrated that they were probably the result of natural, rather than cultural actions.

Hov 681 - 42SA4908 -

Hov 681 is a scatter of early projectile points and lithic debris occurring on a point overlooking Montezuma Canyon. Several upright stones indicated a possible Basketmaker pithouse, but like Hov 388, the tests found no evidence of subsurface material.

III.2

ANALYSIS OF 1976 CERAMIC COLLECTION

By Julia Hammett

The following report is a summary and analysis of the ceramic collection of the Hovenweep 1976 Field Season, which was collected from subsurface contexts in testpits at 25 sites. The ceramics were analyzed by type and feature association. The three main approaches at analyzing the material collected are discussed below.

Dating - The approximate chronological position of a particular site can be estimated by analysis of the numbers of sherds of specific pottery types associated with phases in the Anasazi culture. The date is not absolute in itself, but does provide information concerning the relationships between sites and "ceramic type" groupings, and the approximate time of habitation. It becomes especially useful when tree ring and C14 dates from nearby sites provide absolute chronologies for the various types. The available dendro/C14 dates for the Hovenweep ceramic collection are presented in Table 1 of the last section.

Feature Analysis - Separation of the sherd count into specific features within the individual sites can provide keener insight into the relative development and the function of the features. The development of the site can be identified by means of the relative dating of the feature stratification. Furthermore, the stratigraphy of the features and the associated types of artifacts can help establish data pertinent to the overall research problem.

Comparative Analysis - A third approach to the ceramic analysis of the 1976 year is a comparison with the previous field season's survey collection. Since 1976 is the first subsurface testing season at Hovenweep, we can use the data from the sites tested to evaluate the validity of the survey conclusions.

A. Typing of Ceramics

The Hovenweep 1976 collection was divided into three main groupings (Whiteware, Grayware, and Redware) which in turn were separated into more diagnostic groups (Tables 2-3). The basic guidelines established previously by Washburn (1974, 1975) and Breternitz et al (1974) have been followed. Washburn's two reports summarizing the 1974-1975 collection should be consulted for definitions of the types.

TABLE 2 - 1976 Ceramic Types by Site

Site No.	GRAYWARE Chapin/Hov	Moccasin	Mancos	Plain Gray	CORRUGATED Mancos (Rims)	Mesa Verde (Rims)	Hoven-weep	Unknown (body)	REDWARE Deadman's B/R	Bluff B/R	Plain Redware
3	1	-	-	13	1	-	-	-	1	-	-
12	4	-	-	85	1	16,2P	-	222	1	-	2
15	-	-	-	7	-	-	-	-	-	-	-
24	3	2	3	56,1h	3	4	-	157	-	1	3
47	18	-	5	6,1h	1	5	-	104	2	-	3
49	4	-	7,1h	28	2	7	-	166	2	2	5
53	1	-	-	7	-	2,2P	1W	239	-	-	-
64	1	-	-	3	-	-	-	2	-	-	-
94	-	-	-	2	2	2	-	34	-	-	-
520	5	-	-	17	1	3	-	85	2	-	1
539	-	-	-	-	-	-	-	1	-	-	-
571	31	-	5	80,2h	9	8	-	350	-	-	1
Sub Total	68	2	21	308	20	47,4P	1W	1360	8	3	15

W - Whole Vessel

P - Partial Vessel

h - Handle

TABLE 2 - cont'd

Site No.	GRAYWARE					CORRUGATED			REDWARE		
	Chapin/Hov	Moccasin	Mancos	Plain Gray	Mancos (Rims)	Mesa Verde (Rims)	Hoven-weep	Unknown (body)	Deadman's B/R	Bluff B/R	Plain Redware
597	2	1	3	67,1h	5	-	-	193	2	-	6
623	220	23	22,1h	55,1h	14	1,1W	-	108	38	41	56,1h
626	19	-	-	-	-	-	-	-	-	-	-
643	11	-	5	50,4h	8	3	-	301	3	1	3
648	2	-	-	15,1h	-	-	-	15	-	-	-
652	-	-	-	1	-	-	-	-	-	-	-
656	-	-	-	1	-	-	-	-	-	-	-
685	1	-	-	10	-	4	-	-	1	-	-
691	3,1P	1	-	-	2	-	-	-	-	-	-
707	-	-	-	1	-	-	-	-	-	-	-
708	-	-	-	-	-	2	-	-	-	-	-
709	6,1P	-	-	4,1h	2	4	-	188	-	-	-
714	4	-	-	7	-	1	-	78	-	-	-
Type Totals	2P, 336	27	52	527	50	62,4P	1W	2243	52	45	81

W - Whole Vessel

P _ Partial Vessel

h - handle

TABLE 2 - cont'd

Site No.	WHITEWARE											TOTALS				
	Chapin B/W	Piedra B/W	Cortez B/W	Mancos B/W	Morfield B/G	Wetherill B/W	Tin Cup Polychrome	McElmo B/W	Mesa Verde B/W	Unidentifiable B/W	Unidentifiable Whiteware	Total Grayware	Total Corrugated	Total Whiteware	Total Redware	Site Total
3	1	-	-	1	1	4	-	7	4	2	18,2h	14	1	40	1	56
12	-	-	-	12	11	9	-	31,1P	8,3P 1W	18	52,6h 1W, 1 vessel lid	89	239, 2P	147,4P 2W,1 v. lid	3	478,6P 2 W, 1v. lid
15	-	1	1h	-	-	3	-	7	1	-	8	7	-	21	-	28
24	3	-	3,1h	27,2h	9	15	-	10	4	18	36,6h	65	164	134	4	367
47	2	3	3	13	2	3	1	-	-	8,1h	51	30	109	87	5	231
49	-	3	11,1h	48,1h	7	17	1	4	-	17	79,2h	40	175	191	9	415
53	-	-	1	-	2	3	-	4,1P	3	5	9, 1 v. lid	8	241, 2P,1W	27,1P 1 v.lid	-	275, 3P, 1W, 1 v. lid
64	-	-	-	7	-	2	-	1,1h	-	1	5,2h	4	2	19	-	25
94	-	-	-	4	-	7	-	8	2	2	25,1h	2	38	49	-	89
520	-	-	1h	15,1h	2	9	-	12	2	9	29,4h	22	89	84	3	198
539	-	-	2	1	-	-	-	-	-	-	-	-	1	3	-	4
571	-	11,1h	1,1h	99,2h	8	20	-	29	13	24,1h	154,3h	118	367	366	1	852
Sub Total	6	19	26	233	42	92	2	114,2P	37,3P 1W	106	492,1W 2 lids	399	1426, 4P,1W	1168 5P,2W 2 lids	26	3019, pP, 3W, 2 lids

W - Whole Vessel

P - Partial Vessel

h - ndl

TOTAL 2 - cont'd

Site No.	Chapin B/W	Piedra B/W	Cortez B/W	Mancos B/W	Morfield B/G	Wetherill B/W	Tin Cup Polychrome	McElmo B/W	Mesa Verde B/W	Unidentifiable B/W	Unidentifiable Whiteware	Total Grayware	Total Corrugated	Total Whiteware	Total Redware	Site Total
597	-	-	3,1h	27	2	24	-	28,1h	8	15,2h	58,3h	74	198	173	8	453
623	2	10	5	20,1h	17	6	-	-	-	12,2h	89,2h 1P	322	123,1W	166,1P	136	747,1P
626	-	-	-	-	-	-	-	-	-	-	6	19	-	6	-	25
643	1	2	2,3h	54,2h	13	34	-	26	16	24,1h	81,5h	70	312	264	7	653
648	-	-	1h	8	2	4	-	17,1h 1P	7,1P	12	42	18	15	94,2P	-	127,2P
652	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
656	-	-	-	-	-	1	-	-	-	-	2	1	-	3	-	4
685	-	1	1	4,2h	2	8	-	26,1h	5	7,1h	20	11	4	77	-	93
691	-	-	-	1	-	1	-	-	-	1	1P	4,1P	2	3,1P	-	9,2P
707	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	2
708	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
709	3	5	1h	15,1h	6	6	-	25	5	8	82,3h	21,1P	194	160	-	375,1P
714	-	2	-	10	-	3	-	14	1, 1 sipapu	4	15	11	79	4, 1 sipapu	-	139, 1 sipaup
Total	12	38	42	379	84	179	2	254, 3P	79,4P 1W, 1 sipapu	195	900,2P 1W, 2 lids	952, 2P	2355, 4P,2W	2164 9P,2W, 2 lids 1 sipapu	178	5649,15P 4W, 2 lids 1 sipapu

W - Whole Vessel

P - Partial Vessel

h - handle

TABLE 3 - 1976 CERAMIC VESSEL COUNTS

Black-on-White Ware	Whole Vessels	Partial Vessels	Sherds
Mesa Verde B/W	1	4	79
McElmo B/W	-	3	254
Wetherill B/W	-	-	179
Morfield B/G	-	-	84
Mancos B/W	-	-	379
Tin Cup Polychrome	-	-	2
Cortez B/W	-	-	42
Piedra B/W	-	1	38
Chapin B/W	-	-	12
Unidentified White Ware	1	1	900
Unidentified B/W Ware	-	-	195
TOTAL WHITE WARE	2	9	2164

Gray Ware	Whole Vessels	Partial Vessels	Sherds
Chapin/Hovenweep	-	2	336
Moccasin Gray	-	-	27
Mancos Gray	-	-	52
Plain Gray Ware	-	-	537
TOTAL GRAY WARE	-	2	952

Corrugated Ware	Whole Vessles	Partial Vessels	Sherds
Mancos Corrugated (Rim)	-	-	50
Mesa Cerde Corrugated (Rim)	1	4	62
Hovenweep Corrugated	1	-	2243
TOTAL CORRUGATED	2	4	2355

TABLE 3 - cont'd

Redware	Sherds
Bluff B/R	45
Deadman's B/R	52
Plain Redware	81
TOTAL REDWARE	178

Other Ceramics *

1 Basket Impressed, Cortez B/W sherd (Hov 643)
1 Mancos B/W sherd with Fugitive Red Stain (Hov 571)
2 Whiteware Ladles (Hov 623 and Hov 691)
1 Ceramic Horn (Hov 623)
2 ceramic Vessel Lids (Hov 12 and Hov 53)
1 B/W Olla Rim used as a Sipapu Rim (Hov 714)
1 Whiteware Phallic Handle (Hov 648)

Handles	Whole	Partial
McElmo B/W	-	4
Mancos B/W	2	10
Cortez B/W	-	11
Piedra B/W	-	1
Unidentified B/W	-	8
Unidentified Whiteware	-	39
Redward	-	1
Grayware	-	14
TOTAL	2	88

Polishing Sherds

1 McElmo B/W (Hov 12)
1 Plain Grayware (Hov 24)
2 Plain Redware (
3 Black on Red (Hov 623)
1 Black on White (
1 Whiteware (Hov 643)
9 TOTAL POLISHING SHERDS

TABLE 3 - cont'd

Other Ceramics, contd.

Corrugated Black-on-White Painted Sherds

1 Tin Cup Polychrome (Hov 47)
1 Wetherill B/W (Hov 643)
3 Cortez B/W (Hov's 520, 571, 623)
1 Piedra B/W (Hov 571)
1 Chapin B/W with the paint on the coiled side (Hov 643)

7 TOTAL

* All of these artifacts have been tabulated in their appropriate sherd categories with the exception of the ceramic horn, the ladle, the vessle lids, and the sipapu rim

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ABSOLUTE TOTALS

Vessels	Whole	Partial
White Ware	2	9
Gray Ware	-	2
Corrugated	2	4
TOTAL	4	15

Sherds

White Ware	2164
Gray Ware	952
Corrugated	2355
Redware	178
TOTAL	5649

FINAL CERAMIC TOTAL (RECAPITULATION)

1 Mug
1 Whiteware Bowl
1 Corrugated Vessel
15 Partial Vessels
5649 Sherds
1 Ceramic Horn
2 Partial Ladles
2 Vessel Lids
1 Sipapu Rim

Grayware - The Grayware was divided into two sub-headings: Corrugated and Non-Corrugated. The Corrugated was subdivided into Mesa Verde Corrugated, Mancos Corrugated, Hovenweep Corrugated, and Unknown Corrugated. The Mancos and Mesa Verde varieties are definable by rim sherds (Breternitz, Rohn, and Morris, 1974:22). The Mancos rims consist of a wide fillet of clay added after the spiral coil of the vessel body has been completed (Breternitz et al, 1974). The Mesa Verde have thinner walls than the Mancos, and the rims are left plain or are coiled to the top, and are clearly everted (Abel 1955; Breternitz el, 1974). The Hovenweep Corrugated, which has been discussed by Abel (1955), has a thicker body wall than the other two and has a coarser temper. The Mancos and Mesa Verde varieties are said to have much better workmanship than the Hovenweep. One good example of a Hovenweep Corrugated vessel (Fig 31) was discovered in the 1976 subsurface testing, from a tower at Holly House (Hov 53). Thus for the first time we have good evidence demonstrating the existance of a distinguishable Hovenweep variety. Breternitz et al (1974:22) suggest that it is synonymous with the Mesa Verde variety, deviating only in thickness and texture. The body sherds of all the corrugated types (Mesa Verde, Mancos and Hovenweep) have been classified as "Unknown Corrugated" due to the impossibility of distinguishing them without rim sherds.

The corrugated types are generally representative of the Pueblo II and Pueblo III periods. Of the corrugated vessels found, one whole Hovenweep and three partial Mesa Verde vessels came from towers, and one partial (Mesa Verde) was collected in the Hov 12 kiva (from the roofall). The other whole corrugated (Mesa Verde) vessel came from the kiva/Pithouse structure at the Aneth site (Hov 623).

The Non-Corrugated sherds have been separated into five categories: Chapin/Hov, Mancos Gray, Moccasin Gray, and Plain Grayware. The Chapin/Hov is a conglomerate of the crudely made grayware distinguishable by angular rock temper protruding from the surface. The descriptions of these grayware types overlaps to such a degree that it is impossible to separate them on the basis of body sherds along. Martin (1939) has called the Chapin Grayware a variety of Lino Gray, while Abel (1955) has discussed the Chapin as synonymous with the Lino Gray and Twin Trees Plain, differing only in temper and polish, respectively. One small jar from the pithouse at Hov 691 was recovered (Fig 32). One partial Hovenweep Gray vessel from Hov 709 is the first nearly complete vessel of this type discovered, and demonstrates the validity of Abel's (1955) original definition of Hovenweep Gray as a distinctive type, at least in the vessel shape and rim form (Fig 32). This variety is considered to be of the PIII period (Abel,1955). Hovenweep Gray was defined by Abel as having crushed rock temper. Lacking any nearly complete vessels to study, Abel projected from the available body sherds that the vessel was smaller than corrugated vessels, yet had the general corrugated

Figure 31. Mesa Verde Corrugated and Hovenweep Corrugated (lower right) Vessels From Hovenweep

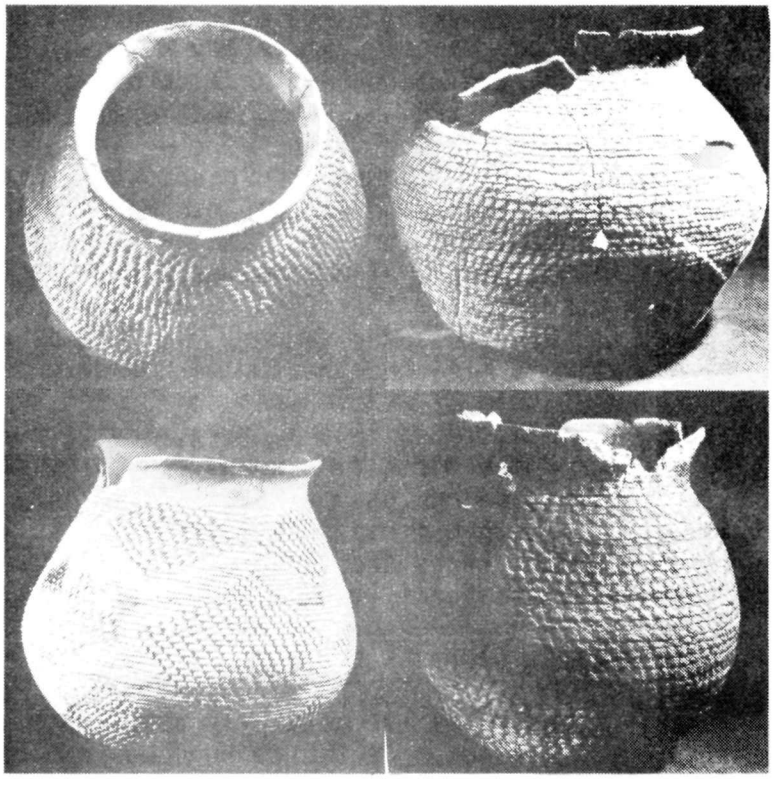
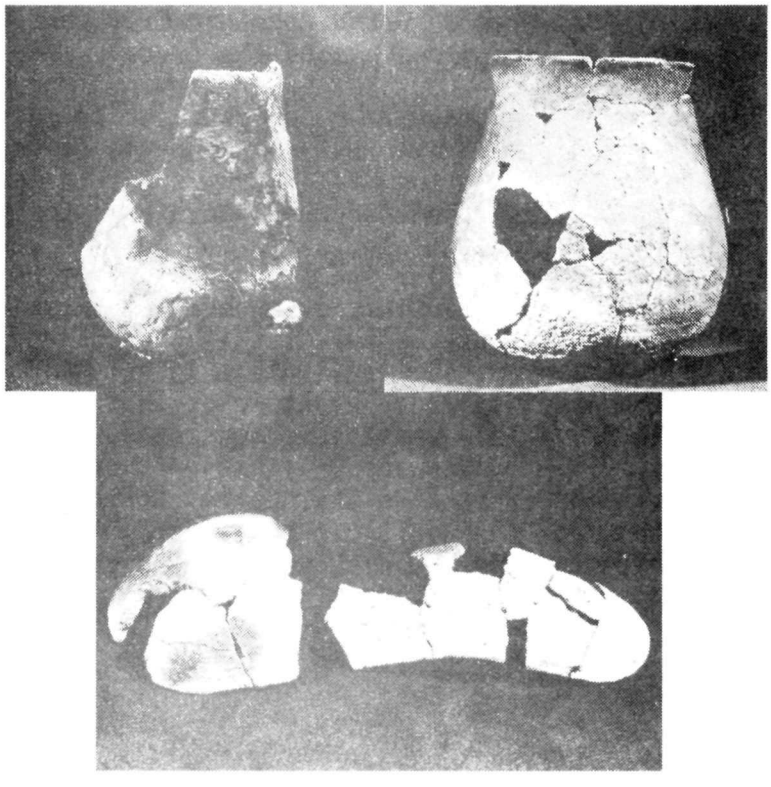


Figure 32. Chapin Gray (upper left), Hovenweep Gray (upper right), and Piedra Black-on-white (bottom) Vessels from Hovenweep



shape. Also, this type had a slightly everted rim.

Description of the Hovenweep Gray Partial Vessel From Hov 709

rim-slightly everted, no banding
thickness of walls - average 5 mm
form-shape similar to corrugated vessel (egg shape) but
size smaller than the corrugated vessel
temper-crushed rock
core texture-very coarse
core color-medium gray
vessel walls-fair to weak
surface finish-roughly scraped, surface unpolished
coil marks complete obliterated
carbon streak-non apparent
surface color-dark gray; fire clouds not apparent

In comparison to similar grayware, the Hovenweep is probably most closely related to Kiet Siel Gray, which is considered its southern counterpart (Abel,1955). The Kiet Siel Gray vessels are more globular in shape. Also, Kiet Siel Gray typically have coils which are flattened but apparent. The recovered partial vessel has no apparent coils.

The Mancos and Moccasin Gray types can only be separated by neck bands formed by rows of wide coils. The Moccasin neck bands are wider than the Mancos Gray, while the latter's coils are usually tooled (Washburn, 1974;Breternitz et al, 1974; Abel, 1955). The body sherds of the Moccasin and Mancos Graywares have probably also been cast into the Chapin/Hov conglomerate previously discussed. The final grayware category is the "Plain Grayware" group, consisting of all plain (smoothed) wares of higher quality temper than the "Chapin/Hov" ceramics.

Redware - The Redware has been divided into three categories: Deadman's Black-on-Red, Bluff Black-on-Red, and Plain Redware (consisting of all plain and indeterminate redware). There was no Abajo Red-on-Orange collected at Hovenweep during the 1976 field season. Both identifiable types of Redware collected are associated to Pueblo I period (Breternitz et al, 1974).

Whiteware - One third of the ceramics collected in subsurface testing fall into the Whiteware category. The Whiteware was divided into eleven groups which are chronologically successive from Chapin Black-on-White (the earliest whiteware dating to AD 500-850) to the Mesa Verde Black-on-White type which is the latest and the most complex and refined form of B/W ceramics. The types include Chapin Black-on-White, Piedra Black-on-White, Cortez Black-on-White, Mancos Black-on-White, Morfield Black-on-Gray, Wetherill Black-on-White,

Tin Cup Plychrome, McElmo Black-on-White, and Mesa Verde Black-on-White. Two categories of unidentifiable whiteware have been separated, primarily as a result of the recovery of a plain, white, lipped vessel from Hov 12 (Fig 33). It is not known if it constitutes a new type ("Hovenweep White"?) or if it represents the plain bottom of a broken B/W vessel which was reworked (it was formed from the bottom of a larger olla). It may be significant, however, that Rohn (1971:185-186) found 18 such vessels at Mug House, which he tentatively classified as unpainted McElmo and Mesa Verde Black-on-White vessels. The unidentifiable whiteware has, therefore, been divided into the categories of "Unidentifiable Black-on-White" and "Unidentifiable Whiteware."

The whiteware data tended to affirm previous assumptions rather than yielding substantial new information for the Anasazi occupation. A mug clearly of the Mesa Verde type was uncovered in a tower site (Hov 12) in the Square Tower Ruin group. Partial whiteware vessels recovered include kiva jars, ollas, seed jars, and two ladles (Fig. 33).

One of the recovered partial ladles is of the half-gourd variety (Fig 32) which has previously been associated with the earlier Black-on-White types (Breternitz et al, 1974). This ladle has a thin white slip and has traces of paint on the rim, and it appears to be a Piedra Black-on-White type. The other partial ladle was found in association with the burial at the Aneth site (Hov 623) and is of the strap handle variety (Breternitz et al, 1974:39).

The largest portion of the identifiable whiteware collection falls between the Mancos-McElmo margins; only 8% is from earlier times and only 6% comes from the Mesa Verde variety. One quarter of the definable whiteware falls into the McElmo type and 61% can be defined under the broad headline of the Mancos (Mancos, Morfield, Wetherill and Tin Cup Polychrome) group. Only three samples of Tin Cup Polyhrome were found. One, a partial ladle, was found offsite. Two sherds were found. One was a Mancos Corrugated rim sherd with polychrome on one side from Hov 47 and the other sherd had Tin Cup paint on the inside and Mancos Black-on-White designs on the outside. The latter sherd came from Hov 49.

Comparative Analysis

Intersite comparisons were drawn from survey data and from subsurface feature association data (Table 4). Overall, the subsurface testing showed an increase in early Black-on-White types and all types of the Grayware group, and a marked decrease in the latest Black-on-White type. Slight development trends were usually present at each site, but generally, the amount of sherds collected within features was not large enough for determining the chronological sequence within the sites.

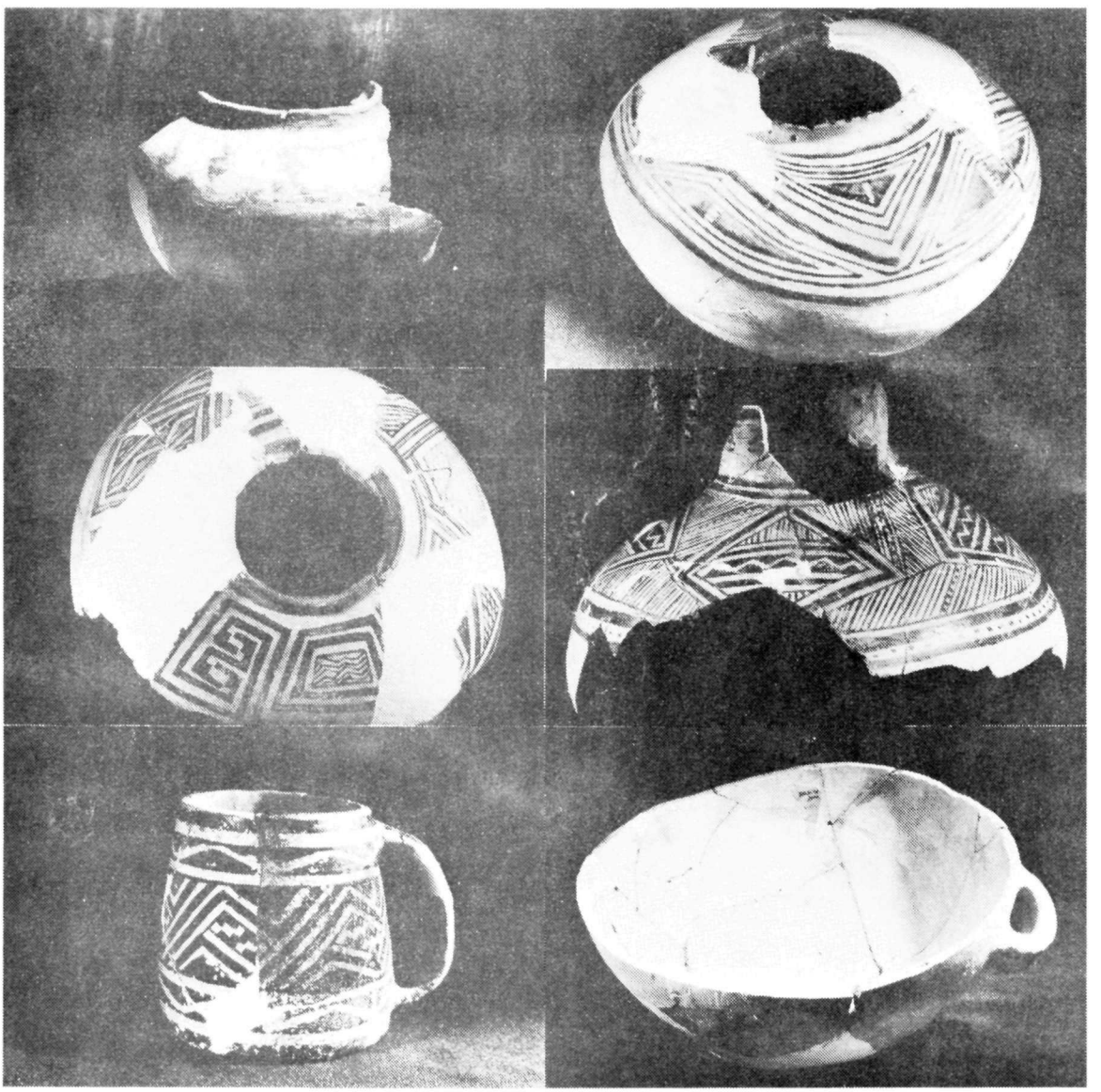


Figure 33. McElmo Black-on-white (upper left and right, middle left), Mesa Verde Black-on-white (middle right and lower left), and plain white (lower right) vessels from Hovenweep

TABLE 4 - 1974-1975 Survey Data

Site No.	GRAYWARE				CORRUGATED		REDWARE				Sub Totals
	Chapin	Moccasin	Mancos	Hov	Mancos MV	Hov	Abajo R/O	Deadman's B/R	Bluff B/R	Plain	
3	-	-	-	-	2	3	-	1	-	-	6
12	-	-	-	-	6	14	-	-	-	-	20
15-16	-	-	-	5	18	17	-	-	-	-	40
24	-	1	1	7	45	47	1	2	-	-	104
47	-	1	1	-	35	45	-	-	-	11	93
49	-	-	5	-	17	40	-	2	-	2	66
53-56	-	-	1	5	8	37	-	-	-	-	51
64-68	1	-	-	9	9	38	-	-	-	-	57
94	-	1	-	-	17	7	-	-	-	-	25
520	-	-	6	-	80	99	-	1	-	6	192
539	-	-	-	-	-	-	-	-	-	-	0
571	-	-	-	-	58	60	-	1	-	-	119
597	-	-	1	-	44	47	-	-	-	-	92
626	-	-	-	-	-	2	-	-	-	-	2
643	-	-	1	-	51	49	-	1	-	3	105
644	-	-	-	-	3	-	-	-	-	-	3
648	-	-	-	-	1	1	-	-	-	-	2
652	-	-	-	-	-	2	-	-	-	-	2
656	-	-	2	-	67	71	-	3	-	-	143
707	-	-	-	-	-	-	-	-	-	-	0
708	-	-	-	-	-	-	-	-	-	-	0
709	-	-	-	-	-	-	1	-	-	-	1
714	-	-	-	-	5	3	-	-	-	-	8
Type Totals	1	3	18	26	466	582	2	11	-	22	1131

TABLE 4 - cont'd

Site No.	Chapin B/w	Piedra B/W	Cortez B/W	Mancos,Mineral Mancos B/W	Mancos,Mineral Morfield B/G	Wetherill B/W	Tin Cup Polychrome	McElmo/MV McElmo B/W	McElmo/MV Mesa Verde B/W	Sub Total	Site Total
3	-	-	-	-	-	-	-	-	-	0	6
12	-	-	-	2		3	-	13		18	38
15-16	-	-	-	3		4	-	18		25	65
24	-	-	-	17		2	-	11		30	134
47	-	-	1	56	2	2	-	9	3	73	166
49	-	-	3	37	2	1	1	-	-	44	110
53-56	-	-	-	-	-	2	-	11		13	64
64-68	-	-	-	5		6	-	5		16	73
94	-	-	-	1	-	2	-	12	-	15	40
520	2	2	3	46	3	22	-	75	12	165	357
539	-	-	-	1	-	-	-	-	-	1	1
571	-	-	2	89 3	62	1	45	52	254	373	
597	-	-	1	20	1	15	-	89	8	134	226
626	-	-	-	-	-	-	-	-	-	0	2
643	-	2	2	36	7	6	1	10	22	86	191
644	-	-	-	1	-	-	-	-	-	1	4
648	-	-	-	-	-	-	-	-	2	2	4
652	-	-	-	-	-	-	-	-	-	-	2
656	-	1	8	10	14	18	-	23	63	197	340
707	-	-	-	1	-	-	-	-	-	1	1
708	-	-	-	-	-	-	-	-	1	1	1
709	-	1	-	44	3	14	-	6	23	91	92
714	-	-	1	-	-	2	-	24	-	27	35
Type Totals	2	6	21	464		161	3	537		1194	2325

One notable observation in the comparison is the increase in corrugated sherds in the subsurface levels over the number representative in the survey. Corrugated represented 45% of the survey collections, but increased to 65% of the subsurface collection. It is expected that the early grayware and whiteware would increase below surface, but the corrugated group which has been associated with the later Anasazi phases also experienced a substantial percentage increase. One reason for this discrepancy is that survey crews tend to collect the Black-on-White ceramics more readily than the gray toned sherds. Certainly this data suggests questions for further study.

The Non-Corrugated Grayware pottery of the Hovenweep area has essentially followed the expected patterns of association. The most significant find was a partial Hovenweep Gray Vessel at Hov 709. Until the appearance of this vessel (definable by corrugated vessel shape and slightly everted rim) there had been considerable doubt as to the validity of such a type (Breternitz et al, 1974). Now it appears clear that the type is present.

Both Grayware and Redware were found in significant amounts in the Aneth site (Hov 623). The site appears to have had a long occupancy, according to the representative ceramic sample. Comparatively, the grayware gathered from this site represented 38% of the total grayware sample collected from Hovenweep in the 1976 field season. The largest assemblage/type was the Chapin/Hov type which consisted of 53% of the total grayware collected from the site. In a cross comparison with the other sites tested, 81% of the Moccasin Gray collected in 1976 came from the Aneth site. Of the Chapin/Hov collected, 67% came from this site.

The Redware sherds, like the Grayware, appeared in high quantities at the Aneth site. Hov 623 produced 76% of all the Redware collected in the 1976 field season. The corrugated and whiteware from Aneth represented only 5% of the season's sherd collection of the respective categories.

Summary

The 1976 field season produced a valuable addition to the previous Hovenweep ceramic data. New evidence for the Hovenweep ceramic types has been obtained. Furthermore, it is obvious that more data is needed to fully interpret the chronological development of ceramic types and their respective feature associations.

III.3

COMPARATIVE ANALYSIS OF THE SURFACE TREATMENT OF PUEBLO II-III CORRUGATED WARES FROM HOVENWEEP NATIONAL MONUMENT, 1975 SURVEY

By

Michael Pendleton and Dorothy Washburn

Comparatively little interest has been focused on aspects of the decorative surface treatment on utility wares. Rather, most attention has centered on the variations in and the implications of the geometric decorations on the black-on-white wares. As a consequence, plain and corrugated wares have usually been duly collected, typed and reported as a certain frequency in the total ceramic assemblage.

In our investigations of the 1975 survey ceramics from Hovenweep National Monument, we encountered difficulties even in assigning the sherds to the utility ware types established for the Mesa Verde region (Breternitz et al, 1974). Clearly, our corrugated sherds were similar to those of the Mesa Verde and rightly belonged in that ceramic series. However, equally clearly it was evident that our sherds differed in significant ways from those presumably manufactured at sites to the east.

Most typological studies of corrugated ware emphasize the vessel form, particularly the shape of the rim; aspects of surface treatment, particularly the general pinched or plain nature of the coils as well as any additional use of applique, etc.; and temper. However, since the sherds analyzed here were from surface surveys of sites during the 1975 Hovenweep Expedition season, no whole vessels and very few rim sherds were recovered. As a result, it was impossible to use the criteria of degree of rim eversion -- the best indicator of the difference between Mancos and Mesa Verde Corrugated (See chapter III.2, this report, for information on whole vessels from the subsurface tests). Secondly, since the survey sample included very few plain gray wares, almost all of the sherds were pinched. Therefore the characteristic of pinched or plain coil treatment was not useful. Often the utility vessels carry decorative patterns in the form of alternating sections of plain and pinched coils, or pinched and incised coils. However, very few of the survey sherds collected were of sufficient size to indicate that these treatment combinations were present. Furthermore, very few sherds carried applique or incised designs. Inspection of the temper revealed that most of the sherds had crushed rock inclusions.

In fact, all the corrugated sherds were so very similar in many respects that they were very difficult to type. Without rim sherds it was practically impossible to distinguish Mancos Corrugated from Mesa Verde Corrugated. Consequently, these two types were lumped together. The type Hovenweep Corrugated was revived and found to differ from Mancos-Mesa Verde Corrugated in size of temper inclusions. Schroeder (1967-68) felt that Hovenweep Corrugated had squarer corrugations and larger temper than the angular corrugations and smaller temper in Mesa Verde Corrugated. For a more detailed discussion of these problems see the 1975 Hovenweep Report.

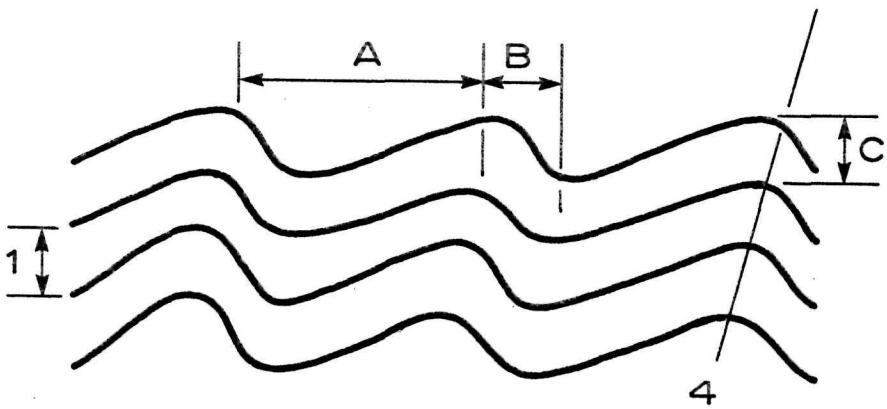
Study of the utility ware from Hovenweep therefore assumed two goals: 1) an attempt to type the sherds within the existing regional typology so that other researchers would be aware of the general nature of the Hovenweep material; and 2) an attempt to study certain decorative aspects of the surfact treatment in detail so that a more specific characterization might be produced of the ceramics from one area. The first objective was treated in the 1975 report.

The present study utilizes the division of the corrugated sherds into two types: Mancos-Mesa Verde Corrugated and Hovenweep Corrugated -- that was established in the first report (Washburn, 1975). Our efforts in this study involve refinement of the criteria which can be used to differentiate these two types. Presumably, Hovenweep Corrugated is a local southeastern Utah variant of the Mesa Verde series. The question was--by a detailed study of aspects of surface treatment--could we discover attributes which supported this differentiation? If not, then these negative results might be supportative of the recent decision to include Hovenweep Corrugated within the type Mesa Verde Corrugated; in effect abolishing its separate distinctive nature (Breternitz et al, 1974).

A total of 3635 sherds were analyzed; 1891 of which were typed as Hovenweep Corrugated and 1744 of which were typed as Mancos-Mesa Verde Corrugated. The following section discusses the attributes studied, each of which was selected on the basis of its measurable and thus replicable nature (Fig 34). All attributes were coded, recorded and the results punched on IBM cards which were submitted to computer analysis on the San Jose State University CDC 3300 computer using the SPSS package of programs. The attributes crest-crest, crest-trough and height were measured in mm; primary angle was measured in degrees. Coil width and sherd thickness were measured in mm as a range of values between the two extremes present on that sherd.

Attributes:

Coil Width (1) This describes the variation in width of a coil



1 = COIL WIDTH
4 = PRIMARY ANGLE
A = CREST — CREST
B = CREST — TROUGH
C = HEIGHT

Figure 34. Model Drawing of Attributes on Corrugated Sherds

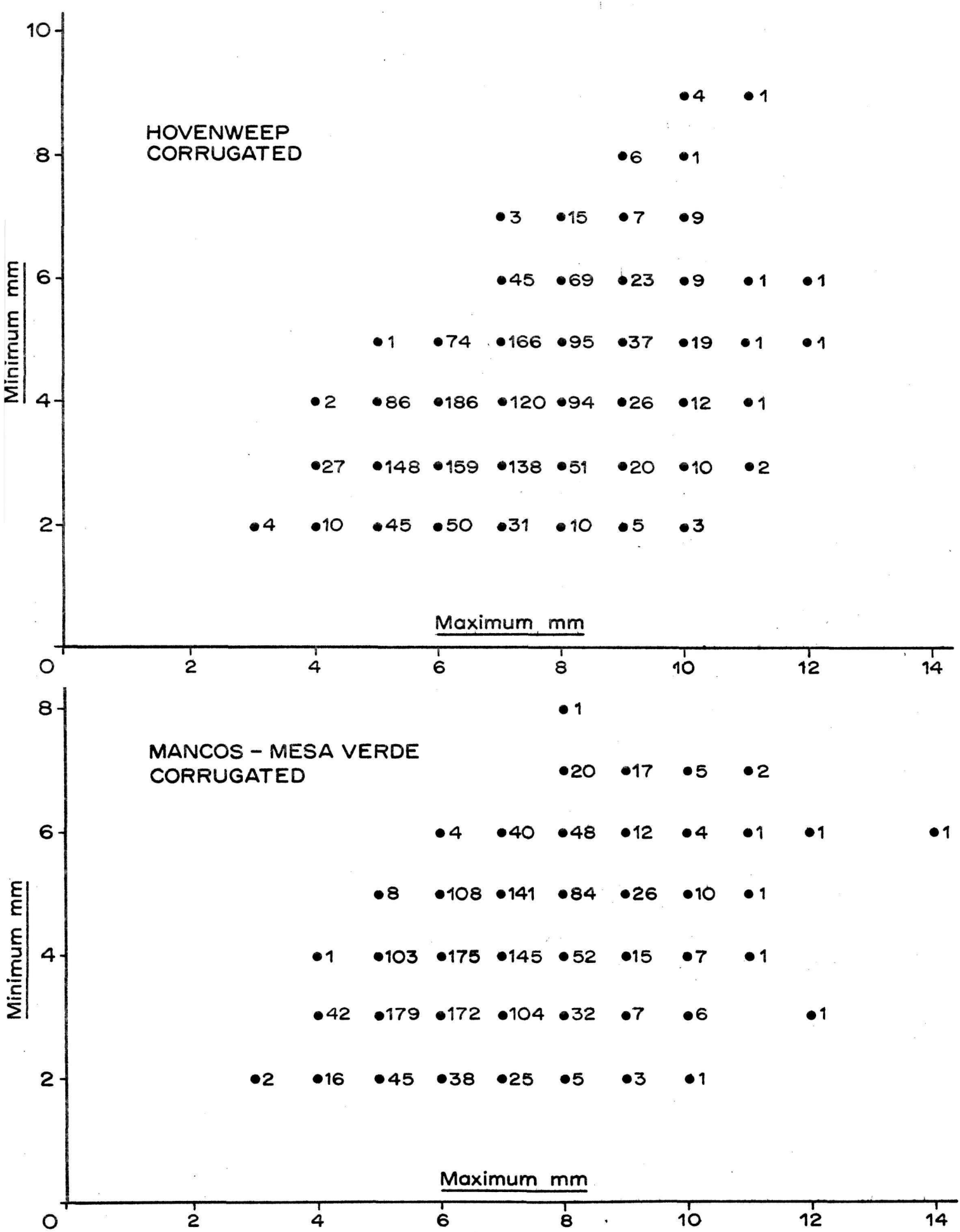


Figure 35. Distribution of Coil Width on Hovenweep and Mancos-Mesa Verde Corrugated Sherds

measured between the upper and lower boundaries of the coil. It is a range of values; the maximum and minimum values were not necessarily taken from the same coil.

Sherd Thickness (2) This describes the variation in thickness of a sherd, as measured in cross section. The thickness value was taken from the outermost edge of the coil to the smoothed interior surface of the sherd. The thinnest measurement was taken from the edge of the deepest convolution to the smoothed interior surface of the sherd.

Wave Form:

(A) Crest-Crest - This is the horizontal distance between areas of pinching pressure which results in a series of "pushed up" areas, commonly called corrugations.

(B) Crest-Trough - This horizontal measurement represents the distance between an imaginary line extended vertically from the highest point in the crest to the lowest point, where the pinching then begins to rise to the next crest. It is, in effect, a measure of the abruptness with which each succedding pinch cuts off the preceding pinch.

(C) Height - This vertical measurement represents the distance from the highest point in the crest to the lowest point in the trough; or the height of each "wave" or corrugation in a coil.

Primary Angle (4) This measurement represents the deviations from the vertical of the angle of pinching of the corrugations. Many corrugations displayed no discernable angle and were recorded as having o° angle. The angle of corrugations on other sherds were so variable that it was inaccurate to generalize the angle. In these cases, the angles were all recorded as 91°. In all other cases the angles fell between 1-90°.

Vessel Construction (5) The following characteristics were recorded if present, and coded as follows:

1. All coils indented
2. Alternate plain and indented coils
3. All coils plain
4. Coils with plain edges but some pinching along the top boundary (i.e., coils were indented but not pinched into waves so that the edge was uneven).

Body sherds were coded from 1-4; rim sherds were coded from 5-8. Codes 5-8 refer to codes 1-4 respectively, except that

they are on rim sherds.

Surface Treatment (6) The following characteristics other than indentations were recorded if present and coded as follows:

1. Surface not tooled (i.e., coils indented but no other treatment applied).
2. Coils fingernail incised on each edge as coil is being attached.
3. Coils fingernail incised on each edge after all coils are attached and the vessel is formed.
4. Coils incised but not by fingernail.
5. Coils smoothed as each coil is attached.
6. Coils smoothed after all coils attached and whole vessel is formed.

Results

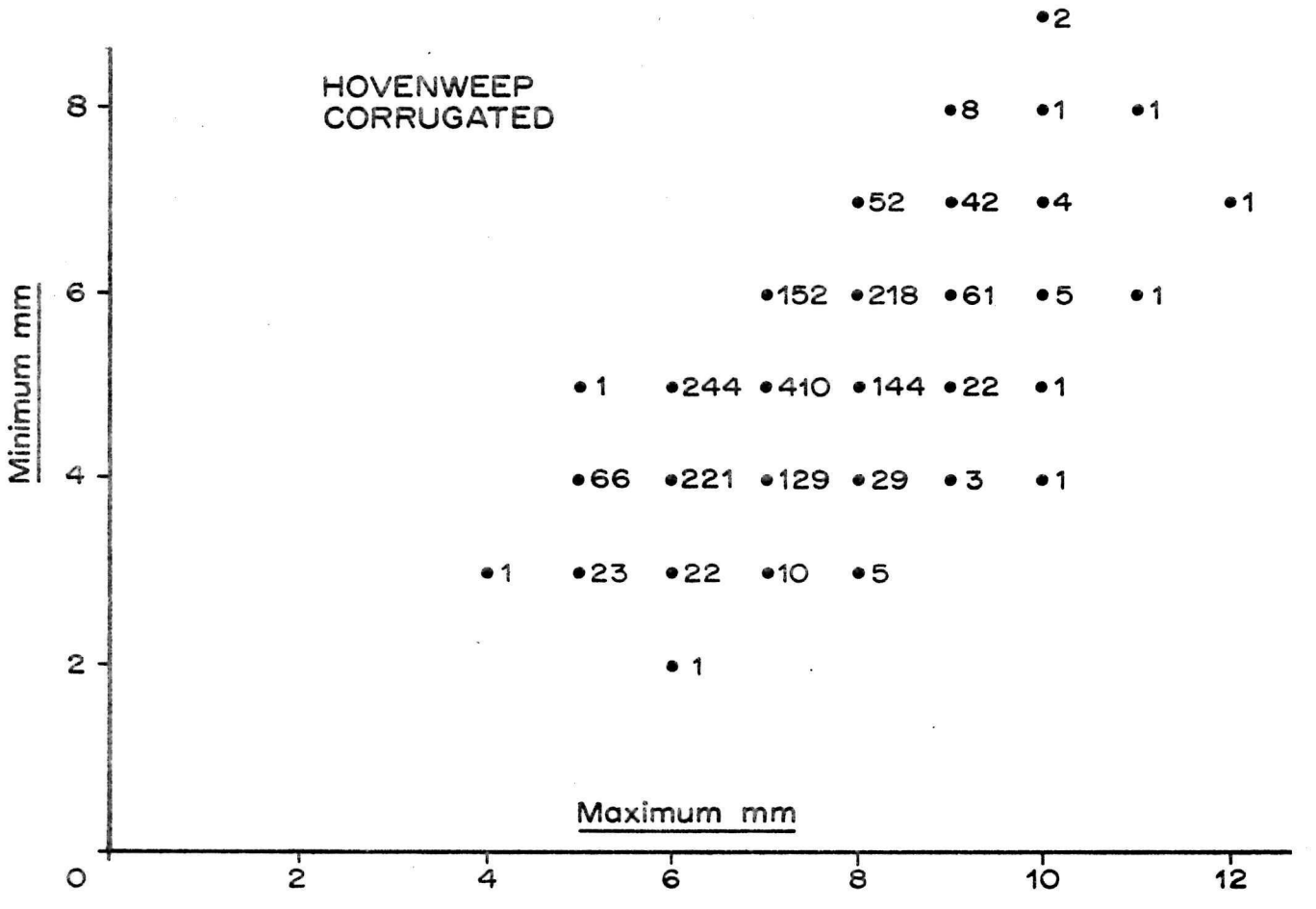
Analysis of the data shows the two types to be very similar in all of the above attributes.

The most frequently used range of coil widths in both types is between 4-6 mm (Fig 35). Likewise, the most frequently used sherd thickness range for both types is between 5-7 mm (Fig 36). There is a much tighter grouping of the sherd thicknesses around the 5-7 mm range than around the predominant range of coil widths.

The three wave form characteristics also showed very close agreement between the two types. Tables 5 and 6 show that the most frequent crest-crest measurements were 10 mm, and the most frequent crest-trough measurements were c. 5 mm. The wave height varied even less. Almost all the height measurements, excepting those with no measurable height or those with heights that varied too widely for accurate measurement, were 1 mm high (Table 7).

The greatest differences appeared to be in the primary angle, or, the slope of the corrugation from the vertical (Table 8). While most Hovenweep Corrugated sherds were angled from between 45° - 65°, there were two sharp peaks of angle preferences for Mancos-Mesa Verde sherds, one at 45° and the other at 60°. Other investigators have noted that Hovenweep type corrugations are more squarish and this might account for the less marked angling relative to the Mancos-Mesa Verde Corrugated sherds. In both types, however, over 60% of the sherds analyzed had such a varied range of angle values that they were recorded as indeterminate (code 91).

The variations in the manner in which the coils are indented



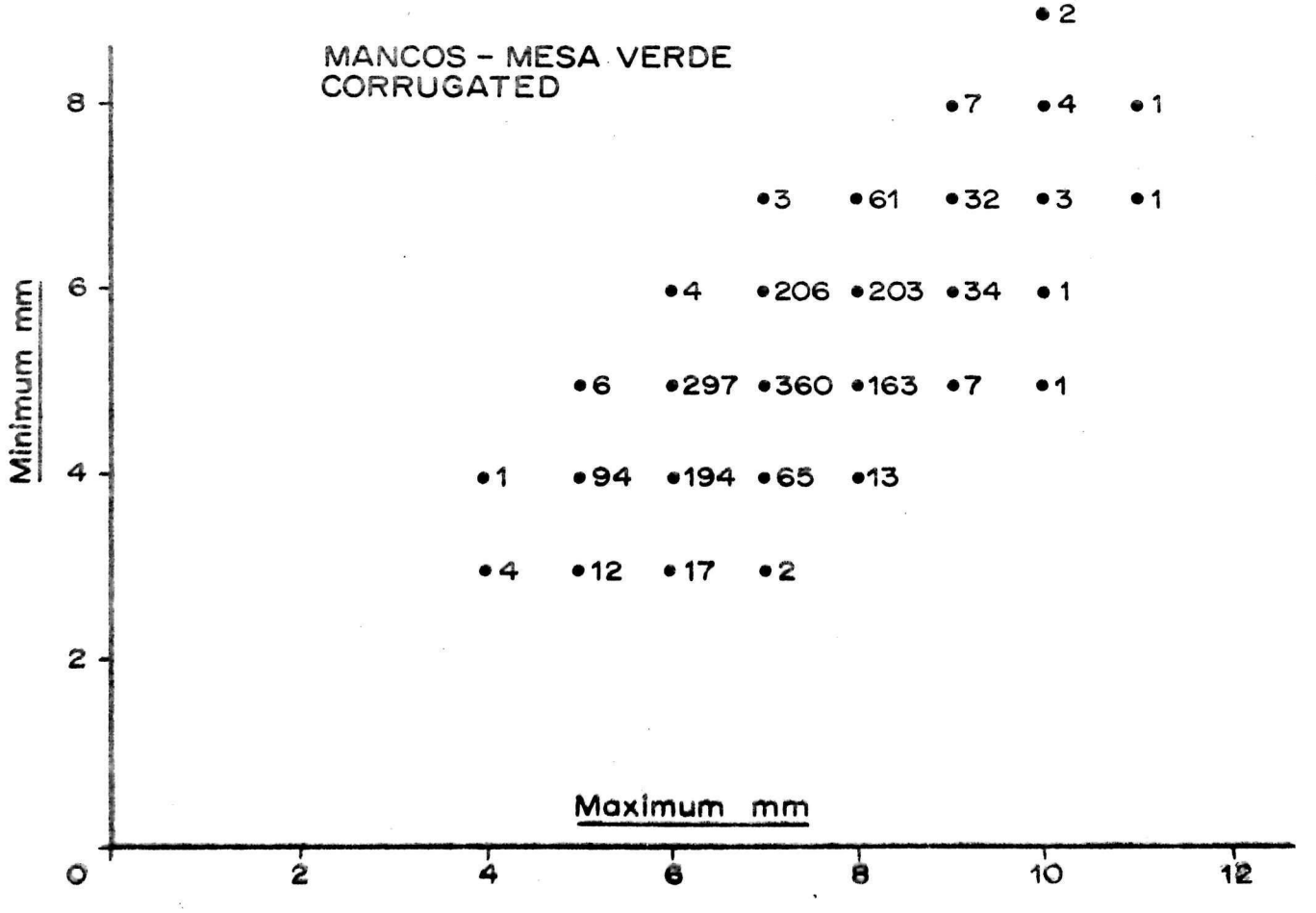


Figure 36. Distribution of Sherd Thickness on Hovenweep and Mancos-Mesa Verde Corrugated Sherds

TABLE 5 - Distribution of Crest-Crest Measurements on Hovenweep and Mancos-Mesa Verde Corrugated

Crest-Crest mm.	Hovenweep #	Hovenweep %	Mancos-Mesa Verde #	Mancos-Mesa Verde %
0	360	19.0	513	29.4
4	1	.1	1	.1
5	4	.2	10	.6
6	32	1.7	30	1.7
7	40	2.1	52	3.0
8	182	9.6	187	10.7
9	133	7.0	131	7.5
10	358	18.9	342	19.6
11	123	6.5	82	4.7
12	214	11.3	177	10.2
13	68	3.6	54	3.1
14	58	3.1	37	2.1
15	39	2.1	29	1.7
16	24	1.3	8	.5
17	7	.4	2	.1
18	1	.1	3	.2
20	5	.3	0	
25	0		1	.1
91	241	12.8	84	4.8

TABLE 6 - Distribution of Crest-Trough Measurements on Hovenweep and Mancos-Mesa Verde Corrugated

Crest-Trough mm.	Hovenweep #	Hovenweep %	Mancos-Mesa Verde #	Mancos-Mesa Verde %
0	360	19.0	513	29.4
1	1	.1	2	.1
2	23	1.2	23	1.3
3	126	6.7	160	9.2
4	355	18.8	339	19.4
5	466	24.6	374	21.4
6	213	11.3	187	10.7
7	75	4.0	50	2.9
8	25	1.3	9	.5
9	1	.1	2	.1
10	5	.3	0	
11	0		1	.1
91	241	12.7	84	4.8

TABLE 7 - Distribution of Coil Heights on Hovenweep and Mancos-Mesa Verde Corrugated

Height mm.	Hovenweep #	Hovenweep %	Mancos-Mesa Verde #	Mancos-Mesa Verde %
0	360	19.0	513	29.4
1	1211	64.0	1090	62.5
2	75	4.0	54	3.1
3	0		2	.1
4	2	.1	0	
5	1	.1	0	
91	242	12.8	85	4.9

TABLE 8 - Distribution of Primary Angles on Hovenweep and Mancos-Mesa Verde Corrugated

Angle	Hovenweep		Mancos-Mesa Verde	
	#	%	#	%
0	36	1.9	28	1.6
5	2	.1	1	.1
10	1	.1	0	
15	0		1	.1
20	1	.1	1	.1
25	2	.1	1	.1
30	5	.3	10	.6
35	10	.5	13	.7
40	27	1.4	48	2.8
45	57	3.0	55	3.2
50	101	5.3	124	7.1
55	83	4.4	74	4.2
60	87	4.6	113	6.5
65	81	4.3	48	2.8
70	66	3.5	57	3.3
75	27	1.4	29	1.7
80	23	1.2	40	2.3
85	36	1.9	27	1.5
90	0		9	.16
91	1246	65.9	1065	61.1

during the vessel construction process are similar on the two types (Table 9). Almost 65% of the sherds in both types had all indented coils. Slightly more than 25% of the sherds in both types had some type of pinching added to the upper edge of the plain, indented coil edge (code 4).

Finally, Table 10 shows that most Hovenweep Corrugated and Mancos-Mesa Verde Corrugated sherds are not tooled beyond the presence of indentations. Our first impressions were that larger numbers of Hovenweep Corrugated sherds were incised, but a tabulation showed that 1) quite a few of the Mancos-Mesa Verde sherds were incised and 2) only 102 more Hovenweep Corrugated sherds were incised. Furthermore, the incisions on both types were usually done as each coil was being attached. Only 1.3% of the Hovenweep Corrugated and 1% of the Mancos-Mesa Verde Corrugated sherds were incised after the whole vessel was completed.

A check for differences in regional distribution between the two types (Fig 37) shows that both types appear with fairly equal variation in the 7 drainage areas. The exceptions are the more frequent appearance of Mancos-Mesa Verde Corrugated in the Allen drainage and Hovenweep Corrugated in the Hovenweep Drainage.

In sum, it appears as if the surface treatment decorative attributes investigated above are not useful indicators of strong differences between the presumably local type, Hovenweep Corrugated, and the two regional or temporal types, here lumped as Mancos-Mesa Verde Corrugated. For sherds, at least, perhaps Breternitz et al are correct in subsuming Hovenweep Corrugated under Mesa Verde Corrugated. On the other hand, the criteria which led to the oroginal separation of the two types, total vessel form, especially rim shape, temper, and patterning of surfact treatments and additional surface treatments other than indentations, may still need to be tested on whole vessels for their validity as distringuishing markers of the two types. This study suggests that details of coil indentations varied, but may have been more the result of widespread use of the same motor patterns for the formation of the corrugations rather than any distinctively regional decorative style.

TABLE 9 - Distribution of Vessel Condition types on Hovenweep and Mancos-Mesa Verde Corrugated

	Vessel Condition	Hovenweep #	Hovenweep %	Mancos-Mesa Verde #	Mancos-Mesa Verde %
1.	all coils indented (1)	1214	64.3	1129	64.8
2.	alternate plain & indented (2)	90	4.8	68	3.9
3.	all coils plain (3)	21	1.1	7	.4
4.	coils w/ indent edge (4)	487	25.8	521	29.9
5.	1 on rim	39	2.1	11	.6
6.	2 on rim	7	.4	0	
7.	3 on rim	0		0	
8.	4 on rim	31	1.6	7	.4

TABLE 10 - Distribution of Surface Treatments on Hovenweep and Mancos-Mesa Verdes Corrugated

Surface Treatment	Hovenweep #	Hovenweep %	Mancos-Mesa Verde #	Mancos-Mesa Verde %
Not tolled	1403	74.3	1407	80.7
Each unit incised	359	19.0	257	14.7
Incised after completion	24	1.3	17	1.0
Other tooling	38	2.0	27	1.5
Smooth each coil	61	3.2	33	1.9
Smooth after completion	3	.2	2	.1

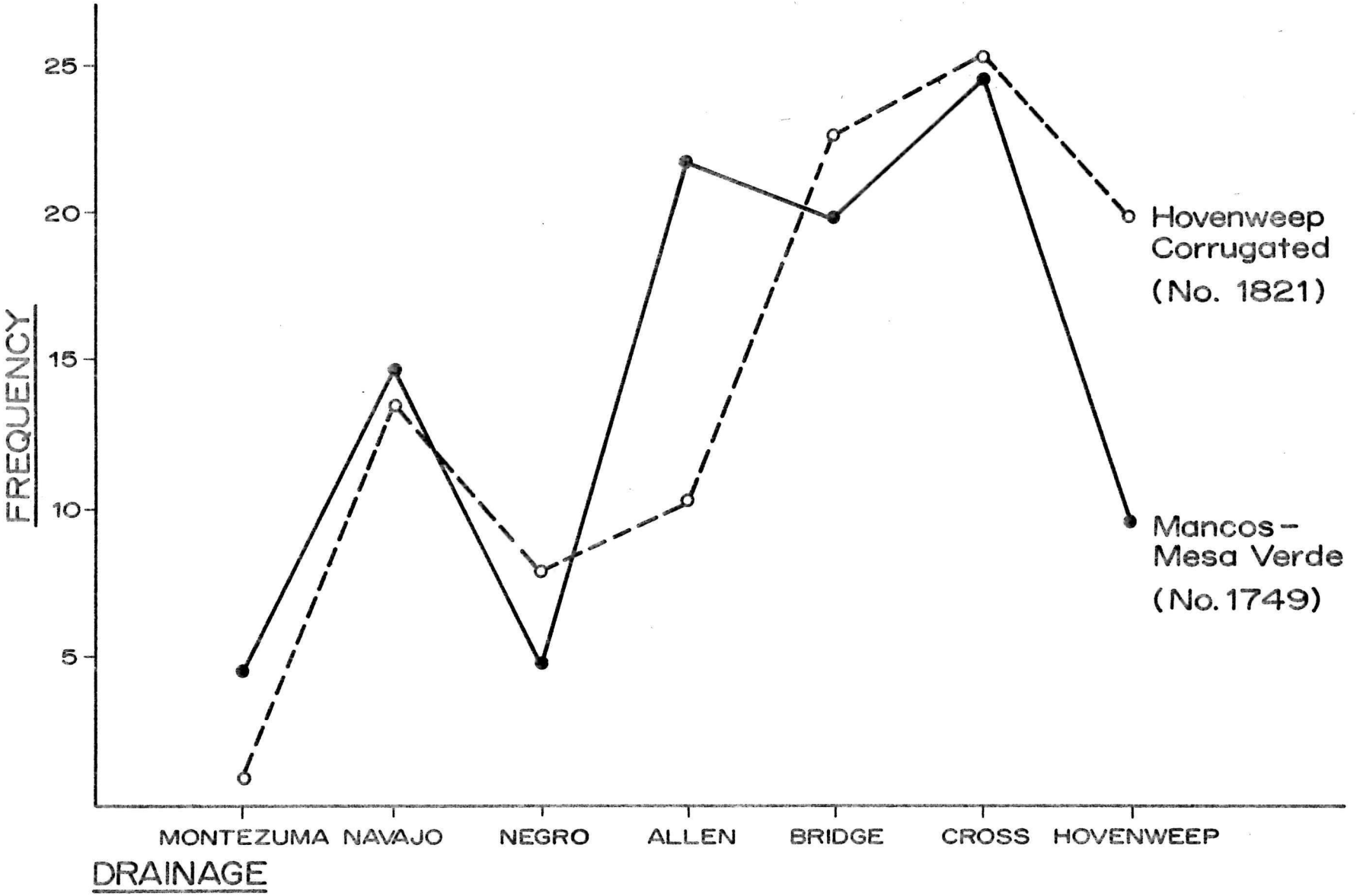


Figure 37. Distribution of Hovenweep and Mancos-Mesa Verde Corrugated in the Seven Drainage Systems on Cajon Mesa

III.4

A STUDY OF LITHIC MATERIALS FOUND IN THE 1976 FIELD SEASON OF THE HOVENWEEP ARCHEOLOGICAL PROJECT

By

Anita B. Hornback

In order to study the Hovenweep 1976 Lithic materials, I covered two aspects of investigation. The first aspect of my study involved experimentation in replicating the use-wear patterns of stone tool edges. By observing the microwear produced by a known action on a known material, the resulting microwear patterns can be compared to the archeological samples in determining functional use. The rocks used were collected from Cross Canyon at Hovenweep in the 1975 field season. The very small amount of raw rock material available to me was one of the major problems in carrying out a full scale experimentation. I was only able to obtain seventeen flakes to use in my experimentation, and so could not perform the many replications needed for accuracy. The stone of each of the seventeen flakes is identified in Table 11. Using the various edges of each flake separately, I was able to get a feel for the cause and effect relationship between a tool and the function it was used for.

Using Tringham's (1974) experimental method as a starting point, and supplementing it with information from Wilmsen (1968), Wylie (1975b), and Gould (1971), I developed my own experimental method. I first determined the material to be worked, and the actions I would perform on each material. This is summarized in Table 12. I then determined the flake edge I would use for each experiment by looking at the data shown in Table 13. This eliminated considerable guessing and repetitive experimentation which I did not have the material for. I used each flake for 1000 strokes, as did Tringham in her experiments (1974:184), but recorded my observations at regular intervals along the way.

Consistencies between my data and that of Tringham's are of interest. Scars from a cutting action were left on both sides of an edge, but the distribution was uneven. The angle of the flake to the worked material, or as I found, the shape of the edge angle (in a plano convex tool) caused differential flaking of the two sides of the edge (Tringham 1974:188). I saw that the action of sawing was not easily distinguished from that of cutting (knife-like), as did Tringham (1974:188). Scraping gave characteristic

Table 11

Identification of Stone types of Experimental Tools, by Marilyn Swift

X-1	quartsite	X-10	chert
X-2	silty chert	X-11	lithified sandstone, H=5
X-3	silty chert	X-12	tuffaceous chert
X-4	chert	X-13	tuffaceous chert
X-5	chert	X-14	agate
X-6	chert	X-15	silty chert
X-7	quartsite, H=7	X-16	chert (greasy nature= opalization)
X-8	chert		
X-9	chert	X-17	lithified sandstone, H=5

Table 12 - Experimental Material and Actions

Worked Material	Actions to be performed
Hard: Bone - fresh cooked	Scraping, sawing, cutting, chopping, drilling
Medium: Wood	Scraping, sawing, chopping, drilling, spokeshaving
Soft: Plant	Cutting
Skin	Scraping, drilling
Flesh - fresh cooked	Cutting

Table 13

Edge Angles

From Wylie 1975, p. 28

Sawing	mean 47 degrees	Range 15-75
Carving	48	25-75
Hidescraping	68	35-95
Chopping & Adzing	73	60-80
Hard Scraping	75	50-90

From Wilmsen 1968, p. 202

Cutting	Range 26-35 degrees
Skinning & hide scraping, heavy cutting of wood, bone or horn, and tool backing	46-55
Woodworking, boneworking, skin softening, and heavy shredding	66-75

From Gould 1971, p. 151

Western Desert Aborigines:

Scraping	mean 67.0 degrees	Range 40-89
Cutting	39.5	19-59

Wongkonguru Aborigines:

Scraping	75.2	50-89
Cutting	35.0	19-59

scalar scars on one surface of the edge only, and drilling (what she calls boring) gave scalar scars and polish on edges and surface of the tip (Tringham 1974:189).I also noted that non-secondarily retouched edges scarred rapidly with the first strokes, to become somewhat like a secondarily retouched edge. Wear on a secondarily retouched edge was slight, and would be hard to diagnose.

Although my experimentation was not extensive, I feel that it was valuable, and would suggest it was a preliminary for anyone contemplating a microwear analysis. The experience of watching the process of an edge wear down cannot be justly described on paper.

Some considerations for future experimentation are 1) an abundance of stone material to work with; 2) additional variables such as heat treatment (Crabtree 1972:5); 3) experimentation with water wear, bag wear, trampling, and pot scraping (Wylie 1975); and 4) research into identification of plant residues on archeological stone tools (Bruier 1976).

The second aspect of my study was a categorization of the tools according to gross morphology and intuited function (Wylie 1975:28). Discussion of this data and analysis follows.

Method of Analysis and Definition of Terms

The lithics from the 1976 field season were anlyzed using a typology modeled after the traditional morphological typology. The lithics were looked at according to general shape of tool and edge, and looked at briefly under a hand lens. They were then put into the category believed to be most accurate from this visual survey. Obvious use-wear was considered in the typology, such as scrapers which only have wear on one side of the edge. The previous years' typology (Culligan 1976) was taken into account in developing the categories. Definitions of the categories used in this typology follow:

1) Choppers - have extremely battered edges, extensive step fractures.

2) Chopper/Scraper - at lease one chopping edge and one scraping edge.

3) Chopper/Spokeshave - at least one chopping edge and one spokeshave edge.

4) Spokeshave - usually secondarily retouched but sometimes naturally shaped into notch or groove. Characterized by profuse step fractures. Shafts were probably drawn through the indentation.

5) Scraper/Spokeshave - have at least one edge used in a scraping action and one spokeshave edge, scraping edge is with secondary retough, or shows obvious use marks indicating scraping action.

6) Knives and Saws - with or without presence of secondary retouch, characterized by wear marks visible on both sides of an edge. Microscopic analysis is needed to distinguish knives from saws, knives having unidirectional striations and uneven microflakes, saws having bidirectional striations and more even microflakes along the edge.

7) Perforator - obtrusion with secondary retough on all sides, visible wear marks on tip.

8) Denticulate - secondarily retouched to produce small, closely spaced rounded saw teeth, probably produced by pressure flaking.

9) Scalloped edge - secondarily retouched to produce broadly spaced crescent-shaped flakes, probably produced by percussion.

10) Biface - all bifacially flaked tools were put in this category, regardless of other morphological characteristics, as bifacially flaked tools are rare at Hovenweep. Each will be described individually (projectile points are treated separately in the following paper).

11) Secondarily Retouched scrapers - unifacially retouched on at lease one edge.

12) Core - raw material left over after making flakes.

13) Hammerstone - have battered surfaces, dimpled rather than fractured from longterm use on a relatively flat surface.

14) Multifunctional tools - tools with too many differently used edges to be put in one category, so each will be described individually.

15) Utilized flakes in a Scraping Action - scaler and step fractures visible on one side of edge only, no secondary retouch. Flakes utilized in a cutting, sawing, or spokeshaving action have been put in their respective categories.

16) Waste Flakes - No secondary retouch or use wear evident.

17) Ground edges - stones with ground edges showing striations.

18) River Cobbles - no apparent use marks.

19) Hoes - long, thin, semi-rectangular, and flat slabs of rock with edges chipped all around. Each will be described individually.

General Discussion of Hovenweep

Lithics

During the season 1921 chipped stone artifacts were recovered. The majority (1006) of these were Waste Flakes, and second in number are Utilized Waste Flakes (380). Of the remaining artifacts, more were unmodified or only slightly modified flakes that were utilized for specific functions. Only a dew of the artifacts - the Bifaces, Hoes, Axe, Kiva Jar Lids, Denticulates, Scalloped edges and a few of the Perforators - were extensively shaped. The Secondarily Retouched Scrapers have simply an edge retouched.

The near absence of non-projectile point Bifaces (3 in 1921 artifacts) or other highly retouched flakes, suggests that the people of this area did not exert much energy into the production of stone tools. Being agriculturalists, they may not have depended much on hunting which requires fine points, scrapers, knives, and other special use tools. Tools were probably simple and functional, for use in making pottery, basketry, and preparation of food crops for consumption. It is because of the simple nature of the chipped stone tools at Hovenweep that it is believed that a microwear analysis alone or in conjunction with a morphological typology would bring forth the most relevant data (Tringham 1974).

Bifaces

Three non-projectile point Befacial tools were found at Hovenweep in the 1976 season. One is a large, long, wide, thin, and leaf-shaped chert artifact (Fig 38). It appears as though it might be unfinished as there is a large knob of stone on one surface. This could also have been an uncontrollable flaw in the stone. The second biface is a chert tool, from Hov 53, scalloped along the two edges, with a flat base. Its function could have been as a knife, and the edges appear slightly worn. The third biface is from Hov 623 and is a fragment. It is broken at both ends, decreasing in width at one end. It is made from a white crystalline stone.

All three of these bifaces were found at kiva or tower complexes, suggesting their use as ceremonial objects.

TABLE 14 - Tool Type By Site

Hov Site Numbers	Chopper			Chopper-Scraper		
	a	b	c	a	b	c
3						
12						
15						
24				1	6	.7
47						
49	1	5.5	.7			
53						
64	1	5.5	10			
94				1	6	5
359	1	5.5	.4	1	6	.4
458						
520	3	17	4.6			
539						
571	4	22	2.0	1	6	.5
597	2	11	1.5	1	6	.75
623	3	17	.69	7	44	1.6
626						
643						
648						
652						
685				1	6	2.3
707						
708						
709	3	17	2.2	3	19	2.2
714						
	18	100		16	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Perforater a	Perforater b	Perforater c	Denticulate a	Denticulate b	Denticulate c
3						
12						
15						
24	2	13.3	1.5	1	33.3	.7
47						
49						
53						
64						
94						
359	1	7	.4			
458						
520						
539						
571	1	7	.5			
597						
623	7	47	1.6	2	66.6	.46
626						
643	2	13.3	1.1			
648						
652	1	7	33.3			
685						
707						
708						
709	1	7	.7			
714						
	15	100		3	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Scalloped a	Scalloped b	Scalloped c	Biface a	Biface b	Biface c
3						
12						
15						
24						
47						
49						
53				1	33.3	10
64						
94						
359						
458						
520	1	8.3	2.5			
539						
571						
597						
623	9	75	2.1	1	33.3	.23
626						
643	1	8.3	.6			
648						
652						
685				1	33.3	2.3
707						
708						
709	1	8.3	.7			
714						
	12	100		3	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Chopper-Spokeshave a	b	c	Spokeshave a	b	c
3						
12				1	1.7	4.5
15						
24				6	10.3	4.4
47				2	3.4	2.8
49				6	10.3	4.3
53						
64						
94						
359				6	10.3	2.5
458				1	1.7	100
520				3	5.2	4.6
539						
571	1	25	.5	5	8.6	2.6
597				3	5.2	2.3
623	2	50	.46	12	20.7	2.8
626				1	1.7	2.9
643	1	25	.6	5	8.6	2.9
648						
652						
685						
707						
708				1	1.7	100
709				5	8.6	3.7
714				1	1.7	3.6
	4	100		58	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Scraper-Spokeshave a	b	c	Knife or Saw a	b	c
3						
12	2	3	9.1			
15						
24	3	4.5	2.2	3	5	2.2
47	3	4.5	4.2	5	8.5	6.9
49	7	11	5.0	4	6.8	2.9
53				1	1.7	10
64	1	1.5	10			
94				2	3.4	10
359	1	1.5	..4	5	8.5	2.1
458						
520	4	6	6.1	3	5	4.6
539						
571	5	7.6	2.6	4	6.8	2.0
597	3	4.5	2.3	2	3.4	1.5
623	30	45	6.9	27	46	6.2
626						
643	2	3	1.1	1	1.7	.6
648						
652						
685	1	1.5	2.3	1	1.7	2.3
707						
708						
709	3	4.5	2.2	1	1.7	.7
714	1	1.5	3.6			
	66	100		59	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont

Hov Site Numbers	Secondarily Retouched Scraper			Core		
	a	b	c	a	b	c
3				1	17	16.6
12	2	.9	9.1			
15	2	.9	16.6			
24	13	6.2	9.6			
47	4	2	5.5	1	17	1.4
49	14	6.7	10.1			
53	1	.5	10			
64	1	.5	10			
94	3	1.4	15			
359	33	16	14			
458						
520	3	1.4	4.6			
539						
571	16	7.6	8.2	2	33.3	1.0
597	6	2.9	4.5			
623	74	35	17			
626	1	.5	2.9			
643	15	7.4	8.6			
648						
652						
685	6	2.9	13.9			
707	1	.5	12.5			
708						
709	15	7	11	2	33.3	1.5
714						
	210	100		6	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Utilized Waste Flakes a	b	c	Waste Flakes a	b	c
3	1	.3	16.6	3	.3	50
12	2	.5	9.1	13	1.3	59.1
15	1	.3	8.3	8	.8	66.6
24	14	3.7	10.4	89	8.8	65.9
47	9	2.4	12.5	46	4.6	63.9
49	22	5.8	15.9	72	7.1	52.2
53	3	.8	30.0	3	.3	30.
64	2	.5	20.0	5	.5	50
94	4	1	20	9	.9	45
359	52	13.7	22	131	13.	55.5
458						
520	8	2.1	12.3	38	3.7	58.5
539	2	.5	50.	2	.2	50
571	44	11.5	22.7	107	10.6	55.1
597	21	5.5	15.9	87	8.6	65.9
623	103	27	23.8	148	14.7	34.2
626	6	1.6	17.1	27	2.7	77.1
643	37	9.7	21.1	106	10.5	60.6
648	1	.3	33.3	2	.2	66.6
652	1	.3	33.3			
685	9	2.4	20.9	22	2.2	51.2
707	3	.8	37.5	4	.4	50
708						
709	26	6.8	19.1	68	6.8	50.
714	9	2.4	32.1	16	1.6	57.1
	380	100		1006	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Ground Edges a	Ground Edges b	Ground Edges c	River Cobbles a	River Cobbles b	River Cobbles c
3						
12						
15	1	4.3	8.3			
24	2	8.7	1.5	1	17	.7
47	1	4.3	1.4			
49	3	13	2.2	1	17	.7
53						
64						
94						
359	5	22	2.1			
458						
520				1	17	1.5
539						
571	1	4.3	.5			
597	4	17	3	2	33	1.5
623						
626						
643	4	17	2.3	1	17	.6
648						
652						
685	1	4.3	2.3			
707						
708						
709	1	4.3	.7			
714						
	23	100		6	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Hoes			Axe		
	a	b	c	a	b	c
3						
12						
15						
24						
47						
49	3	100	2.2			
53						
64						
94						
359						
458						
520						
539						
571						
597						
623						
626						
643						
648						
652						
685				1	100	2.3
707						
708						
709						
714						
	3	100		1	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont'd

Hov Site Numbers	Hammerstone a	Hammerstone b	Hammerstone c	Multi-Use a	Multi-Use b	Multi-Use c
3	1	5	16.6			
12	1	5	4.5			
15						
24						
47				1	10	1.4
49	4	20	2.9	1	10	.7
53						
64						
94	1	5	5			
359						
458						
520	1	5	1.5			
539						
571	3	15	1.5			
597	1	5	.75			
623				7	70	1.6
626						
643						
648						
652				1	10	33.3
685						
707						
708						
709	7	35	5.1			
714	1	5	3.6			
	20	100		10	100	

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Table 14 cont.

Hov Site Numbers	Kiva Jar Lid a	b	c	Total
3				6
12	1	50	4.5	22
15				12
24				135
47				72
49				138
53	1	50	10	10
64				10
94				20
359				236
458				1
520				65
539				4
571				194
597				132
623				432
626				35
643				175
648				3
652				3
685				43
707				8
708				1
709				136
714				28
	2	100		1921

a = Number of artifacts in this catagory
b = Per Cent within the catagory
c = Per Cent within the site, totals for site are on last page of Table

Figure 38. Examples of Bifacial (upper row) and Unifacial (lower row) Tools From Hovenweep

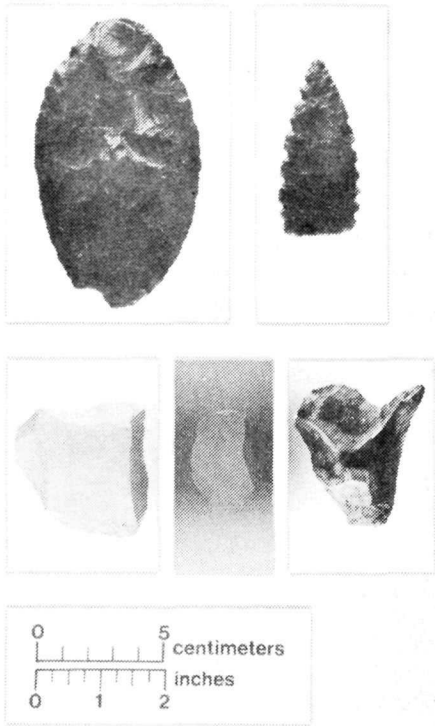
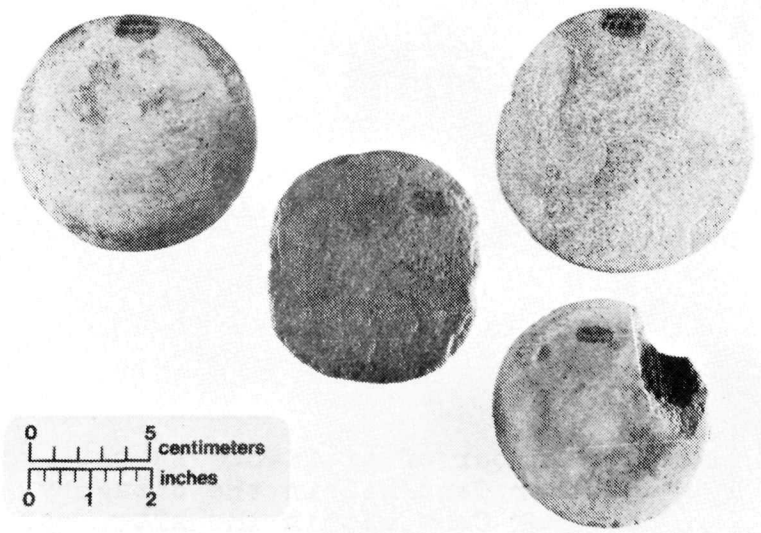


Figure 39. Jar Lids From Hovenweep



Multi-Use Tools

The creation of a multi-use category was the result of discovery of several tools which had most or all of their edges utilized, with many various functions represented. The presence of these tools is an example of the simple use of a flake with very little retouch. The extensive use of the tools in this category make one think of the "favorite tool", a flake that was just right for all sorts of jobs. Since there are only 10 artifacts in this category, I will described each to show the extent of their multiplicity:

1) Hov 623 - a secondarily retouched tool with six scraping edges, one of which is scalloped, one perforating edge, and one knife or saw edge.

2) Hov 49 - a tool with three edges secondarily retouched for scraping, one chopping edge, and 2 spokeshave edges.

3) Hov 652 - a tool with one scalloped, one secondarily retouched, one scraping edge, one deep spokeshave, and one possible perforator edge.

4) Hov 623 - a tool with one knife or saw edge, one secondarily retouched scraper edge, one chopped edge, and two edges used as spokeshaves.

5) Hov 623 - a tool with 2 secondarily retouched edges, 3 spokeshave edges, and one chopping edge.

6) Hov 623 - a tool with two ground edged, one secondarily retouched scraping edge, and one spokeshave.

7) Hov 623 - a tool with perforator, knife or saw (utilized, not retouched), spokeshave, and secondarily retouched scraper edges.

8) Hov 623 - a tool with 3 secondarily retouched scraper edges, and one each spokeshave, chopper, and knife or saw edges.

9) Hov 623 - a tool with knife or saw (utilized, not retouched), chopper, and utilized scraping edges.

10) Hov 47 - a tool with 2 spokeshave edges and one perforator.

Seven of these tools were from a complex kiva structure at the Hob 623 Aneth Trading Post site!

Jar Lids

Two stone Jar Lids (Fig 39) were found during the 1976 season, both at large tower complexes (Hov 12 and Hov 53). Both appear to have been ground into shape, possibly after initial shaping by chipping. The lid from Hov 12 was round, while that from Hov 53 was squarish in shape

Axe

One chipped stone axe was recovered at Hovenweep (Fig 40). It shows signs of being hafted midway along the length, and is chipped at the indentations. Heavy use can be seen at one end.

Hoes

Three chipped stone Hoes (Fig 41) were recovered from a single site, Hov 49. They were all chipped into shape, but appear to be unfinished and show no signs of hafting or wear. Hov 49 is a probable water control site, so the hoes may have been prepared for farming.

Ground Edge Tools

In Wylie's 1975 paper, he discussed the use of flakes and drills in the making of pottery. Of the 40 flakes which he discussed, 37 of them came from the surfaces of 35 Anasazi sites in Manti-LaSal National Forest near Blanding. These sites are within 160 kilometers of Hovenweep National Monument. In the 1976 season's assemblage, 23 lithics were identified as having ground edges. Although these lithics have not been studied in detail, there is a good possibility that they obtained their ground edges by being used as pot scrapers, as suggested by Wylie. They were well spread out over the study area and found at 10 different sites of various types.

Conclusions

Although I have only been able to do a limited amount of experimentation, I believe that a well-rounded study of lithics should include a microwear analysis. The tools from Hovenweep especially warrant this type of a study, as their function is not always evident from general morphology alone. Often it is only the tiny microflakes which suggests how a tool might have been used. Microwear analysis can also be used to test the validity of the typology used, to study each edge individually, and by using a blend of microwear and descriptive criteria, to determine the functions of the stone tools in the daily subsistance patterns of the Prehistoric culture.

Figure 40. Examples of Axes and Mauls From Hovenweep

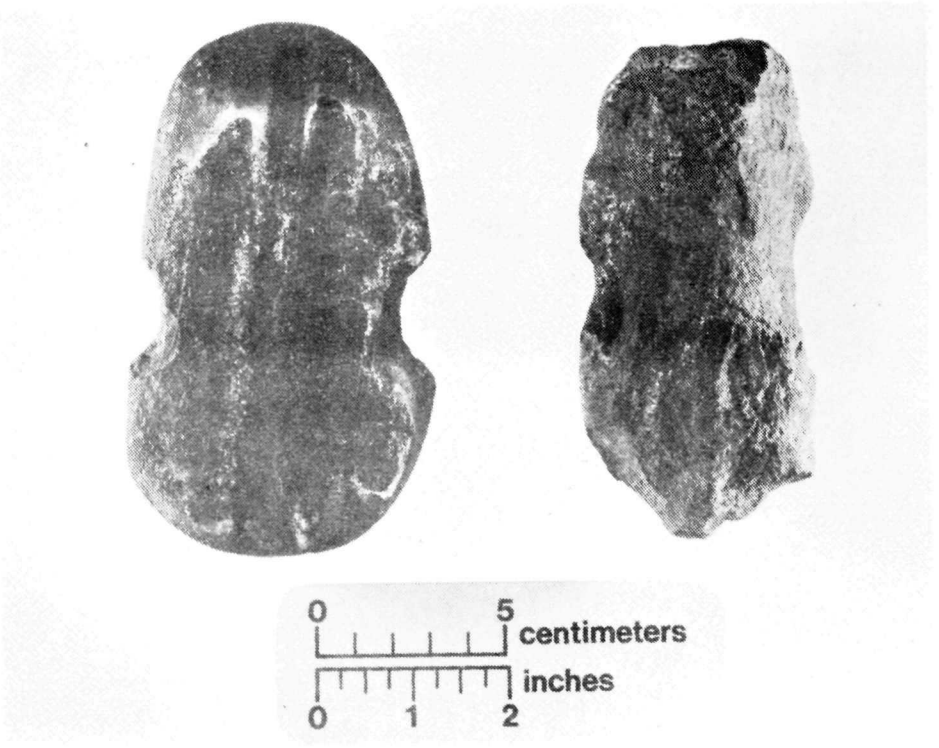
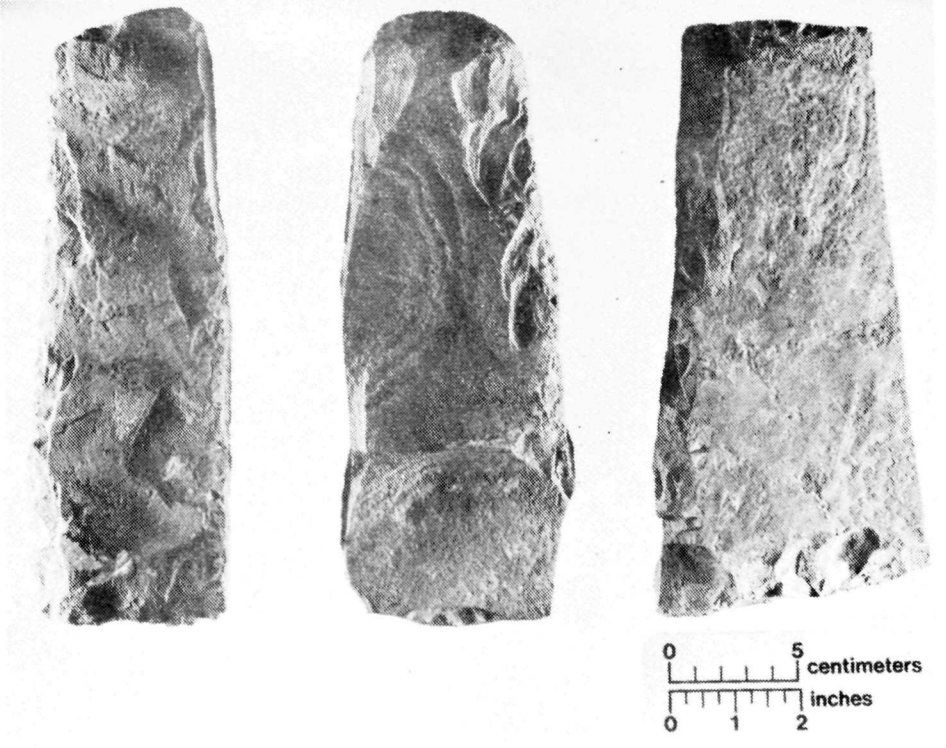


Figure 41. Hoes From Hov 49



III.5

PROJECTILE POINTS
HOVENWEEP 1976

By Patricia A. Hicks

Excavations and further surface survey on Cajon Mesa during 1976 contributed a total of 18 projectile points of known types to our sample from previous years. An additional three points recovered in 1976 could not be typed. As outlined in our 1975 report (Hicks (1976), the most important criterion utilized in typing the Hovenweep collection is the formation and further modification of the projectile point base. Other criteria we have relied upon are the type of notching present, e.g. corner notching or side notching, and the general shape of whole points (c.f. Miller 1974:107; Hayes 1964:129; Irwin-Williams 1973).

The 1976 sample (Fig 42) includes one San Jose phase Archaic point, two Armijo phase Archaic points, four Late En Medio points, five Basketmaker III - Pueblo III corner notched points, and six Pueblo II - Pueblo III side notched points (see Irwin-Williams 1973 and Hicks 1976 for proposed temporal ranges of these types). Revised means and ranges for the various attributes recorded on the Hovenweep collection are given in Table 15. No additional points of any type common to the Plano phase of the PaleoIndian culture period were recovered. No projectile points typical of Irwin-Williams' (1973) Jay and Bajada Archaic phases have yet been recovered on Cajon Mesa, although there is evidence from sites to the north and to the south that supports their presence in the general Hovenweep - Mesa Verde area (Hunt and Tanner 1960; Mohr and Sample 1959).

We have yet to recover controlled stratigraphic evidence for an early Archaic occupation on Cajon Mesa, but the projectile point sample does strongly suggest a probable middle and late Archaic occupation. Independent evidence, in the form of a C-14 date of 455 B.C. ± 145, has been obtained from a shelter at Hov 648. Approximately 50 meters above this shelter crew members discovered a late En Medio (ca. 0 - 400 A.D.) projectile point. It must be noted that the proposed temporal range for Late En Medio as well as the other Archaic phases have always been viewed by us as tentative, since our typology was developed by Irwin-Williams (1973) from data recovered in the north-central New Mexico area, leading us to expect some temporal variation between the two areas. The discrepancy in the two dates given above may thus be accounted for by an earlier appearance of the Late En Medio peoples in the Cajon Mesa area, or perhaps more probably by the fact that the projectile point cannot be directly associated with the shelter.

It had been hoped that the 1976 test excavations would provide

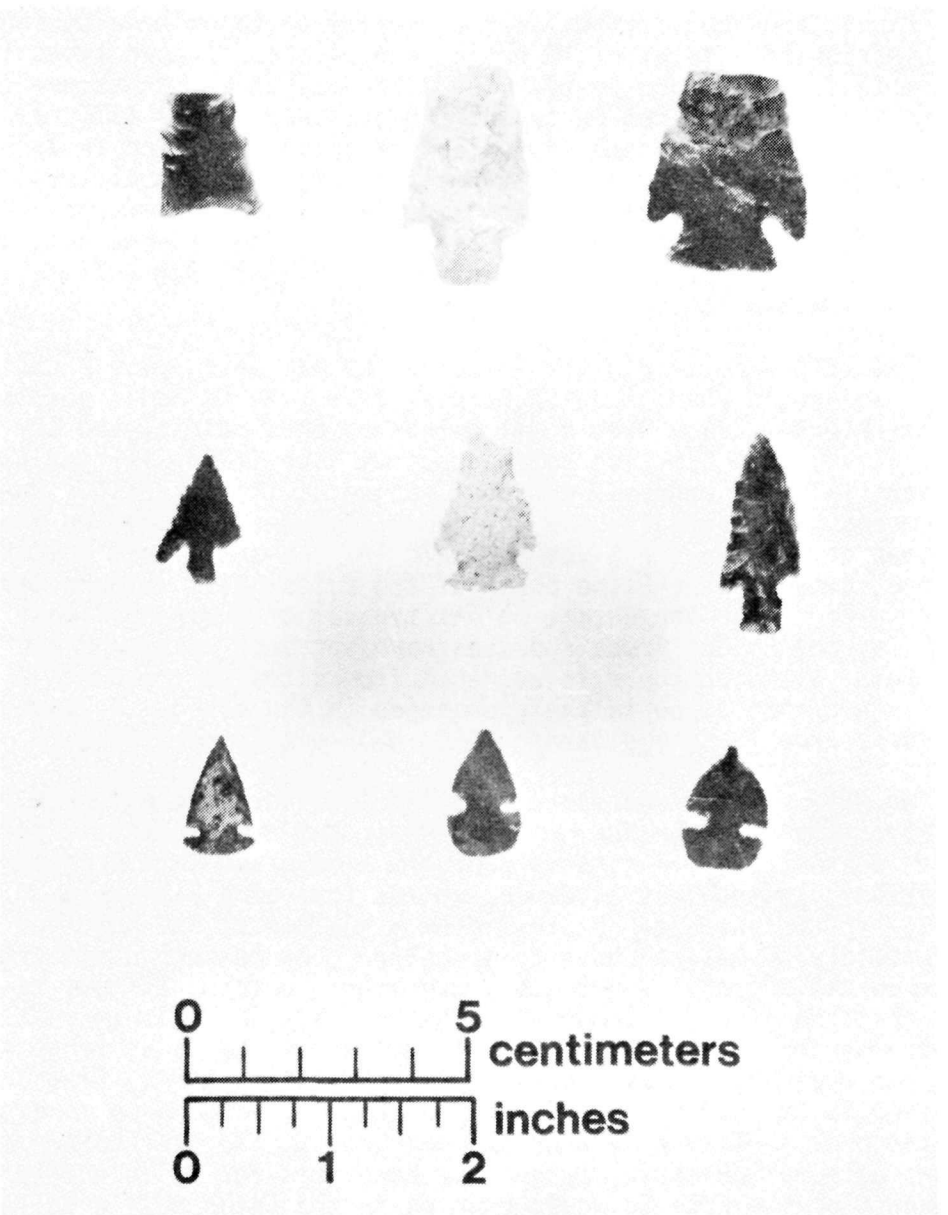


Figure 42. Examples of 1976 Hovenweep Projectile Points. Upper left - Armijo; upper middle and right - Late En Medio; middle row - BMIII-PIII corner notched; lower row - PII-III side notched

Table 15

Revised Means & Ranges of Various Attributes

of Hovenweep Projectile Point Types

Point Type	No. in Sample	Basel Width		Shoulder Width		Stem Width		Thickness		Length of Whole Points	
		Mean and (no.)	Range	Mean and (no.)	Range	Mean and (no.)	Range	Mean and (no.)	Range	Mean and (no.)	Range
Pueblo II - Pueblo III side notched	25	14.59mm (17)	5-25mm	13.14mm (21)	7-25mm	9.41mm (22)	6-17mm	3.44mm (25)	2-6mm	22.22mm (9)	18-19mm
Basketmaker III - Pueblo III corner notched	13	12.56mm (9)	5-17mm	17.25mm (8)	12-23mm	9.09mm (11)	4-13mm	4.23mm (13)	3-6mm	31.5mm (4)	24-37mm
Late El Medio	19	14.56mm (18)	11-20mm	21.07mm (14)	11-29mm	12.32mm (19)	9-16mm	5.26mm (19)	3-7mm	42.17mm* (6)	30-61mm*
Armijo	14	14mm (13)	11-18mm	16.11mm (9)	10-19mm	11.75mm (12)	9-16mm	5.07mm (14)	4-6mm	n.a.*	n.a.*
San Jose	7	14mm (4)	12-21mm	16.17mm* (6)	16-19mm*	14.4mm (5)	10-19mm	5.14mm (7)	4-7mm	n.a.*	n.a.*

* No change from previous years

The number in parentheses in the mean column refers to the number of specimens on which the measurement could be taken.

us with a well stratified sample of cultural materials that would allow us to better define the temporal span of the Basketmaker III - Pueblo III corner notched and the Pueblo II - Pueblo III side notched point types. This objective was not realized. Of the total 1976 sample, including those points which could not be typed, only ten or 47.62% came from subsurface locations (Table 16). None of these samples was well suited for a stratigraphic study. For example, at Hov-623 one Basketmaker III - Pueblo III corner notched point was recovered from the surface of the midden, while one unknown type point was recovered from the 20-30 cm. level in the midden, and one Pueblo II - Pueblo III side notched point was recovered from the Kiva floor at 227 cm.

The great majority of the Basketmaker III - Pueblo III corner notched and the Pueble II - Pueblo III side notched points recovered exhibited gross morphological characteristics which we consider typical of these types for the Cajon Mesa area. However, there were four projectile points recovered which exhibited some variation from the norm. The Basketmaker III - Pueblo III corner notched point from Hov-623, for example, exhibits attributes reminiscent of a type which Wylie (n.d.) refers to as "Abajo Tanged", since it has a narrow stem and long flaring tangs. Similar points were found by Martin (1939) at BM III and Pueblo I sites on Cajon Mesa, so it appears to be distinct type. The other three unusual points have been classified as belonging to the Pueblo II - Pueblo III side notched type. Although they are from two different sites, they have several peculiarities in common. All have large, convex, boat shaped bases (Fig 42), and exhibit very little secondary retouch along the blade or the base, having been fashioned from very thin (2mm. thick) flakes. Two of these points were found during the testing of the tower at Hov-53 at depths of 77cm. and 90cm., while the other was recovered while testing a room at Hov-47. The point from the 90 cm. depth at Hov-53 has a drill-like tip, but it seems highly unlikely that it was ever used for this purpose, due to its fragility. It is also doubtful that they were intended for any utilitarian (i.e. hunting) purpose.

It is hoped that further archaeological testing on Cajon Mesa will enable us to better define the various temporal spans of our projectile point types. The C-14 date from the shelter at Hov-648 has provided us with further evidence for a late Archaic occupation of the Mesa. Additional testing of other shelters in the Hovenweep area will hopefully reveal further information about the Archaic use of the region.

TABLE 16 - Hovenweep 1976 Projectile Points By Site

Possible Types	Site
San Jose	Hov 621
Armijo	Hov 359 Hov 621 (not tested)
Late En Medio	Hov 15 Hov 94 Hov 375 (not tested) Hov 648
BMIII-PIII corner notched	Hov 29 Hov 597 Hov 623 Hov 372 (not tested) Hov 686 (not tested)
PII-PIII side notched	Hov 47 Hov 49 Hov 53 (two points) Hov 571 Hov 623
Unknowns	Hov 94 Hov 623 Hov 11 (not tested)

III.6

GROUND STONE TOOL ANALYSIS 1976

Sixty-one ground stone tools were recovered from twelve sites at Hovenweep in 1976. Thirteen of the tools were metates which, like in previous years, were left at the Hovenweep Lab for analysis in a future study. Forty-seven other ground stone items were also recovered, but they are too fragmentary to analyze. The 1975 tool typology (Cockayne 1976) was followed in this year's study so as to provide continuity in terminology and approach. Table 17 lists the tool types by site, while Fig 40 illustrates one of the mauls recovered from the tests, along with a chipped stone axe. Tables 18-20 provide measurements for each tool type.

As can be seen from the accompanying tables and comparisons with the 1974-75 collections (cf. Winter 1975; Cockayne 1976), the 1976 tools compare favorable with the survey collections, and appear to generally represent Pueblo, rather than Basketmaker materials, since small handstones and trough and earlier basin metates are absent. As with the ceramics and chipped stone tools, the remodeled kiva at Hov 623 (Aneth) above the San Juan River yielded the greatest number of tools, particularly in terms of metates. Individual tools of interest from this and other sites include a finely ground, notehed maul from Hov 623 (Fig 40), an apparent paint pallette with red pigment imbedded in the surface from Hov 24, and a flat, highly polished cooking stone (piki stone) from Hov 24.

TABLE 17 - Ground Stone Tools by Type and Site 1976

Site	Slab metate	Beveled edge mano	parallel edge mano	cooking stone	convex mano	hammerstone	polishing stone	rubbing stone	maul	paint palletts	Totals
623	6				1	1	1	1	1		11
12	2	1				1					5
685	2		3								5
53	1	3	2								6
709	1	2	4								7
15		3									3
47		1									1
571		1	1		1					1	4
49	1	1				2	1				5
3		2	1								3
24		2	3	1		1		1	1	1	10
626							1				1
Total	13	16	15	1	2	5	3	2	2	2	61

KEY TO TABLES 18-20

Stone Type - Number	Type	Characteristic or grain diameter
01	coarse sandstone	.5 - 2 mm
02	fine sandstone	.062 - .25 mm
03	conglomerate	3.175 mm
04	quartzite	quartz crystals in sandstone base
05	medium sandstone	.25 - .5 mm
06	volcanic rock	light in color
07	quartz	colorless, vitreous lustre, hardness 7, lack of cleavage
08	volcanic rock	dark in color
09	lithified sandstone	
10	granite, diorite, basalt	

Primary Surface Treatment

Battered - B - resulting from use as a percussion tool
Bit - b - end ground down to form a sharp edge
Ground - G - surface obviously ground down to form a flat plane
Pecked - P - surface, edge or end of tool pitted
Polished - p - surfaces are highly glossy and smooth
Rubbed - R - surface smoothed erosionally

examples of terminology: IGS (1 ground surface); 2BE (battered ends), 1Be (1 battered edge)

Shape Number	Shape	Characteristic
01	highly fragmented	unclassifiable
02	round	culturally modified
03	round	naturally round
04	oval	culturally modified
05	oval	naturally oval
06	rectangular	culturally modified
07	rectangular	naturally rectangular

Secondary Surface Treatment

Number	Treatment
02	no secondary treatment
03	notched on edges
04	notched on edges and grooved
05	one surface beveled, with one angle
06	two surfaces beveled, with one angle
07	one surface beveled, with two angles
08	two surfaces beveled, with four angles
09	parallel or flat

TABLE 18 - BEVELED MANOS

Hov	F.S.	Shape	Secondary Surface	Surface	Stone	Length (cm)	Width (cm)	Thickness (cm)	Weight (gram)
15	22-1	06	08	4GS	03	20.6	12.3	4.4	1740
12	20-1	06	05	2GS,IBE,IBe	05	11.5	12.2	4.7	1015
15	5-1	04	08	4GS	01	10.8	11.6	3.8	870
15	18-1	04	08	4GS	01	10.6	10.1	3.6	725
709	37-1	06	06	1GS,2BE	05	21.5	12.4	3.3	1276
53	47-1	06	06	2GS,LBE	01	23.5	11.1	3.4	1437
53	26.1	06	05	3GS	05	26.3	11.6	3.4	1750
53	50-1	06	05	3GS,2GE,1Be	02	12.6	8.5	2.6	464
47	12-1	06	05	1GS,1BE	02	11.8	10.3	3.8	501
49	33-1	06	05	2BS,2BE	02	10.5	8.1	2.5	290
709	42-1	08	05	2GS,1Ge,1Be	02	13.6	10.5	2.8	470
571	20-2	06	05	3GS	02	12.0	8.8	2.4	470
685	24-1	06	05	3GS,2Ge	05	29.5	12.8	2.7	2262
3	15-1	06	05	3GS	05	27.0	11.8	2.4	1201
24	60-1	06	06	1GS	05	7.8	10.9	2.5	290
24	60-2	06	06	1GS,1Be	02	10.0	11.0	2.6	451
3	13-1	06	05	2GS	05	23.8	12.9	2.4	1280

TABLE 19 -FLAT OR PARALLEL MANOS

Hov	F.S.	Shape	Secondary Surface	Surface	Stone	Length (cm)	Width (cm)	Thickness (cm)	Weight (gram)
685	23-1	06	09	2GS	05	20.00	13.0	1.6	870
12	20-3	06	09	2GS	05	9.65	15.1	2.60	(Frag)
709	104-1	06	09	2GS	02	16.3	11.4	1.55	501
623	111-1	06	09	2GS	02	25.6	13.7	1.7	1157
685	2-1	06	09	2GS	02	28.5	13.1	3.3	1890
24	34-1	06	09	2GS,1BE	05	22.0	11.8	4.7	2030
53	34-1	06	09	2GS	02	7.6	11.6	4.5	580
685	25-1	06	09	1GS	02	28.0	11.9	3.7	2040
571	3-3	06	09	1GS	05	11.1	9.0	3.7	601
709	4-1	07	09	1GS	05	18.3	10.6	3.3	860
53	34-2	06	09	2GS	03	21.3	11.7	6.7	2262
709	3-1	06	09	1GS,1BE	03	13.3	12.35	4.9	1187
709	41-1	06	09	1GS	03	17.4	7.9	6.3	1157
3	14-1	06	09	2GS	03	28.5	12.4	4.8	2436
24	23-1	06	09	2GS	05	22.6	15.7	4.8	2929
Convex Mano (fragment)									
571	20-3	06	09	12-2GS	05	14.0	8.7	2.65	NA (frag)
623	105-1	06	09	12-1GS	05	10.4	12.3	4.8	1015

TABLE 20 - OTHER GROUND STONE TOOLS

I. HAMMERSTONE

Hov.	F.S.	Shape	Secondary Surface	Surface	Stone	Length (cm)	Width (cm)	Thickness (cm)	Weight (gram)
49	74.1	09	02	2PE	07	9.00	5.80	5.55	435
12	49-11	05	02	2BE,2GPS	04	9.85	9.05	4.70	580
24	61-1	09	02	2PE	?	10.80	6.60	5.50	501
623	113-1	09	02	2BE	?	18.05	8.76	6.50	(frag)
49	22-1	09	02	2PE	?	15.50	8.35	6.50	1230

II. POLISH STONES

623	106-1	09	02	2pS	?	9.00	6.00	3.5	290
626	10-1	01/05	02	2GS	?	NA	NA	NA	(frag)
49	45-1	01/05	02	2pS	?	9.7	4.9	4.3	240

III. RUBBING STONES

623	137-1	05	02	1GS	?	22.00	14.9	8.1	4089

IV. HAMMERS (Mauls)

623	29-1	06	03	2GS,1Be	10	13.8	8.1	2.20	401

V. PAINT PALETTE

571	109-1	-	-	1GS	?	11.80	8.60	2.45	320

VI. COOLY SLAB

	65-1-3	06	09	1GS	02	28.00	18.00	1.8	(pieces missing)

III.7 WORKED BONE ARTIFACTS

By Thomas D. White

Nineteen artifacts of worked bone were recovered from nine sites. As a group, the artifacts exhibited a wide range in design and function (Table 21). Turkey (Meleagris gallopavo) and deer (Odocoileus hemionus) bones were almost exclusively utilized, the former being the most numerous. Except for two bone tubes which possess sawed ends, the remainder of the artifacts appear to have been manufactured by grinding smooth the broken shaft. The artifacts were placed in functional classes as proposed by Kidder (1932) and used by Brew (1946) and Swannack (1969). The true functions of these tools are, of course, unknown.

Perforating Tools

The following were classified on the basis of the possession of a functional point. Design, material, and, no doubt, function differ.

Class A Awls - articular head unaltered

Four were found. Two were fashioned from the distil ends of turkey radii. The other two were made from the distil and proximal ends, respectively, of the tarsometatarsus of a turkey. The latter has worn transverse grooves near the tip. This characteristic has been postulated to be the result of wear due to weaving (Rohn, 1971).

A fifth awl, manufactured from the distil portion of a turkey tarsometatarsus, should be included here. Unfortunately, the tip and much of the articular head are missing.

Class B Awls - articular head split but otherwise unaltered

None of this type was found.

Class C Awls - articular head partially worked

Two awls of this type were recovered from a single site. They were both fashioned from the distil portion of a turkey tibiotarsus. The condyles have been worn by grinding. One was fire darkened with the point broken; the other was intact. Both are scored with much microwear and appear to be polished.

Two additional awls should probably be included within this

TABLE 21 WORKED BONE ARTIFACTS

Tool	Bone Element	Species	Length	Site
Perforating Tools				
Class A Awl	radius	turkey	11.6[a]	Hov. 571
Class A Awl	radius	turkey	8.5	Hov. 714
Class A Awl	tarsometatarsus	turkey	7.6	Hov. 94
Class A Awl	tarsometatarsus	turkey	11.6	Hov. 643
Class A Awl*	tarsometatarsus	turkey	7.9+	Hov. 12
Class C Awl	tibiotarsus	turkey	4.9+	Hov. 571
Class C Awl	tibiotarsus	turkey	11.8	Hov. 571
Class C Awl*	tibiotarsus	turkey	15.2+	Hov. 685
Class C Awl*	tibiotarsus	turkey	14.0+	Hov. 53
Class D Awl	metapodial	deer	9.1	Hov. 53
Class D Awl	?	deer	5.9+	Hov. 53
Class E Awl	?	turkey	4.5	Hov. 643
Class E Awl	?	? avain	7.1	Hov. 12
Other	antler	deer	4.1	Hov. 623
Scraping Tools				
Ulna Scraper	ulna	turkey	10.2	Hov. 685
Metatarsus Scraper	metatarsus	deer	10.7+	Hov. 709
Humerus Scraper	humerus	deer	10.6+	Hov. 53
Bone Ornaments				
Bone Tube	?	turkey	4.8	Hov. 685
Bone Tube	?	? avian	4.9	Hov. 643

*Tool is referred to classification though a diagnostic attribute may be missing.

+Indicates tool is not complete.

[a]All measurements are in centimeters.

classification. Both were manufactured as previously described. Unfortunately, the articular heads of both are missing. One of these exhibits an unusually long, sharp point produced by grinding at a very acute angle.

Class D Awls - articular head worked until removed

A beautifully fashioned awl of this type was found. It was manufactured from the proximal end of a deer metapodial. The lateral portion of the bone was split off the shaft and polished to an ivory-like smoothness. A flat, blade-like tool concave on one side was produced with a sharp point. Interestingly, use wear is perpendicular to the longitudinal axis of the tool.

Another similar awl was recovered in association with the awl previously described. It was split from the long bone of a deer. Both edges and the inner surface bear grinding marks. The functional tip has been broken off. The opposite end has been worn to produce a blunt, spatulate handle.

Class E Awls - sharpened bone splinter without articular head

Two artifacts of this type were identified. Both were fashioned from the shafts of avian long bones, at least one of them turkey. They were ground to produce narrow, sharp points.

Other Perforating Tools

A single artifact manufactured from deer antler was recovered. A short section of antler was split and ground on three sides to produce a flat, triangular object. It is convex on one side only. There is no apparent use wear. The point is much too delicate to be useful as a pressure flaker. Indeed, it is probably spurious to include this artifact within a classification of perforating function.

Scraping Tools

The following artifacts possess an edged functional surface. All but one were made from deer bone, probably due to its relative hardness.

Ulna Scraper

This tool was constructed by grinding the proximal end of a turkey ulna to produce a bevel. The distil articular head was partly removed and roughly squared off. The functional end is nearly identical to the "tibia scraper" illustrated in Rohn (1971:222).

However, Rohn's scraper is over twice the length of this tool. He hypothesized it could have served as a flesher, but this particular tool would probably have been too brittle for this function.

Metatarsus Scraper

This tool was produced from a metatarsus of a deer. Only the anterior portion of the shaft was utilized. The functional end has been ground on three sides to produce a chisel-like edge. Unfortunately, the other end is missing. Approximately 4 cm behind the functional edge, there are two shallow grooves worn into the shaft perpendicular to the longitudinal axis of the tool. The tool is roughly U-shaped in cross section. The grooves appear on only one side of the shaft. At the apex of the "U", there are many transverse scorings associated with the two grooves. It is possible that the tool was once hafted. The tool has apparently seen heavy use.

Humerus Scraper

A single, incomplete specimen was recovered. This is the familiar humerus scraper commonly associated with PII (Brew, 1946) and PIII (Rohn, 1971) cultural levels in the Four Corners area. The handle portion, the distil condyles, have been broken off. The remainder of the tool has been highly polished.

Bone Ornaments

Bone tubes are most often referred to as beads (Martin, 1938; Swannack, 1969; Hayes & Lancaster, 1975). Brew (1946) quite correctly pointed out that this was not necessarily true. In lieu of a known function, they are referred to simply as ornaments.

Bone Tubes

The remaining two artifacts were produced from the shafts of avian long bones; one being turkey. They are nearly identical in length although one is nearly twice the diameter of the other. Both possess incised grooves immediately adjacent to the smoothed ends. This would suggest that their manufacture involved a series of widely overlapping cuts around the shaft to produce a nearly square cut.

Discussion

The only artifact with a known temporal association was the humerus scraper. It was recovered from the Holly House Ruin Group (Hov. 53), a canyonhead tower complex. The majority of humerus scrapers recovered from Mug House were fashioned from bighorn sheep (Ovis canadensis) instead of deer (Rohn, 1971). No bighorn sheep

remains have been recovered from Cajon Mesa, Utah as yet. The absence of bighorn sheep remains is probably due to the lower elevation of Cajon Mesa and its more xeric habitat.

In themselves, the remainder of the artifacts do not reveal indications of time of occupation or manufacture. Studies at Mesa Verde (Rohn, 1971) indicate that in sites where turkey bones predominate, a PIII cultural level may be indicated. However, this has not been demonstrated for Cajon Mesa. That nineteen artifacts were distributed through nine sites renders any further discussion of their significance untenable due to the small sample size.

III.8 MISCELLANEOUS ARTIFACTS

Fifteen miscellaneous pendants, turquoise fragments and other artifacts from seven widely separated sites were recovered during the test excavations. Table 22 lists the artifacts by site, while Figs. 43-44 illustrate various specimens. They included several polishing sherds, a clay ball and a pendant from the kiva at the Aneth Trading Post site (Hov 623), a probable spindle whorl and a clay jar plug from the tower at Twin Tower (Hov 12), an apparent Tchamahia from Hov 597, and a piece of turquoise from one of the Holly House (Hov 53) towers.

TABLE 22 - Miscellaneous Artifacts from 1976 Hovenweep Tests

Site	Polishing Sherds	Spindle Whorl	Tachamahia	Polished ground Stone	Clay ball	Turquoise	Pendant	Clay Jar Plug	Total
623	2			1	1		1		5
12	1	1						1	3
597			1				2		3
571							1		1
685				1					1
53						1			1
24							1		1
Total	3	1	1	2	1	1	5	1	15

Figure 43. Pendants From Hovenweep

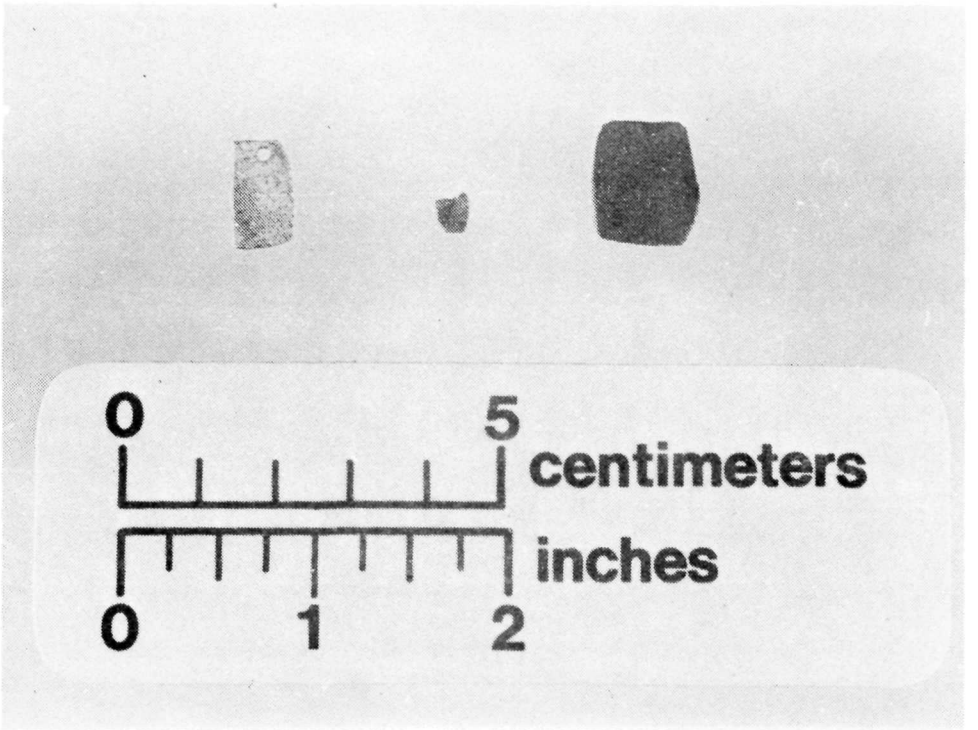
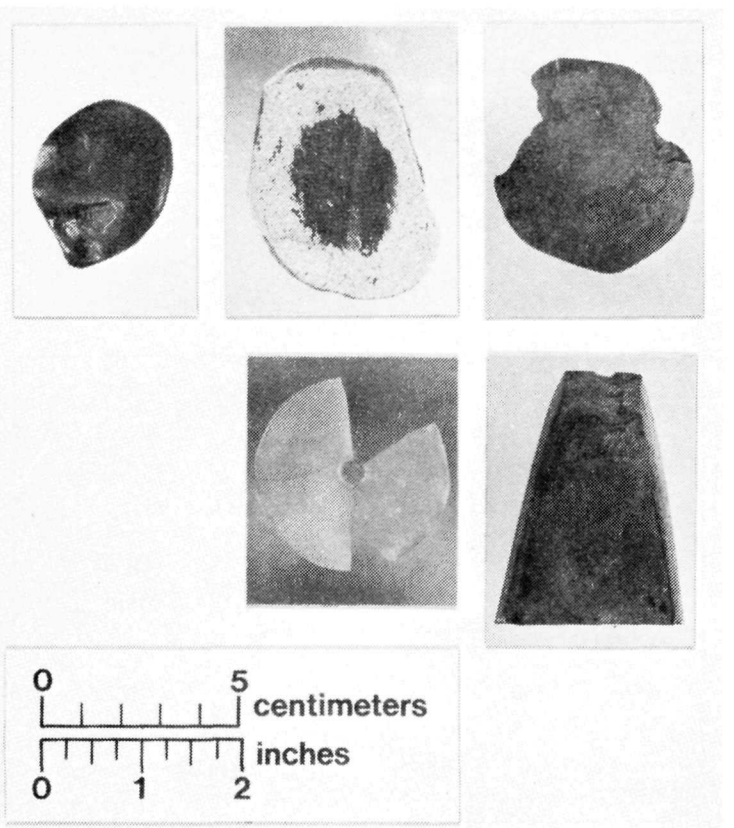


Figure 44. Miscellaneous Artifacts From Hovenweep



III.9

FARM FIELD LOCATION THROUGH PALYNOLOGY

By Anne I. Woosley

INTRODUCTION

Agriculture probably influenced most aspects of Anasazi society. An understanding of prehistoric Anasazi lifeways must necessarily deal with the reconstruction of this economy. Farm fields, their distribution and possible association with soil and water control devices, are basic to Anasazi agricultural management. It was, therefore, suggested (Winter, 1975) that pollen studies of soil sediments might aid in the location of farm fields at Hovenweep, the argument being that farm field sediments would contain a higher percentage of cultigen and associated weedy pollen types as compared with areas never under cultivation. The difference in pollen types would appear in diagrams resulting from pollen analysis. For example, a sample containing Zea (maize), Cucurbita (squash), Phaseolus (bean), Cleome (beeweed), and a number of pollen grains attributed to the Chenopodiaceae (Goosefoot Family), Compositae (Daisy Family), or the Labiatae (Mint Family) could be interpreted as representing a farm field. Another sample including pollen grains identified as Chenopodiaceae, Compositae, Juncaceae (Rush Family), Pinaceae (Pine Family), or Ulmaceae (Elm Hamily) would not, even though possibly economically manipulated wild plants occur, since none of the domestic plant species appear.

Since complex soil and water manipulation is fundamental to Anasazi agriculture, samples which were examined for pollen content were recovered from rim dams, akchin terraces, reservoirs and other contexts usually associated with the maintenance of farm fields. Additionally, samples were taken from two flood plain areas and from along transects mapped in a possible dry farm site. Samples were also thought to describe conditions potentially useful for farm field identification in terms of on-site versus off-site locations.

SAMPLING

Two-hundred and five samples were recovered and analyzed at the San Jose State University Pollen Laboratory. Three series of samples examined flood plain sediments from Hackberry and Square Tower Canyons. Sediments were collected by J. Winter from the floor of canyons proceeding down canyon from the canyon heads at 25 meter intervals. C.

Pierce recovered a fourth series of samples from the flats around Hovenweep 47, a large Prudden Unit above Horseshoe House. Pierce established 8 transects based upon cardinal compass points and took soil at 25 meter intervals beginning at the periphery of the site and continuing outwards. Approximately 10 samples were taken along each transect using a modified pinch technique (Weir, 1976). The final group of samples, recovered by various members of the 1976 Hovenweep field crew, represented a variety of contexts including check and rim dams, talus and akchin terraces, as well as a small number of miscellaneous samples recovered from the vicinity of sites, but presumably outside their immediate influence.

In all instances approximately 100 grams of soil was collected and placed in sealed plastic bags. Contamination may not have always been averted and will be discussed below.

POLLEN EXTRACTION METHODOLOGY

The present study used a methodology developed by the author especially for arid land sediments (Woosley, 1976). Such soils frequently present problems not encountered under other conditions. In particular, two problems arise: the relatively small quantity of pollen preserved and the adverse reaction of pollen to harsh chemical treatment. Since it is often impossible to control for the former, the palynologist must assume responsibility for the latter. The extraction technique used on all Hovenweep samples employs minimum use of harsh chemicals detrimental to delicate pollen grains and mechanical sieving through micron-sized mesh mylon screen. The high frequency of arboreal and non-arboreal, of anemophilous and entomophilous pollen types represented in all samples attests to the suitability and success of the technique. The method is summarized below.

1. Add concentrated HCL to 50 grams of sample.
2. Wash in H_2O to remove acid.
3. Add concentrated HF.
4. Boil in HF for 1 hour
5. Wash in H_2O to remove acid.
6. Add Calgon to distilled H_2O and residue of sample.
7. Decant and allow sample to settle until clear.
8. Stain in safranine T, O, or Y.
9. Sieve sample successively in 100 , 60 , 40, 20 or 10 mesh nylon screens
10. Pan in watch glass to concentrate pollen.
11. Prepare slides.

POLLEN IDENTIFICATION

The identification of archeological pollen was made with the help of a modern reference collection. Some of the modern comparative material was collected during previous Hovenweep field seasons by G. Weir and Wm. Litzinger and subsequently prepared by the author. All of the archeological pollen identified was represented by modern counterparts in the reference collection.

Identification of pollen grains and other micro-remains was made with a Swift binocular microscope. Usually a 40x magnification (40x lens) proved adequate for identification. In a limited number of samples oil immersion was necessary so that the fine morphological detail of small pollen grains could be clearly seen. Sometimes phase-contrast lighting gave additional morophological detail to identify badly crushed grains. Approximately 2 to 3% of non-distorted pollen grains in each sample were unfamiliar to the author and not represented by comparative material and, therefore, remained classified as unknowns.

GENERAL RESULTS

The degree of preservation from virtually all samples is immediately apparent (Tables 23-24). A wide range of arboreal and non-arboreal plant types are represented throughout. Although heavy pollen producers such as Juniperus (juniper) and Pinus (pine) account for a substantial portion of the total pollen count per sample, other plants often not frequently expected in the pollen diagrams commonly occur, e.g., Asclepias (milkweed), and Prosopis (mesquite or screw bean). Most striking is the high percentage of Zea pollen which has previously been identified in much lesser amounts from analysis not only conducted at Hovenweep, but at other Southwestern sites.

Results of pollen studies further demonstrates the homogeneity of plant types present in a diverse number of samples. Samples analyzed from talus terraces or check dams, from flood plains or reservoirs, and from on-site or off-site locations show the same kinds of plants in similar percentages appearing in all samples. Pinus (average count 18%) and Juniperus (average count 22%) are most abundant. Cleome (12%), Zea (4-6%), and Cucurbita (3%) occur in comparable amounts from all of these contexts as do members of the Chenopodiaceae and Compositae Families.

The wide range of plant types represented as well as their comparable amounts in most samples give rise to questions of possible intermixing of pollen from different plant zones existing in a limited area and the mixing of pollen from various times including prehistoric, historic, and modern periods. Some kinds of inter-mixing or contamin-

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H12 S101	H12 S103	H12 S108	H12 S117	H15 S16	H15 S17	H24 S46	H53 S4	H53 S5	H53 S8	H53 S9	H53 S11	H53 S12	H53 S13	H53 S14	H53 S15
Cucurbitaceae																
Cucurbita					1	2		1	1	1	1	1	1	1	1	1
Gramineae	1	1	2	2	2	2	3	3	3	3	3	3	3	3	1	3
Zea	2	2	2	2	2	2		2	2	2	2	2	2	2	2	2
Leguminosae	2	2	2	2	2	2		2	2	2	2	3	2	2	2	2
Asclepiadaceae																
Asclepias	2	2	2	2	1	2										
Cactaceae																
Opuntia	2	2	2	2		1		1		2		2	1	1		1
Capparidaceae																
Cleome	3	2	3	2				3	3	3	3	3	3	3	3	3
Chenopodiaceae	2	2	2	2	3	3	4	3	3	3	3	2	2	3	3	3
Compositae	2	2	2	2	2	2		3	2	2	2	2	2	2	3	3
Artemisia																
Cruciferae					2	1	3	1	1	2	2	2	2	1	1	1
Cupressaceae																
Juniperus	3	3	3	3	3	3	4									
Cyperaceae																
Scirpus																
Fagaceae																
Quercus	1	2	1	2	1	2										
Juncaceae																
Juncus																
Labiatae	1			1	1	1										
Malvaceae																
Sphaeralcea																
Nyctaginaceae																
Pinaceae																
Pinus	3	3	3	2	3	3	4									
Polygonaceae			2	1	1			1	1	1	1	1	1		1	1
Eriogonum	1	1														
Rumex		1	1													
Ranunculaceae																
Clematis																
Salicaceae																
Salix	1	1	1	1												
Solanaceae	2	2	2	2	2	2		2	3	2	2	3	2	2	2	2
Datura								2	2	2	2	2	2		2	2
Lycium-like				1	1			1	1	1	1	1		1	1	
Typhaceae																
Typha	1	1	2	2				2	2	2	2	2	2	3	3	3
Ulmaceae																
Celtis	2	2	2	2	1	2		2	2	2	2	2	2	2	2	2

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H64 S7	H64 S10	H94 S14	H94 S15	H94 S26	H520 S4	H520 S5	H539 S1	H539 S2	H539 S001	H539 S004	H539 S007	H539 S8	H539 S11	H539 S12
Cucurbitaceae															
Cucurbita	1	1	2	2	2			2	2	2	2	2	2	2	2
Gramineae	2	2				2	2						1	1	1
Zea	2	2	2	2	2			1	1	2	2	1	2	2	2
Leguminosae	2	2	1	1	1	2	2	1	1	2	2	1	1	1	1
Asclepiadaceae															
Asclepias			2	2	2										
Cactaceae															
Opuntia															
Capparidaceae															
Cleome	2	2	2	2	2	2	2	3	2	2	2	2	2	3	2
Chenopodiaceae	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
Compositae	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2
Artemisia			2	2	2	2	2	2	2	2	2	2	2	2	2
Cruciferae	2	2	1	2	2	1	1	1	1	1	2	2	2	2	2
Cupressaceae															
Juniperus	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Cyperaceae			1	1	1										
Scirpus		1	1	1	1										
Fagaceae															
Quercus	1	1	2	1	2			1	2	2	1	1	1	2	2
Juncaceae															
Juncus	1	1	1	1	1			1		1			1	1	1
Labiatae						1	2								
Malvaceae								1			1				2
Sphaeralcea						1						1			1
Nyctaginaceae															
Pinaceae															
Pinus	2	2	3	3	2	3	2	3	3	2	2	3	3	3	3
Polygonaceae	1	1													
Eriogonum															
Rumex															
Ranunculaceae	1	1	1	1	1	2	2	2	2				2	2	
Clematis															
Salicaceae															
Salix	1	1													
Solanaceae	2	2	2	2	2	2	2	3	2	3	3	2	3	3	2
Datura	1	1													
Lycium-like	1	1				2	2								
Typhaceae															
Typha			1	1	2			1	1	1		1	2		2
Ulmaceae															
Celtis	2	2	2	2	2										

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H539 S13	H539 S15	H539 S1A	H539 S2A	H456 S1	H456 S2	H456 S4	H456 S6	H456 S8	H456 S10	H456 S13	H456 S14	H623 S43	H623 S44
Cucurbitaceae														
Cucurbita	2	2			1	1	1	1	1	1	1	1		
Gramineae	1	1	2	2	2	2	2	2	2	2	2	2	2	2
Zea	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Leguminosae	1	1	2	2	2	2	2	1	2	1	2	1	2	2
Asclepiadaceae														
Asclepias					1	1	1	1	1		1	1		
Cactaceae														
Opuntia														
Capparidaceae														
Cleome	2	2	2	2	2	3	3	3	3	3	3	3	2	2
Chenopodiaceae	1	1	2	3	3	3	3	2	2	3	3	3	2	2
Compositae	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Artemisia	2	2	2	2										
Cruciferae	2	2	1	2	2	2	2	2	2	2	2	2	2	2
Cupressaceae	3	3	3	4										
Juniperus	3	3	3	4	3	3	3	3	3	3	3	2	3	3
Cyperaceae					1	1		1		2	2			
Scirpus					1	1	1	1	1	1	1	1		
Fagaceae														
Quercus	2	2												
Juncaceae														
Juncus	1	1			1	1	1	1	1	1	1	1		
Labiatae					1	1			1			1		
Malvaceae	2				1			1						
Sphaeralcea		1												
Nyctaginaceae														
Pinaceae														
Pinus	3	2	3	2	2	2	2	2	2	2	2	2	2	2
Polygonaceae														
Eriogonum														
Rumex														
Ranunculaceae	2	2			1			2			2			
Clematis														
Salicaceae														
Salix													2	1
Solanaceae	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Datura													2	2
Lycium-like			1	2									2	2
Typhaceae														
Typha	1	1												
Ulmaceae														
Celtis			2	1										

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H626 S1	H643 S5	H643 S7	H643 S8	H643 S10	H643 S11	H643 S13	H643 S28	H644 S1	H644 S2	H644 S3	H644 S4	H644 S5	H644 S6
Cucurbitaceae														
Cucurbita	2	1	2	2	2	2	2	2						
Gramineae	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Zea	3	1	1	2	2	2	2	2	2	2	2	2	2	2
Leguminosae	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Asclepiadaceae														
Asclepias		2	2	1	2	1	1	1						
Cactaceae														
Opuntia														
Capparidaceae														
Cleome	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Chenopodiaceae	2	2	3	3	2	2	2	3	2	2	2	2	2	1
Compositae	1	2	2	1	2	2	2	2	2	2	2	1	2	1
Artemisia	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Cruciferae	1								1	1	1	1	1	1
Cupressaceae														
Juniperus	2	3	3	3	3	3	3	3	3	3	3	3	4	3
Cyperaceae														
Scirpus														
Fagaceae														
Quercus		2	2	2	2	2	1	1	2	2	2	2	2	2
Juncaceae														
Juncus	2													
Labiatae	1													
Malvaceae														
Sphaeralcea														
Nyctaginaceae														
Pinaceae														
Pinus	2	2	3	2	2	2	2	3	3	3	2	3	3	4
Polygonaceae														
Eriogonum														
Rumex														
Ranunculaceae														
Clematis														
Salicaceae														
Salix	1													
Solanaceae	2													
Datura	2	2	2	2	2	2	2	2	2	1	2	2	2	1
Lycium-like	2	1	1	2	2	2	2	2	1	2	2	2	2	2
Typhaceae														
Typha		2	2	2	2	2	2	2						
Ulmaceae														
Celtis		1	2	2	2	2	2	2						

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H644 S7	H644 S9	H644 S10	H644 S11	H644 S13	H644 S15	H644 S16	H644 S17	H644 S18	H644 S19	H648 S9	H665 S1	H665 S2	H665 S3
Cucurbitaceae														
Cucurbita														
Gramineae	2	3	2	2	3	3	2	2	2	2	2	2	3	3
Zea	2	2	2	2	2	2	2	2	2	2		1	2	2
Leguminosae	2	2	2	2	2	2	2	2	2	2		2	2	2
Asclepiadaceae											2			
Asclepias														
Cactaceae														
Opuntia														
Capparidaceae														
Cleome	2	2	2	2	2	2	2	2	2	2				
Chenopodiaceae	2	3	3	2	2	3	3	2	3	2	3	3	3	3
Compositae	1	2	2	2	2	2	2	2	3	3	2	3	2	2
Artemisia	2	2	2	2	2	2	2	2	2	2	2			
Cruciferae	1	1	1	1	1	1	1	1			1	2	2	2
Cupressaceae														
Juniperus	3	3	3	3	3	3	2	3	3	3	3	3	3	3
Cyperaceae												1	1	2
Scirpus												1	1	1
Fagaceae														
Quercus	2	1	?	1	2	1	2	2	2	2	2			
Juncaceae											1			
Juncus														
Labiatae											1			
Malvaceae												1		
Sphaeralcea												1	1	1
Nyctaginaceae											1			
Pinaceae														
Pinus	3	3	3	3	3	3	3	3	3	2	3	3	3	3
Polygonaceae												1	1	1
Eriogonum														
Rumex														
Ranunculaceae														
Clematis														
Salicaceae														
Salix														
Solanaceae												3	3	2
Datura	1	2	2	2	2	2	2	2	2	2				
Lycium-like	2		1		1		2			1				
Typhaceae														
Typha											2	2	2	2
Ulmaceae														
Celtis														

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H665 S4	H665 S5	H665 S6	H685 S23	H685 S24	H687 S1	H691 S9	H714 S2	H714 S3	H714 S4	H714 S18	H714 S20	H714 S27	H714 S28
Cucurbitaceae														
Cucurbita						2	2	2	2	2	2	2	2	2
Gramineae	2	2	3	2	2	2	2	2	2	2	2	2	2	2
Zea	2	2	2			2	2	2	2	2	2	2	2	2
Leguminosae	2	2	2	2	2	1	2	2	2	2	2	2	2	2
Asclepiadaceae														
Asclepias						2	2							
Cactaceae														
Opuntia														
Capparidaceae														
Cleome			2	2	2	2	2	2	2	2	2	2	2	2
Chenopodiaceae	2	3	3	3	3	2	2	2	2	2	2	2	2	2
Compositae	2	2	2	3	3	2	2	3	3	3	2	2	3	2
Artemisia				2	3	2								
Cruciferae	2	2	2			2		1		2		1		1
Cupressaceae														
Juniperus	3	3	3			3	3	3	3	3	3	3	3	3
Cyperaceae	2	1	2											
Scirpus	1	1	1					1	1	1	1	1	1	1
Fagaceae														
Quercus				1	1	2	2	1	2	1	1	1	2	2
Juncaceae														
Juncus						1		1	1	1	1	1	1	1
Labiatae				1	1		1	1	1		1	1	1	1
Malvaceae						1	1	1	1	1	1	1	1	1
Sphaeralcea	1	1	1											
Nyctaginaceae														
Pinaceae														
Pinus	3	3	3	3	2	2		3	3	3	3	3	3	3
Polygonaceae	1	1	1											
Eriogonum														
Rumex														
Ranunculaceae					1									
Clematis					1									
Salicaceae														
Salix						1		1			1			
Solanaceae	2	2	3			2	2	2	2	2	2	2	2	2
Datura														
Lycium-like							1	1	1	1	2	2	2	2
Typhaceae														
Typha	2	2	1			1		1	1	1	2	2	2	2
Ulmaceae														
Celtis				2	2	2								

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	H714 S29	SQTW S1	SQTW S2	SQTW S3	SQTW S4	SQTW S5	SQTW S6	SQTW S7	SQTW S8	SQTW S9	SQTW S10	SQTW S11	SQTW S12	SQTW S13
Cucurbitaceae														
Cucurbita	2	1	1	1	1	1	1	1	1	1	1	1	2	1
Gramineae	2	2	2	1	1	2	2	2	1	2	2	2	2	2
Zea	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Leguminosae	2				1	2	2	2	2	2	2	2	2	2
Asclepiadaceae														
Asclepias		1	2	2	1	2	2	2	1	1	1	1	1	1
Cactaceae														
Opuntia		2		1	1					1	1			2
Capparidaceae														
Cleome	3	2	2	2	2	2	2	2	2	3	2	2	2	2
Chenopodiaceae	2	2	2	2	2	2	2	2	3	2	2	2	2	2
Compositae	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Artemisia		2	2	2	2	1	1	2	2	1	2	1	1	1
Cruciferae		1		1		1	1	1		1	1			2
Cupressaceae														
Juniperus	3	3	3	4	4	4	3	3	4	3	4	3	3	3
Cyperaceae														
Scirpus				1										
Fagaceae														
Quercus	2	1	2	1	1	2	2	1	1	2	1	2	1	1
Juncaceae														
Juncus	1	1	1	1										
Labiatae	1													
Malvaceae	1													
Sphaeralcea														
Nyctaginaceae														
Pinaceae														
Pinus	3	3	3	3	3	3	3	3	3	3	2	3	3	3
Polygonaceae				1						1				
Eriogonum														
Rumex		1				2					2			
Ranunculaceae														
Clematis														
Salicaceae			1											
Salix				1				2			1	1		
Solanaceae	2	2	2	2	2	2	1	2	2	2		2	2	2
Datura		2	2	1	1	1	1	2	1	1	1	2	1	1
Lycium-like	1													
Typhaceae														
Typha	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Ulmaceae														
Celtis		2	1	1	1	1	2	2	2	1	1	1	1	1

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	SQTW S14	SQTW S15	SQTW S16	SQTW S17	SQTW S18	SQTW S19	SQTW S20	HKBI S3	HKBI S4	HKBI S9	HKBI S6	HKBI S1	HKBI S13	HKBI S7
Cucurbitaceae														
Cucurbita	2	2	2	2	1	1	1	1	1	2	1	1	1	1
Gramineae	2	2	2	2	1	1	2	2	2	2	2	3	3	2
Zea	2	2	2	2	1	2	2	2	2	2	2	2	2	2
Leguminosae	2	2	2	2	2	1	1	2	2	2	1	1	2	1
Asclepiadaceae														
Asclepias	1	2	2	1	1	2	2							
Cactaceae														
Opuntia							1	1			1	1	1	1
Capparidaceae														
Cleome	2	2	2	2	2	2	2	2	2	2	2	2	2	3
Chenopodiaceae	2	2	2	2	3	2	3	3	3	3	3	3	3	3
Compositae	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Artemisia	1	1	1	1	2	2	2							
Cruciferae	2		2		1	1	1		1			2		
Cupressaceae														
Juniperus	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Cyperaceae								1		1	1	1	1	1
Scirpus								1				1		
Fagaceae														
Quercus	1	1	1	1	2	2	1	1	1	2	2	2	2	2
Juncaceae														
Juncus									1				1	
Labiatae									1				1	
Malvaceae														
Sphaeralcea														
Nyctaginaceae														
Pinaceae														
Pinus	3	3	3	3	3	3	3	3	2	3	3	3	3	3
Polygonaceae					1		2	1	1	1	1		1	
Eriogonum														
Rumex		2		2		2								
Ranunculaceae								1						1
Clematis														
Salicaceae														
Salix						1		1		1			1	
Solanaceae	2	2	2	1	2	2	2	2	2	2	2	2	2	2
Datura	2	2	2	2	1	1	2							
Lycium-like								1	1	1	1	1	1	1
Typhaceae														
Typha	1	1	1	1	1	1	1	1	1	2	1	2	2	2
Ulmaceae														
Celtis	1	1	1	1	1	2	2	2	1	2	1	1	2	2

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

Table 23 - MAJOR POLLEN TYPES AT HOVENWEEP 1976

	HKBI S14	HKBI S5	HKBI S12	HKBII ST1	HKBII ST2	HKBII ST3	HKBII ST4	HKBII ST5	HKBII ST6	HKBII ST7	HKBII ST8	HKBII ST9
Cucurbitaceae												
Cucurbita	1	1	1									
Gramineae	2	2	2	2	2	2	2	2	2	2	2	2
Zea												
Leguminosae	1	1	1									
Asclepiadaceae												
Asclepias												
Cactaceae												
Opuntia	1	1	1	1		1			2		2	2
Capparidaceae												
Cleome	3	3	3	3	3	3	2	2	2	3	3	3
Chenopodiaceae	2	2	2	2	2	2	2	2	2	2	2	2
Compositae	2	2	2	2	2	2	2	2	2	2	2	2
Artemisia					2	2	2	2	2	1	2	2
Cruciferae	2	2	1									
Cupressaceae												
Juniperus	3	3	3	3	3	3	4	4	3	3	3	3
Cyperaceae	1	1	1									
Scirpus	1	1										
Fagaceae												
Quercus	2	2	2	1	1	2	1	1	1	1	1	2
Juncaceae												
Juncus												
Labiatae												
Malvaceae		1										
Sphaeralcea												
Nyctaginaceae												
Pinaceae												
Pinus	2	2	3	3	3	3	3	3	3	3	3	3
Polygonaceae					1	1	1	1	1	1	1	1
Eriogonum				1				1				1
Rumex				1								
Ranunculaceae		1	1									
Clematis												
Salicaceae												
Salix				1	1	1	1	1	1	1	1	1
Solanaceae	2	2	2	2	2	2	2	2	2	2	2	2
Datura												
Lycium-like	1	1	1	1	1		1	1		1		1
Typhaceae												
Typha	2	2	2									
Ulmaceae												
Celtis	2	2	2	2	2	2	2	2	2	1	1	1

Key: 1 - .1 to 3% of sample N
2 - 3.1 to 10% of Sample N
3 - 10.1 to 20% of Sample N
4 - 20.1+% of Sample N

TABLE 24 - Hov 47 Pollen Transect Data

Transect 1

	S1	S2	S3	S4	S5	S7	S8	S9	S10	S11
Cleome	x	x	x	x	x	x	x	x	x	x
Asclepias	x	x	x	x	x	x	x	x	x	x
Cheno-ams	x	x	x	x	x	x	x	x	x	x
Cyperaceae		x		x		x	x	x	x	x
Juncus	x									
Solanaceae	x	x	x	x	x	x	x	x	x	x
Typha	x			x					x	
Zea	x	x	x	x	x	x	x	x	x	x
Phaseolus	x	x	x	x	x	x	x	x	x	x
Cucurbita	x	x	x	x	x	x	x	x	x	x
Celtis	x	x	x	x	x	x	x	x	x	x

Transect 2

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Cleome	x	x	x	x	x	x	x	x	x	x	x
Asclepias	x	x	x	x	x	x	x	x	x	x	x
Cheno-ams	x	x	x	x	x			x	x	x	x
Cyperaceae				x				x		x	x
Juncus			x			x			x	x	x
Solanaceae	x	x	x	x	x	x	x	x	x	x	x
Typha	x	x	x	x	x	x	x	x	x	x	x
Zea	x	x	x	x	x	x	x	x	x	x	x
Phaseolus	x	x	x	x	x	x	x	x	x	x	x
Cucurbita											
Celtis											

Transect 3

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Cleome	x	x	x	x	x	x	x	x	x	x
Asclepias	x			x		x		x		x
Cheno-ams	x	x	x	x	x	x	x	x	x	x
Cyperaceae	x	x			x	x				x
Juncus										
Solanaceae										
Typha										
Zea	x	x	x	x	x	x	x	x	x	x
Phaseolus	x	x	x	x	x	x	x	x	x	x
Cucurbita			x		x			x		x
Celtis	x	x	x	x	x	x	x	x	x	x

Key - x - present in sample

TABLE 24 - Hov 47 Pollen Transect Data

Transect 4

	S1	S2	S3	S4	S5	S6	S7	S8
Cleome	x		x			x		
Asclepias								
Cheno-ams	x	x	x	x	x	x	x	x
Cyperaceae								
Juncus								
Solanaceae								
Typha								
Zea	x	x	x	x	x	x	x	x
Phaseolus								
Cucurbita								
Celtis	x	x	x	x	x	x	x	x

Transect 5

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Cleome	x	x	x	x	x	x	x	x	x	x
Asclepias	x	x	x	x	x	x	x	x	x	x
Cheno-ams	x	x	x	x	x	x	x	x	x	x
Cyperaceae			x					x	x	x
Juncus	x	x	x	x	x	x	x	x	x	x
Solanaceae	x	x	x	x	x	x	x	x	x	x
Typha	x	x	x	x	x	x	x	x	x	x
Zea	x	x	x	x	x	x	x	x	x	x
Phaseolus	x	x	x	x	x	x	x	x	x	x
Cucurbita	x	x						x		x
Celtis	x		x	x	x	x	x	x	x	x

Transect 6

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Cleome	x	x	x	x	x	x	x	x	x	x
Asclepias	x							x		
Cheno-ams	x	x	x	x	x	x	x	x	x	x
Cyperaceae	x	x	x	x		x		x	x	x
Juncus	x	x	x	x	x	x	x	x	x	x
Solanaceae	x	x	x	x	x	x	x	x	x	x
Typha	x	x	x				x		x	x
Zea	x	x	x	x	x	x	x	x	x	x
Phaseolus										
Cucurbita	x	x	x	x	x	x		x	x	x
Celtis	x						x	x	x	x

Key - x - present in sample

TABLE 24 - Hov 47 Pollen Transect Data

Transect 7

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Cleome	x	x	x	x	x	x	x	x	x	x
Asclepias										
Cheno-ams	x	x	x	x	x	x	x	x	x	x
Cyperaceae										
Juncus	x	x	x	x	x		x	x	x	x
Solanaceae	x	x	x	x	x	x	x	x		x
Typha	x	x	x	x	x	x	x	x	x	x
Zea	x	x	x	x	x	x	x	x	x	x
Phaseolus										
Cucurbita		x	x	x	x	x	x		x	x
Celtis	x	x	x	x	x	x	x	x	x	x

Transect 8

	S1	S2	S3	S4	S5	S6	S7	S8	S9
Cleome	x	x	x	x	x	x	x	x	x
Asclepias	x	x		x		x		x	
Cheno-ams	x	x	x	x	x	x	x	x	x
Cyperaceae	x	x	x	x	x		x		x
Juncus	x	x	x		x	x	x		x
Solanaceae	x	x	x	x	x	x	x	x	x
Typha	x	x	x	x	x	x	x	x	x
Zea	x	x	x	x	x	x	x	x	x
Phaseolus	x	x	x	x	x	x		x	
Cucurbita	x	x	x	x	x		x		x
Celtis	x	x	x	x	x	x	x	x	x

Key - x - present in sample

ation are naturally produced, others are artificial. In dealing with pollen analysis, some sort of contamination is always probable.

Certainly in this area of extreme wind and water activity, pollen grains may easily be transported from plant zone to plant zone (particularly since they are so close together), among sites, or even from distant geographic regions. Pinus may travel for hundreds of miles, as grains are borne on air currents (Butzer, 1972). Zea pollen usually falls within 3 or 4 feet of a plant in undisturbed conditions, but may travel for 1.8 miles or more from the source plant in windy regions (Stanley and Liskens, 1975). Water may also wash both types of pollen grains far from their original sources. The fact that plants from divergent, though closely situated, ecological habitats often occur together in the same sample indicates some intermixing taking place.

Artificial sources of contamination include inadequate handling of samples in the field when collecting soils and improper packing of samples for transport to the pollen laboratory. It is often difficult to properly clean implements used to recover sediments when water is at a premium. Samples collected from Hovenweep 47 illustrate the possible mixing of prehistoric and modern pollen types. Samples were taken between 25 and 130 centimeters (average depth between 30 and 60 centimeters) in depth, immediately cross-cutting generations of vegetational growth and soil deposition.

Perhaps, however, the most interesting aspect of the Hovenweep research was the large percentage of cultigen and associated weedy plant species represented in the pollen counts. Most samples had large quantities of such pollen. The occurrence of maize has been termed significant at .22% in a 24,000 pollen grain sample and also at 1.09% in a sample of 21,500 grains (Martin and Byers, 1965 p.128). But 4 to 6% count of maize pollen is not uncommon for Hoverweep samples consisting of 200+ pollen grains! Beans and squash, too, sometimes occurred in large quantities at 2 to 7%.

Also of importance are the so-called manipulated wild plants. On the average, Cleome is the most abundant of these plants at 18% per 200+ pollen grain sample count, but Asclepias, Helianthus-type (sunflower), Ephedra (Mormon tea), Juncus (bullrush), Mentha-type (mint), Calochortus (lily), and Rhus (squawbush) were no doubt systematically exploited by the prehistoric inhabitants of Hovenweep. Quantities of pollen grains attributable to members of the Solanaceae (Nightshade Family) such as Datura (jimson weed), Lycium-type (wolfberry), Nicotiana-type (wild tobacco), Physalis-type (ground cherry), and Solanum-type (wild tomato or potato) were also sometimes identified. Some of these plants, particularly Datura, have important ceremonial functions and are associated with Indian rituals throughout the Americas. The use by Indian populations of the aforementioned plant genera is supported by good ethnographic data; all

are or were common at Hovenweep (refer also to Winter 1976).

CONCLUSIONS

Inter-mixing or contamination from artificial and natural sources are facts which must be dealt with when interpreting the pollen record at Hovenweep and any other archeological context. Most of the artificial contamination can be controlled. For example, a simple solution to the plastic bag breakage problem is the use of "whirl-packs". Whirl-packs are self-sealing, sterile, and heavy duty. Staples are not needed to close this type of bag. Staples all too frequently tear the fabric of other types of bags and should never be used with sediments to be tested for pollen content.

During samplong in the field and especially if extra water, other than that available for drinking is difficult to obtain, a series of clean implements washed with soap and water at camp and carried in clean plastic bags could easily prevent contamination of this sort. A trowel or shovel could be used for the heavy work, digging a profile for example, but another clean implement could then be employed to collect the actual sediment sample to be analyzed. Old soup spoons are ideal for this purpose. They are light and easily transportable. Twenty could be carried into the field with not undue effort. Though simplistic, these types of precautions are a necessity if accurate pollen analysis is to be accomplished.

Compared with artificial contamination, natural inter-mixing resulting from water washing or wind transport is much more difficult to control. It is the opinion of this author that these two factors are the main variable which must be controlled in defining farm fields. Most pollen diagrams simply cannot render the type of precise data necessary to determine such specific problems as the location or distribution of fields. Plants produce such varying amounts of pollen and there exists such over-lap in pollen dispersal from plant zone that it is almost impossible to denote precisely the boundaries of specific plants. The establishment of the boundary of individual plants is what would be necessary to determine the location of a farm field. In a region such as Hovenweep where wind and water are two significant factors influencing pollen dispersal and distribution, such precise information about the location of plants can rarely be gained from pollen analysis.

On the other hand, more general interpretations are certainly possible with pollen data. The pollen diagrams discussed during the course of this research must reflect a flourishing farming economy. Even if pollen from different time periods was inter-mixed, as at Hov 47, the large amount of cultigens and associated wild manipulated plants as well as crop weeds indicate extensive agricultural practices.

Important here is that when G. Weir (1975) collected surface samples from controlled, non-site location using a modified pinch technique at modern Hovenweep, he found no cultigens whatever. The samples described in this research contain not only pollen attributable to the plant families he identified, but additionally they contain the domestic plant complex characteristic of the Anasazi agricultural economy. The proportion of such cultigen pollen was also identified in higher quantities than from other Southwestern sites.

While it may never be possible to answer some of the elusive specific questions, it will be possible to deal with general problems relating to an agricultural economy through time. The level of our interpretations will be limited to a great extent by existing environmental conditions and by the sophistication of our methodology.

III.10

SOIL CHEMISTRY STUDIES OF HOV. 24

By Allan McIntyre

INTRODUCTION

The soils of Hov 24 were studied to determine if intra-site chemical and pH differences are present in the soil. The analysis involved testing for pH, Nitrogen Nitrates, Phosphorus, and Potasium (i.e., the major soil elements) in various features of the site.

The basic premise underlying the analysis of soils in archaeological sites is that areas of activity and deposition can be identified through their differentialchemical composition. Europeans were the first to analyze archaeological sediments. Walther Lorch (1939, 1952) in Germany and Olaf Arrhenius (1931,1934,1935,1954,1961) in Sweden concentrated on locating archaeological sites by chemical analysis. More recently, Deetz and Dethlefsen (1963) demonstrated that soil profiles which accurately show distributions of various cultural features could be constructed through the use of pH, while Van Der Merwe and Stein (1972) have attempted to define the limits of the Utz site near Miami, Missouri. The latter investigators have also developed means for determining the difference between postmolds and rodent burrows by soil chemistry. Other archeologists interested in soils include Schnell (1932), Krieger (1940), Solecke (1951,1953) Dietz (1957), Cornwell (1958,1964), Cook and Heizer (1961,1965), Duma (1972), Eidt (1973), Limbrey (1975) Noisat (1976) and McIntyre (1977). All have studied archeological soils, although some are rather limited in their applicability to a broad range of archaeological problems.

Until recently very little work has been attempted in the investigation of archaeological soils in the Southwestern United States and only one study has been conducted in the area of Hovenweep National Monument (Noisat,1976).

Hov. 24 (see Fig. 5) was selected for several reasons. First, it appears to represent a long series of occupation beginning with late Basketmaker III or early Pueblo I, lasting through Pueblo III Prudden Unit. It is also located on a ridge above the Square Tower complex in Little Ruin Canyon and is associated with two other ridgetop pueblos and the Hov. 94 farming community in an adjacent arroyo. The presence of these sites indicates that a rather sizable mesa top population of farmers once lived on Cajon Mesa prior to the development of the Canyonhead towers in the thirteenth century A.D. It was therefore anticipated that the site would reveal various layers

of deposition associated with habitation.

SAMPLING AND TESTING

Extraction of soil samples for analysis was carried out during the 1976 Hovenweep Archaeological Field School. All samples were taken from 10 cm. layers and were placed in sterile polyethylene bags, sealed, and tagged with their proper provenience. Each sample contained more than 200 mg. of soil, and each was analyzed with a La Motte soil analysis kit, Model STH-5007.

PRELIMINARY FINDINGS

pH

Potential (p) of Hydrogen (H) consists of three possible chemical situations: acidic soils, which are below 7.0 on the scale, and can be explained as a preponderance of hydrogen over hydroxyl ions; alkaline soils, which are above 7.0 on the scale, with a preponderance of hydroxyl ions over hydrogen; and finally, neutral soils, with a balance of hydrogen and hydroxyl ions designated as 7.0 on the pH scale. The pH scale operates as a negative logarithm of the activity of hydrogen ions in solution form.

The results (Table 25) reveal that the pH of the site is moderately alkaline which agrees with Noisat's (1976) investigation of the soils of water control sites. It apears that the pH of the whole mesa is much the same with little regard to whether the soil is within a site or outside of it. It may be important, however, that much of the site soil that was tested was deposited by weathering and aeolian deposition. The only distinct cultural surface which would have been tested in the kiva was the floor, but because sampling would have disturbed it, no soil was taken. It can be observed, however, that there is a rise in pH value close to the surface of the floor at approximately 155 cms. This is probably the result of rooffall and wood ash from burned beams which were found at this level.

It has been noted by Cornwall (1966:57) that redeposition as occurred in the Hov. 24 kiva "will go on at a rate decreasing according to an exponential curve, in accordance with the decrease of the gradients which activate the transporting agencies". Since this filling is occurring through aeolian and alluvial deposits, we may assume the soils which fill the kiva are representative of existent soils in the area and are at about ph 8.2.

The range of pH in the samples tested varies from 8.0 to 9.6,

Hov. 24 Test Pit 1 Kiva

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature	
15	8.6	10	200+	330	9	Topsoil - Fine sandy silt
35	8.2	0	25	280	9	Aeolean
55	8.2	0	25	280	17	Small gravel and charcoal flecks, Aeolean and Aluvial
75	8.2	0	25	160	17	gravel stratas.
95	8.2	0	25	175	17	90 cm - Hit Rubble
115	8.4	0	50	100	17	
135	8.4	0	100	100	28	140 cm - Hit Bench
155	8.6	0	150	165	28	No immediate soil change charcoal and small pieces
175	8.2	0	100	220	28	of rotting roof beam.
200	8.4	0	100	170	28	170 cm - dense rubble plus rotting roof beams.

215 cm. Hit floor - did not penetrate, plaster over pecked stones.

* = Pounds per acre

TABLE 25 - Soil Chemical Tests at Hov 24

Hov. 24 Test Pit 10 Table 25 cont'd

Low Rubble Mound

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature
10	8.2	0	200	230	30
20	8.2	0	100	210	31
30	8.6	0	75	120	35
35	9.6	0	100	220	35
40	8.2	0	50	95	36

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature
5	8.6	0	200	350	20
25	8.6	0	200+	575	23
45	8.4	0	200+	400	26
60	8.6	0	150	400+	29
70	8.4	0	200+	500	32

Test Pit 8 - Midden Area

* = Pounds per acre

Nov. 24 Test Pit 3 Contiguous Room Blocks Table 25 cont'd

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature
10	8.6	0	200+	220	11
20	8.0	0	200+	300	14
30	8.6	10	200+	325	21

Test Pit 4 Contiguous Room Blocks

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature
30	8.4	0	200+	250	24

Test Pit 11 Contiguous Room Blocks

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature
10	8.6	10	200+	300	11
20	8.4	0	50	200	16
30	8.2	10	100	375	24
40	8.6	10	25	230	36

Test Pit 6 Small three sided masonry room

Depth in Centimeters	pH	Nitrates*	Phosphorus*	Potassium*	Feature
20	8.4	0	100	300	22
40	8.4	0	150	200	22
60	8.6	0	50	250	25

* = Pounds per acre

the mean value is 8.4. The 9.6 pH value was obtained from a surface jacal structure, which may account for the high alkaline pH value obtained from the sample.

NITROGEN NITRATES:

Nitrates are the chemical salts of nitrogen which are in the soil and are readily available to plants, stimulating above ground plant growth. Nitrates are necessary for plant growth. Too much nitrogen, however, can produce over-rapid growth, softness of tissues, a general weakness of the plant, and greater susceptability to disease, infection, and injury. At flowering time excess nitrogen causes plants to resume growth which retards flower and seed formation.

Table 25 indicates a low nitrogen content, which possibly is due to the depletion of nitrates from soils through poor agricultural maintenance, i.e., the removal of harvested crop plants (Black,1960). Leaching may also cause the low nitrate quantities, since nitrogen present in the form of nitrates is soluable and does not form insoluable compounds with soil constituents, and is transported readily by ground water and subsequently lost through ground water movement (Black, 1960).

PHOSPHORUS:

In general the total amount of phosphorus in the soils is small. Outside of the Hovenweep area it has been found that the average value of phosphorus per acre is 562.36 kilos (Lipman and Conybeare, 1936). This is equal to 0.062 percent phosphorus per acre, assuming 907,029.47 kilos of surface soild per acre. As yet we have not determined the correct figures for the amount of surface soil in the vicinity of Hovenweep National Monument; we shall therefore utilize Lipman and Conybeare's figures in our analysis of phosphorus percentage. Our mean phosphorous count is 55.19 kilos per acre or 0.00608 percent phosphorus per 907,029.47 kilos of surface soil.

Phosphorus in soils occurs in two broad categories: organic and inorganic. The proportionate amounts of phosphorus in these two categories varies widely (Black,1960). The extreme values reported in the literature for surface samples of soil (Basu and Kibe, 1945; Ghani and Allem, 1943) range from 3% organic and 97% inorganic on the one hand and 75% organic and 25% inorganic on the other. The content of organic phosphorus increases as the content of nitrogen increases and pH decreases.

The phosphorus in our samples is of small but ample quantities for successful plant growth.

Referring to Table 25, it will be noted that phosphorus quantities are highest in the midden area and the contiguous room

blocks. We may assume that the high quantities found in the room blocks are present due to several various reasons. Cook and Heizer, (1965) present four possible ways in which site soils are altered.

> "First, In all primitive and many civilized societies the urine and feces of men and animals are not disposed of by sewage systems but are deposited on the surface of the living area. Secondly, Dead bodies, unused portions of animal flesh, rejected parts of wild or cultivated food plants are scattered as refuse over the surface, or buried just underground. Thirdly, In some primitive and many civilized communities the excreta of domestic animals are saved and applied to the local soil as manure. Fourth, A special case, and one which must be watched for and excluded when possible, is the use of mineral fertilizers as a function of modern agriculture" (Cook and Heizer, 1965).

The phosphorus measured in the midden area is probably due to human habitation. Cook and Heizer (ibid) estimate that phosphorus created by humans, per day, per 453.51 kilos body weight, will equal approximately 17.5 grams of phosphorus deposited daily in urinary and fecal matter.

Phosphorus deposited in the soil through decomposition of the bodies of man and animals occurs as pockets of higher pH value than the surrounding areas. It is estimated (Bell, Davidson, and Scarbough, 1961) that the amount of phosphorus released is .77%-1.10% (Sherman, 1947) of the total body weight. Cook and Heizer (ibid) further estimate that 100 corpses will distribute about 124 kilos of phosphorus per year.

POTASSIUM:

The content of potassium in soil is usually greater than the amount of nitrates or phosphorus.

Soil potassiums is divided into three groups: (1) non-exchangeable, (2) exchangeable, and (3) water soluable. In this study the soil solution of potassium was not measured independently but was included with exchangeable potassium, since the two fractions are extracted simultaneously by salt solutions.

Potassium availability to plants promotes strong stalks and stems. It also produces well developed roots to absorb soil nutrients. Too much potassium causes an increase in the water content of the plants and their resistence to drought and frost injury is affected and their maturity is delayed.

Our mean of 114.56 kilos per acre of potassium averages out to

0.01263 percent potassium per 907,029.47 kilos of surface soil per acre, based on Lipman and Conybeare's (ibid) averages of soil surface weight. The potassium is of low but ample quantities to sustain plant growth and is highest in the midden area. It is of interest to note that although the soil was found to be sterile of cultural material at 75 cm., the pH, phosphorus, and potassium levels are all still high. We can trace features visually, but the chemical analysis of soils is needed to actually define the sterility of a feature.

CONCLUSIONS

The Hov. 24 study indicates considerable variability among the soils which were analyzed. The midden area was definately recognizable through the high pH, phosphorus and potassium amounts measured. It should theoretically be possible to locate burials in a midden area by analyzing soil samples across the midden, assuming that the areas of highest elemental display are areas of burial. The soils in the kiva apparently act as a catch basin for weathering soils in the area. From the time the site is abandoned, soil builds up within the depression, and this soil can be used as an example of what has happened to the soils in the region from the time of abandonment to the time it is sampled. Any surface within a site that has been directly utilized will be able to be detected by high amounts of pH, phosphorus, and potassium.

The pH of the area studies is highest in areas in which ash, cultural fill, and direct surface contact is made. The Nitrates of the area are practically nill, possibly due to leaching. The phosphorus values are stable throughout the site with some variations occurring when pH and potassium both rise in quantity. The potassium of the area seems to fluctuate with phosphorus. The potassium is always found in higher quantities than the phosphorus and seems to stay at a normal range above phosphorus amounts.

The Hov. 24 study indicates that archaeological soil analysis is possible in Southwestern contexts but that a baseline must be established before intersite comparative studies can be conducted.

III.11

SAMPLING PROCEDURES, 1974-1975:

PHYSIOGRAPHIC ANALYSIS OF HOVENWEEP SURVEY QUADRATS

By Gail Del Pero

INTRODUCTION

This discussion deals with 1) probability sampling procedures, 2) developing a procedure to analyze physiographic features of a region and 3) the application of random and cluster analysis as applied to regional analysis.

Archaeological research is based upon sampling. It is from the sampled population (population of cultural material at the time of survey or excavation) that the archaeologist makes inferences about the target population (population of cultural material at the time of occupation). The validity of inferences based on the sample are dependent upon the accuracy of that data. Thus the method of selecting the sample is one of the major decisions made by the archaeologist when he or she begins the research. The sampling method may be based upon intuition which may be adequate when the archchaeologist is primarily interested in description and historical reconstruction, but as the emphasis shifts to explanation, the intuitive method becomes suspect. It is at this point that probability sampling become important. While it is recognized that the archaeologist has some intuitive thoughts or hunches concerning the causes of his research explanation, this should be incorporated into the probability sample design.

By probability sampling is meant any technique (simple random, cluster, stratified, systematic, etc.) which provides a reliable and accurate sample of the total universe or area which is being investigated. Accuracy is determined by precision and bias. Following Cowgill (1975) precision here is defined as a measure of the probability that the one sample mean (m) actually obtained differs by more than some given amount from m, the mean of all samples obtained if the same sampling procedure were to be repeated independently a large number of times (independence here implies that inclusion of an observation in one sample has no effect on its chances of being included in another sample). Bias is the difference between the value obtained for precision and the true population parameter which the sample statistic is used to estimate. Bias occurs when the actual procedure for picking observations from the population differs seriously for whatever probability sampling scheme is presupposed by the sampling model. Note that when bias is present it is not the samples that are biased but rather the procedures that may be biased.

Probability sampling is advocated over the intuitive approach because the degree of precision and bias can be estimated by probability methods while in intuitive methods the amount of bias can not be estimated or controlled. Thus the risks of error are reduced by using probability methods.

To obtain the highest degree of precision entails complete excavation or survey. This in turn means a great deal of expenditure both in man-hours and money, which in most instances is unrealistic. The archaeologist is thus faced with selecting a sampling method which will be compatible in terms of cost, efficiency and precision.

As mentioned above, there are several probability methods to choose from. Simple random sampling is probably the easiest to apply, since it is one in which each point, traverse or quadrat is chosen randomly by means of a table of random numbers. A systematic sample has an initial point chosen randomly and all others determined by a fixed interval of space. A stratified sample is one in which the study area is subdivided into predetermined strata. It is here that the archaeologist's intuition comes into play. Sampling points within strata may be chosen randomly, systematically, or in an aligned fashion. Alignment fixes the intervals between the points within strata (Berry, 1968). Consistency in procedure application at this initial level of sampling is imperative to insure the highest precision obtainable. In regional survey the sample unit which seems to be most acceptable in terms of cost and efficiency is an area of space termed the quadrat. The quadrat may be square or rectangular but in order to maintain a degree of control, the sample units need to be of equal area and shape. In effect what usually occurs is that quadrats are chosen according to some sample design, and then all sites (the focus of the survey) in these quadrats are incorporated into the sample and recorded. It should be noted that the classification of a sampling procedure is in terms of the population that has been defined. If the population is the collection of sites in the region, then quadrats chosen randomly represent a form of cluster sampling. If, however, the quadrats are the population, then the sampling procedure would be simple random sampling.

HOVENWEEP SAMPLING METHOD

The sampling procedure generally used at Hovenweep was a stratified approach, with the regional survey covering a period of two years. The focus of the survey as in all regional surveys is an attempt to understand the interrelationships among sites. The 1974 survey sample was selected in two ways: 1) all five Monument Ruins groups (M.R.) were surveyed (4 located at canyonheads and 1 on the mesa edge), representing a clustered sample of quadrats; and 2) four 40 acre (predetermined quadrat size) areas were chosen randomly on the basis of their being mesa or canyon bottom (Winter, 1975:11-12). The 1975

survey sample units were randomly stratified on the basis of plant communities (adjusting percentages from each to account for M.R. already surveyed belonging to a botancial zone) as well as selected "water control"units (quadrats 42 and 43; Winter, 1976:4). The breakdown of the stratified sample according to botancial zone is presented in Table 26.

On the basis of this sampling procedure the likelihood of introducing uncontrolled bias and loss of precision is greatly increased. This is the result of inconsistent use of variables in the strata selection (physiographic for 1974 and botancial for 1975) and the introduction of selected sample units ("water control"). This situation could have been better controlled for in one of two ways. The object of the Hovenweep project was to analyze agricultural techniques used by the Anazasi (Winter, 1976:1). Since it is known that water is a necessity for an agricultural environment and water is known to be scarce on Cajon Mesa, stratifying according to those physiographic features having the most water potential such as canyon drainages where most of the water supply would likely be, as well as where floodwater farming would have the highest potential, and non-canyon areas (Matson and Lipe, 1975) would be an alternative to stratifying by botantical zones which admittedly are difficult to define (see Table 27). Still another approach might be to make a two phase project out of the two year survey. The first phase would be to completely survey the M.R. as was done the first year and analyze them as one complete known population. The second phase would be to use a stratified systematic unaligned sample (Berry, 1968) giving assurance of samples widely dispersed over the research area (Judge, Ebert and Hitchcock, 1975) including only those M.R. quadrats that were selected according to the sampling procedure. This sample would represent only part of a larger population. The analysis approach in each phase would vary and the amount of bias could be controlled.

METHODOLOGY

Cajon Mesa varies physiographically, so to assume that the physiographic units would occur randomly throughout the mesa is inaccurate. By consulting topographic maps the per cent of each physiographic unit on the mesa was determined. First, the boundaries of the region under consideration are established. In this care the boundaries are well defined with the exception of the northeastern boundary which is cultural and for purposes of this analysis was considered to be 6600 feet. The Mesa is bounded by Yellowjacket Canyon running into McElmo Creek on the east, the San Juan River on the south and Cross Canyon running into Montezuma Creek on the west (Winter, 1976:3). The physiographic units were then chosen, which included: 1) mesa (table-topped hills or mountains bordered on all sides by cliffs and representing the remnant of formerly extensive

Table 26 1974-75 Survey Sample Stratified By Botanical Zone

STRATIFIED SAMPLE ACCORDING TO BOTANCIAL ZONE

Pinyon-Juniper			Sage			Shrubland		
Quadrat	# Sites	Comment	Quadrat	# Sites	Comment	Quadrat	# Sites	Comment
13	11		36	4		23	7	1 is sage
14	10	5 are sage	35	3		24	5	
15	10	3 are sage	34	7		49	2	2 are sage
16	11	2 are sage	43	4	2 are p-j (W.C.)	51	5	
18	3	3 are sage	2a	14	Sq. Tower M.R.!	50	4	
20	1	1 is sage	2b	---	"	9	6	
28	6		2c	6	"	1	6	
26	4	4 are sage	2d	2	"	56	5	
27	3	2 are sage	2e	18	"	53	10	
5	10	Cutthroat M.R. .35 quadrat	2f	13	"	54	1	
33	4	1 is sage	2g	3	"	57	3	
31	5	1 is sage	2h	---	"	58	1	
32	3	1 is sage	2i	8	"	59	12	
11	10		2j	4	"	55	---	
12	8		3a	15	Holly M.R.	22	---	
21	---		3b	5	" &.625 quadrat	48	---	
17	---		4a	20	Hackberry M.R.	16	62	
17.35	100	21*	4b	13	"			
			4c	18	"			
			4d	1	" &.425 quadrat			
			42	7	(W.C). quadrat			
			37	2				
			40	3	3 are shrubland			
			44	6				
			47	3				
			8	7				
			45	3				
			46	10				
			25	3				
			29	2				
			6	7				
			7	7				
			52	---				
			30	---				
			38	---				
			39	---				
			35.05	219 @				

! The M.R. were divided into equal area units to be analyzed with the other quadrats

* 10 of the p-j quadrats or 21% of the sites show some sage which in part supports the premise the dividing line between p-j and sage is very vague (Winter:1975:232)

@ sage is overrepresented if sage occupies 1/3 of the area of the region (Winter 1975,227). The sample represents 51.24%.

Table 27 - Pinyon-Juniper Mesa Top Quadrats

Pinyon - Juniper mesa quadrats	19	26	27	28	12	13	14	33	16	31	11
mesa top (no specific location on mesa top)	1	4	2	5	8	11	10	1	7	3	2

observed total = 54

expected = $\frac{\text{observed}(N)}{\#\ K}$ x physiographic %

expected = $\frac{54}{11}$ x .3434 = 1.69

Quadrat	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
19	1-1.69= -.69	.4761	.28
26	4-1.69= 2.31	5.3361	3.16
27	2-1.69= .31	.0961	.057
28	5-1.69= 3.31	10.9561	6.48
12	8-1.69= 6.31	39.8161	23.56
13	11-1.69= 9.31	86.68	51.29
14	10-1.69= 8.31	69.06	40.86
33	1-1.69= -.69	.4761	.28
16	7-1.69= 5.31	28.1961	16.68
31	3-1.69= 1.31	1.7161	1.02
11	2-1.69= .31	.0961	.057

143.724 = x-chi

df = k-1 = 11-1 = 10

with 10 df the x-chi has to be greater than 18.31 to show significance

layer of resistant rock); 2) Talus slope (area varying by degrees of inclination leading from the mesa edge down into canyons); 3) canyon bottom; and 4) canyon terraces (broad area of a former floodplain which lies above the present water level) (Strahler, 1974). These physiographic units were then located on topographic maps, cut out, weighed and converted to percentages. These percentages (mesa = 34.34%, talus slope = 47.35%, canyon bottom = 9.09% and terrace = 8.3%) were then used to compute the expected number of sites occurring in a specific physiographic unit (Janardham, 1965). The next step was to list those physiographic specifics which were noted in the field survey but which did not show up on the topographic map. For example, talus base would be listed under slope but not under mesa while arroyo would not be listed under slope but could be under the other three designated units. In case a specific unit could occur in more than one physiographic units, the percentage assigned to it would total the combined percentages of the physiographic unit.

The available data can be analyzed in several ways using statistical means. As long as the sampling units (quadrats) are the elements in the sample rather elementary statistical methods can be employes as long as the condition of randomness is met (the quadrat is the unit by which the sample elements were chosen). The variables present in this data are nominal (classificatory) as opposed to interval (measurement) variables. In formulating a specific research hypothesis the main objective is to determine if the variables involved are independent or associated. The most widely accepted basic statistic for nominal data is that of the x-chi, which is desirable since it is a nonparametric or one that makes no assumption about the population distribution. The x-chi shows heterogeneous comparisons of observed and theoretical frequencies. A significant x-chi indicates that the observed frequency differences are probably due to some other factor than sample fluctuation. One would then reject the null hypothesis that differences in observed frequencies are due to sample fluctuation. The x-chi will indicate if the variables are related but not how strongly related. The contingency coefficient will illustrate the degree of relationship for nominal data in samples with two or more variables (Siegel, 1956).

Table 27 is a one sample x-chi taking physiographic variation into consideration. In this case the concern is whether the sample data site density on the mesa top is higher than would be expected for pinyon-juniper mesa quadrats. Only the sample units which are considered are those that have mesa top sites in pinyon-juniper quadrats. The probability of obtaining a x-chi as large as 143.72 is greater than .001 with 10 df. (Siegel, 1956; Table C). Thus the research hypothesis of a relationship existing between mesa top sites and pinyon-juniper botanical quadrats can be accepted. One theory explaining the relationship significance may be that at higher elevations water is more readily available and not as much a factor

in site determination. However, precise knowledge of what percent of the botancial zone pinyon-juniper occupies on the mesa is lacking and may be another factor contributing to the significance.

Similarly, Table 28 shows another one sample x-chi which tests whether edge rim site density is higher than would be expected for sage mesa quadrats. The significance may indicate a general movement of sites from general mesa top location (previous example) to edge rim to be closer to water sources for agricultural fields as dependence on agriculture increased. However, it should be noted that although the x-chi is significant, the majority of the sites (62/71 = 87.32%) are from M.R., which represents a clustered quadrat sample.

One of the most powerful nonparametric tests is the Mann-Whitney U test, which tests whether two independent groups have been drawn from the same population (Siegel, 1956). The two independent groups in this case are the botancial zones (sage quadrats and pinyon-juniper quadrats) and the population is the botancial environment of Cajon Mesa. In this case the research hypothesis is that the average site density is higher in the sage botancial zone as opposed to the pinyon-juniper zone. A z score of 4.54 (see Table 29) has a one-tailed probability of .0003 (Siegel, 1956: Table A). Since this is lower than the significance level of .01 the research hypothesis can be accepted. However, if sage is over represented in the sample (see Table 26), the results are suspect.

Up to this point the emphasis has been on the sample unit (quadrat) and thus the nonparametric methods based on random selection can be applied. However, if the emphasis shifts from the quadrat to the site the statistical implementations are drastically changed. The sites were recorded as a result of being part of the randomly selected quadrats. In other words the sites are not independent observations but rather dependent upon being part of the randomly selected quadrats. This creates a cluster effect usually displaying some degree of homogeneity within the cluster (Kist, 1957). This results in a loss in a sampling precision arising from the increased probabilities of similarities in sub-populations in each cluster (Holmes, 1967), which means that the cluster sample will yield greater sampling errors (Blalock, 1972). The implications of the effect of cluster upon inferential statistics becomes manifest when one tries to determine significance. Due to the homogenity of the cluster a fewer number of cases are needed to obtain an accurate estimate of the mean. Thus cluster sample (N) may in fact be as efficient as a simple random sample of a smaller size. Many formulas use N as the denominator of a fractional index. In these formulas, the use of the incorrect N (cluster N) as a divisor will produce a smaller result than if the denominator, corrected to the simple random N, was divided into the same numerator. The incorrect N (cluster N) produces values of the test smaller than does the adjusted N. Consequently, it is more likely that significance will be attained with the unadjusted, incorrect N (Mueller,1975).

Table 28 - Sage Mesa Top Quadrats

Sage Mesa Quadrats	3b	7	8	4a	4b	4c	2e	2f	2g	2i	2j	3a	2a	2c	46
Edge Rim	2	2	1	11	2	6	14	8	2	3	4	3	5	2	6

observed total = 71

$$\text{expected} = \frac{\text{observed}(N)}{\#\ k} \times \text{physiographic \%}$$

$$\text{expected} = \frac{71}{15} \times .3434 = 1.625$$

Quadrat	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
3b	.375	.140625	.087
7	.375	.140625	.087
8	-.625	.390	.24
4a	9.375	87.89	54.086
4b	.375	.140625	.087
4c	4.375	19.140	11.778
2c	12.375	153.14062	94.240
2f	6.375	40.640	25.009
2g	.375	.140625	.087
2i	1.375	1.890	1.163
2j	2.375	5.640	3.471
3a	1.375	1.890	1.163
2a	3.375	11.390	7.009
2c	.375	.140625	.087
46	4.375	19.140	11.778
			210.376 = x-chi

with 14 df the x-chi has to be greater than 23.68 to show significance

Table 29

Mann-Whitney U Test

Pinyon-Juniper Quadrat	# Sites	Rank
19	1	2
20	1	2
18	3	11
27	3	11
32	3	11
26	4	18
33	4	18
31	5	21.5
28	6	24
12	8	31.5
14	10	35
15	10	35
5	10	35
11	10	35
13	11	38.5
16	11	38.5
n_1 =16		R_1 =367

Sage Quadrat	# Sites	Rank
4d	1	2
2d	2	5
37	2	5
29	2	5
35	3	11
2g	3	11
40	3	11
47	3	11
45	3	11
25	3	11
36	4	18
43	4	18
2j	4	18
3b	5	21.5
2c	6	24
44	6	24
34	7	28
42	7	28
8	7	28
6	7	28
?	7	28
2i	8	31.5
46	10	35
2f	13	40.5
4b	13	40.5
2a	14	42
3a	15	43
4c	18	44.5
2e	18	44.5
4a	20	46
n_2= 30		R_2= 714

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$U_1 = 249$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

$U_2 = 231$

The smaller of U_1 and U_2 will be used.

Correct for tied scores

$\Sigma T = \Sigma(\frac{t^3-t}{12})$ where t is the number of observations tied for a given rank

t's = 3,3,9,5,2,3,5,2,5,2,2,2,

$\Sigma T + 98.5$

Table 29 (cont'd)

when n_2 (number of cases in the larger group) is greater than 20 convert to z score

$$z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\left(\frac{n_1 n_2}{N(N-1)}\right)\left(\frac{N^3-N}{12}\right) - \Sigma T}}$$

$z = 4.54$

For example, if the cluster sample is 380 but in reality this corresponds to a simple random N of 100 the expected frequency for X-chi (# observations) will be much lower for the incorrect N resulting in a much higher possible x-chi than would be obtainable with the correct N.

Unfortunately statistical methods for estimating the effects of clustering upon a sample are lacking except in areas where the total population is known or interval (measurement) variables are being analyzed. Thomas (1975)has suggested a method to correct for clustering when the variables are interval and the population distribution is considered to be normal. In cluster sampling the sample mean is in fact the ratio between two random variables, each varying from sample to sample, i.e., cluster to cluster. This new statistic he terms ratio mean (r) and uses it to compute the variance to give an estimate of the population parameter. He cautions that the number of clusters should always exceed 30 in order to approach the sample normality and control bias. He further notes that cluster size must be taken into consideration as it is a source of bias on the ration mean.

Read (1975) has suggested a method for estimating the precision of an estimate for a parameter in clustered sample as well as determining what size cluster sample would have to be obtained to match the efficiency of a simple random sample. However, for this to be a workable method the entire population must be known which necessitates the complete survey and location of all the variables of interest in a region.

Neither of these alternatives are suitable for the type of data available for this study. What is needed is a set of nonparametric statistics developed for cluster sampling which can be applied to nominal data for which the complete population is not known. Selection of a probability sampling method which is constructed in accordance with the type of information one is interested in will greatly help to present accurate information about the sample obtained, as a result of the sampling procedure.

III.12

HOVENWEEP LITHIC SOURCES

By Marilyn Swift

As was suggested in Hovenweep 1975 (Swift 1976), the location of Cajon Mesa within specific Geologic Formations probably provided a rich source of tool material for the Hovenweep Anasazi. To test this statement the 1975 Hovenweep Lithic Collection, with the exception of projectile points and utilized flakes, has been analyzed by site and geologic material, to show distribution of geologic type material. A surface survey was also conducted during 1976 at randomly selected study locations to isolated specific geologic source areas, should they exist. Following is a discussion of the results of these studies.

FINDINGS

Materials used as tools in 33 survey quadrats were: variations of igneous rocks, sandstone, chert (including silty chert), banded chert, weathered chert, plain tuffaceous chert, jasper, agate, petrified wood, quartz, porcellanite, quartzite, lithified sandstone with igneous clasts, chalcedony, lithified sandstone, silicious shale and siltstone (for definitions of these types see Swift (1976). The distribution of these materials whose sample size is greater than 10 appears to be amorphously scattered across the top of the mesa (Table 30). For instance, chert tools were collected from sites in Cow Canyon, Big Ruin Canyon, Cross Canyon, Hovenweep Canyon, Negro Canyon, Bridge Canyon, Wickiup Canyon,Montezuma Canyon, Allen Canyon, and McElmo Canyon. Tuffaceous Chert tools were collected from Negro Canyon, Cow Canyon, Cross Canyon, Hovenweep Canyon, Wickiup Canyon, Allen Canyon and McElmo Canyon. Quartzite tools were found in Negro Canyon, Cow Canyon, Hovenweep Canyon, Little Ruin Canyon, Wickiup Canyon, Allen Canyon, and McElmo Canyon.

Since geologic source availability coule be a factor which explains the wide spread of material on Cajon Mesa, a survey was run of various study areas to determine the availability of various materials in the immediate site area. If in fact stone tool material was readily available to the Hovenweep inhabitants, then the local canyons should yield a variety of stone types suitable for tool manufacture. Following is a description of stone types by study area as were noted during the 1976 Field Session.

From the canyon botton of Big Ruin Canyon, which is in the Morrison Formation, the following stones were noted: a pinkish gray chert, 5 YR 8/1; a light brownish gray chert, 5 YR 6/1; a pale yellow brown chert, 10 YR 6/2; a pinkish gray silty chert 5 YR 8/1. (The

TABLE 30 - 1975 Tool Material by Site

Survey Areas	VARIATIONS OF IGNEOUS ROCKS	SANDSTONE	CHERT	SILTY CHERT	BANDED CHERT	WEATHERED CHERT	TUFFACEOUS CHERT	JASPER
NEGRO 1								
Quad 11								
Site: 582								
586			1(1.7					
587								
588							1(3.6)	
NEGRO 2								
Quad 12								
Site: 510				2(5.3)			1(3.6)	
COW CANYON 1								
Quad 13								
Site 657				1(2.6)				
659								
662			1(1.7)					
571			3(5.2)	3(7.9)		1(14.3)	1(3.6)	
572				1(1.7)				
BIG RUIN 1								
Quad 14								
Site: 639								
BIG RUIN 3								
Quad 16								
Site: 693								
709								
CROSS CANYON 2								
Quad 18								
Site 557								
558								
559								
CROSS CANYON 7								
Quad 23								
Site 632								
636			1(1.7)	3(7.9)			3(10.7	

Note: Numbers in Parenthesis indicate percentage of sample size.

TABLE 30 - cont'd

Survey Areas	AGATE	PETRIFIED WOOD	QUARTZ	PORCELLANITE	QUARTZITE	IGNEOUS LITHIFIED SANDSTONE	CHALCEDONY	SOLIDIFIED SANDSTONE	SILICIOUS SHALE	SILTSTONE
NEGRO 1										
Quad 11										
Site: 582					2(3.4)					
586										
587					1(1.7)					
588					2(3.4)					
NEGRO 2										
Quad 12										
Site: 510										
COW CANYON 1										
Quad 13										
Site: 657					1(1.7)					
659					2(3.4)					
662										
571				2(7.1)	2(1.7)					
572					1(1.7)					
BIG RUIN 1										
Quad 14										
Site: 639						4(66.7)				
BIG RUIN 3										
Quad 16										
Site: 693					1(1.7)					
709										
CROSS CANYON 2										
Quad 18										
Site: 557										
558										
559										
CROSS CANYON 7										
Quad 23										
Site: 632			2(22.2)							
636				1(3.6)			1(20.0)			

TABLE 30 - cont'd.

Survey Areas	VARIATIONS OF IGNEOUS ROCKS	SANDSTONE	CHERT	SILTY CHERT	BANDED CHERT	WEATHERED CHERT	TUFFACEOUS CHERT	JASPER
CROSS CANYON 8								
Quad 24								
Site: 671							1(3.6)	
CROSS CANYON 9								
Quad 25								
Site: 665						1(14.3)		
HOVENWEEP 5								
Quad 26								
Site: 518			1				1(3.6	
519				1(1.7)			1(3.6)	
HOVENWEEP 6								
Quad 27								
Site: 504							1(3.6)	
505						3 (42.9)	1(3.6)	
HOVENWEEP 7								
Quad 28								
Site: 544					1(2.2)		1(3.6)	
547						1(14.3)		
HOVENWEEP 8								
Quad 29								
Site: 507								
HOVENWEEP 10								
Quad 31								
Site: 560					2(4.3)			
561					2(4.3)			
600				2(5.3)			3(10.7)	
HOVENWEEP 11								
Quad 32								
Site: 522							3(10.7)	
523								
HOVENWEEP 12								
Quad 33								
Site: 564							1(3.6)	
600							1(3.6)	

TABLE 30 - cont'd.

Survey Areas	AGATE	PETRIFIED WOOD	QUARTZ	PORCELLANITE	QUARTZITE	IGNEOUS LITHIFIED SANDSTONE	CHALCEDONY	SOLIDIFIED SANDSTONE	SILICIOUS SHALE	SILTSTONE
CROSS CANYON 8										
Quad 24										
Site: 671										
CROSS CANYON 9										
Quad 25										
Site: 665										
HOVENWEEP 5										
Quad 26										
Site: 518										
519										1(50.0)
HOVENWEEP 6										
Quad 27										
Site: 504				1(3.6)						
505				1(3.6)						
HOVENWEEP 7										
Quad 28										
Site: 544			1(11.1)		1(1.7)					
547										
HOVENWEEP 8										
Quad 29										
Site: 507										1(50.0)
HOVENWEEP 10										
Quad 31										
Site: 560				2(7.1)	2(3.4)					
561					1(1.7)					
600					3(5.2)					
HOVENWEEP 11										
Quad 32										
Site: 522										
523							1(20.0)			
HOVENWEEP 12										
Quad 33										
Site: 564										
600										

TABLE 30 - cont'd

Survey Areas	VARIATIONS OF IGNEOUS ROCKS	SANDSTONE	CHERT	SILTY CHERT	BANDED CHERT	WEATHERED CHERT	TUFFACEOUS CHERT	JASPER
BRIDGE 2								
Quad 34								
Site: 47	1(33.3)				1(2.2)			
49			1(1.7)		1(2.2)			
BRIDGE 3								
Quad 35								
Site 48			3(5.2)					
555								
BRIDGE 4								
Quad 36								
Site: 514			3(5.2)					
BRIDGE 5								
Quad 37								
Site 578					1(2.2)			
LITTLE RUIN 5								
Quad 42								
Site 541								
WICKIUP 1								
Quad 45								
Site: 520				2(5.3)	6(13.0			
597			1(1.7)	2(5.3)	5(10.9)			
WICKIUP 2								
Quad 46								
Site: 678								
680			1(1.7)					
549			4(6.9)	1(2.6)	2(4.3)		2(7.1)	
551					1(2.2)			
552			1(1.7)	1(2.6)				
553			3(5.2)	1(2.6)				
554			1(1.7)	1(2.6)	1(2.2)			
BUTTE 2								
Quad 47								
Site: 617			1(1.7)		1(2.2)			
618								
619								
LITTLE MONTEZUMA 2								
Quad 49								
Site: 681					1(2.2)			

TABLE 30 - cont'd.

Survey Areas	AGATE	PETRIFIED WOOD	QUARTZ	PORCELLANITE	QUARTZITE	IGNEOUS LITHIFIED SANDSTONE	CHALCEDONY	SOLIDIFIED SANDSTONE	SILICIOUS SHALE	SILTSTONE
BRIDGE 2										
Quad 34										
Site: 47								1(33.3)		
49				2(7.1)						
BRIDGE 3										
Quad 35										
Site 48										
555				1(3.6)						
BRIDGE 4										
Quad 36										
Site: 514										
BRIDGE 5										
Quad 37										
Site: 578										
LITTLE RUIN 5										
Quad 42										
Site: 514					1(1.7)					
WICKIUP 1										
Quad 45										
Site: 520										
597										
WICKIUP 2										
Quad 46										
Site: 678										
680					1(1.7)					
549			2(22.2)		5(8.6)					
551			1(11.1)		1(1.7)					
552			1(11.1)		2(3.4)					
553	1(25.0)			1(3.6)	2(3.4)		1(20.0)			
554	1(25.0)									
BUTTE 2										
Quad 47										
Site: 617					1(1.7)					
618					1(1.7)					
619										
LITTLE MONTEZUMA 2										
Quad 49										
Site: 681	1(25.0)		1(11.1)		4(6.9)					

TABLE 30 - cont'd.

Survey Areas	VARIATIONS OF IGNEOUS ROCKS	SANDSTONE	CHERT	SILTY CHERT	BANDED CHERT	WEATHERED CHERT	TUFFACEOUS CHERT	JASPER
MONTEZUMA 1								
Quad 50								
Site: 676	1(33.3)			1(2.6)				
715	1(33.3)							
716				1(2.6)				
MONTEZUMA 2								
Quad 51								
Site 667								
668			1(1.7)	1(2.6)				
669			1(1.7)					
670			1(1.7)					
ALLEN 2								
Quad 53								
Site: 525			4(6.9)	1(2.6)	1(2.2)		1(3.6)	
526								
527			2(3.4)					
529			1(1.7)					
530								
531					1(2.2)			
ALLEN 3								
Quad 54								
Site: 651								
WEST ALLEN 2								
Quad 56								
Site 613								
614			2(3.4)					
EAST ALLEN 1								
Quad 57								
Site: 569			1(1.7)		9(19.6)			
570				2(5.3)				
MCELMO 1								
Quad 59								
Site 601				1(2.6)			1(3.6)	
602					2(4.3)	1(14.3)		
604				1(2.6)				
605		1(100)	6(10.3)	4(10.5)	5(10.9)			
606				1(2.6)				
608			1(1.7)	2(5.3)	2(4.3)			

TABLE 30 - cont'd

Survey Areas	AGATE	PETRIFIED WOOD	QUARTZ	PORCELLANITE	QUARTZITE	IGNEOUS LITHIFIED SANDSTONE	CHALCEDONY	SOLIDIFIED SANDSTONE	SILICIOUS SHALE	SILTSTONE
MONTEZUMA 1										
Quad 50										
Site: 676								1(33.3)	1(33.3)	
715										
716										
MONTEZUMA 2										
Quad 51										
Site: 667										
668									1(33.3)	
669										
670				2(7.1)						
ALLEN 2										
Quad 53										
Site: 525					5(8.6)					
526					1(1.7)					
527										
529										
530	1(25.0)		1(11.1)							
531								1(33.3)		
ALLEN 3										
Quad 54										
Site: 651				3(10.7)	5(8.6)					
WEST ALLEN 2										
Quad 56										
Site: 613				1(3.6)						
614										
EAST ALLEN 1										
Quad 57										
Site: 569										
570									1(33.3)	
MCELMO 1										
Quad 59										
Site: 601				1(3.6)	2(3.4)					
602										
604					1(1.7)					
605				9(32.1)						
606					1(1.7)					
608				1(3.6)	1(1.7)	1(16.7)	1(20.0)			

TABLE 30 - cont'd.

Survey Areas	VARIATIONS OF IGNEOUS ROCKS	SANDSTONE	CHERT	SILTY CHERT	BANDED CHERT	WEATHERED CHERT	TUFFACEOUS CHERT	JASPER
SANDSTONE 1								
Quad 10								
Site: 701					1(2.2)			
698								
OTHER								
Site: 10				2(3.4)				
438			1(1.7)					
UNKNOWN			5(8.6)		1(2.2)			
656							1(3.6)	
TOTAL	3	1	58	38	46	7	28	1
PERCENT OF SAMPLE	1.0	0.3	19.2	12.6	15.2	2.3	9.3	0.3

TABLE 30 - Cont'd

Survey Areas	AGATE	PETRIFIED WOOD	QUARTZ	PORCELLANITE	QUARTZITE	IGEOUS LITHIFIED SANDSTONE	CHALCEDONY	SOLIDIFIED SANDSTONE	SILICIOUS SHALE	SILTSTONE
SANDSTONE 1										
Quad 10										
Site: 701										
698						1(16.7)				
OTHER:										
Site: 10										
438										
UNKNOWN					4(6.9)					
656					1(1.7)		1(20.0)			
TOTAL	4	1	9	28	58	6	5	3	3	2
PERCENT OF SAMPLE	1.3	0.3	3.0	9.3	19.2	2.0	1.7	1.0	1.0	0.7

numbers following each stone are Munsell color system codes to provide exact description). From along the canyon edges a green gray and gray red tuffaceous chert, 5 GY 6/1 and 5 R 4/2, and a light gray quartzite, N7, were found. One large quarry site in which many banded chert flakes and cores, 5 YR 8/1 - 5 GY 6/1, was noted approximately 100 meters north of site 5MT 729.

From within Hovenweep Canyon in the Morrison Formation, a river cobble of light brown quartzite, 5 Yr 6/4; pale orange chert, 10 YR 8/2; a pinkish gray quartzite, 5 YR 8/1; a light brown silty chert, 5 YR 6/4; and a white quartz river cobble, N9, were found.

Around the area of the Cajon Ruin Group in Allen Canyon in the Burro Canyon Formation, were found: a medium gray chert, N5; a light gray opalized chert, N8; a greenish gray silty chert, 5 GY 6/1; a light yellowish gray quartzite 5 YR 8/1; and a large grained light pinkish gray quartzite, 5 YR 8/1.

Little Ruin Canyon also located within the Burro Canyon Formation, yielded the following geologic resources: a river cobble of very light gray chert, N8; a river cobble of pinkish gray chert, 5 YR 8/1; a river cobble of pinkish gray quartzite, 5 YR 8/1; a river cobble of white quartz, N9; a greenish gray silicified sandstone 5 GY 6/1; and a dark green silty chert, 5 GY 6/1. These were noted at both canyon top and canyon bottom locations.

From McElmo Canyon in the Morrison Formation near Ismay Trading Post, a light gray quartzite, N7; banded chert, 5 YR 8/1 - 5 GY 6/1; and petrified wood, dark grayish black, N2 were found along the canyon edges.

This surface sample of unworked rock shows that a variety of material was readily available within the different areas of Cajon Mesa. The only difference in material is due to the different formations in which the areas were located. Many of the areas studied, however, are situated within several hundred meters of another formation. Cajon Ruin Group, for instance, is located both along a mesa top within the Burro Canyon Formation and Allen Canyon which is in the Morrison Formation.

A comparison of tool material recovered from the geologic survey with the material represented in the Lithic collection indicates that the following geologic types were not located: certain igneous rocks, Jasper, agate, porcellanite, chalcedony, silicious shale, and siltstone. Because jasper, agate and chalcedony tend to be found as vein forming minerals, it is likely that they will be found in isolated veins along the mesa.

In conclusion it appears that a ready availability of tool material enabled the Anasazi inhabitants of Cajon Mesa to gather their raw materials from resource areas located close to the site. It is unlikely that most of the tool material was traded over long distances, although rare items such as porcellanite were probably traded. Aside from the one quarry site located in Big Ruin Canyon, large quarrying areas were probably rare at Hovenweep, and most raw lithic material was probably collected from canyon bottom locations near most of the sites.

III.13

FURTHER STUDIES OF THE POTENTIAL FAUNAL RESOURCES ON CAJON MESA

By Thomas D. White

In spite of the well developed agricultural practices of the Anasazi, they were still dependent upon hunting to supplement their diet and provide materials for tools and, possibly, spiritual activities. This study is a continuation of the effort to determine which of the many physiographic and plant zones (Rado, 1976) on Cajon Mesa have the greatest potential to provide the faunal resources required by the Anasazi farmers. It is intended that this information may contribute to our understanding of the distribution of Anasazi archeological sites (Winter, 1976:112).

Methods

An effort was made to duplicate the trapping methods performed the preceding summer (Rado, 1975:56). The same bait, cracked corn and oats, was employed for the live traps. Fifty traps, ten meters apart, in alternating rows were set each night. For each trapped animal, a numbered ear tag was assigned and the following data were recorded: sex, relative age, trap location, and weight, using a Pesola spring scale (accurate to the nearest gram). Trapping was performed from June 26, 1976 to August 13, 1976. The population of each species trapped was calculated using the Schnabel variation (Smith, 1966) of the Lincoln Index.

Hectare (one hundred meter square) quadrats were established in four new areas. Rado's canyon rim (Quad 2) and canyon bottom (Quad 3) were retrapped to provide a comparison of trapping success and overall population changes during the past year. Quads 2 and 3 were trapped five nights each. The following is a description of the newly established trapping sites.

Grazed Sage (Quad 8)

This was a flat mesa top area dominated by big sage (Artemisia tridentata). Sporadically, it has been grazed by Anglo-American sheep. The quad was located approximately one mile to the east of the Square Tower Monument Ranger Station. Several PII Prudden units have been located in the general area. This area was trapped a total of five nights.

Broad Canyon Bottom (Quad 11)

This area was located in Hovenweep Canyon. The hectare trapping site was quite flat without any major drainages. The vegetation was dominated by big sage and greasewood (Sarcobatus vermiculatus). The area was directly east of Painted Hand Ruin (Hov. 600). This area was trapped a total of eight nights.

Pinyon-Juniper (Quad 12)

This quadrat was the most complex physiographically. It was selected for the availability of water. A permanent seep was located in the creek bed. Dry stream beds ran sinuous courses throughout the trapping area. The area was further complicated by the partial inclusion of the Cutthroat Castle Tower Group (Hov. 70). Slickrock and pinyon-juniper (Pinus edulis and Juniperus osteosperma) woodland created a mosaic of microhabits surrounding the big sagebrush covered ruins. The area was trapped a total of eight nights.

Sand Dunes (Quad 13)

This represented the southern most trapping effort. This area is characterized by the highest temperatures and the lowest precipitation. A gradient for temperature (increasing) and precipitation (decreasing) exists going from north to south (Litzinger, 1976). It was chosen because dunes on Cajon Mesa are typically rich in archeological sites (Winter, 1976: 102). The quadrat contained both active and stabilized dunes. The dominant vegetation is blackbrush (Coleogyne ramosissima). The dunes were located approximately five miles north of Aneth, Utah, at the extreme southern end of Cajon Mesa. Since the dunes were within the Navaho Reservation, the quadrat was subject to occasional grazing of sheep and goats. This area was trapped a total of five nights.

Results

The population density estimates for each species trapped in each quadrat are summarized in Table 31. A comparison of last years trapping results from the canyon rim (Quad 2) and canyon bottom (Quad 3) communities reveals that population densities for most species decreased, except of deer mice on the canyon rim and kangaroo rats on the canyon bottom. There was a concomitant decline in species diversity in both communities. It was felt that since there were increases and decreases in both communities, the results reflect a real change in population structure. This is supported by the fact that the three most numerous trapped species (deer mice, pinion mice and kangaroo rats) exhibited a reduction in mean weight. Together, these results may indicate a decreased amount of precipitation and/or a relatively poor seed and insect year.

TABLE 31

1976 MAMMAL TRAPPING DATA AND POPULATION ESTIMATES *

Special	Total New Captures	Mean Weight (grams)	Quad Two	Quad Three	Quad Eleven	Quad Eight	Quad Twelve	Quad Thirteen
Rock Squirrel	3	635	P					
Whitetail Antelope Squirrel	1	100						P
Colorado Chipmunk	6	45	P	P				
Silky Pocket Mouse	11	6	1.0	P	2.5	P	P	3.8
Ord Kangaroo Rat	15	54	P	4.0	8.4	3.0		P
Western Harvest Mouse	5	10		1.3	P		1.6	
Deer Mouse	36	15	14.0	P	20.5	4.0	4.1	P
Pinon Mouse	31	17	6.0	9.9			14.8	2.0
Whitethroat Woodrat	6	118		P			4.8	
Bushytail Woodrat	1	114	P					
Desert Cottontail	1	925	P					
#Species Present			8	7	4	3	5	5

* Population densities are expressed in individuals per hectare.

P-Indicates species was trapped but population density was too low to estimate.

Species diversity ranged from eight species in the canyon rim community (Quad 2) to only three species in the grazed sage community (Quad 8). These results were probably due to the fact that the deep soil mesa top sage community does not offer as many microhabitats as the varied vegetation and physiographic features of the canyon rim.

Diversity, however, did not fully determine potential faunal resources. Biomass, the total weight of all organisms (in this case, small mammals only), rendered a more valuable indicator of potential faunal resources. Due to the presence and numbers of larger mammals (i.e., whitethroat woodrat and pinon mouse), the pinyon-juniper community (Quad 12) revealed the greatest amount of mammalian biomass. These results were in apparent contradiction to Rado's data. The quadrat with the least mammalian biomass was the sand dunes (Quad 13) as should be expected of the hottest and dryest environment.

Discussion

The above data, if taken alone, would render a simplistic and erroneous concept of the potential faunal resources of Cajon Mesa. Unfortunately, population density estimates of the largest, most valuable species (i.e., mule deer, blacktail jackrabbits, desert cottontails) are unavailable. These species not only produce the greatest amounts of meat but also provide the most useful materials for manufacturing tools. In general, the distribution of these species can be characterized as follows: mule deer - recent sitings have been confined to the pinyon-juniper zone; formerly, they probably ranged into the sage zone canyons where water was available; blacktail jackrabbits - these animals prefer open, flat environments where visibility is good, mainly the sage and shadscale zones; desert cottontail - these animals prefer brushy areas with good cover, they can be found abundantly throughout the pinyon-juniper and sage zones.

The results of this study and the above discussion suggest that the pinyon-juniper zone has the greatest faunal resources at least seasonally and when water is present. The absence of water in his quadrat was probably the cause of Rado's observation that the pinyon-juniper zone had the least resources. There were water sources near his canyon rim and canyon bottom communities which he found to be the most productive.

Paradoxically, the broad canyon bottom (Quad 11) of this study produced the second highest mammalian biomass. In addition, the grazed sage community (Quad 8) with the smallest diversity had a greater biomass than the sand dunes (Quad 13). This may be explained by the relatively large populations of kangaroo rats and deer mice, the former species possessing the ability to utilize metabolic water and not depend upon a constant water source. On the other hand, these two species are small and would probably require a large effort to

capture and thus a small reward. It is doubtful that Anasazi hunters possessed means of capturing small prey as efficiently as fifty metal livetraps.

Summary

Potential faunal resources appear to be linked directly to the temperature and precipitation gradients. The further north on Cajon Mesa one travels, the more likely one is to observe increased plant and animal diversity. With the addition of physiographic variables, there exists microhabitats in each plant zone favoring an increase in the population densities of certain species. Seasonally, when deer were present, Anasazi hunters probably relied most upon the pinyon-juniper plant zone. However, when deer were absent, the superior visibility in the sage zone possibly attracted the most Anasazi hunters. Within these two plant zones, the canyon rims and canyon bottoms were probably the most productive hunting areas. These habitats were the most likely to contain water and the best shelter, hence, attracting the greatest amount of game. Evidently, faunal resources were not a direct factor in the selection of habitation sites on the mesa top or sand dunes.



INTERPRETATIONS

Walled-in cistern at Hov 3

IV. INTERPRETATIONS

1. Farm Fields and Water Control

Introduction

Following the typology established by Hack (1942), ten major types of potential farm fields and water control devices (Table 32) were identified at Hovenweep by structural and pollen associations in the 1975-1975 survey seasons (Winter 1976:III.1.A). As described in chapter I of this report, one of the primary purposes of the past summer's testing program was to verify the presence of these fields and investigate crop types, construction techniques and maintenance activities. Towards this end possible water control structures and fields at sixteen sites were tested, along with potential dry fields and floodplain fields in four major locations (Table 33). Many of these sites had previously yielded cultigen pollen, along with structural evidence of possible dams and terraces, so most of the tests were designed to determine the boundaries of the fields and the types of activities which went on in them. Pollen from sediments at all of the sixteen sites has been analyzed (chapter III.9), with striking results (Table 33). The overall tests and structural findings at each site have already been described (III.1), so the following brief discussions key in on the agricultural data. Detailed descriptions of each field type and the full range of agricultural activities which may have occurred at each can be found in Winter (1976:III.1.A). Although the tests were by no means exhaustive, since none of the sites were excavated totally, the stratigraphic profiles, structural remains and pollen are highly suggestive of prehistoric farming activities.

A. Floodwater Fields

The majority of the historic Pueblo farm fields were floodwater farms or temporales which used run-off moisture from higher elevations. Similarily, most of the probable field locations at Hovenweep are check dams, slope wash terraces, akchins and other types of floodwater fields. Dry farms, dunes and other non-floodwater fields were probably used as well, but due to the structural associations the terraced farms are much more visible.

1. Akchins - One of the four probable akchin sites which were surveyed on Cajon Mesa was tested. This site is Hov 94, which consists of ten dams and associated terraces on an alluvial fan on the eastern tributary of Little Ruin Canyon (see Fig 18, Winter 1976), in asso-

TABLE 32 - HOPI AND ZUNI WATER CONTROL DEVICES, CORRELATED WITH FIELD TYPES

Field Type	Hopi Devices	Zuni Devices
1. Floodwater fields		
a. akchin fields	earth banks, ditches and channels	earth and brush dams and barriers, windbreaks
b. main wash flood-plains	earth spreaders, ditches, diversion dams	earth and brush dams and barriers, windbreaks
c. low terraces	none mentioned	none mentioned
d. arroyo bottoms	stone, earth and brush check dams with trinchera terraces	stone, earth and brush check dams and trinchera terraces, windbreaks
e. slope wash fields	boulder block walls and terraces	none mentioned
2. Sand dune fields	rock and brush windbreaks	none mentioned
3. Seepage fields	none mentioned	none mentioned
4. Springside fields	ditches, reservoirs, dams, banks, boulder terraces, pot irrigation. waffle gardens	pot irrigation, waffle gardens, jacal walls, ditches, banks, dams
5. Stream-side fields	canals, dams, banks, ditches	dams. log aqueducts, waffle plots, ditches, banks, pot irrigation
6. Dry fields	none mentioned	none mentioned
	Miscellaneous	
	Rock and earth reservoirs and rock tanks for domestic water	walk-in wells

TABLE 33 - 1976 Sites Correlated With Possible Farm Field Type And Cultigen/Weedy Pollen Type

	Cleome	Asclepias	CHENO-Ams	Cyperaceae	Juncus	Rumex	Solanaceae	Datura	Lycium-type	Typha	Zea	Phaseolus	Cucurbita	Clematis	Celtis	Labiatae
A. Floodplain Fields																
1. Akchins																
Hov 94	x	x	x	x	x		x			x	x		x		x	
2. Main Wash Floodplains																
Sq.Tower	a	a	a			f	a	a		a	a		a		a	
Hackberry #1	a		a	m	f		a		a	a	a		a		a	
-dam-	x	x	x		x		x			x	x		x		x	
Hackberry #2	a	a					a		m						a	
Hov 539(control)	x		x		x		x			x	x		x			
Hov 15(control)		x	x				x		x		x		x		x	x
Hov 665(control)			x	x			x			x	x					
3. Arroyo Bottoms																
a.Trincheras																
Hov 644	x		x					x	x		x					
Hov 539	x		x		x		x		x	x	x		x		x	
Hov 652 *																
b.Linear terraces																
Hov 539	x		x		x		x			x	x		x			
Hov 652 *																
4. Slope Wash Fields																
Hov 49 *																
Hov 12	x	x	x			x	x			x	x				x	x

TABLE 33 - cont'd.

	Cleome	Asclepias	CHENO-Ams	Cyperaceae	Juncus	Rumex	Solanaceae	Datura	Lycium-like	Typha	Zea	Phaseolus	Cucurbita	Clematis	Celtis	Labiatae
B.C. - Sand Dunes and Seepage Fields - No sites tested																
D. Springside Gardens																
1. Cisterns																
Hov 3 *																
Hov 64 (ditch)	x		x	x	x		x	x	x		x		x		x	
2. Terrace																
Hov 53 *																
Hov 64 *																
3. Rim dam																
Hov 53	x		x				x	x	x	x	x		x			
Hov 12	x	x	x			x	x		x	x	x				x	x
E. River Irrigation																
none tested																
F. Dry Fields																
Hov 47	m	f	m	f	f		m			m	a	m	m		m	
Hov 94(control)	x	x	x	x	x		x			x	x		x		x	
Hov 623(control)	x		x				x	x	x		x					
Hov 691(control)	x	x	x				x		x		x		x			x
Hov 626(control)	x		x		x		x	x	x		x		x			x
Hov 714(control)	x		x	x	x		x		x	x	x		x			x
Hov 643(control)	x	x	x					x	x	x	x		x		x	
Hov 12(control)	x	x	x			x	x			x	x				x	

TABLE 33 - cont'd

	Cleome	Asclepias	CHENO-Ams	Cyperaceae	Juncus	Rumex	Solanaceae	Datura	Lycium-type	Typha	Zea	Phaseolus	Cucurbita	Clematis	Celtis	Labiatae
G. Reservoirs																
Hov 714	x		x	x	x		x		x	x	x		x			x
Hov 456	x	x	x	x	x		x				x		x			x
Hov 665			x	x			x			x	x					
H. Mesa Top Terraces																
Hov 571 *																
Hov 656 *																
Hov 643	x	x	x					x	x	x	x		x		x	

Key: X - pollen present at site
a - pollen present in all transects at site
m - pollen present in most " " "
f - pollen present in few " " "
* - pollen not analyzed
control - pollen from samples located 100+ meters away from site

ciation with a small unit pueblo and a series of storage rooms (see following sections for descriptions of the latter features). As described in chapter III.1, two of the ten dams and the terraces between them were examined by a nine meter long trench (Fig 20 and 45-46). The 75cm. high dams were built on a stream bed and backed up by a pile of cobbles, gravels and sand. No intentional filling seems to have occurred, beyond the initial construction of the dams and cobble backing, and the terraces built up through the deposition of layers of sand and gravel by flooding. No actual furrows, hills or other evidence of field surfaces were visible along the trench, but the pollen samples (Table 33) demonstrate that corn and squash were grown in the terraces while beeweed, milkweed, rushes, sedges, cattails, and solanaceous plants were probably semi-cultivated or encouraged weeds.

2. Main Wash Floodplains - The broad alluvial floodplains of large canyons historically were an important field location for the Hopi, but due to the impermanent nature of the ditches and earth banks which were used, they are very difficult to identify structurally. Pollen taken from a 1974 test pit in the floodplain of Hackberry Canyon below Hackberry House suggested that possible floodplain fields were present at Hovenweep, so a major experiment of the summer was to determine if floodplains in three locations were farmed (Fig. 47-48). Two transects measuring approximately 400 meters long were set up along the floodplains some 500 meters below the Square Tower and Hackberry House ruin clusters, while a third transect was established in the canyon approximately two kilometers below the Hackberry group. Soil samples were taken from ten - twenty regularly spaced stations in each transect (Tables 23 and 33). Since this was a preliminary test to determine if fields were located in the immediate area, and not a test to identify the exact vertical level of the fields, a pinch sampling technique across a 100 cm. column was used.

As shown by the Tables, every one of the samples from the Square Tower and Hackberry transects yielded the pollen of corn, squash, beeweed, solanaceous plants and cattail, and many samples yielded the pollen of milkweed, jimson weed, wolfberry and other weedy types. The more distant samples from Hackberry Canyon, in contrast, yielded no cultigen pollen, although many weedy types were present. Certain of the cultigen pollen from the ruin transects could have been washed in from the habitation sites at the heads of the canyons, but it is likely that the amounts and variety of the cultigen/weedy pollen can only be explained by the fact that extensive farm fields were present in the immediate areas. Structural evidence supports this suggestion, since a previously undiscovered series of floodplain dams were found in the transect immediately below Hackberry House. Floodplain farming was therefore very important at Hovenweep, although it appears to have been restricted to the canyons immediately below the major ruin clusters,

Figure 45. Cross-Section of Hov 94 Akchin Dams and Terrace

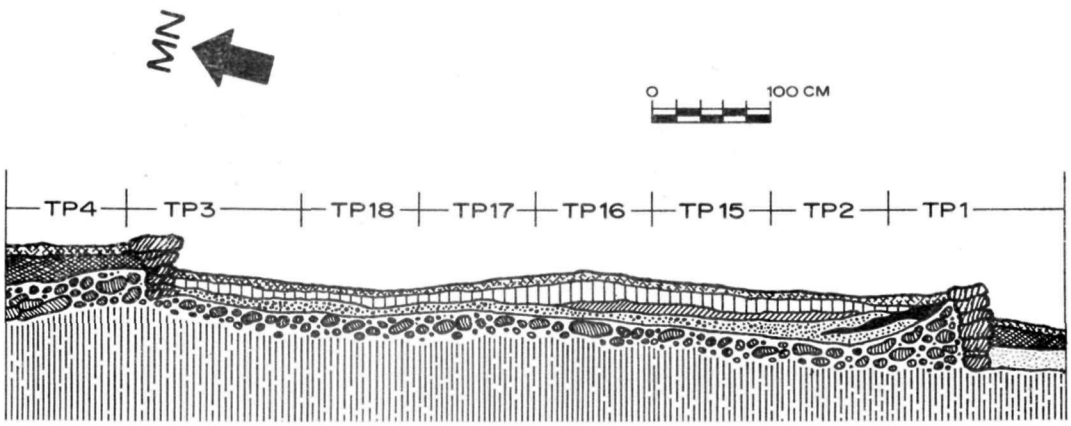


Figure 46. Hov 94 Akchin Dam During Tests



Figure 47. Floodplain Field Test Locations in Little Ruin Canyon Below Square Tower Ruin Group

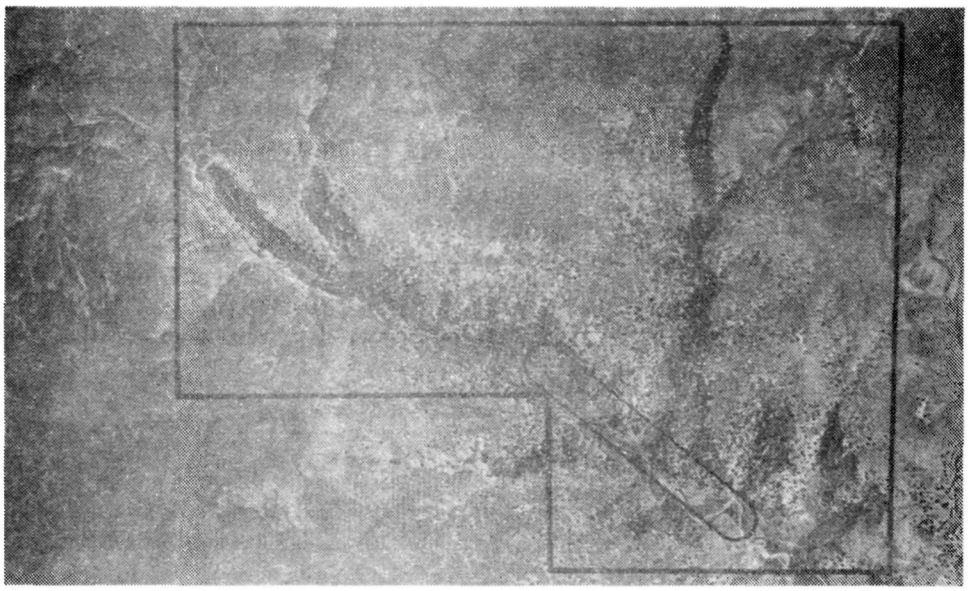


Figure 48. Floodplain Field Test Locations in Canyon Below Hackberry House Ruin Group



and not practiced in more distant locations. Most of the larger canyon bottoms around the ruins were probably farmed in this manner, and the fields would have been an especially important source of crops if the rainfall pattern prohibited mesa top dry farming. Control tests at three other sites support this hypothesis, since pollen samples from Hov 539, 15 and 665 yielded evidence of corn, squash and various weeds. Each site is situated along the floodplain of a canyon or arroyo, and the samples were taken from control test pits located at least 100 meters from the nearest feature.

3. Arroyo Bottom Fields - Check dams and the trinchera terraces behind them are the most common form of water control fields identified at Hovenweep, with thirty of the four hundred sites surveyed in the 1974-75 seasons having one or more crude rock dams placed across the bottoms of mesa top and canyon side arroyos. Ten checkdams at three sites were trenched in 1976 in order to analyze construction techniques, sedimentation processes and farming practices.

At both Hov 644 and 652, long trenches were established across several dams and the terraces between them, while at Hov 539 a single dam was investigated. Several linear dams and terraces which linked up with the check dams were also investigated at Hov 539 and 642 (Figs. 28-30, 49-50). Tests at all three sites demonstrated that the dams were low (never exceeding one meter high), and crudely built structures (usually one-two courses wide of unshaped sandstone blocks) laid directly on bedrock or sterile stream bed gravels and sands. None of the terraces showed any signs of having been filled in manually, and each was composed of shallow, eroded laminae of soil, gravel, clay and/or silt. As demonstrated by the 1974-1975 tests at the reconstructed Hov 71 dam, the structures probably functioned first to build up a suitable layer of soil for crops, and then to retain moisture and soil during floods. Like many Hopi trincheras, the top of one terrace usually ended at the bottom of the next higher dam.

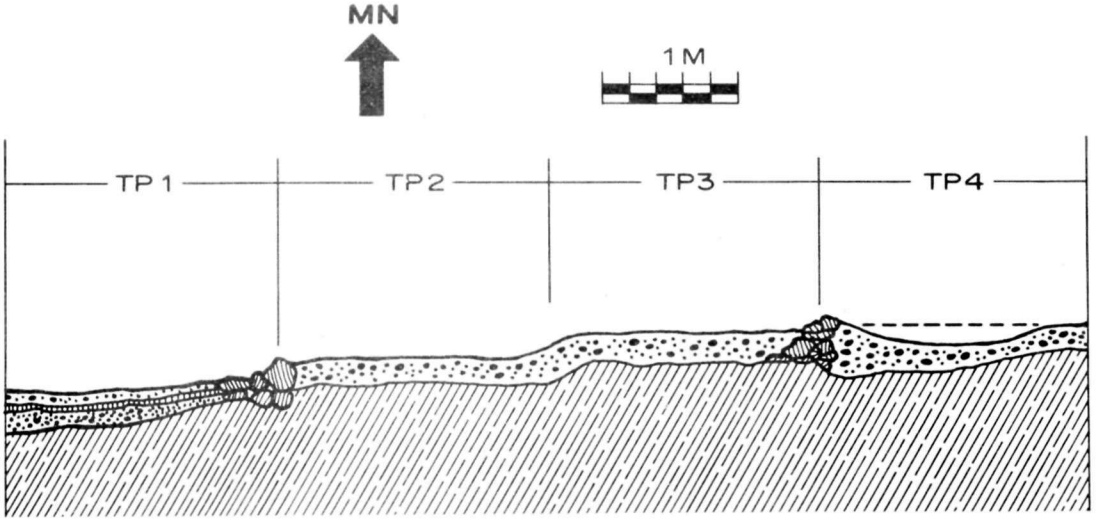
Pollen tests at Hov 644 and 539 demonstrated quite clearly that intensive agriculture occurred in the terraces. Certain of the pollen could have been blown or washed in, but again the amazingly large numbers and variety of the pollen preserved in the sediments could only have come from fields in the immediate vicinity. Corn and beeweed appear to have grown at all of the terraces, while squash was another fairly important crop. The pollen of cattail and sedge suggests that small reservoirs were periodically formed behind the dams, and cattail pollen from several granaries and middens examined in the 1975-1975 seasons suggests that the weeds which grew in the moist soil were probably important sources of food, along with the domesticates and semi-cultivates.

Pollen tests also served to delineate the boundaries of the fields at Hov 644, where a series of fourteen pollen pits were

Figure 49. Arroyo Dam at Hov 644



Figure 50. Cross-Section of Arroyo Dams and Terrace at Hov 644



established within a radius of twenty-four meters around two terraces (Fig 29). All of the samples yielded the pollen of corn, beeweed, jimson weed and wolfberry, so the terraced fields behind the dams appear to have been fairly extensive.

4. Slope Wash Sites - Tests at four sites uncovered the remains of probable linear terraces which ran along talus slopes. The terraces at two of the sites (Hov 64 and 53) were probably irrigated by springs, so they are described in a later section. The terraces at the remaining two sites (Hov 12 and 49) appear to have been true slope wash terraces which were moistened by run-off from the steep talus slopes above the dams.

Hov 49 is the most complex and puzzling water control site yet identified on the mesa, and as described in chapter III.1, we still are unsure of the internal structure of the site and the function of the various features. The curving, double row of upright slabs on the floodplain (Fig 251, 51) could represent any number of features, including a slab lined ditch, or an agricultural retaining wall, while the possible "floodplain terrace" wall below the talus slope, could be the remains of a field system, large room, pithouse or some other unidentified feature (Fig 52). About the only thing we are fairly certain of is that agriculture occurred somewhere in the vicinity, as shown by the pollen of maize, beeweed, cattail and solanaceous plants retrieved during the 1975 survey. Three apparent chipped stone hoes from the site (Fig 41) also support this hypothesis. One area which was almost definitely farmed was the slope wash terrace on the talus, where a single course rock wall runs along the slope.

The other possible slope wash site tested during the summer was Hov 12 (Twin Towers), which is one of the largest complex of towers, probable kiva depressions, roomblocks, midden and talus walls on the mesa. Several important tests were made at the site, including a 6.5 meter long trench which cut through three walls on the talus slope (Fig 15, 53). Two of the walls apparently outlined a room, but the downslope wall's construction, stratigraphy and pollen associations are suggestive of a retaining wall for a slope wash field. The "wall" is actually a pile of rough, unshaped cobbles, backed up by midden and eroded soil rich in corn, beeweed, milkweed, cattail, dock, solanaceous, hackberry and virgin's bower pollen. The wall probably supported a small garden which was moistened by run-off from the nearby talus slope. Similar cobble walls and associated terraces at Hov 64 and 53 were probably watered by a combination of irrigation ditches and slope run-off (see following section).

B.C. Sand Dunes and Seepage Fields

No possible seepage fields were found at Hovenweep, and none

Figure 51. Upright Slab "Ditch"(?) at Hov 49

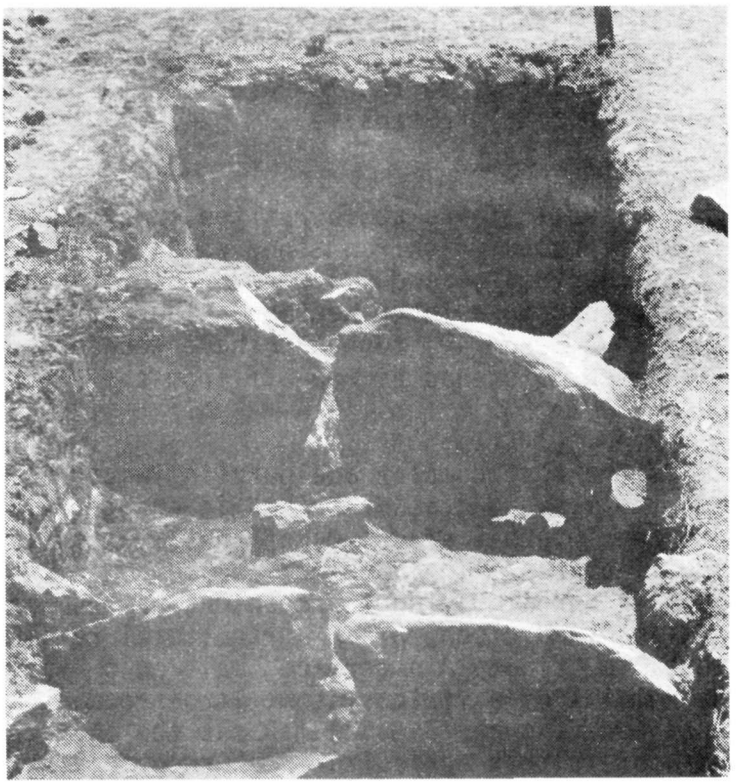
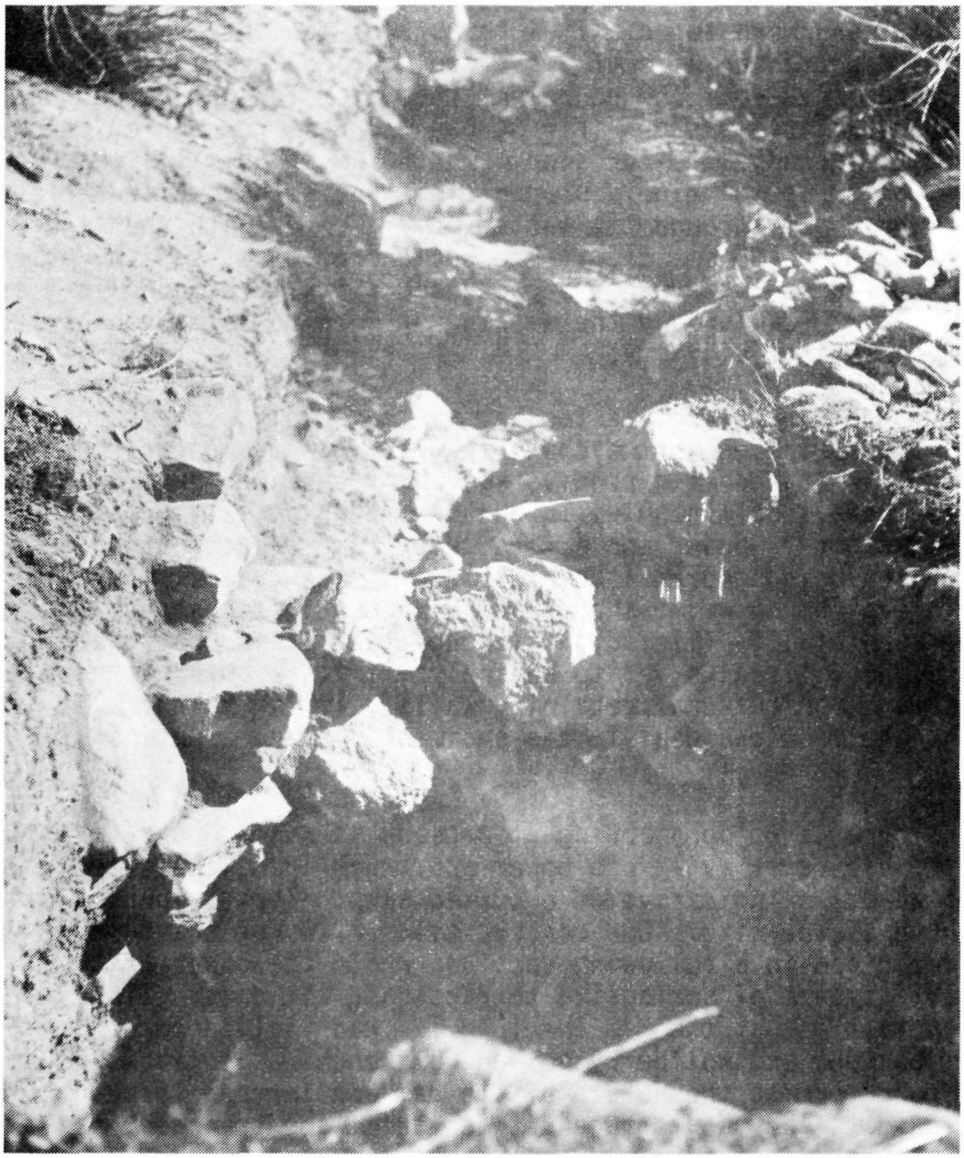


Figure 52. "Floodplain Terrace"(?) Wall at Hov 49



Figure 53. Cobble Wall at Hov 64



of the dunes in the dry, lower elevations of the mesa were tested.

D. Springside Gardens

Perhaps the most fascinating tests of the summer were run at the modified springs. The excavations at the Hackberry House (Hov 64) seep were especially interesting, since they uncovered what appear to be the remains of a cistern, irrigation ditch and springside garden system. The source of the water for the garden was a large, rock lined cistern (Fig 54-55) which is now buried below the sediments around a shelter seep. The 50 cm. high walls were formed from 4-6 courses of finely shaped sandstone slabs, while the earth ditch which cut through the walls and linked up with the seep was 30 cm. wide and 20 cm. deep. The pollens of corn, squash, wolfberry, jimson weed, sedges, rushes and beeweed which were found in the ditch suggest that farming and the washing of food vessels probably occurred in the immediate vicinity.

The ditch was not tested beyond the point on the talus slope below the spring where the channel split into two parts, but it is likely that it fed an extensive system of terraced gardens. Over a hundred meters of linear walls run down both sides of the canyon below Hackberry House, and a five meter long trench on the west side of the canyon uncovered a complex maze of rock walls, including a possible pithouse wall, a probable kiva ventilator shaft, and two crude cobble walls (Fig 56). Although the pollen from the sediments behond the walls have yet to be analyzed, it is possible that the walls were agricultural retaining walls, similar to those at Hov 12. A C14 date from charcoal in tne sediment yielded a date of AD 1260 ± 120.

There is no open spring at present at Holly House (Hov 53), but the hackberry, virgin's bower and other lush vegetation at the canyonhead are indicative of a buried seep. Three types of tests were run at the site. One concentrated on two of the towers, which are described in a following section, while the other examined a probable system of springside terraces and rim dams. Since a 1974 pollen test pit at the rim dam (Fig 17) had yielded corn, bean, cattail, beeweed and wolfberry pollen, a trench was established at the site to determine the nature of the dam and terrace system. Two of the low dams and the terrace between them were trenched, revealing well-shaped, mortared sandstone blocks set on bedrock. For some reason the farmers placed a thin layer of adobe wash directly over the bedrock, which was gradually covered over by a sterile layer of sediments which formed the terrace. Quantities of corn, squash, cattail, wolfberry, jimson weed and beeweed pollen from the sediments verified the presence of an agricultural field. A much smaller rim dam and terrace system at Hov 12 was also tested, and it was similarly built on bedrock with cultigen rich sediments.

Figure 54. Cistern Wall and Ditch at Hov 64

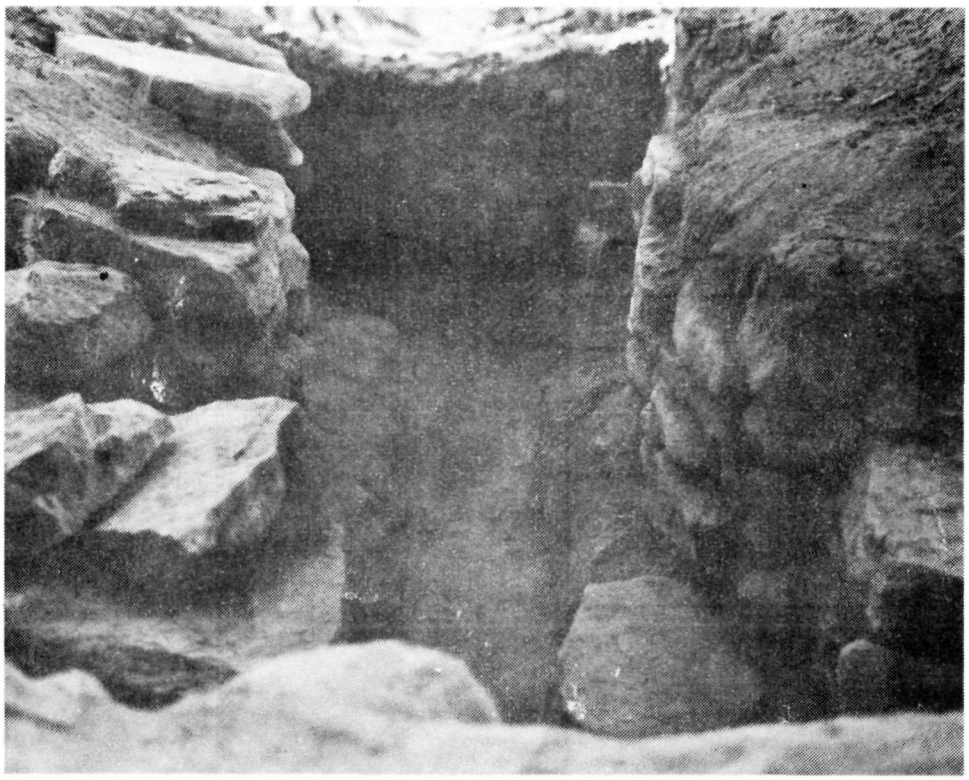
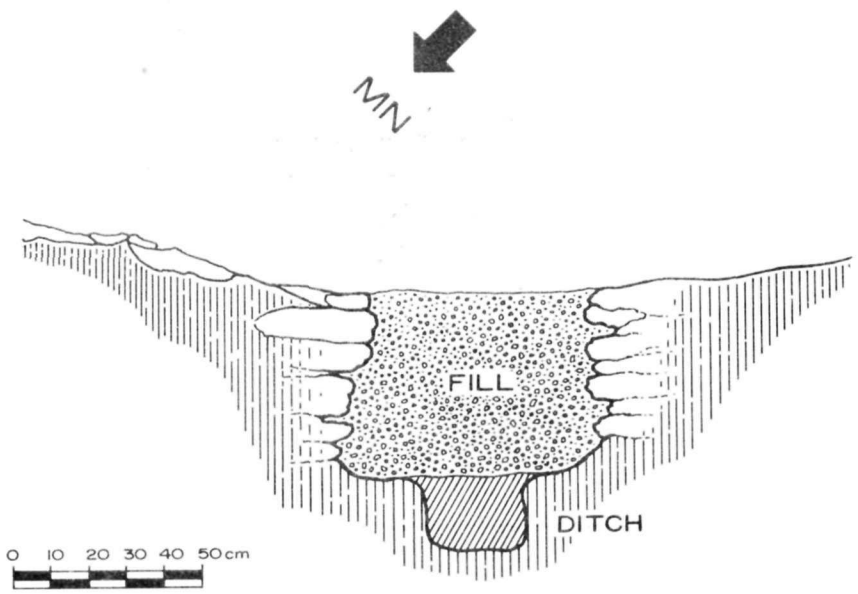


Figure 55. Cross-Section of Cistern Wall and Ditch at Hov 64



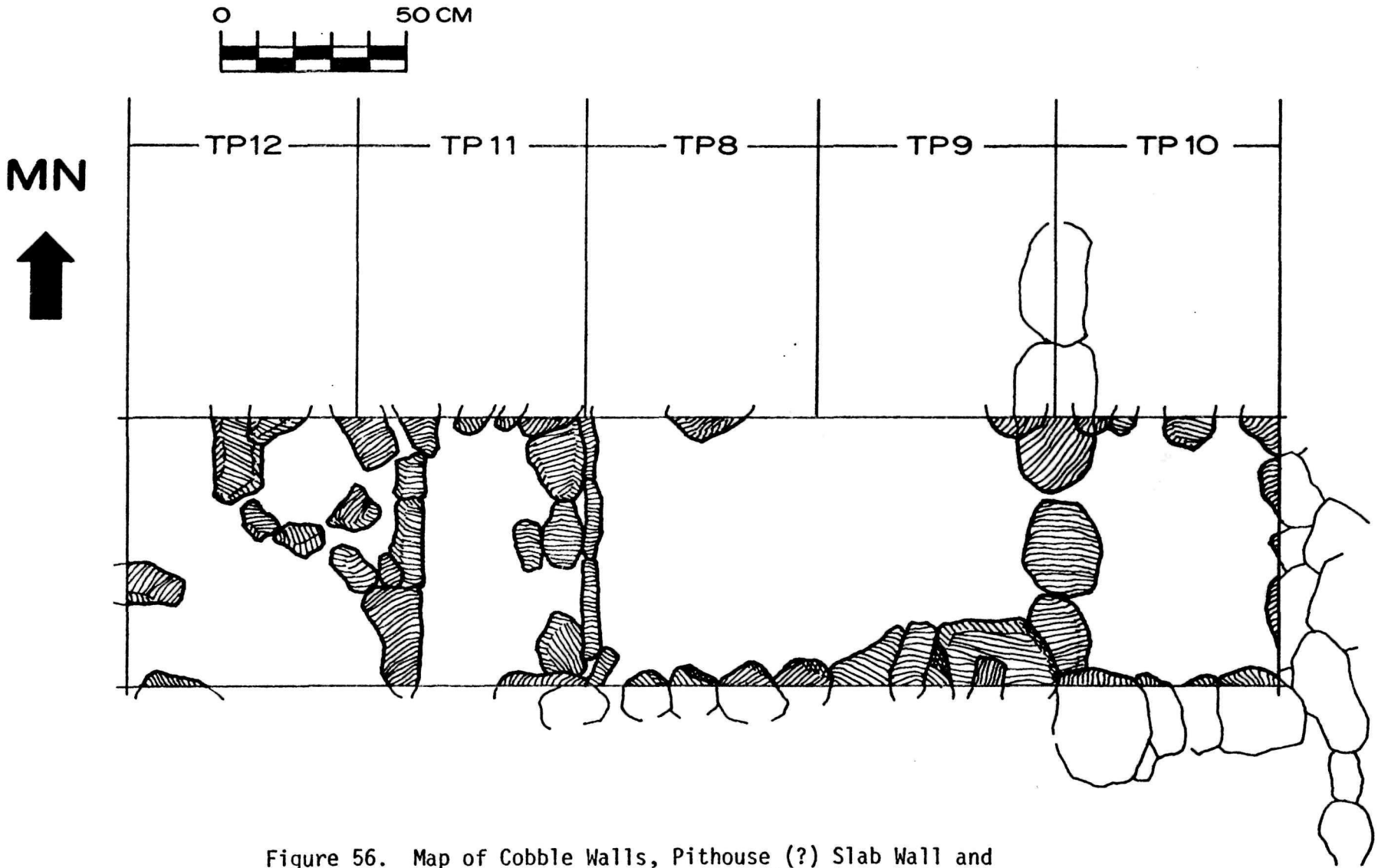


Figure 56. Map of Cobble Walls, Pithouse (?) Slab Wall and Ventilator Shaft (?) at Hov 64

The three meter long trench on the talus slope below Holly House uncovered the remains of cobble walls which are very similar in appearance to those at Hov 12 and 64. Pollen samples from the sediments behind the walls have not yet been analyzed.

The final seep test in 1976 was at Hov 3 in a shelter at the head of Little Ruin Canyon in the Square Tower ruin cluster (Fig 16). Both a walled-in pool of water and a nearby depression were tested to trace the construction sequence at the site and obtain economic data. The stratigraphic record is suggestive of a long period of construction, use, modification, abandonment and historic use. The pool (see cover, this section) seems to have been used first in an unmodified form then it was cleaned out and surrounded by a cobble stone wall. This cistern was probably used as a source of domestic and agricultural water, as revealed by the pollen of corn, cattail, groundcherry, wolfberry, dock, rushes, milkweed and other plants found in the sediments immediately outside of the shelter in 1974. Periodic dredging and cleaning occurred as the sediments built up, and over time a mound of dark clay was formed adjacent to the pool. The nearby depression may also have been used in prehistoric times, but recent use as a stock tank has destroyed evidence of its construction sequence.

E. River Irrigation

Aside from historic Navajo fields in McElmo and Montezuma Canyons, no river irrigated farms have been identified at Hovenweep.

F. Dry Fields

Due to the absence of structural associations, dry fields are the most elusive and difficult to identify of the Anasazi-Pueblo farm fields. Dry farming is presently non-existent among the Hopi, but the clustering of unit pueblos which generally date to Pueblo I,II and early III times on the ridges and flats of Cajon Mesa suggests that the rich soils of the mesa top were intensively farmed during the eleventh, twelth and early thirteenth centuries. Dry farming is still common in the northern pinyon-juniper forests of the mesa, in fact, where the average annual precipitation is 400-450 mm, and it is likely that extensive dry fields once surrounded the Anasazi mesa top unit pueblos. To test this hypothesis, the flats around the Hov 47 unit pueblo to the north of Hackberry House were examined with a series of pollen transects, as described in chapter III.9 and shown in Fig 57. Seventy-nine samples were taken from eight 250 meter long transects, under the assumption that large amounts of corn and other cultigen pollen should reveal the locations, and perhaps even the boundaries of prehistoric fields. Corn pollen normally travels no more than a few meters from the source plant (Martin and Byers 1965; Raynor et al 1972), so even moderate amounts of maize pollen (1%)

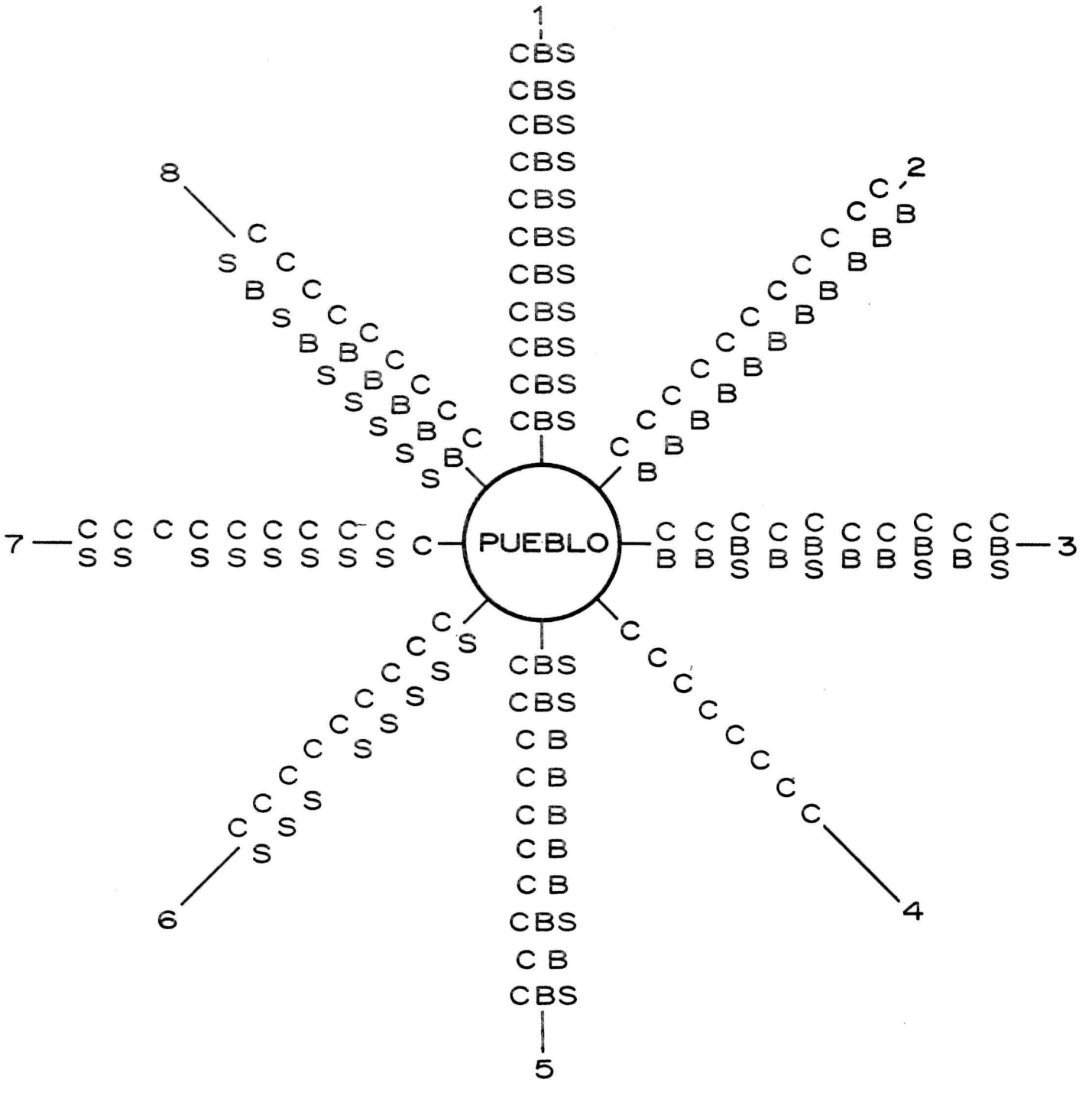


Figure 57. Transect Map of Presence/Absence Pollen Distribution of Corn, Beans and Squash at Hov 47

in the soils of otherwise sterile locations which lack artifacts, walls and other evidence of human use should indicate the locations of ancient farm fields.

The data presented in Table 24 in chapter III.9 and illustrated in Fig. 57 demonstrates that the dry field tests were one of the most valuable aspects of the summer's testing program. Every single one of the 79 samples yielded maize pollen, often at 4-6% of the total count, and bean and squash pollen were common in many of the samples, along with the pollen of beeweed, milkweed and other potential semi-cultivates. Even if mixing occurred across the levels of the pinch samples, it is obvious that farming had to have occurred in the immediate vicinity to account for such large amounts of cultigen pollen. No check dams, terraces, ditches or other structural features occur in the flats, so it is likely that an extensive dry field system once surrounded the pueblo. In fact, the non-random distribution of bean and squash pollen along the transects suggests crop patterning within the fields, as illustrated in Fig. 57, which diagrams the presence/absence distribution of maize, bean and squash pollen. Transects 2 and 3, for example, were composed primarily of corn and beans, while transect 4 was solely corn and transect 5 was mainly corn and beans. Transects 6 and 7, in contrast, were only corn and squash, while transects 8 and 1 were all three crops. Corn thus occurred all around the pueblo, while beans and squash were generally localized. Squash occurred primarily in the western fields, while beans were generally restricted to other areas.

Limited control test pits around certain of the other pueblos were also indicative of dry fields. Soil samples were taken from pits located 100+ meters outside of the limits of ten sites, and of these the samples from seven sites yielded cultigen pollen. Dry farming was thus probably fairly common around the pueblos on the mesa, but it was probably restricted to the areas immediately adjacent to the villages, since Glen Weir's control samples (chapter IV.4.B) from areas well away from the sites yielded no evidence of cultigen pollen.

G. Reservoirs and Tanks

Three of the ten possible reservoirs which were surveyed on the mesa were trenched this past summer. Hov 714 is the largest of the sites, with a 120 meter long, D-shaped masonry wall and several apparent check dams and gates. Five test pits bisected both the inner and outer walls (Fig 18), and as described in chapter III.1 the stratigraphic evidence indicates that the inner wall may have served to slow down and channel flood water from surrounding slickrock areas, much in the same way the Mummy Lake directed water on Chapin Mesa (Rohn 1963). Layers of cobbles, gravels and sediments built up behind the wall (Fig 58), which still function to hold back water during large rain-

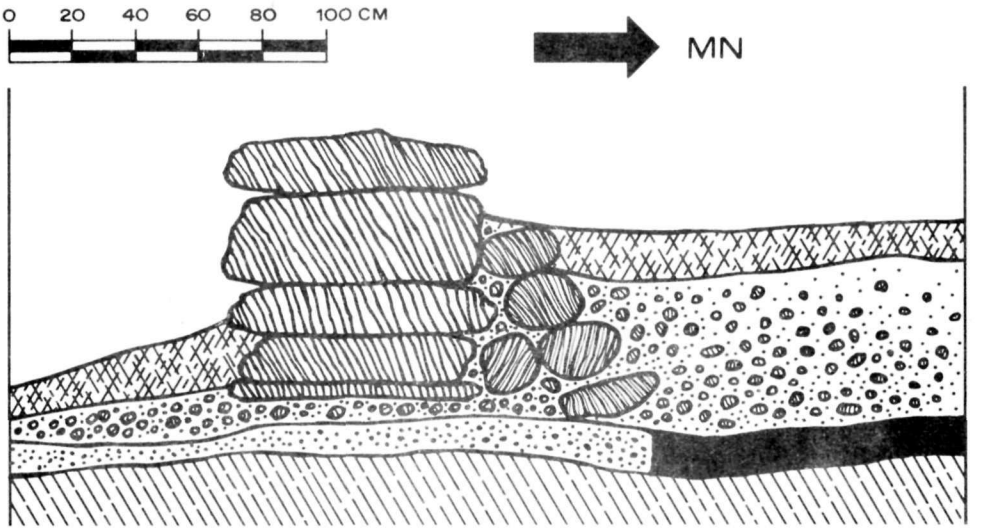


Figure 58. Cross-Section of Reservoir Wall at Hov 714

Figure 59. Tower Wall at Hov 571



storms. Percolation to a filled in seep in the cliffs below the reservoir may have been enhanced by the dams, and it is even possible that a 20cm. thick layer of charcoal or peat behind the inner dam aided this function. A combination of agricultural and domestic water uses were probably served by the reservoir, as indicated by the pollen of corn, squash, beeweed, sedges, rushes, cattail, wolfberry and other plants found in the sediments.

Another of the mesa top dams which was examined this summer is Hov 456, located in an arroyo several hundred meters north of the Cajon Ruin complex. Beeweed, sedge, wolfberry, cattail and corn pollen from a 1974 pollen pit indicated that agricultural activities had occurred nearby, so one of the dam's banks which had been cut through by the arroyo was trenched by six test pits to determine the construction sequence (Fig 26). Unlike the other reservoirs, the dam was built of earth rather than masonry, but the function was probably the same: to store domestic water for the nearby habitation sites and form moist farming areas. Eight pollen samples from the tests yielded evidence of squash, corn, milkweed, beeweed, rushes, sedges, and unidentified solanaceous plants.

The third reservoir tested over the summer was Hov 665, which is located at the base of a steep talus slope and cliff in Cross Canyon. Three test pits examined a large standing masonry wall which links the cliff with a boulder (Fig 27), and which probably formerly linked up with another wall to form an arc shaped, twenty meter long impoundment dam. Like most of the other dams tested at Hovenweep, the sterile fill behind the wall was composed of rubble, cobbles, gravels and clay lenses. Maize, cattail, rush, and solanaceous pollen indicate that agricultural activities occurred near this isolated, run-off reservoir.

H. Mesa Top Terraces

Tests at three mesa top Prudden Unit pueblos uncovered evidence of a unique type of agricultural terrace which appears somewhat similar to the tiny pot irrigated gardens at the village of Zuni. Low rock gridworks measuring two-five meters across were revealed at Hov 643, 656 and 571, which are large pueblos in the northern pinyon-juniper forests. The grids are most clearly represented at Hov 656 and 571, where the one course high, checkerboard shaped structures were built on sterile sands and lacked any evidence of associated artifact scatters, use surfaces, floors, or related features (Figs. 21-23). The pollen samples from Hov 571 have not yet been analyzed, but samples taken from a pollen pit at 656 in 1975 yielded corn, bean, milkweed and solanaceous pollen.

The walls at Hov 643 were much more complex, and probably represent multi-purpose features rather than simple farming areas. Agriculture undoubtedly occurred nearby, as indicated by the pollen

of corn, squash, jimson weed, wolfberry, beeweed and other plants from both of the possible terrace areas, but the structural and stratigraphic evidence demonstrates that processing and other activities probably occurred in the area as well (see chapter III.1).

IV.2

Other Types of Sites

A. Towers

Perhaps the most enigmatic aspect of Cajon Mesa is the Hovenweep tower, which has fascinated explorers and archeologists since the days of Jackson, Holmes and the Wetherills in the 19th century. Occurring mainly at the canyonheads, these imposing one and two story masonry structures have generated considerable speculation about their age and function. Defense has been suggested the most often as a function for the towers, as shown by the early claim by Eastwood in 1893 that the ancient inhabitants "guarded every spring with towers of stone" (1893:360). Fewkes (1919), Morley (1908), Morley and Kidder (1917), Martin (1938), Riley (1948) and practically every other archeologist who has worked on the mesa has offered a variety of other suggestions, ranging from storage and ceremonial use to communication and astronomical observation. The latter possibility has been raised by the current research of Williamson and Reyman, who have hypothezied that certain of the wall features of the towers, such as the oddly shaped portholes, may have served as lunar and solar observation points. Williamson's work has been especially interesting in this regard, since he has evidence that various of the tower portholes were used as solstice and equinoctial alignments (personal communication).

Whatever the towers were directly used for, it is likely that they indirectly served a number of economic, agriculturally related activities. Whether they were used to guard the springs, store the crops, bring rain, provide a planting calendar, or all of these and other purposes, their overall use was probably oriented around the successful maintenance of a farming economy. Because of this possibility, seven towers at six sites were tested in 1976 to obtain economic, environmental and ceremonial data. The results of the tests were striking; although the tests were limited to two-three test pits per tower, a wealth of intact vessels, chipped and ground stone tools, structural associations, and pollen and flotation samples were recovered, suggesting a multitude of uses for this single category of structure called "tower" (chapter III gives detailed descriptions of many of the artifacts from the tests). In fact, it appears on the basis of our research that the tower category is actually an architectural rather than a functional classification. Certain tower rooms appear to have been ceremonial rooms, others were grinding rooms, still others were processing or manufacturing areas, and others may have been cooking or living areas. Many of the larger towers are multi-roomed structures in which a

variety of different economic, social and ceremonial activities probably occurred, including possible storage, ceremonial, food processing, tool making, calendric and other activities. It is also apparent that the architectural style and uses of the structures changed through time, from the small, crudely built mesa top towers of PII-early PIII period times to the imposing multiple story towers of the thirteenth century.

Three sites (Hov 47, 571 and 597) with the small, collapsed, earlier towers were tested in 1976 (Table 34). Each tower was composed of a circular or d-shaped wall (Fig 59) with a crude use surface; no other features were apparent. A nearby storage room at Hov 571 yielded a late PII-early PIII C14 date, while the ceramics from the other sites indicate use from PI or earlier through PIII times. All of this evidence indicates that the towers were probably built during PII-early PIII times, which agrees with Martin's (1939) observation that similar towers at five sites on Cajon Mesa were of the same general time period. Martin excavated seven mesa top towers completely, and found that the only obvious features besides the walls and floors were tunnels which linked up with nearby kivas. This probably explains the absence of any obvious features beyond use surfaces in the tests this summer, since our tests were limited and may have missed the tunnel openings. The main purpose of the early Hovenweep tower would thus have been to provide an entrance way for adjacent kivas, in much the same way that mesa top towers on Cedar Mesa to the west and Mesa Verde to the east were also linked to kivas.

The later, 13th century canyonhead and edge towers, in contrast, were much better built and apparently served numerous purposes. None of the pollen or flotation samples from these or the other non-water control structures have been analyzed, but the vessels, grind stones, animal bones, and other artifacts and architectural features point to a variety of uses. At Hov 685 at the edge of Big Ruin Canyon, for example, a d-or circular-shaped tower housed several slab grinding bins and associated manos and metates, which indicate that the tower was used as grinding room (Fig 10,60). A room at Boulder House at Hov 53 (Holly House), in contrast, appears to have been used at least in part as a tool manufacturing or ceremonial room, as indicated by the bone awls and scraper, delicate bifacial points or drills (Fig. 42), and corrugated jar found on the floor on in the fill. A room in the adjacent Holly House on the canyon edge could also have served as a ceremonial or storage room; a finely shaped serrated biface (Fig. 38) was found in it, along with ground stone, a kiva jar and two corrugated vessels, one of which contained partial skeletons of a rabbit, lizards, birds, a mouse and a toad. Rohn (1971) has suggested that similar bone filled jars at Mug House served symbolic and ceremonial functions.

TABLE 34 - 1976 Tower Data

Site	Date	Features	Artifacts
47	AD1615±120(poor date) BMIII-PIII ceramics	crude wall; use surface; no roof fall	sherds;lithics
597	AD1190±100 PII-III ceramics	no clear wall; use surface; rubble	sherds; lithics
571	PI-III ceramics	crude wall; rubble fill	sherds; lithics
685	PI-III ceramics	circular or d-shaped wall; bedrock floor; slab grinding bins	sherds; lithics; manos; metates; bifacial blade
53 - Boulder House - AD1201+vv		multiple roomed, two-three story rectangular tower; plaster floor; fire-pit	Mesa Verde corrugated vessel; bifacial drills or points; bone awls; bone scraper
53 - Holly House - south room AD1246 +L AD1267 +B		multiple roomed, two-three story rectangular tower; plaster floor; firepit	ground stone; McElmo B/W kiva jar; Mesa Verde and Hovenweep corrugated vessels; serrated biface
12 - Twin Tower, northwest room, west Tower AD1231 +v		multiple room, two-story rectangular structure; plaster floor covered with footprints	intact Mesa Verde B/W mug, olla, kiva jar; corrugated vessels; spindle whorl

TABLE 34 - cont'd.

714	PI-III ceramics		
-central room -		circular wall; plaster floor; fire-pit; sipapu	sherds and lithics
-outer room -		rectangular wall; dirt floor	sherds and lithics

Figure 60. Grinding Bins and Wall at Hov 685 Tower



Figure 61. Walls, Plaster Floor and Footprints in Tower at Hov 12 (Twin Towers)



Similar towers at Hov 12 and 714 also possibly served a combination of ceremonial, storage and perhaps habitation/work purposes. A room at one of the Twin Towers at Hov 12, for example, yielded a kiva jar, mug, olla, bowl, two corrugated vessels, jar lids and a spindle whorl. The vessels were smashed in the roof fall above a plastered floor which was covered with human footprints (Fig 61).

The Hov 714 tower complex at the edge of Big Ruin Canyon appears to have housed a kiva surrounded by storage or work rooms, and is thus similar to double walled towers at Horseshoe House (Hov 57) and Cutthroat Castle (Hov 70). The central room contained a plaster floor, circular masonry wall, firepit and probable sipapu, while one of the surrounding room contained no obvious features, other than a dirt floor (Fig 62). Like many of the kivas at Mug House, the sipapu was formed from the broken neck of an olla which was buried in the floor and filled with sand (cf. Rohn 1971).

B. Pithouses and Kivas

Six possible pithouses, several possible pithouse/kivas, and eight apparent kivas were examined at thirteen sites; maps and short descriptions are presented by site in chapter III.1.

The best defined pithouse occurred at Hov 691, where a shallow, one by two meter wide slab sided structure was uncovered (Fig 3). A crude use surface, partial Chapin Gray jar, smashed ladle (Piedra B/W?) and roof beams dated at AD660±100 were recovered from the structure.

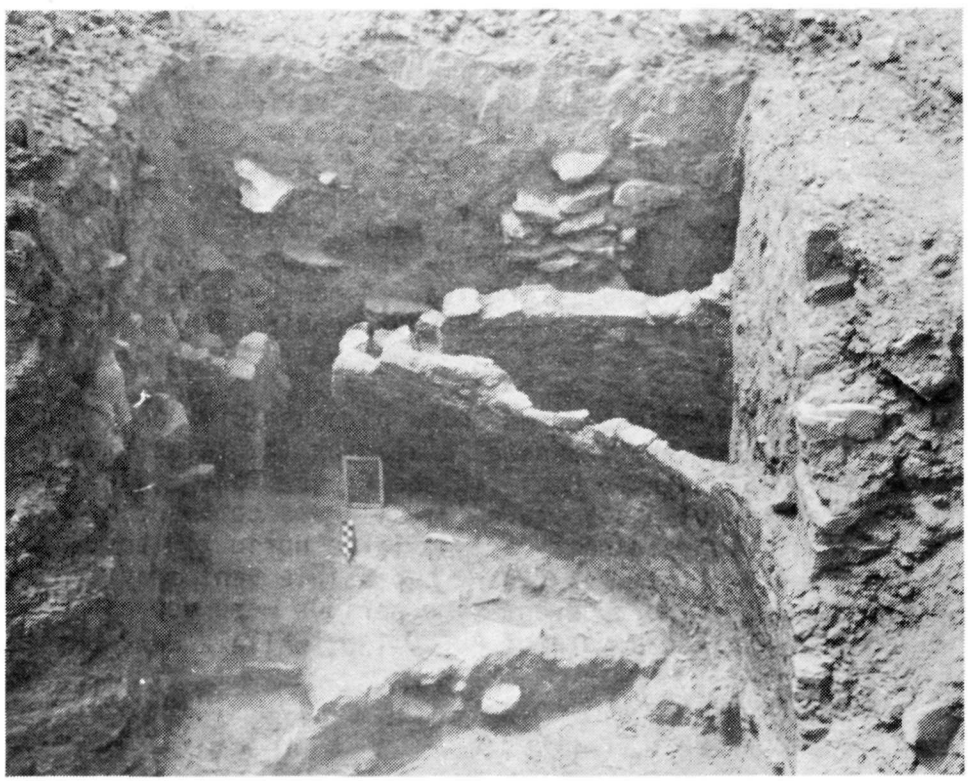
A larger semi-subterranean room was uncovered at Hov 626, which is also in the pinyon-juniper forest. Burned earth walls, an adobe floor at 85cm. below surface, charred post stubs dated at AD973+vv and AD1023 vv, and an apparent slab and adobe partition were revealed by the four meter long trench (Fig 4), along with Chapin Gray and whiteware pottery. Although the dendro dates are relatively late, the architecture and ceramics are very suggestive of the late Basketmaker III and Pueblo I pithouses found by Martin (1938,1939), Wheat (1955), Rohn (1975), Matheny (personal communication) and Brew (1946) in nearby sites on Cajon Mesa and Alkali Ridge and in Montezuma Canyon.

The third possible pithouse found during the summer was at Hov 24 on a ridge above Little Ruin Canyon, where a thick basin shaped lens of burned logs was found resting on a use surface to the north of the unit pueblo (Fig 5). Several apparent burned earth walls and rubble layers were revealed in the fill; ceramics from the site indicate a BMIII-PIII occupancy, so the presence of a possible pithouse at Hov 24 is not surprising, even though the unit pueblo dates to a later period.

Figure 62. Room Wall at Hov 714 Tower



Figure 63. Kiva at Hov 623 (Aneth Trading Post)



A similar structure was uncovered just to the south across Little Ruin Canyon at Hov 520, where a shallow slab lined depression was found to contain a basin shaped floor. Unlike Hov 24 the structure was rebuilt in later times into a masonry walled unit pueblo room. Ceramics from the site also indicate a BMIII-PIII period of use.

The fifth possible pithouse which was tested was uncovered on the talus slopes at Hackberry House (Hov 64), in a complex Maze of apparent talus terraces, midden layers and a probable kiva vent shaft in a five meter long trench (Fig. 14, 56). The structure was composed of a row of one meter high upright sandstone slabs, with a rough use surface at their base. Several probable use surfaces, rich midden and the probable vent shaft were then superimposed over the slabs.

The final possible pithouse examined during the summer was at the Hov 49 water control site in an arroyo above Horseshoe and Hackberry Houses. Since it is also possible that this curving, double row of upright slabs with associated use surface was a water control device, it has already been discussed in chapter III.1 and IV.1.A.

The two possible pithouse/kivas and eight kivas seem to represent several architectural styles which were used on the mesa during the 10th through 13th centuries. Several of the structures appear to have been pithouses which were remodeled into kivas, while the other eight are kivas which are generally in the Mesa Verde style.

The most complex of the structures was found at the Aneth Trading Post (Hov 623) overlooking the San Juan River, where a series of circular, parallel masonry walls, several superimposed floors, and a tunnel or vent shaft were exposed in a sewer line trench (Fig 8,63). The tests yielded the richest and most varied collection of chipped and ground stone tools, ornaments and ceramics recovered during the summer, including parts of a Piedra B/W bowl, numerous B/R sherds and an intact Mesa Verde corrugated vessel, so it appears that the structure was used over a considerable period of time. The sequence of use is unclear, but it may represent the remodeling of a PI-II period pithouse into a later kiva. A nearby burial and tests in the extensive, one meter deep midden surrounding the kiva attest to the site's antiquity.

The other possible remodeled pithouse/kiva occurred at Hov 15, which is a large shelter site located on the talus slopes downcanyon from Stronghold House in the Square Tower ruin cluster. This complex rectangular structure (Fig 11) was composed of a well made cobble wall with an inner face of large upright slabs, a possible masonry bench, a plaster floor, a possible vent shaft and PI-III period sherds. Two apparent time periods were represented, since a C14 sample yielded a date of AD920±130, while a dendro specimen was

dated at AD1188vv.

The eight apparent kivas which were uncovered generally share a number of PII-III period traits which are representative of the Mesa Verde style of kiva architecture, with well made, shaped cobblestone benches and walls, pilasters and recesses, and plaster floors with firepits. The tests at Hov 24(Fig 5), near the Square Tower group, for example, revealed a pecked and shaped cobblestone wall covered with thick plaster, a probable bench and recess and a plaster floor, dated by C14 to AD 1080±120. Probable kivas at two similar sites on adjacent ridges to the south of Little Ruin Canyon were also tested. The kiva at Hov 520 (Fig 6) included an upright slab wall covered with plaster, a clay or adobe floor, and dense burned roof fall, dated by dendro to AD1173+v and by C14 to AD1120±120. Corn from a storage room in the adjacent Hov 597 (Fig 7) site yielded a C14 date of AD1190±100, but the 160cm. deep test pit in the apparent kiva depression failed to uncover a floor or walls. A 170cm. deep trench in a similar depression at Hov 571 (Fig 22) in the pinyon-juniper forests of Cow Mesa also failed to reach the floor, while the tests at Hov 643 across Big Ruin Canyon uncovered a typical Mesa Verde style kiva with a pecked stone wall, a bench, a possible recess, a firepit or ashpit and a plaster floor (Fig 21).

Nearly identical structures were uncovered on the talus slopes below Twin Towers (Hov 12) and at the akchin farm site at Hov 94 on the mesa to the northeast. A pecked stone wall, possible bench and pilaster, shallow firepit and plaster floor were revealed at Hov 12 (Fig 64). A small McElmo B/W seed jar was found on the bench, while a corrugated Mesa Verde vessel came from the fill above the floor. The roof was dated by C14 to AD1240±130, which indicates that the kiva is contemporaneous with the tower, with its date of AD1232+v.

The Hov 94 kiva is part of a small unit pueblo overlooking the akchin dams. As at Hov 12, 643 and 24, the structure contained a pecked stone wall, a bench, and a plaster floor (Fig 65), with a C14 date of AD1380±120.

The final apparent kiva tested during the summer was in the tower complex at Hov 714, which has already been described in chapter IV.2.A.

C. Storerooms, Shelters and Other Types of Sites

Tests at most of the thirty sites uncovered a variety of features which most likely had economic functions of one type or another, such as storage, cooking, tool making, habitation, and garbage dumping. Table 35 lists the possible structures and features by site, while chapter III.1 gives brief descriptions of each feature.

Figure 64. Work In Progress at Hov 12 Kiva



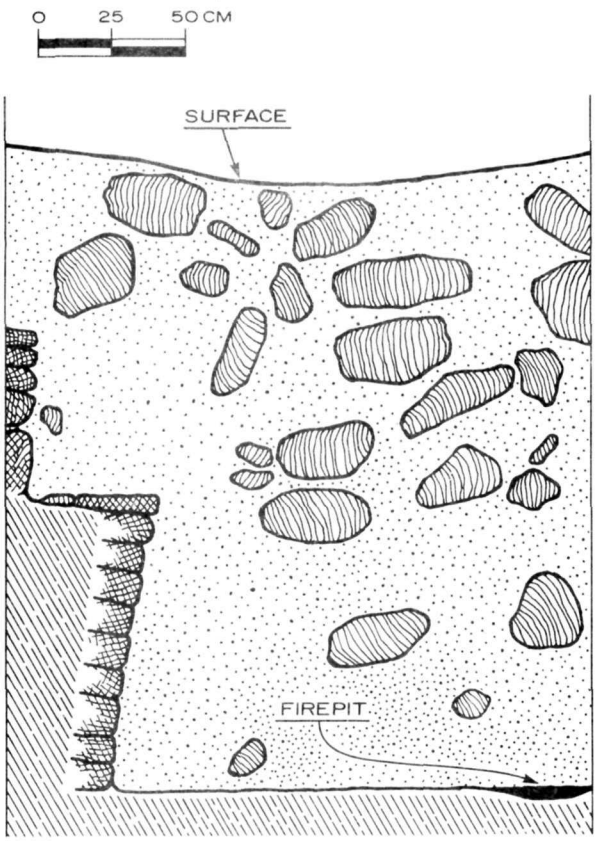


Figure 65. Cross-Section of Kiva at Hov 94

TABLE 35 - Features Uncovered at 1976 Tests

(* see chapter IV.1,2.A-B for description of towers, pithouse/kivas and water control devices)

	undefined wall	possible storage room	room with firepit
626	crude earth wall		
24		-two contiguous rooms separated by a wall of well shaped masonry blocks; plaster and slab floors - a three sided room with well shaped, pecked block walls; dirt floor	
47	row of upright slabs associated with burned jacal		room with two hearths. dirt floor and 100 burned corn cobs
520		-masonry walled room with puddled floor in rebuilt pithouse(?) -room surrounded by a double wall; outer wall of well shaped pecked blocks, inner of upright slabs set in adobe; clay floor with room dividing wall	
597	masonry walled room with two superimposed floors; remains of a smashed Mancos corrugated vessel and 100 burned corn cobs on upper floor		
623			
709	-two parallel walls,possibly representing a work area; -alignment of rubble -crude masonry wall associated with use surface	two rooms in rubble mount with rock walls and dirt floors	
685			
15			

TABLE 35 - cont'd

	slab cist	Burial	Possible kiln or roasting pit	midden
626				
24				60 cm.thick
47				25-30cm. thick
520				10cm.thick slope wash
597				35cm.thick
623		gray ladle as grave good		1 m.thick
709	ash filled rectangular cist containing broken Hovenweep Gray vessel			
685				

TABLE 35 - contd

	possible plaza	shelter	lithic scatter	Navajo hogan
626				
709				
685	three sterile layers above bedrock			
15			two contiguous rooms; one with ten course high mortared wall and plastered slab floor; other with circular, 3-sided masonry wall abutting onto rear wall of shelter	

TABLE 35 - cont'd

	Date	Tower	Pithouse/kiva	water control device
626	AD973+vv AD1023vv		x	
24	AD1080±120 BMIII-PIII ceramics		x	
47	AD1615±120 BMIII-PIII ceramics		x	
520	AD1120±120 AD1173+v BMIII-PIII ceramics		x	
597	AD1190±100 PII-III ceramics	x	x	
623	BMIII-PIII ceramics		x	
709	AD695±100 BMIII-PIII ceramics			
685	PI-III ceramics	x		
15	AD920±130 AD1188vv PI-III ceramics		x	

TABLE 35 - cont'd

	undefined wall	possible storage room	room with firepit
707			
708			
648			
64			
12		two parallel well built masonry walls with two superimposed use surfaces built on fill	
3			
714			
94		room with two stone walls and plaster floor; rock covered cist and metate on floor	
643			three of four rock walls examined, along with a dirt floor and basin shaped firepit
571	isolated wall	corner of rock walled room examined, along with dirt floor	

TABLE 35 - cont'd

	slab cist	Burial	possible kiln or roasting pit	midden
707				
648			heavily burned room surrounded by upright slabs and adobe collar; slab floor, with smashed Mesa Verde and McElmo B/W bowls on surface	shallow slope wash
714				30cm.thick
94				complex,1 meter deep with several pits in it
643				50+cm deep,with use surface and slab lined cist below the midden
571				highly vandalized midden

TABLE 35 - cont'd

	possible plaza	shelter	lithic scatter	Navajo hogan
707		three small overhangs with thin layers of fill		
708		two masonry walls outside of a small overhang, with 35 cm. of fill		
648		-shelter with one masonry wall -second shelter with thin layer of fill and Archaic period C14 date		
64		masonry wall and use surface with firepit above two meters of nearly sterile fill		
32				
3		remains of four+ masonry walled rooms on ledge, with manos, corn and sherds in a few cms. of fill		
94		one room in overhand tested, with one rock wall and use surface uncovered; bedrock tunnel links room up with other rooms, with a McElmo B/W olla in the tunnel		

TABLE 35 - cont'd

	Date	Tower	pithouse/kiva	water control device
707	PII ceramics			
708	PIII ceramics			
648	445BC±145 (shelter) AD1151+vv (kiln or pit)			
64	AD1260±120 PII-III ceramics		x	x
12	AD1232+v(tower) AD1240±140 PII-III ceramics	x	x	x
3	BMIII-PIII ceramics			x
714	PI-III ceramics	x	x	x
94	AD1380±120 PII-III ceramics		x	x
643	BMIII-PIII ceramics		x	x
571	PI-III ceramics	x	x	x

TABLE 35 - cont'd

	possible plaza	shelter	lithic scatter	Mavajo hogan
359			10-25cm.thick aeolian layer with chipped stone tools	
458				burned use surface with 20cm.thick layer of nails,china,hinges,etc. on it
388			thin tool scatter with isolated slabs	
681			thin tool scatter with isolated slabs	

TABLE 35 - cont'd

	Date	Tower	pithouse/kiva	water control device
359	possible PaleoIndian and Archaic points found during survey, with BMIII-PIII sherds			
458	Navajo- probably 20th century			
388	BMII?			
681	possible Archaic-BMIII points found during survey			
53	AD1201+vv AD1236+B AD1246+L AD1267+B	x		x
656	PI-III ceramics			x
49	PI-III ceramics		x?	x
456	PIII ceramics; Archaic point found during survey			x
665	PII-III ceramics			x
539	PII ceramics			x
644	PII ceramics			x
652	?			x

Key - x-see IV.1 and IV.2 for details

IV.3.

ECONOMY

A. General

A detailed economic analysis of the Hovenweep agricultural system is not yet possible, since an immense amount of pollen and flotation samples from the floors, vessels, storage bins, middens and other food-associated areas of the thirty sites remains to be processed. Several general statements can be made, however, on the basis of the farm field pollen tests, the survey pollen samples and the maize and faunal remains from the sites.

1. Crops - Maize, beans and squash were the most common crops at Hovenweep. Based on the pollen samples it appears that extensive fields grew in dry farm locations around the villages on the mesa tops and in floodwater locations in the canyons and mesa top arroyos. Maize and squash were probably grown in almost every arable location, except for the broad mesa tops and canyon bottoms away from the villages, while beans seem to have been restricted to the fields around the mesa top villages. All three crops were sometimes grown in the same field, but at times corn grew alone, and at other times corn grew with beans or squash. Cotton was also probably grown, as indicated by pollen from a shelter in the Square Tower ruin complex. The exact location of the cotton fields are not known, but they may have been around the springs, since Hopi cotton fields were restricted to the moist springside terraces around the mesa and in irrigated fields in Moencopi Canyon.

A number of wild or weedy plants were probably semi-cultivated or encouraged in the fields. Cleome (beeweed) was probably very common around the fields and middens, as were various members of the Chenopodiaceae and Amaranthaceae families. Most of the CHENO-ams pollen from tests were probably Sarcobatus (greasewood) and Atriplex (which grew naturally around the fields), but others might have been Chenopodium (goosefoot) and Amaranthus (pigweed) which could have been intentially grown or encouraged in the fields. Datura (jimson weed) almost certainly seems to have been semi-cultivated in the fields, while Physalis (ground cherry), Lycium (wolfberry) and other solanaceous plants were also probably manipulated in one manner or another. Other weedy desirables were Typha (cattail), Asclepias,(milkweed), Juncus (sedge), various rushes in the Cyperaceae family, Rumex (dock), various mints in the Labiatae family, and perhaps even Clematis (virgin's bower) and Sphaeralcea (globemallow). It is even possible that the impressive stands of Celtis (hackberry) which now surround many of the canyon head ruins and seeps were grown for shade around the spingside gardens, in much the same way that the Hopi grow cotton-

wood and other shade trees.

We are still not certain when the farming of these various crops and possible semi-cultigens began at Hovenweep, but it may be significant that the dry field samples from Hov 691, an apparent BMIII pithouse dated at AD 660±120, yielded the pollen of corn, squash, beeweed, milkweed, jimson weed, wolfberry, cattail and hackberry.

2. Animal Foods - The domesticated animals of the Hovenweep Anasazi were the dog and turkey. Numerous species of local mammals, birds and other animals were hunted and trapped (see chapter IV.3.c), including mule deer (Odocoileus hemionus), rabbit (Sylvilagus), hare (Lepus), woodrat (Neotoma) and various other rodents. Many of the smaller animals were probably trapped around the gardens and in the canyons, while the deer may have been hunted on the mesa during the winter and in the nearby highlands during the warmer months.

IV.3.B

HOVENWEEP MAIZE 1974-1976

By Dorothy Reaves

Introduction

Several recent papers dealing with Anasazi maize have attempted to relate morphological variation with agricultural trade and social habits (Miksicek, 1974; Winter, 1976). 8-rowed cobs have been of primary interest since a clinal distribution seems to occur across parts of the Southwest.

Galinat and Gunnerson (1963) pioneered the research on the spread of 8-rowed "mais do ocho" across the western hemisphere. They lumped many types of corn found from Mexico to Canada into the same general category, which includes Northern flint corn, the flour corns of Missouri, and many flour corns of Western Mexico. This 8-rowed type of corn seems to have first appeared in Western Mexico about 700 A.D., then spread to the Southwestern United States. Their study also suggested that latitude can be a substitute for altitude in the adaptation of maize. In Mexico and the Southwest the 8-rowed corn grew best in relatively high altitudes (Mangelsdorf, 1974). Both latitude and regional altitude should therefore be taken into consideration in attepting to understand the gradual spread of the 8-rowed cob across the hemisphere. This concept has not appeared in an inter-regional study of the Southwestern maize and needs consideration in further research.

Hovenweep maize was first studied in the summer of 1974 when 67 cobs were collected from the Monument surveys, which concentrated on the canyon head tower clusters. Much of this maize was dried and unburnt, and several cobs may actually have been recent Navajo corn (Winter, 1975). Most of the sites were given tentative PII-PIII dates. Only Navajo corn was found during the 1975 surveys. In 1976, however, 203 corn cobs and numerous cob fragments and kernels from 6 sites were recorded from Cajon Mesa (Table 36). Two of the sites yielded nearly all of the cobs, leaving the other four sites with less than five cobs each. Although this is probably an insufficient sample for a valid intra-regional study, the data does add to our understanding of the local farming patterns.

1. Intra-Regional Study

The two sites (Hov 597 and 47) yielding the greatest number of cobs in 1976 are dated to BMIII-PIII times. Both are mesa top unit

TABLE 36

ATTRIBUTE DATA
HOVENWEEP MATERIAL

SITE	# COBS	MEAN ROW#	%ROW # 8	10	12	14	MEAN DIAM.	MEAN RACHIS	RACHIS/COB DIA. RATIO	MEAN CUP. WIDTH	MEAN GL. WIDTH	MEAN GL. THICK.
47	97	10.2	21	52	27	-	10.6	3.7	3.0	4.1	2.8	2.4
597	97	9.3	43	47	10	-	10.5	3.4	3.2	4.1	3.1	2.4
12	4	11.0	-	50	50	-	10.5	2.9	3.7	4.3	3.1	2.0
714	1	10.0	-	100	-	-	10.5	3.5	3.0	4.5	3.0	2.0
3	3	8.7	67	33	-	-	10.3	2.8	3.8	4.3	3.3	2.2
623	1	10.0	-	100	-	-	10.5	3.5	3.0	4.5	3.5	3.0
TOTAL	203	9.8	31	50	18	-	10.5	3.5	3.1	4.1	2.4	2.4

pueblos, and at both the corn was recovered from apparent store rooms. The sites are located approximately 10 kilometers apart (see Fig. 1), with the Square Tower, Holly and Horseshoe-Hackberry ruin clusters between them, so they present an ideal opportunity to begin our examination of intra-regional variation.

All of the maize found during 1976 was highly carbonized. Since the 1974 material was uncarbonized, the data is not completely comparable. Cobs generally shrink when burned, so cupule width and the cob/rachis ratio cannot be accurately compared from the two years. The number of rows on the cob does not change, however, so row comparison is valid with both collections of corn. Table 36 and the 1974 data (Winter 1975, Table 7) show that the maize from the two years at Hovenweep have very similar proportions of 8-row, although the 1976 cobs were generally much smaller.

In fact, when the 1974-76 collections are broken down geographically, a north-south cline of row number appears. Hovenweep 47, located to the north of the Square Tower complex, averages 21% 8-row for 97 cobs; 48 cobs from nine sites in the Square Tower cluster averaged 29% 8-row; while 99 cobs from Hovenweep 597 to the south of the Square Tower group averaged 43% 8-row. Due to the carbonization problem, it is not possible to discern geographic patterns in cupule width and the other morphological characteristics.

2. Inter-Regional Distribution

Earlier studies by Winter (1973,1976) have indicated an east-west trend in percentage of 8-row cobs across the northern Southwest in PII-III times (Table 37). Sites in the west, such as the Median Village and Evans Mound Fremont sites, exhibit relatively low number of 8-row cobs, compared with sites much further to the east, at Mesa Verde. Sites in the middle location, such as 42KA274 and 42KA178 in Glen Canyon, also have low frequencies, while sites located between Glen Canyon and Mesa Verde, such as Cedar Mesa, have higher frequencies. As suggested by the present data, the Hovenweep material fits well into this pattern, since the 1974-76 collection averaged 31% 8-row. The clinal distribution may partially be due to altitudinal changes, but it is probable that regional exchange patterns were at work as well.

DISCUSSION

Two trends in row number have appeared from this data. An intra-regional cline shows an east-west pattern. The Mesa Verde sites in southwest Colorado and southeast Utah are generally very high in 8-row, the Fremont sites in southwest Utah are very low, and the Kayenta sites in between are generally intermediate. Regional

TABLE 37

PERCENTAGE OF 8-ROWED COBS
ACROSS NORTHERN SOUTHWEST

Site	#Cobs	%8-Row
Evans Mound	132	25.7
Median Village	188	20
Glen Canyon		
42KA274	507	23
42KA178	208	22
Elk Ridge	133	24
Cedar Mesa	735	33
Comb Ridge	75	19
Hovenweep	270	31
Mesa Verde		
Step House	5932	30
Long House	2171	42
Mug House	3621	46

exchange patterns most likely explain this trend, although altitude may also be a factor. Seed corn was probably exchanged throughout the northern Southwest, with the farmers in any one place readily exchanging corn among themselves. This pattern is very evident in areas like Mesa Verde and Hovenweep, where the corn is quite similar within each region, and progresively dissimilar as one gets further away. At Hovenweep, a north-south trend is evident, as shown by a cline in 8-rowed material from Hovenweep 47 in the north to Hovenweep 597 in the south.

IV.3.C

AN ANALYSIS OF THE 1976 FAUNAL REMAINS

By Thomas D. White

During the 1976 field season, faunal remains were recovered from nineteen sites. A total of 1433 bone items were studied. Since every bone identified in the field was saved, much of this material was extremely small and/or fragmentary. Of the total, only 505 (35.2%) bone artifacts were identifiable to the generic level. The remainder of the unidentified artifacts represented amphibian, reptilian, avian, and mammalian remains. The identified materials produced 27 genera and at least 28 species (Table 38).

By far, the most commonly occurring species were the cottontail rabbits (Sylvilagus sp.). Most were presumably the desert cottontail (S. auduboni). The mountain cottontail (S. nuttalli) however, is also known to occur in the general area. In any case, this genus represented 50.9% of the identified materials. It was recovered from thirteen sites, more than any other in this study.

With 67 (13.3%) identified elements found in eleven sites, the turkey (Meleagris gallopavo) proved to be the second most commonly occurring taxon in both numbers and frequency. Egg shells indicate that turkeys were kept at least at two locations, Hov. 24 and 53. Domesticated turkeys are known to have provided food, clothing, and materials for tools to the Anasazi (Hargrave, 1965). Turkey bones were the most commonly utilized materials in the worked bone artifacts recovered this field season (see Chapter III.7).

Remains of the blacktail jackrabbit (Lepus californicus) were the third most abundant with 28 identified elements representing 5.5% of the known faunal remains. They were found in ten sites, making them the third most frequently recovered. With the exception of a single element, they were found in sites that also contained elements of Sylvilagus sp. It is interesting that Sylvilagus elements were nearly ten times more abundant. This would seem to indicate that the environment surrounding these ten sites formerly favored Sylvilagus.

It was surprising that mule deer (Odocoileus hemionus) remains were fifth numerous with only 18 (3.6%) bone elements. They were present in only seven sites, five of which contained only a single element. At one of these (Hov. 707), the element was a recent deposition, not associated with Anasazi activities. It is noteworthy that five of the elements were worked bone artifacts. This seems to emphysize the importance and relative scarcity of mule deer as a prey species. It is unlikely that during Anasazi occupation Cajon Mesa

TABLE 38

FREQUENCY (%) OF TAXA IDENTIFIED

FROM FAUNAL REMAINS FROM NINETEEN SITES

SITE	Bone elements per site	SPECIES (bone elements per species)												
		Western Spadefoot Toad (3) *Scaphiopus hammondi*	Collared Lizard (9) *Crotaphytus collaris*	Desert Spiny Lizard (5) *Sceloperus magister*	Turkey (67) *Meleagris gallopavo*	Mourning Dove (1) *Zenaidura macroura*	Poorwill (1) *Phalaenoptilus nuttalli*	American Goldfinch (4) *Spinus tristis*	Rufous-sided Towhee (3) *Pipilio erthropthalmus*	Human (19) *Homo sapiens*	Dog or Coyote (2) *Canis* sp.	Gray Fox (2) *Urocyon cinereoargenteus*	Pika (1) *Ochotona princeps*
Hov. 3	6					16.7							
Hov. 12	44				20.5					2.3			
Hov. 15	11				9.1								
Hov. 24	1				100								
Hov. 47	28												
Hov. 49	5									60			
Hov. 53	127	2.4	7.1	3.9	1.6					7.1			
Hov. 64	8												
Hov. 94	91				1.1								
Hov. 520	10				10					10			
Hov. 571	27				18.5					18.5		3.7	3.7
Hov. 623	13				7.8						7.8		
Hov. 643	22				81.8							4.5	
Hov. 648	6												
Hov. 685	45				53.3	2.2					2.2		
Hov. 707	39												
Hov. 709	1												
Hov. 714	4				100								

TABLE 38 - Cont'd.

SITE	Cottontail (257) *Sylvilagus* sp.	Blacktail Jackrabbit (28) *Lepus californicus*	Porcupine (1) *Erethizon dorsatum*	Rock Squirrel (6) *Spermophilus variegatus*	Whitetail Antelope Squirrel (1) *Ammospermophilus leucurus*	Colorado Chipmunk (7) *Eutamian quadrivittus*	Northern Pocket Gopher (5) *Thomomys talpoides*	Silky Pocket Mouse (2) *Perognathus flavus*	Ord Kangaroo Rat (6) *Dipodomys ordi*	Deer Mouse (10) *Peromyscus maniculatus*	Pinon Mouse (16) *P. truei*	Northern Grasshopper Mouse (1) *Onychomys leucogaster*	Woodrat (15) *Neotoma* sp.
Hov. 3										16.7			
Hov. 12	38.6	4.5				2.3		2.3	2.3	6.8	20.5		
Hov. 15	45.5	9.1					18.2	9.1	9.1				
Hov. 24													
Hov. 47	89.3								3.6				
Hov. 49						40							
Hov. 53	59.8	2.4		1.6		1.6	1.6		1.6	3.9	1.6		5.5
Hov. 64	50												
Hov. 94	74.7	13.2											2.2
Hov. 520	70	10											
Hov. 571	22.2	3.7		7.4					3.7	3.7		3.7	
Hov. 597		50				50							
Hov. 623	53.8	15.4		7.8									
Hov. 643	9.1	4.5											
Hov. 648	66.7										16.7		16.7
Hov. 685	26.7	4.4	2.2				2.2				2.2		2.2
Hov. 707	61.6	7.8		5.1	2.6	2.6					7.8		10.3
Hov. 709													
Hov. 714													

TABLE 38 - Cont'd

SITE	SPECIES (bone elements per species)		
	Mule Deer (18) *Odocoileus hemionus*	Domestic Sheep (8) *Ovis* sp.	Cattle (6) *Bos taurus*
Hov. 3			66.7
Hov. 12			
Hov. 15			
Hov. 24			
Hov. 27		7.1	
Hov. 49			
Hov. 53	7.1		
Hov. 64		25	25
Hov. 94	4.4		
Hov. 520			
Hov. 571	3.7		
Hov. 597			
Hov. 623	7.8		
Hov. 643			
Hov. 648			
Hov. 685	2.2		
Hov. 707	5.1		
Hov. 709	100		
Hov. 714			

was an unsuitable environment for deer. It is reasonable then to assume their scarcity was due to human hunting activities. This could serve to explain the abundance of Sylvilagus remains, the apparent alternative favored prey. This could also be significant in the absence of bighorn sheep (Ovis canadensis) remains on Cajon Mesa. This species was present and utilized by Anasazi at nearby Alkali Ridge (Brew, 1946) to the west and Mesa Verde (Swannack, 1969; Rohn, 1971) to the east. Requiring a high, mesic environment, this could explain how bighorn sheep would be rapidly removed from the relatively xeric environment of Cajon Mesa early during human occupation.

An especially intriguing discovery was made at Hov. 53. A Hovenweep Corrugated storage jar was recovered intact from the floor of Holly House. It was filled with dirt which proved to contain 175 bones. The bewildering variety included:

Western Spadefoot Toad: three bones

Collared Lizard: six bones

Spiny Lizard: five bones

American Goldfinch: three right humeri and a maxillary

Rufous-sided Towhee: Carpometacarpus, ulna, tibiotarsus

Sylvilagus: cranium and proximal humerus

numerous amphibian and reptilian vertebrae and fragments

numerous avian fragments

numerous rodent fragments

This "recipe" was entirely reminiscent of one of two bone filled corrugated jars found at Mug House (Rohn, 1971: 104). Rohn observed that there were 17 individuals of ten species in his jar. He noted that some organisms appeared incomplete and that many inedible parts were included. He presumed the contents filled some unknown, symbolic function. Although it is possible that parts were lost, the precedure of filling the Hov. 53 jar appeared to be identical although there were minor differences in the frequency, parts, and species used. It is apparent that this concoction was not intended to be consumed. The flesh from a toad would render a meal extremely bitter and distasteful.

The remainder of the faunal remains represents both Anasazi associated artifacts and recent intrusions. Certainly, the sheep, cattle, much of the rodent and some of the Sylvilagus remains are recent. A single tibia from a pika (Ochotona princeps) is something of a mystery. This species inhabits talus sloped in alpine regions. Any further remarks would be purely speculative.

Summary

With the exception of the pika, the faunal remains represent species presently existing on Cajon Mesa. This could indicate that no major vegetational or climatic changes have occurred in the last 1000 years. Large game (i.e., mule deer and bighorn sheep) have been rate to nonexistant probably due to human activities. Cottontails (Sylvilagus sp.) appear to have been the major prey species toward the end of Anasazi occupation. It appears as though through necessity, turkeys became an important source of food and materials.

IV. 4. PALEOENVIRONMENT

A. General

The Anasazi agricultural system at Hovenweep was undoubtedly dependent upon a complex chain of environmental variables, including growing season, weather patterns, amount and time of precipitation, soil quality and a host of other factors. The development, maintenance and decline of the farming based economy can only be appreciated and understood by reconstructing the relationship of the farmers with their environment, and identifying the mutual effects each had on the other. Such a reconstruction is at the core of the Hovenweep Agricultural Project, and although it is premature to attempt a definitive statement, since an enormous amount of data remains to be analyzed, a number of preliminary observations can be made.

1. Prior Research In The Four Corners Area - Beginning with Martin and Byer's(1965) and Fritts et al's (1965) preliminary statements which emerged from the Wetherill Mesa Project, a number of researchers have concluded that fluctuations in the floral composition of the Four Corners area occurred several times during and after the Anasazi occupation of the region. The reasons for this fluctuation and the relations with climatic change and farming activities are poorly understood, but most authors agree that definite alterations occurred in floral distributions in and around Mesa Verde, at least in the late Pueblo and post-abandonment periods. Martin and Byers (1965), for example, noted an increase in juniper and pine pollen and a decrease of Cheno-ams, grasses, Compositae and Cleome after the Anasazi abandonment of the Mesa in the late 1200s, which they correlated with possible three possible reasons: 1) climatic change which forced an abandonment of farming and favored a woodland expansion; 2) widespread secondary plant succession following abandonment with an expansion of trees into formerly disturbed or cultivated areas; and/or 3) local secondary plant succession only in the immediate area of the archeological sites, with no widespread expansion of woodland. Although they were careful to emphasize that they lacked the data to prove any one of these possible explanations, they were intrigued by the fact that similar changes occurred elsewhere in the northern Southwest, as at Navajo Reservoir (cf. Schoenwetter and Eddy 1964) which might indicate that climatic change was a factor. Three possible climatic shifts were noted at Navajo Reservoir, where arboreal tree pollen achieved a maxima during the period AD300-88, at AD1100, and from AD1500-1700.

Following their lead, several other researchers have attempted to test certain of these possible explanations for Mesa Verde or immediately adjacent areas, such as Mancos Canyon. At Mesa Verde,

Wycoff (1976) examined sediments from the Mummy Lake Reservoir on Chapin Mesa and found that arboreal pollen (pine, juniper and oak) increased two-three times after abandonment, while nonarboreal types decreased to half of their original maxima. He interpreted this as resulting from secondary forest succession onto previously cleared land, but he offered no evidence to show that climatic change was not a factor. Wycoff concurred with Rohn (1971:256) and Osborne (1976:43) who argued that deforestation during the peak of the agricutural period probably stripped much of the Mesa of its trees, resulting in extensive repopulation by pine and juniper after abandonment.

Evidence for post-abandonment change has also been found by Scott (1974,1976) at the 5MTUMR344 site in Mancos Canyon and the nearby Hoy House in Johnson Canyon. Although she was careful to refrain from choosing between climatic change and secondary succession as the cause for this floral change, Scott did note that pine apparently receded in PIII times at Hoy House, probably as a result of cultural pressure, and that Cleome underwent a dramatic increase in mid-PIII times, perhaps through its use as a starvation plant (cf. Martin and Byer 1965). Scott also noted strikingly different arboreal pollen percentage differences for the BMIII and PII levels at 5MTUMR344, with the BMIII pollen samples similar to modern samples with their high arboreal pollen content while the PII samples were much lower. Scott concluded that several periods of floral changes had occurred in the canyon.

Strong evidence for climatic change was obtained by Fritts et al (1965) from the Wetherill Mesa dendrochronological samples. A definite period of drought occurred between AD1273-1285, which is the time of final abandonment of Mesa Verde. The authors concluded that both the summers and winters were drier than present during this period, and that the drought was of greater length and intensity than any period since AD1673. They did not feel that the drought was the sole cause of abandonment, however, since other droughts of even greater intensity occurred at AD517, 565, 614, 844 and 1170, with the 1170 drought being especially dry. Droughts which approached the magnitude of the AD1273-1285 period also occurred at AD1218 and 1237. Since the Anasazi managed to survive the earlier droughts, most of which were longer and drier than the AD1273-1285 period, Fritts et al concluded that drought was probably only part of a complex chain of factors which contributed to abandonment.

Based on these and other studies, Nickens (1977) has suggested that a complex combination of variables was responsible for several periods of abandonment in Johnson Canyon near Mesa Verde. Although drought was probably the primary indirect cause, Nickens suggests that declines in the corn and bean crops, animal protein, and drinking water, and an increase in child mortality rates were the direct causes of the abandonment, along with the failure of the local farmers to develop an intensive water control network. As a consequence,

several types of settlement pattern shifts occurred, with the population first moving off of the mesa tops and down into the cliff dwellings at about AD1130, where they lived until the 1160s. The canyon was then abandoned until AD1195, when the cliff dwellings were reoccupied, only to be totally abandoned at approximately AD1230. In support of his argument Nickens cites Cordell's (1975) conclusion that the Wetherill Mesa dendrochronological and site survey data are indicative of scarcity in arable land and minor fluctuations in climatic regime, which resulted in decreased crop yield. Nickens also notes that periods of drought in several other regions of the northern Southwest apparently resulted in episodes of abandonment around AD1114-89, as at Red Rock Plateau in the Kayenta area (Lipe 1974) and Black Mesa in northeastern Arizona (Karlstrom et al 1976).

2. Hovenweep Data - With the above regional statements as a background, we can begin to appreciate the complex settlement pattern shifts which occurred at Hovenweep during its occupancy by Anasazi farmers and foragers. We still lack controlled evidence for the use of the area by earlier Big Game hunters and gatherers, and the Archaic occupancy of the area is limited to a handful of projectile points and a C14 date of 445BC±145, but evidence is accumulating which indicates that an intensive agricultural and foraging economy was developing by Basketmaker III times, at approximately AD660. The deep soils of the mesa top seem to have been the focal point for this economy, and by the 11th and 12th centuries numerous mesa top pueblos were organized around the dry farming of corn, beans, squash and various manupulated weeds. Certain of these pueblos and farming areas were probably used well into the 13th century, but after AD1200 dramatic shifts in settlement and field location apparently occurred, as the Anasazi moved their villages and farms to the springs, arroyos and floodplains in and around the canyons. Although many of these locations were probably utilized before the 1200s as well, it was during the mid 1200s that most of the canyonhead tower clusters, and probably the water control farm fields around them, were built and utilized. None of the towers and associated ruins appear to have been built or remodeled after AD1277, and by AD1280 the Hovenweep area was probably totally abandoned.

This brief synopsis of an extremely complicated series of economic developments and settlement pattern shifts raises numerous questions concerning the environmental relationships. None of them can be fully explored until the controlled pollen columns, floor scrapings, fill samples and other materials from the 1976 tests are examined. A number of preliminary observations, however, have emerged from the survey pollen samples and the controlled farm fields tests. The following paper by Glen Weir describes several apparent shifts in vegetation on the mesa, which may well be correlated with climatic and settlement pattern changes.

IV.4.B

POLLEN EVIDENCE FOR ENVIRONMENTAL CHANGE AT HOVENWEEP NATIONAL MONUMENT, A.D. 900-A.D. 1300

By Glendon H. Weir

In order to interpret the fossil pollen record on Cajon Mesa it is essential to analyze both the modern pollen rain and the distribution of modern plants. This is necessary since the modern pollen rain is used as the basis with which to compare the fossil pollen rain and to infer the past vegetation. Accordingly, the relationship of the modern pollen rain to the present flora and vegetation must be established in order to define the variables involved. Then by using the modern pollen rain as the analog of the fossil pollen rain, the present and inferred past flora and vegetation may be quantitatively compared and any changes in their relationship determined. Finally, the climatic and edaphic parameters of the past vegetation distributions may be inferred from the pollen evidence present in the fossil pollen rain, thereby giving us an insight into past environmental conditions.

Modern Pollen Rain

Modern pollen sample counts and provenience data are recorded in Tables 39-40. These data as diagrams of the percentile compositions and distribution of the modern pollen rain have been plotted in Figure 66.

The regional modern pollen rain of the Cajon Mesa area reflects the kinds of plants and types of vegetation present today. However, as is always the case, the relationship of the pollen rain to the actual plants and vegetation present is reflected primarily by the wind-pollinated plants. The insect - and self-pollinated plants produce a much smaller proportion of any pollen rain, yet their pollen can be used in association with the wind-pollinated vegetation to establish past distributions.

The modern pollen record of Cajon Mesa today shows a strong association with the dominant vegetation elements in the various vegetation zones in Figure 67. In the northern Pinyon Juniper Woodland the dominant vegetation is Pinyon Pine (Pinus Edulis) and Utah Juniper (Juniperus osteosperma). Pinyon Pine averages about 35 to 40% of the modern pollen rain, a figure which reflects the high pollen productivity of this plant, while juniper, also a high pollen producer, averages some 30% of the modern pollen rain. The other arboreal pollen types, cottonwood (Populus), oak (Quercus) and willow (Salix) are much smaller percentile components of the pollen rain

TABLE 39

LOCATION AND PROVENIENCE OF POLLEN SAMPLES

Vegetation Zone	Sample Number	Description	Period
Pinyon	M1	Relict edge	Modern
Pinyon	M2	Relict 100' N.	Modern
Pinyon	M3	Relict 100' W.	Modern
Pinyon	M4	Relict 100' S.	Modern
Pinyon	M5	Relict 100' E.	Modern
Pinyon	38	Climax Lowry Garden	Modern
Pinyon	37	Climax Lowry Garden	Modern
Pinyon	M41	Climax mature stands	Modern
Pinyon	M42	Clinax mature stands	Modern
Pinyon	M43	Climax mature stands	Modern
Ecotone	M6	½ mi. W. Cutthroat Castle	Modern
Ecotone	M7	100' S. ridge top	Modern
Ecotone	M8	100' W. ridge top	Modern
Ecotone	M9	100' N. ridge top	Modern
Ecotone	M10	100' E. ridge top	Modern
Ecotone	M11	Colorado Utah line 100' N.	Modern
Ecotone	M12	Colorado Utah line 200' N.	Modern
Ecotone	M13	Colorado Utah line 300' N.	Modern
Ecotone	M14	Colorado Utah line 400' N.	Modern
Ecotone	M15	Colorado Utah line 500' N.	Modern
Sagebrush	M16	Grass Relict 50' E.	Modern
Sagebrush	M17	Grass Relict 100' E.	Modern
Sagebrush	M18	Grass Relict 150' E.	Modern
Sagebrush	M19	Grass Relict 200' E.	Modern
Sagebrush	M20	Grass Relict 250' E.	Modern
Sagebrush	M44	Climax Square Tower area	Modern
Sagebrush	M45	Climax Square Tower area	Modern
Sagebrush	M46	Climax Square Tower area	Modern
Sagebrush	65	Control Tumble Mustard	Modern
Ecotone	M21	Ute Reservation SE 50'	Modern
Ecotone	M22	Ute Reservation SE 100'	Modern
Ecotone	M23	Ute Reservation SE 150'	Modern
Ecotone	M24	Ute Reservation SE 200'	Modern
Ecotone	M25	Ute Reservation SE 250'	Modern
Shadscale	M26	Relict Cajon NW-SE 50'	Modern
Shadscale	M27	Relict Cajon NW-SE 100'	Modern
Shadscale	M28	Relict Cajon NW-SE 150'	Modern
Shadscale	M29	Relict Cajon NW-SE 200'	Modern
Shadscale	M30	Relict Cajon NW-SE 250'	Modern

Table 39(continued)

Vegetation Zone	Sample Number	Description	Period
Shadscale	M50	Climax Ismay Post slope	Modern
Shadscale	M51	Climax Ismay Post slope	Modern
Shadscale	M52	Climax Ismay Post slope	Modern
Hopsage	M47	Climax Navajo Reservation	Modern
Hopsage	M48	Climax Navajo Reservation	Modern
Hopsage	M49	Climax Navajo Reservation	Modern
Ecotone	M31	4 mi. San Juan bench NE	Modern
Ecotone	M32	4 mi. San Juan bench 100'	Modern
Ecotone	M33	4 mi. San Juan bench 150'	Modern
Ecotone	M34	4 mi. San Juan bench 200'	Modern
Ecotone	M35	4 mi. San Juan bench 250'	Modern
Blackbrush	M36	Relict Aneth N-S 50'	Modern
Blackbrush	M37	Relict Aneth N-S 100'	Modern
Blackbrush	M38	Relict Aneth N-S 150'	Modern
Blackbrush	M39	Relict Aneth N-S 200'	Modern
Blackbrush	M40	Relict Aneth N-S 250'	Modern
Blackbrush	M53	Climax Brushland Aneth	Modern
Blackbrush	M54	Climax Brushland Aneth	Modern
Blackbrush	M55	Climax Brushland Aneth	Modern
Alluvial	M56	Climax Brushland Hatch	Modern
Alluvial	M57	Climax Brushland Hatch	Modern
Alluvial	M58	Climax Brushland Hatch	Modern
Alluvial	M59	Climax Brushland Hatch	Modern
Alluvial	M60	Climax Brushland Hatch	Modern
Pinyon	39	Control Lowry	Historic
Sagebrush	79	Control H551 FS1 Wick. 2	Historic
Sagebrush	92	Control H555 FS2 Brid. 3	Historic
Sagebrush	82	Control H555 FS3 Brid. 3	Historic
Sagebrush	94	Control H555 FS4 Brid. 3	Historic
Shadscale	93	Control H666 FS1 Mont. 2	Historic
Shadscale	41	Control H666 FS2 Mont. 2	Historic
Blackbrush	80	Control H666 FS3 Navajo	Historic
Blackbrush	89	Control H667 FS1 Navajo	Historic
Pinyon	68 H600FS43	Painted Hand reservoir	Basketmaker II
Pinyon	88 H600FS44	Painted Hand reservoir	Basketmaker II
Pinyon	104 H388FS3	Cutthroat pithouse	Basketmaker II (?)
Pinyon	113 H542FS5	Hovenweep 7 pithouse	Basketmaker III
Pinyon	116 H596FS1	Sandstone 1 pithouse-cist	Basketmaker (?)

Table 39(continued)

Vegetation Zone	Sample Number	Description	Period
Pinyon	123 H596FS2	Sandstone 1 pithouse-cist	Basketmaker (?)
Pinyon	15 H656PS1	Prudden Site terrace	Pueblo I, II, III
Pinyon	16 H656PS2	Prudden Site terrace	Pueblo I, II, III
Pinyon	122 H643FS7	Big Ruin 1 Prudden midden	Pueblo I, II, III
Pinyon	114 H709FS29	Big Ruin 3 Prudden midden	Pueblo I, II, III
Pinyon	85 H644FS3	Big Ruin 1 Check Dam	Pueblo II
Pinyon	87 H644FS4	Big Ruin 1 Check Dam	Pueblo II
Pinyon	107 H385FS5	Cutthroat 1 midden	Pueblo II
Pinyon	99 H593FS7	Sandstone 1 floor	Pueblo II
Pinyon	103 H383FS4	Cutthroat 1 granary	Pueblo II, III
Pinyon	54 H600FS46	Painted Hand Great Kiva	Pueblo II, III
Pinyon	45 H600FS47	Painted Hand Great Kiva	Pueblo II, III
Pinyon	71 H714FS2	Big Ruin Canyon reservoir	Pueblo II, III
Pinyon	81 H714FS3	Big Ruin Canyon reservoir	Pueblo II, III
Pinyon	83 H714FS5	Big Ruin Canyon reservoir	Pueblo II, III
Pinyon	48 H714FS7	Big Ruin Canyon reservoir	Pueblo II, III
Pinyon	51 H714FS8	Big Ruin Canyon reservoir	Pueblo II, III
Pinyon	55 H714FS9	Big Ruin Canyon reservoir	Pueblo II, III
Pinyon	0-7 H70FS22	Cutthroat 1 talus dam	Pueblo III
Pinyon	0-2 H70FS23	Cutthroat 1 floodplain dam	Pueblo III
Pinyon	97 H648FS3	Big Ruin room fill	Pueblo III
Pinyon	63 H616FS3	Big Ruin 1 Check dam	(?)
Pinyon	69 H616FS4	Big Ruin 1 Check dam	(?)
Pinyon	61 H642FS1	Big Ruin 1 Check dam	(?)
Pinyon	7 H439FS2	Keeley 3 Check dam #3	(?)
Pinyon	73 H446FS2	Keeley 3 Check dam #2 edge	(?)
Pinyon	84 H445FS3	Keeley 3 Check dam #2	(?)
Pinyon	86 H589FS1	Negro 1 terrace	(?)
Pinyon	120 H595FS3	Square Tower 1 ceramic	(?)
Sagebrush	126 H340FS2	Square Tower 1 lithic	(?)
Sagebrush	101 H340FS3	Square Tower 1 lithic	(?)
Sagebrush	98 H352FS5	Square Tower 1 lithic	(?)
Sagebrush	118 H440FS4	Hackberry 1 lithic	(?)
Sagebrush	112 H440FS5	Hackberry 1 lithic	(?)
Sagebrush	117 H500FS3	Navajo 3 grinding stone	(?)
Sagebrush	121 H549FS20	Wickiup 2 lithics	Archaic
Sagebrush	124 H681FS18	Little Montezuma 2 pithouse	Archaic, Basketmaker II
Sagebrush	62 H652FS4	Big Ruin 2 Check dam	Basketmaker II
Sagebrush	64 H642FS5	Big Ruin 2 Check dam	Basketmaker II
Sagebrush	60 H600FS45	Painted Hand reservoir	Basketmaker II
Sagebrush	108 H24FS21	Square Tower 1 midden	Basketmaker III
Sagebrush	7 H49LC4	Bridge 2 terrace Check dam	Basketmaker III
Sagebrush	12 H49LC5	Bridge 2 terrace rock arc	Basketmaker III
Sagebrush	78 H49FS2	Bridge 2 terrace bench	Basketmaker III

Table 39 (continued)

Vegetation Zone	Sample Number	Description	Period
Sagebrush	77 H49FS3	Bridge 2 terrace bench	Basketmaker III
Sagebrush	96 H520FS10	Prudden Unit midden	Basketmaker III
Sagebrush	4-3 H3FS7	Square Tower 1 spring side	Pueblo I, II, III
Sagebrush	3-4 H3FS8	Square Tower 1 spring side	Pueblo I, II, III
Sagebrush	2-6 H3FS9	Square Tower 1 spring side	Pueblo I, II, III
Sagebrush	1-6 H3FS10	Square Tower 1 spring walls	Pueblo I, II, III
Sagebrush	2-5 H437FS8	Hackberry 1 check dam	Pueblo I, II, III
Sagebrush	1-5 H437FS9	Hackberry 1 check dam	Pueblo I, II, III
Sagebrush	0-5 H437FS10	Hackberry 1 check dam	Pueblo I, II, OII
Sagebrush	1-4 H473FS10	Navajo 1 canyon check dam	Pueblo I, II, III
Sagebrush	105 H22FS14	Square Tower 1 midden	Pueblo II
Sagebrush	109 H23FS7	Square Tower 1 midden	Pueblo II
Sagebrush	106 H23FS8	Square tower 1 midden	Pueblo II
Sagebrush	1-2 H379FS6	Square Tower 1 check dam	Pueblo II
Sagebrush	103 H420FS3	Hackberry 1 midden	Pueblo II
Sagebrush	4-6 H421FS2	Holly 1 check dam	Pueblo II
Sagebrush	2 H421FS3	Holly 1 check dam	Pueblo II
Sagebrush	1-8 H424FS8	Holly 1 check dam	Pueblo II
Sagebrush	0-8 H424FS9	Holly 1 check dam	Pueblo II
Sagebrush	0-6 H424FS10	Holly 1 check dam	Pueblo II
Sagebrush	0-3 H424FS11	Holly 1 check dam	Pueblo II
Sagebrush	74 H513FS1	Big Cahone Lake reservoir	Pueblo II
Sagebrush	19 H513CL1	Big Cahone Lake dam edge	(?)
Sagebrush	20 H513CL2	Big Cahone Lake dam butt	Pueblo II
Sagebrush	21 H513CL3	Big Cahone Lake dam edge	Pueblo II
Sagebrush	9 H535LC1	Little Cahone Lake core	(?)
Sagebrush	10 H47LC2	Bridge 2 mound	(?)
Sagebrush	11 H47LC3	Bridge 2 mound	( )
Sagebrush	22 H538WC1	Little Ruin 5 check dam #1	Pueblo II
Sagebrush	23 H538WC2	Little Ruin 5 check dam #2	Pueblo II
Sagebrush	24 H538WC3	Little Ruin 5 check dam #3	Pueblo II
Sagebrush	25 H538WC4	Little Ruin 5 check dam #4	Pueblo II
Sagebrush	26 H538WC5	Little Ruin 5 check dam #5	Pueblo II
Sagebrush	27 H538WC6	Little Ruin 5 check dam #6	Pueblo II
Sagebrush	50 H538FS1	Little Ruin 5 check dam #1	Pueblo II
Sagebrush	42 H538FS1-1	Little Ruin 5 check dam #5	Pueblo II
Sagebrush	53 H538FS3	Little Ruin 5 check dam	Pueblo II (?)
Sagebrush	58 H538FS2	Little Ruin 5 check dam #2	Pueblo II
Sagebrush	47 H538FS2-1	Little Ruin 5 check dam #5	Pueblo II
Sagebrush	46 H538FS3	Little Ruin 5 check dam #5	Pueblo II
Sagebrush	95 H538FS5	Little Ruin 5 check dam	Pueblo II
Sagebrush	72 H539FS6	Little Ruin 5 check dams	(?)
Sagebrush	52 H539FS7	Little Ruin 5 check dam #1	(?)
Sagebrush	44 H539FS8	Little Ruin 5 check dam #1	(?)
Sagebrush	49 H539FS9	Little Ruin 5 check dams	(?)
Sagebrush	43 H539FS11	Little Ruin 5 check dams	(?)

Table 39(continued)

Vegetation Zone	Sample Number	Description	Period
Sagebrush	28 H539WC7	Little Ruin 5 check dam #7	(?)
Sagebrush	29 H539WC8	Little Ruin 5 check dam #8	(?)
Sagebrush	30 H539WC9	Little Ruin 5 check dam #9	(?)
Sagebrush	31 H539WC10	Little Ruin 5 check dam 10	(?)
Sagebrush	32 H539WC11	Little Ruin 5 check dam 11	(?)
Sagebrush	33 H539WC12	Little Ruin 5 check dam 12	(?)
Sagebrush	34 H539WC13	Little Ruin 5 check dam 13	(?)
Sagebrush	35 H539WC14	Little Ruin 5 check dam 14	(?)
Sagebrush	36 H539WC15	Little Ruin 5 check dam 15	(?)
Sagebrush	90 H540FS4	Little Ruin 5 check dam	(?)
Sagebrush	75 H541FS1	Little Ruin 5 check dam	(?)
Sagebrush	1-1 H11FS11	Square Tower 1 talus dam	Pueblo II, III
Sagebrush	3-1 H12FS2	Square Tower 1 rim dam	Pueblo II, III
Sagebrush	3-7 H53FS16	Holly 1 rim dam terrace	Pueblo II, III
Sagebrush	4-5 H53FS17	Holly 1 rim dam terrace	Pueblo II, III
Sagebrush	2-8 H57FS2	Hackberry 1 rim dam	Pueblo II, III
Sagebrush	3 H61FS22	Hackberry 1 talus terrace	Pueblo II, III
Sagebrush	17 H71RS1	Ranger Station akchin dam	Pueblo II, III
Sagebrush	18 H71RS2	Ranger Station dam #2	Pueblo II, III
Sagebrush	100 H71FS4	Square Tower 1 rim dam	Pueblo II, III (?)
Sagebrush	111 H405FS1	Hackberry 1 midden	Pueblo II, III
Sagebrush	3-8 H423FS5	Hackberry 1 talus dam	Pueblo II, III
Sagebrush	4-8 H423FS6	Hackberry 1 terrace	Pueblo II, III
Sagebrush	4 H423FS7	Hackberry 1 terrace	Pueblo II, III
Sagebrush	5-1 H455FS3	Holly 1 habitation	Pueblo II, III
Sagebrush	5 H472FS3	Hovenweep 3 midden	Pueblo II, III
Sagebrush	4-2 H476FS3	Navajo 1 granary walls	Pueblo II, III
Sagebrush	0-1 H10FS3	Square Tower 1 granary	Pueblo III
Sagebrush	2-1 H11FS10	Square Tower 1 talus dam	Pueblo III
Sagebrush	2-7 H53FS15	Holly 1 rim dam terrace	Pueblo III
Sagebrush	1-7 H57FS1	Hackberry 1 rim dam	Pueblo III
Sagebrush	4-7 H61FS9	Hackberry Canyon terrace	Pueblo III
Sagebrush	3-5 H71FS2	Square Tower 1 rim dam	Pueblo III (?)
Sagebrush	4-4 H71FS3	Square Tower 1 rim dam	Pueblo III (?)
Sagebrush	6 H71FS4	Square Tower 1 akchin dam	Pueblo III (?)
Sagebrush	1 H71FS5	Square Tower 1 akchin dam	Pueblo III (?)
Sagebrush	4-1 H345FS2	Square Tower 1 check dam	Pueblo III (?)
Sagebrush	0-4 H367FS4	Square Tower 1 granary	Pueblo III (?)
Sagebrush	110 H0FS1	Site A check dam	(?)
Sagebrush	70 H0FS2	Bridge 3 plant quad	(?)
Sagebrush	59 H0FS4	Bridge 3 plant quad	(?)
Sagebrush	57 H0FS00-1	Cross canyon 3 plant quad	(?)
Sagebrush	76 H509FS1	Cross Canyon 4 terrace	(?)
Sagebrush	2-4 H400FS1	Hackberry 1 granary	(?)
Sagebrush	3-2 H460FS2	Hovenweep 1 granary	(?)
Sagebrush	91 H493FS1	Bridge 2 terrace	(?)

Table 39 (continued)

Vegetation Zone	Sample Number	Description	Period
Sagebrush	13 H49LC6	Bridge 2 terrace patch	(?)
Sagebrush	2-2 H426FS1	Holly 1 check dam	(?)
Sagebrush	3-6 H344FS6	Square Tower 1 talus dam	Pueblo II, III
Shadscale	125 H359FS21	Cajon 1 lithic	Pueblo II (?)
Shadscale	102 H359FS20	Cajon 1 lithic	Pueblo II (?)
Shadscale	2-3 H456FS4	Cajon 1 reservoir	Pueblo III
Shadscale	C1 HOFS10	Climax ¼ mi. NE Cajon	Early Control
Shadscale	C2 HOFS11	Relict Control	Early Control
Shadscale	C3 HOFS12	Climax ¼ mi. NE Cajon	Late Control
Shadscale	C4 HOFS13	Relict Control	Late Control
Shadscale	C5 HOFS14	Climax ¼ mi. NE Cajon	Early Control
Hopsage	C6 HOFS15	Climax 2 mi. E. Mont. Creek	Early Control
Hopsage	C7 HOFS16	Climax 2 mi. E. Mont. Creek	Early Control
Hopsage	C8 HOFS17	Climax 2 mi. E. Mont. Creek	Early Control
Hopsage	C9 HOFS18	Climax 2 mi. E. Mont. Creek	Late Control
Hopsage	C10 HOFS19	Climax 2 mi. E. Mont. Creek	Late Control
Blackbrush	66 H608FS15	McElmo 1 terrace	Pueblo 1
Blackbrush	110 H651FS9	Allen 3 lithics dune	(?)
Blackbrush	C11 HOFS1	Climax Lower Cajon drain.	Early Control
Blackbrush	C12 HOFS2	Climax Lower Cajon drain.	Early Control
Blackbrush	C13 HOFS3	Climax Lower Cajon drain.	Early Control
Blackbrush	C14 HOFS4	Climax Lower Cajon drain.	Late Control
Blackbrush	C15 HOFS5	Climax Lower Cajon drain.	Late Control
Alluvial	40 HOCC7	Cross Canyon 7 patch	(?)
Alluvial	8 HOCC1	Cross Canyon 1 patch	(?)
Alluvial	3-3 H483FS1	Black Steer talus terrace	(?)
Alluvial	14 HOCH1	Bridge 2 spring patch	(?)
Alluvial	119 H631FS2	Cross Canyon 2 ceramic	(?)
Alluvial	C115 H557FS4	Cross Canyon 2 lithic	(?)
Alluvial	C16 HOFS6	Climax Mont. Crk. drain.	Early Control
Alluvial	C17 HOFS7	Climax Mont. Crk. drain.	Early Control
Alluvial	C18 HOFS8	Climax Mont. Crk. drain.	Late Control
Alluvial	C19 HOFS9	Climax Mont. Crk. drain.	Late Control

KEY - Table 40

AP - arboreal (tree) pollen
cf - compare, compares favorably
CHENO-Am. - CHENOPODIACEAE-Amaranthus
Cyl. - Cylindropuntia type
ECONOMIC - manipulated plant pollen
FS, letters - field sample
H - fossil pollen rain sample
H.S. - high spine
L.S. - low spine
M - modern pollen rain sample
NAP - non-arboreal pollen
nev. - nevadensis type
Platy. - Platyopuntia type
tor. - torreyana type
* - see Table 39 for location, provenience and zone

TABLE 40 Modern Pollen Sample Counts

M13	M12	M11	M10	M9	M8	M7	M6	M43	M42	M41	37	38	M5	M4	M3	M2	M1	*SAMPLE
90	60	97	62	82	74	73	69	67	68	87	56	87	94	66	71	43	291	Pinus AP
46	45	59	42	63	68	44	60	48	55	40	20	16	28	25	28	51	206	Juniperus
11	3		3						2			3	2		3	4	14	Populus
2	10	4	5	2	7	2	4	4	5	10	5	5	10	18	5	4	10	Quercus
	4				1	4			4	3	15	2	3		2	8		Salix
8	1	8	6	6	3	8	3	8	4	2	7	13	2	3	4	1	16	COMPOSITAE H.S.
																		NAP
12	13	28	18	10	15	25	10	16	23	21	10	20	13	27	25	20	20	L.S.
					2					6					13			Liguliflorae
54	38	74	48	25	15	40	10	18	22		15	6	6	2		10	49	Artemisia
24	20	25	24	24	15				24	38	61	36	30	31	23	26	48	CHENO-Am.
	2		1	1	3			2		2			3				4	Sarcobatus
	7	16	5	4	4	20	25	6	5	18	6	2	2	5	2	5	2	Ephedra nev.
	1	3		1	3	10	2	4		16			1	2	2		3	tor.
47	25	71	26	9	8	21	9	12	11	4	12	5	6	5	9	13	7	GRAMINEAE
						8		1	1									Typha
											2			1	1			CYPERACEAE
					4	2	3	8	2						3		8	ROSACEAE
																		Opuntia Cyl.
																		Platy.
						1		1							1			CRUCIFERAE
							1	2			4	1	1	1				LABIATAE
						1			1		3	4		1	1	1		LEGUMINOSAE
					1			1	1		1		1	2	3	3		LILIACEAE
											8				2	13		SOLONACEAE
				6	13	12	18	3	6	5	36	29	14	18	12	10		Other
																		Cleome ECONOMIC
																		Cucurbita
																		Zea
																		cf Phaseolus
																		Gossypium
294	229	385	240	227	236	261	204	201	234	252	261	229	216	207	208	201	691	TOTAL N

TABLE 40(continued)

M28	M27	M26	M25	M24	M23	M22	M21	65	M46	M45	M44	M20	M19	M18	M17	M16	M15	M14	*SAMPLE
73	69	67	47	50	50	31	55	57	54	57	48	97	40	45	48	76	65	73	Pinus AP
9	8	8	31	36	20	28	34	25	14	22	25	33	29	35	23	51	50	57	Juniperus
												1			2			2	Populus
												4				3			Quercus
												2							Salix
5	8	6	8	4	2	7	12	1	3	5	4		3	3	4		4	3	COMPOSITAE
																			H.S. NAP
20	13	15	19	14	12	8	19	10	17	12	13	18	12	14	19	21	9	19	L.S.
	8	4			4							2			1	2			Liguliflorae
13	9	8	31	29	30	35	57	47	30	50	38	60	32	54	24	57	20	19	Artemisia
58	37	46	39	49	47	35	42	20	42	32	16	37	39	40	40		32	21	CHENO-Am.
5	5	4	7	8	2			5	4			11		1	2				Sarcobatus
6	6	4	6	7	6	10	8	10	14	7	25	21	17	15	12	30	18	10	Ephedra nev.
1	3	3	3	5	1	5	4	5	7	2	10	2	3	7	8	7	2	5	tor.
32	18	22	27	59	31	45	39	59	40	30	31	47	37	76	40	30	25	17	GRAMINEAE
																			Typha
																			CYPERACEAE
	6	9										1			4				ROSACEAE
																			Opuntia Cyl.
												3							O. Platy.
	1							21											CRUCIFERAE
		2																	LABIATAE
																			LEGUMINOSAE
		2																	LILIACEAE
																			SOLONACEAE
1	11	7				1						3			2	2			Other
																			Cleome ECON
																			Cucurbita
																			Zea
																			cf Phaseolus
																			Gossypium
223	202	207	218	260	205	205	270	260	225	217	210	342	212	290	229	277	225	226	TOTAL N

TABLE 40 (continued)

M39	M38	M37	M36	M35	M34	M33	M32	M31	M49	M48	M47	M52	M51	M50	M30	M29	*SAMPLE
55	72	34	41	58	47	65	63	64	42	79	58	59	59	56	63	59	Pinus AP
1	2	2	2	9	4	14	10	13	4	1	2	11	15	13	3	4	Juniperus
4	2	2	2	2		2						1			1	2	Populus
							2						1		2	2	Quercus
		2											1	1		1	Salix
4	8	4	7	4	8		3	9	7	10	8	9	6	5	4	5	COMPOSITAE H.S. NAP
6	9	6	8	6		20	4	15	11	6	14	14	15	15	11	12	L.S.
2	3	3	4	4	6	3	5	6	4	6	4	4	2	4	4	4	Liguliflorae
2	3	8	9	21	19		26	25	11	16	12	16	10	12	25	19	Artemisia
57	68	69	82	75	67	72	93	80	82	56	71	87	77	64	66	61	CHENO-Am.
		3			2		3	3	3	2	4	4	3	4	3	5	Sarcobatus
11	12	6	9	4	6	2	5	4	2	3	4	4	8	10	6	3	Ephedra nev.
14	19	11	14	2	4	6	7	3	7	2	2	2	4	4	4	4	tor
34	49	34	38	34	26	20	26	24	23	25	22	26	22	26	34	29	GRAMINEAE
																1	Typha
2	2		2												3	2	CYPERACEAE
19	23	15	17	11	8	12	8		2								ROSACEAE
																	Opuntia Cyl.
																	Platy.
																	CRUCIFERAE
																	LABIATAE
																	LEGUMINOSAE
																	LILIACEAE
																	SOLONACEAE
7	1				4		4		13								Other
																	Cleome ECONOMIC
																	Cucurbita
																	Zea
																	cf Phaseolus
																	Gossypium
214	273	216	235	228	203	214	263	246	211	203	201	237	222	215	228	214	TOTAL N

TABLE 40 (continued)

M60	M59	M58	M57	M56	M55	M54	M53	M40	*SAMPLE
52	54	47	55	58	48	69	59	42	Pinus AP
10	5	5	9	8	4		3	1	Juniperus
14	8	8	6	2	4		3	3	Populus
									Quercus
9	7		3	2					Salix
4	5	5	2	2	3	1	5	2	COMPOSITAE H.S. NAP
5	8	5	6	8	5	8	8	4	L.S.
					3		3	4	Liguliflorae
16	17	5	4	11	6		5	5	Artemisia
77	92	71	77	84	58	34	85	65	CHENO-Am.
26	34	36	20	24	5	8	2		Sarcobatus
2	4	7	4	8	10	7	15	8	Ephedra nev.
9	11	6	11	18	14	15	18	15	tor.
21	18	22	19	24	34	34	46	36	GRAMINEAE
5	5	5	2	2					Typha
13	7	7	3	5	6		2	2	CYPERACEAE
		7			17	24	15	15	ROSACEAE
									Opuntia Cyl.
									Platy.
									CRUCIFERAE
									LABIATAE
									LEGUMINOSAE
									LILIACEAE
									SOLONACEAE
5	8	2	6	8	30		13	5	Other
									Cleome ECONOMIC
									Cucurbita
									Zea
									cf Phaseolus
									Gossypium
268	283	218	227	205	244	204	284	207	TOTAL N

KEY - Fig 66

AP - arboreal (tree) pollen
AZ - Alluvial Zone
BB - Blackbrush Brushland
CHENO-Am. - CHENOPODIACEAE-Amaranthus
F - fossil pollen rain
HS - Hopsage Shrubland
H.S. - high spine
L.S. - low spine
M - modern pollen rain
NAP - Non-arboreal (other) pollen
nev. - nevadensis type
PJ - Pinyon Juniper Woodland
SG - Sage Grassland
SS - Shadscale Shrubland
tor. - torreyana type

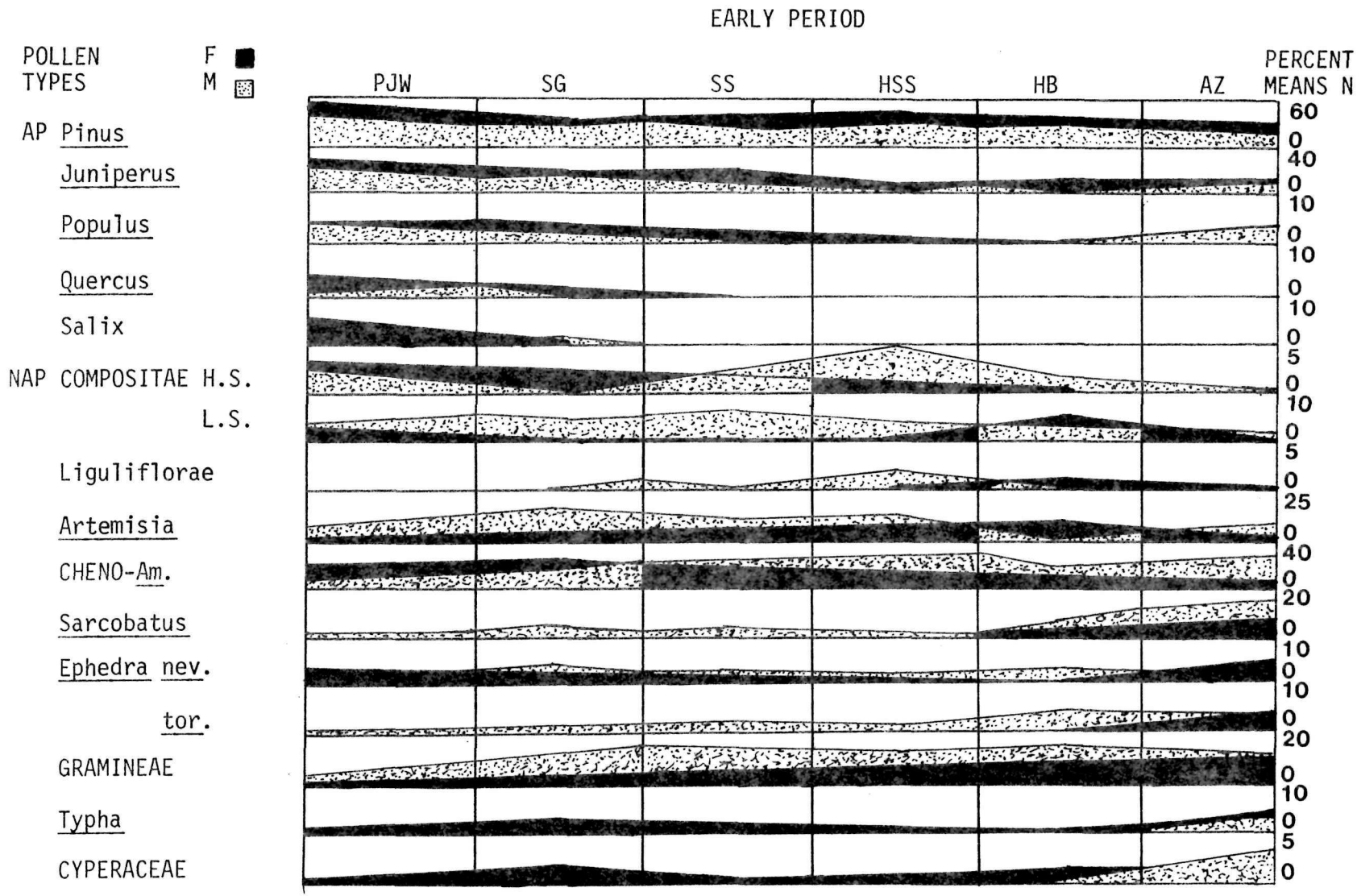


Figure 66 Modern and fossil pollen diagrams

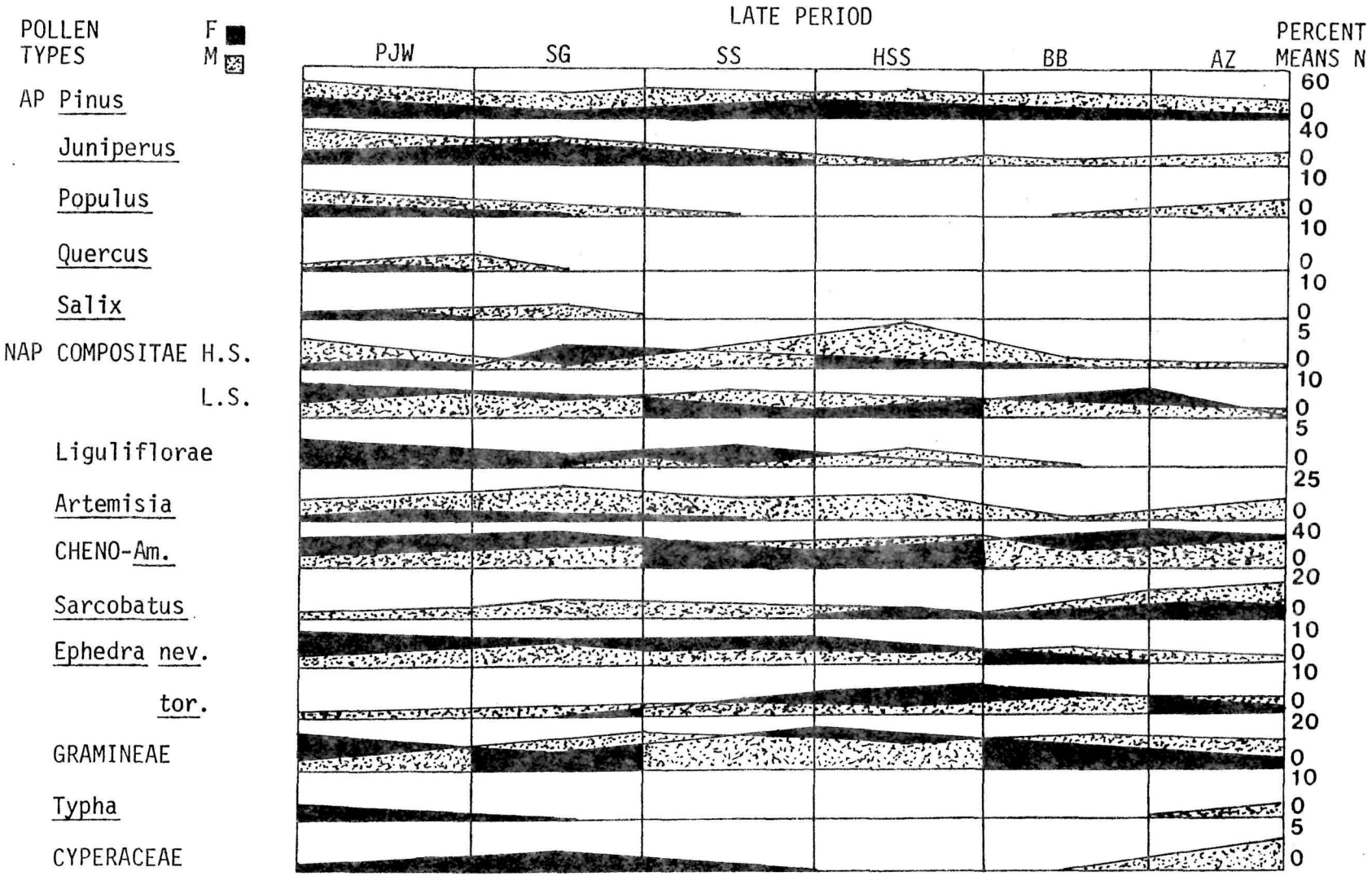
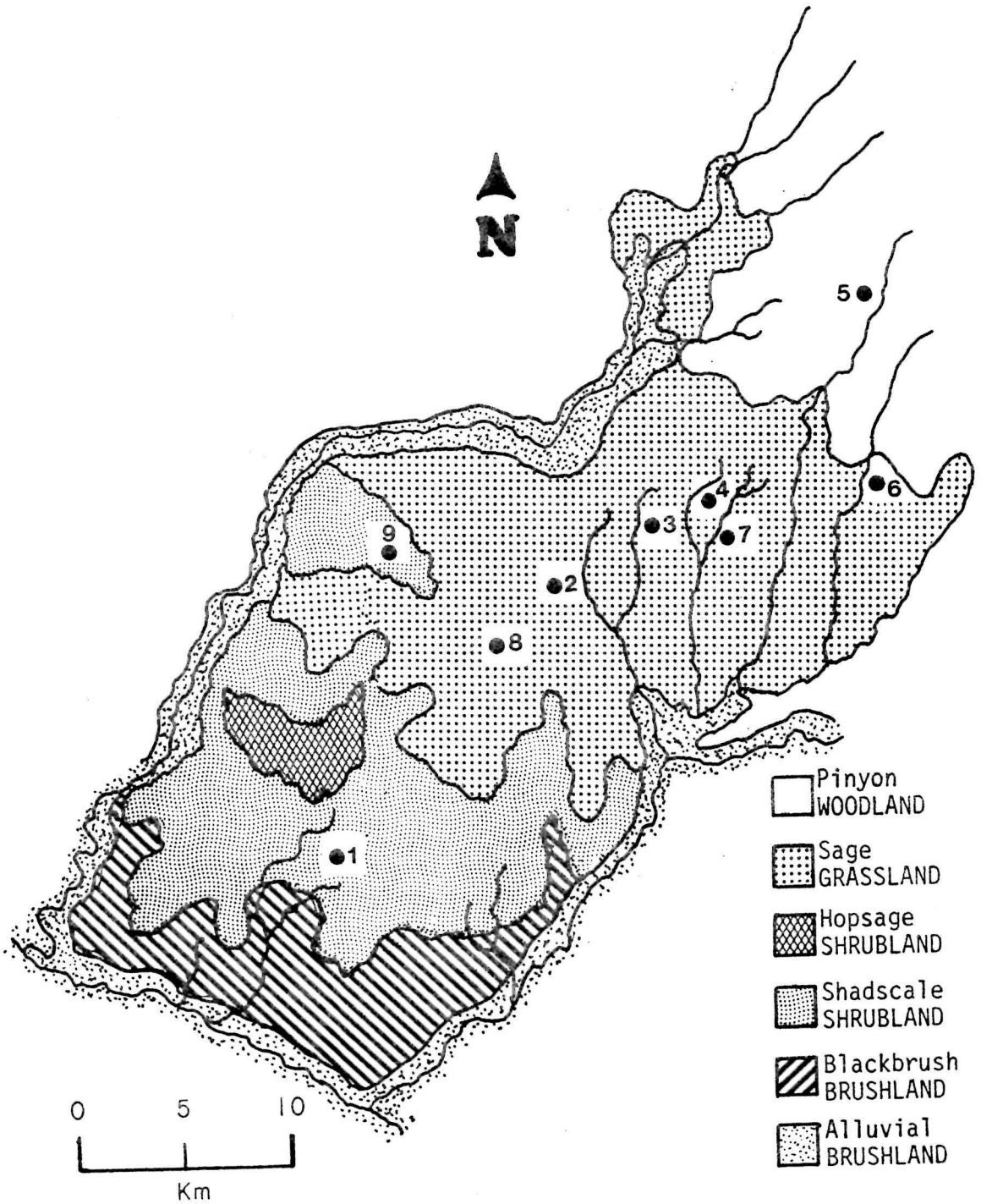


Figure 66 (continued)

KEY - Fig 67

1. Cajon (NPS) Ruin Group
2. Square Tower (NPS) Ruin Group
3. Holly (NPS) Ruin Group
4. Hackberry (NPS) Ruin Group
5. Cutthroat (NPS) Ruin Group
6. Hovenweep #1 (BLM) Sample
7. Hovenweep #1 (BLM) Sample
8. Navajo #1 (BLM) Sample
9. Black Steer #1 (BLM) Sample



GHW

Figure 67 Cajon Mesa vegetation zones 1976

(ranging from 1 to 5%), thus reflecting their lesser representation across the zone today. Non-arboreal pollen types present in the modern Pinyon Juniper Woodland include the composites (Compositae; high spine types such as the Sunflower or Helianthus, 1-2%; low spine types such as Ragweed or Ambrosia, 2-49%; the Liguliflore, such as the Dandelion or Taraxacum, 0 to less than 1%; and Sagebrush or Artemisia, about 10%). Also included are the Chenopodiaceae - Amaranthus pollen type, such as Shadscale (Atriplix) and Goosefoot (Chenopodium) (15-25%), Greasewood (Sarcobatus) (1-2%), Jointfir (Ephedra) (2-5%), the Grasses (Gramineae) (about 5%), Cattail (Typha) and the Sedges (Cyperaceae) (both less than 1% each).

Pinyon relict stands and the climax vegetation show no detectable difference between their percentile pollen compositions due to their similar pollen composition. The modern pollen rain in the Pinyon-Juniper Woodland - Sage Grassland ecotone is also similar, yet displays generally higher percentages of grass and sagebrush (10 and 15%, respectively), and somewhat lower percentages of pinyon and juniper (30 and 15%, respectively).

The dominant modern vegetation of the Sagebrush Grassland is composed of Artemisia and associated grasses. As expected, the pollen record of these plants reflects this dominance in percentiles of 15-29%. The arboreal components of this zone are also reflected in the modern pollen rain. For example, tree pollen percentages include juniper (10-15%), cottonwood (1%), oak (1-2%), and willow (less than 1%). Although pines are essentially absent from the zone, pine pollen averages about 30%, mostly coming from the pine trees in neighboring areas. Non-arboreal pollen types present in this zone include the composites (high spine 1-2%), the Chenopodiaceae - Amaranthus type (CHENO-Am.) (20-25%), Greasewood (2-3%), jointfir (2-10%), and only traces of sedges and cattail since these plants are also essentially absent from the zone. The pollen spectra of relict grass stands were indistinguishable from those of the zone climax vegetation, since both sagebrush and grass pollen is thoroughly mixed by the wind in these areas. As expected, the Sagebrush Grassland - Shadscale Shrubland ecotone showed increasing pollen percentages of CHENO-Am. (about 30%) and the composites (from 2-7%), reflecting the increasing representation of these plants in the ecotone.

The Shadscale Shrubland is composed of shrubs, grasses and herbs associated with the dominant plant Shadscale (Atriplex confertifolia). This dominance is reflected in the pollen rain by the high CHENO-Am. percentage (more than 3%). Arboreal pollen types present include about 30% pinyon (although the tree is not actually present in this zone), from 2-10% juniper (although only a few trees grow in the zone) and pollen from cottonwood, oak and willow (less than 1%). Non-arboreal pollen types found in the Shrubland, aside from the dominant CHENO-Am. type, include the composites (high spine 0-3%, low spine 6-8%, Liguliflorae 1-2%, sagebrush 5-10%), greasewood (2%), Jointfir

(2-5%), and the grasses (10-15%). Cattail and sedge pollen types and plants were absent from the zone, and the Shadscale Shrubland was sharply delimited from the island Hopsage Shrubland with no distinguishable ectone.

The hopsage Shrubland is distinguished from the surrounding shrublands by an essentially pure stand of Hopsage, (Grayia spinosa) which is reflected in the modern pollen record by high CHENO-Am. percentages (about 35%). Of the arboreal pollen types, pinyon percentiles remain high (20-30%), juniper declines to about 2%, and cottonwood, oak and willow pollen disappear from the modern pollen record. None of these trees are present in the zone. Non-arboreal pollen types present in the zone are high spine (increasing to a maximum of 5%) and low spine (declining to 3-6%) composites; the Liguliflorae (which peak at about 2-3%); sagebrush (which remains at about 5-10%); greasewood (which declines to less than 1%); jointfir (less than 1-2%); and the grasses (7-10%), although the grass plants are not well-represented in the zone.

In the Blackbrush Brushland vegetation zone, the dominant floral element is Blackbrush (Coleogyne ramosissima) and, although it is not shown in Figure 66 as part of the anemophilous modern pollen rain, it is represented (at 8%) by data for the Rosaceae in Table 40 pollen counts. Arboreal pollen types include pine (15-25%), juniper (about 1%), and cottonwood (less than 1%), although these trees are not in the zone. Oak and willow trees and pollen are absent from both the zone and the pollen record. Non-arboreal pollen types in the Brushland are decreasing high spine (from 3-1%) and low spine (3-2%) composites; Liguliflorae (1-2%); sagebrush (0-4%); high levels of CHENO-Am. (25-35%); increasing greasewood (from less than 1% to 10%); increasing jointfir (3-7%); and higher levels of the grasses (15-17%). Cattail pollen is absent from the zone, although the pollen of the sedges reappear (at about the 1-2 percentile level). Since the Hopsage Shrubland is not mesa-wide, the Shadscale Shrubland-Blackbrush Brushland transition represents an ecotone between these vegetation zones, and is characterized by high levels of pine (20-25%), high spine composites (3-4%), CHENO-Am. (35%), and grasses (10-15%). The Blackbrush Brushland-Alluvial Zone ecotone is variable and marked in places by abrupt changes in elevation where the mesa drops suddenly into the San Juan River Valley, and in other areas by a more gradual transition into greasewood (Sarcobatus vermiculatus) dominated brushland. The ecotone represented by this latter transition is characterized by high Pine pollen levels (25%), and decreasing jointfir (6-3%) and grass (17 to less than 15%) levels.

The Alluvial Zone is a highly variable plant and topographic zone on the western, southern and eastern borders of Cajon Mesa (Fig. 67). The Alluvial Greasewood Brushland portion of this zone is characterized by a plant invader from the Mediterranean area, Salt Cedar (Tamarix pentandra), which was introduced historically to the

Southwest by the Spanish in the 16th century, and as recently as 80 years ago was not noticed in the Alluvial Brushland of Cajon Mesa (Eastwood, 1893). Since that time salt cedar has aggressively extended its range in the area of Cajon Mesa at the expense of the co-dominant native greasewood in the Alluvial Brushland, and is weakly represented in the modern pollen record (2-3%). Arboreal pollen components of the Alluvial Brushland include pine (20-25%); juniper (2-4%); cottonwood (2-8%); and willow (from less than 1% to a maximum of 4%). Oak pollen is absent from the modern pollen record. Non-arboreal pollen types present in the Alluvial zone include high spine (1-2%) and low spine (2-4%) composites; (Liguliflorae pollen types were not present in the modern pollen record of the Alluvial Zone); sagebrush (2-8%); increasing CHENO-Am. (35-37%) and greasewood, whose pollen type increases from 10 - 18% of the pollen record; declining Jointfir(1%) and grasses (10-8%); cattail (1-3%) and the sedges (increasing from 1-3%).

Together, these data from the modern pollen rain of Cajon Mesa present a picture of the modern flora and vegetation of Cajon Mesa. The relationship between the modern pollen rain and the modern flora and vegetation studied in this research is not a direct 1:1 relationship, and can best be quantified in terms of the means of the percentile components of all pollen samples from the various vegetation zones and ecotones. This has been done graphically in Figure 66 and is based on the data in Table 40.

The statistical relationship of the modern pollen rain to the modern flora and vegetation is influenced by three factors: (1) the high pollen productivity of certain anemophilous plants such as pine, juniper and jointfir; (2) potential sample bias due to local over-representation of pollen from certain plants; and (3) the differential preservation of certain pollen types.

Pine, juniper and jointfir, for example, disperse large amounts of pollen widely on the prevailing winds of the Cajon Mesa area. This results in these pollen types being present in high amounts in vegetation zones where the parent plants do not actually occur. Long distance transport of pine pollen is routinely recorded from as far away as 50 or more miles from its source of origin (Bryant, 1966) and the pine pollen of Cajon Mesa is no exception. This is why it is essential that this aspect be taken into consideration when examining the relationship between the modern pollen rain and the extant flora and vegetation. The second factor in relating the modern pollen rain to the present flora and vegetation is the local over-representation of certain pollen types (from such wind-pollinated types as the CHENO-Am.), which through improper sampling could lead to sample bias. As a result, one might be misled into thinking that high percentages of this pollen type actually result from high numbers of plants in the vegetation. Actually, a relatively small number of Chenopodiaceae-Amaranthus plants are sufficient to produce these high

percentages of pollen (Bohrer, 1972). The sampling techniques in this research were designed to mimimize this potential sample bias (Weir, 1976). The third factor is the differential pollen preservation of certain pollen types such as Berberis and cottonwood in soil environments. Due to the chemical composition and physical morphology of certain pollen grains, oxidation can occur as the result of repeated wetting and drying. This type of moisture cycle often occurs in many southwestern soil environments and thus greatly reduces the total number of pollen grains that remain preserved. More importantly, it leads to a greater destruction of thin-walled pollen types (Bryant, 1968; Faegri and Iversen, 1975). Therefore, certain pollen types are rarely recorded in the modern or fossil pollen aspectra of samples collected on Cajon Mesa in proportion to their actual or potential occurrence.

With these constraints, the relationship of the modern pollen rain to the flora and vegetation of Cajon Mesa today is considered to be significant, as the modern pollen rain percentages bear a recognizable and apparently consistent relationship to the actual flora and vegetational distributions observed on the Mesa today. Accordingly, the relationship of the modern pollen rain to the present flora and vegetation was used as a guide to the interpretation of the past flora and vegetation as reflected in the fossil pollen samples.

Fossil Pollen Rain

The record of the fossil pollen rain on Cajon Mesa was derived from sediment samples collected from environmental profiles and at various types of cultural (aboriginal) sites. Both types of pollen samples were collected for one or both of two purposes. The first was to derive a record of the fossil pollen rain of the Cajon Mesa area in order to infer past environmental conditions in the area. The second purpose was to use the fossil pollen rain as a means to identify the range of potential plant resources which aboriginal inhabitants of Cajon Mesa may have used. This aspect of the research is discussed and the results interpreted elsewhere (Weir, 1976). The first purpose was accomplished by excluding all fossil pollen types representing plants which are known to have had the potential for use by the aboriginal inhabitants of Cajon Mesa. Also excluded were certain over-represented pollen types from plants which were present as a result of local disturbance. This bias was determined by non-site control sample comparisons. The remaining, or background, pollen types are believed to represent the fossil pollen rain of Cajon Mesa at the time they were deposited, and are the fossil equivalents of the pollen types found in the modern pollen rain.

The fossil pollen samples in Table 41 are graphically represented in Figure 66, where the mean percentile composition and distribution of the fossil samples are plotted against similar data for the modern

KEY - Table 41

cf - compare, compares favorably
CHENO-Am. - CHENOPODIACEAE-Amaranthus
FS - field sample
H - fossil pollen sample
H.S. - high spine
L.S. - low spine
nev. - nevadensis type
Plat - Platyopuntia type
tor. - torreyana type
* - see Table 39 for location, provenience and zone

1 - 1 to 4% of Sample N
2 - 5 to 20% of Sample N
3 - 21 to 40% of Sample N
4 - 41 to 80% of Sample N
5 - 81 to 100% of Sample N

TABLE 41

FOSSIL POLLEN SAMPLE COUNTS

*SAMPLE SITES:	H3FS7	H3FS8	H3FS9	H3FS10	H10FS3	H11FS10	H11FS11	H12FS2	H47LC2	H47LC3	H49LC4	H49LC5	H49LC6	H53FS15	H53FS16	H53FS17	H57FS1	H57FS2	H61FS22	H70FS21	H70FS23	H71FS2	H71FS3	H71FS4	H71FS5
POLLEN TYPES:																									
Cleome									1	1	1		1	1					1					1	
Cucurbita																									
Zea	1		1		2	1	1				1	1		1	1	1			1	2	1		1		1
cf Phaseolus																									
Gossypium																									
Sarcobatus		1	1			1			2	2		1	1	1								1			
COMPOSIT. (HS)									1	1	1		1	1							1		1	1	1
COMPOSIT. (LS)	2	2	2		2		2		2	2	1	1	1	2	1	2			2	2	2	2	2	2	2
Artemisia	2	2	3	1	2		1		2	2	2	1	2	2			1	2	1	1	2		1	1	
Liguliflorae					1				1					1						1					
Quercus		1	1		1				1	1	1		1			1				1			1		
Juniperus	1	1	1		1			1	2	2	2	1	2	2		1	1	2		2			1		
Pinus	2			2	2	2	2	1	3	3	3	2	3	3	2			3	1	2	3	2	3	3	
ROSACEAE	1	2	1		1	1		1	2	1	1	1	1					1			1			1	
OPUNTIA (Plat)											1	1	1												
CHENO-Am.	2	3	3	2	2	2	2	1	1	3	3	1	2	3	2	2	1		2	1	2	3	2		1
CRUCIFERAE			1																			1			
CYPERACEAE			1		1	1			1	1				1							1				
Ephedra (nev.)		2	2	2	2	1		1	1	2	1	2	2	2	2	2			1	1	1	2	2	1	1
(tor.)				1	1	1			1	1				1					1		1				
GRAMINEAE	1	1	1	1	1	1	1	1	1	1	1		2	2		2	1	1	2	1	2	1	1		1
LEGUMINOSAE						1		1						1											1
LILIACEAE	1	1	1								1		1			1			1		1				
Populus	1		1		1	1			1	1		1	1	1		1		1	1		1		1	1	
Salix			1		1	1		1						1		1			1		1	1	1	1	1
LABIATAE							1			1															
SOLONACEAE			1						1	1	1	1	1			1			1						
cf Lycium	1	1							1	1						1			1						
Typha (lat)		1	1						1	1			1	1					1		1				
Other	1	1	1		1	1		1	2	1		1	1			1			1	1	1	1	1	1	1
TOTAL N	211	177	104	237	215	252	203	221	184	186	223	199	203	229	184	187	209	224	199	237	207	178	207	211	219

Table 41(continued)

*SAMPLE SITES:	H71RS1	H71RS2	H345FS2	H366FS6	H367FS4	H379FS6	H383FS4	H400FS1	H421FS2	H421FS3	H423FS5	H423FS6	H424FS7	H424FS8	H424FS9	H424FS10	H424FS11	H426FS1	H437FS8	H437FS9	H437FS10	H455FS3	H456FS4	H460FS2	H472FS3
POLLEN TYPES:																									
Cleome		1	1					1		1	1	1		1		1		1	1				1	1	1
Cucurbita																						1			
Zea	1	1	1	1	2			1	1	1		1	1			1	1	1	1				1		2
cf Phaseolus								1										1							
Gossypium					1																				
Sarcobatus				2																		2		1	
COMPOSIT. (HS)	1	1		1	1				1			1						1				1	1	1	
COMPOSIT. (LS)	1	1	2	2	2	2		1				2	1				1	2	2		1	2	1	2	1
Artemisia	2	2	1		1	2		3		1		2	1	1			1	2	1			2	1	2	3
Liguliflorae				1									1												
Quercus								1															1	1	1
Juniperus	1	1	1		1			1	1		1		2			1	1						1	1	2
Pinus	2	1	2	2	1	2	2		2	3	1	2	2			1	1	2	3		1	2	3		3
ROSACEAE	1	1		1												1									1
Opuntia (PLAT)				1																			1		
CHENO-Am.	2	1	2	3	2	2	2	2		3	1	2	2	2				2	3		1	2	2	3	2
CRUCIFERAE				1				1					1					1	1				1		
CYPERACEAE			1	1				1											1				1	1	
Ephedra (nev.)	2	1	1	1	1	2	1	2		1		2	1					1	2			2	2	2	1
(tor.)	1	1		2		1		1											1				2		
GRAMINEAE	1	1	1	2	1		1	1	2	2		1	1	1		1	1	1	1			1	2	1	1
LEGUMINOSAE	1			1	1				1					1					1						
LILACEAE				1				1					1									1	1		1
Populus	1		1			1		1	1		1	1	1				1	1				1	1	1	1
Salix								2			1	1	1				1	1	1				1	1	
LABIATAE				1				1						1									1		
SOLONACEAE	1							1				1	1				1					1	1		
cf Lycium	1							1				1	1					1					1		
Typha (lat)				1					1				1			1	1	1					1	1	1
Other	1	1	1	1				1		1	1	1	1	1		1	1				1	1	1		1
TOTAL N	225	198	229	209	209	232	241	204	197	219	213	216	225	243	233	194	211	204	221	--	214	206	216	198	202

Table 41(continued)

*SAMPLE SITES:	H473FS10	H476FS3	H483FS1	H513CL1	H513CL2	H513CL3	H535LC1	H538WC1	H538WC2	H538WC3	H538WC4	H538WC5	H538WC6	H539WC7	H539WC8	H539WC9	H539WC10	H539WC11	H539WC12	H539WC13	H539WC14	H539WC15	H656PS1	H656PS2	HCSpCH1
POLLEN TYPES:																									
Cleome			1				1																		
Cucurbita																									
Zea			1	1		1	1	1			1		1						1				2	1	
cf Phaseolus																							1		
Gossypium																									
Sarcobatus				2	2	1	2	1	1	2		1	1		1	1	1	1	1	1					1
COMPOSIT. (HS)				1	1	1	1	1	1	1	1		1	1		1	1	1	1	1			1		1
COMPOSIT. (LS)	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Artemisia	2		2	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2
Liguliflorae				1	1	1		1						1	1				1		1				
Quercus			1	1	1		1	1	1	1		1			1	1					1		1	1	
Juniperus			1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Pinus		1		2	2	2	3	3	3	3	3	3	3	2	3	3	3	2	2	3	2	1	4	3	3
ROSACEAE				1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1		1	1	1	1
Opuntia (Plat)					1	1																			
CHENO-Am.		1	3	2	2	2	3	1	1	2	2	2	2	1	1	1	2	1	1	1	2	1	2	2	2
CRUCIFERAE																									1
CYPERACEAE			1	1	1	1																			
Ephedra (nev.)	1	1	2	2	2	2	2	1	2	2	2	1	1	1	2	2	1	1	2	1	2	1	1	2	2
(tor.)					1	1	1	1		1		1											1		
GRAMINEAE	1	1	1	1	1	2	2	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1
LEGUMINOSAE						1													1						
LILACEAE	1			1	1		1						1												1
Populus	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1		1	1	1
Salix		1	1	1		1	1																		1
LABIATAE						1									1										
SOLONACEAE				1	1		1														1	1	1	1	1
cf Lycium				1																					1
Typha (lat)	1	1	1	1	1	1	1		1		1		1	1	1	1	1	1		1	1	1	1		1
Other				1	1	1	1	1	1		1		1	1	1	1	1	1	1		1	1	1	1	1
TOTAL N	193	224	229	236	231	203	225	211	209	204	223	219	234	242	214	203	205	215	224	214	207	203	525	228	211

Table 41 (continued)

*SAMPLE SITES:	HWfPCC1	HWfPCC7	HLTGFS2	HLTGFS3	HLTGFS4	H340FS2	H359FS20	HOFS10	HOFS11	HOFS12	HOFS13	HOFS14	HOFS15	HOFS16	HOFS17	HOFS18	HOFS19	H608FS15	H557FS4	HLGFS4	H551FS1	H555FS2	H555FS3	H555FS4	H666FS1
POLLEN TYPES:																									
Cleome																					1	1		1	1
Cucurbita																						1	1		
Zea																		1		1	1	1	1	1	1
cf Phaseolus																						1			
Gossypium																									1
Sarcobatus																		2	2		1	1		1	
COMPOSIT. (HS)	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
COMPOSIT. (LS)	2	1	1	1	1			1	1		1	1	1	1	1	2	2	1	2	2	1	2	2	2	2
Artemisia	1		1	2	2	1	1	1	2	1	1	1	1	1		1	3	2	2	1	1	1	1	1	1
Liguliflorae			1	1	1		1			1	1		1	1	1	1	1	1			1	1	1	1	1
Quercus	1		1	1	1	1		1	1		1	1								1	1	1	1		
Juniperus	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2		1	3	2	2	2	2	1
Pinus	3	1	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	4	3	3	3	1	2
ROSACEAE	1				1					1								1				1			2
Opuntia (Plat)																		1			1		1		
CHENO-Am.	3	1	1	1	1	3	2	3	2	3	3	3	3	3	2	2	3	3	3	2	3	3	3	3	3
CRUCIFERAE					1				1	1	1					1		1		1		1			
CYPERACEAE						1	1		1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	2
Ephedra (nev.)	1	1	1	1	2	1	2	1	1	2	2	1	1	1	1	1	1	1	2	1	2	1	2	1	1
(tor.)		1					2	1		1	2							2	1	1	1	1	1	1	2
GRAMINEAE	1		1	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	2	1	2	1	2
LEGUMINOSAE											1					1		1		1		1		1	1
LILACEAE										1	1	1					1	1					1		
Populus	1					1		1	1			1	1	1	1	1	1			1	1	1	1		2
Salix						1		1	2				1	1	1	1	1			1	1		1	1	
LABIATAE											1						1	1		1		1		1	1
SOLONACEAE	1	1	1	1	1															1	1	1	1	1	
cf Lycium		1																					1	1	
Typha (lat)		1				1	1	1	1			1	1	1	1	1	1		1		1	1	1	1	2
Other	1	1	1	1	1				1	1	2	1	2		1		1			1	2	1	2	1	1
TOTAL N	215	206	234	239	243	213	239	217	203	207	201	215	211	227	207	236	241	206	202	214	225	213	234	207	245

Table 41(continued)

*SAMPLE SITES:	H66FS2	H66FS3	H667FS1	H600FS43	H600FS44	H388FS3	H542FS5	H596FS1	H596FS2	H643FS7	H709FS29	H644FS3	H644FS4	H385FS5	H67FS9	HOFS1	HOFS2	HOFS3	HOFS4	HOFS5	HOFS6	HOFS7	HOFS8	HOFS9	H593FS7
POLLEN TYPES:																									
Cleome			1	1			1		1		1														
Cucurbita	1																								
Zea	1	1			2					1	1		1	1											
cf Phaseolus										1	1														
Gossypium	1																								
Sarcobatus	1	1		1			1		1		1		1		1	1	2	1	1	2	2	2	2		
COMPOSIT. (HS)	1	2	1	1	2		1	1	1	1	1	1	1	1	1	1			1			1	1	2	
COMPOSIT. (LS)	2	2	1	1	1	2	1	2	2	2	1	2	2	1	2	2	2	2	1	2	2	2	1	1	
Artemisia	2	2	2	1		1	1	1	2	2	1	2	1	1	2	2	2			1	1			1	
Liguliflorae	1	1	1		1		1			1		1					1	1		1	1				
Quercus				1	1	2		2	1	2		1	1	1										2	
Juniperus	2	1	2	1	2	3	4	3	4	3	3	2	2	3		1	1	1		2	2			2	
Pinus	2	2	2	2	3	3	2	4	3	4	2	3	3	3		3	3	3	2	2	2	2	2	1	3
ROSACEAE	1	1			1				1										2	2	1	1	1		
Opuntia (Plat)	1				1	1	1		1	1						1			1					1	
CHENO-Am.	3	3	3	2	3	4	3	3	4	3	4	2	3	3		2	2	2	3	3	2	2	3	3	3
CRUCIFERAE	1						1		1	1			1				1			1		1			
CYPERACEAE	1	2	1	2	1		1	2	1		1	1		1		1	1	1	1		1	1	1	1	1
Ephedra (nev.)	1	1	1	1	2	1	1	1	2	2	1	2	1	1		1	1	1	1	1	1	2			2
(tor.)	1	2	1						1		1	1	1					1	1	2	1	2	2	1	
GRAMINEAE	2	1	1	2	1	1	3	3	2	1	1	3	2	1		2	2	2	2	2	2	2	2	1	1
LEGUMINOSAE	1		1	1				1	1			1						1							
LILACEAE	1			1		1	1			1			1	1			1		1				1		1
Populus	2	1	2	1	1	1	2	1	1	1	2	2	1	2		1	1								2
Salix	1	1	1	1			1		1		1	1	1	2											2
LABIATAE	1	1	1		1	1		1	1		1			1				1				1	1		
SOLONACEAE	1			1		1	2	1	2	2	1		1												
cf Lycium				1					1	1															
Typha (lat)	2	1	1	2	1	1	1	1	1		1	1	1	1		1	1	1			1	2			1
Other		2	1	1		1		2		1	1	1	1	1			1		1	1		1	1	2	1
TOTAL N	203	218	223	204	215	231	217	212	242	210	211	227	202	219	--	204	207	218	223	201	234	218	242	203	211

Table 41(continued)

*SAMPLE SITES:	H600FS46	H600FS47	H714FS2	H714FS3	H714FS5	H714FS7	H714FS8	H714FS9	H70FS22	H616FS3	H648FS3	H616FS4	H642FS1	H439FS2	H446FS2	H446FS3	H589FS1	H595FS3	H340FS3
POLLEN TYPES:																			
Cleome														1					
Cucurbita																			
Zea	1	2				1		1	1				1						
cf Phaseolus																			
Gossypium																			
Sarcobatus		1	1		1	1		1		1	1	1		1		1	1		1
COMPOSIT. (HS)	1	2	1	1	1	2	1	1		2	2	1	2	2	1	1	1	1	1
COMPOSIT. (LS)	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	2	1	2	1
Artemisia			2	1	2	2	1	2	1	1	2	1	1	2	1	2	2	1	1
Liguliflorae	1	1	1			1	1				1			1	1		1		1
Quercus	1		1		1	1	1			1	1	1	1	1	1		1		1
Juniperus	2	2	3	2	3	3	3	2	1	2	1	2	2	1	2	2	2	2	2
Pinus	3	3	3	3	3	3	3	3	2	3	3	3	3	2	3	2	3	3	3
ROSACEAE	1		1			1		1									1		
Opuntia (Plat)	1					1					1	1	1						
CHENO-Am.	3	3	2	3	3	2	3	3	2	3	2	2	3	2	3	2	3	2	3
CRUCIFERAE	1	1				1	1			1		1							
CYPERACEAE	1	1	1	1		1	1	1			1		1	1	1	1	1		1
Ephedra (nev.)	1	2	2	2	2	2	1	1	2		2		2	2	2	2	1	2	1
(tor.)		1	1		1	1	1	1	1	1	1	1		1	1		1	1	1
GRAMINEAE	1	1	2	1	2	2	1	2	2	1	2	1	2	1	2	1	2	1	2
LEGUMINOSAE			1		1			1											
LILACEAE						1													1
Populus	1	1	1		1	1	1		1	2	1	2	2	1	1	1	1	1	1
Salix			1	1	1		1	1		1	1	1	1	1	1		1	1	1
LABIATAE									1						1				
SOLONACEAE																			
cf Lycium											1								
Typha (lat)	1	1	1	1	1		1	1		1		1	1		1	1	1		1
Other	1	1	1		1	1	1		1	1		1	1	1		1	1		1
TOTAL N	193	214	227	214	233	242	219	205	216	238	226	247	203	213	212	207	223	234	218

pollen rain. This was done in order to view the differences in composition and distribution across the vegetational zones of Cajon Mesa in the past.

The range of the fossil pollen data is divided into two parts, an Early Period (about A.D. 700-A.D. 900) and a Late Period (about A.D. 1100-A.D. 1300) based on the association of the fossil pollen samples with prehistoric aboriginal sites of probable period and date in Table 40.

The composition of the fossil pollen rain for the Early Period on Cajon Mesa reflects higher levels of fossil aboreal pollen, and a wider distribution of the fossil tree pollen throughout the vegetation zones of Cajon Mesa than is seen in the modern pollen rain of the area. For example, in the Pinyon Juniper Woodland, pine pollen of the Early Period occurs at percentile levels from 45-30%, as compared with modern pollen rain figures for the same area of from 40-30%. In other zones pine pollen shows higher but varying percentages for the Early Period. Similarly, juniper fossil pollen is present in the Pinyon Juniper zone of the Early Period at 35% levels, as compared with modern pollen levels for that zone of about 30% average. Like the pine pollen, juniper pollen of the Early Period ranges in varying, but higher percentile amounts across the other vegetation zones of Cajon Mesa. Other fossil arboreal pollen types, such as cottonwood, oak and willow are generally present in higher amounts in the fossil pollen record than is found in the modern pollen rain, and have a wider distribution across the past mesa vegetation zones.

Fossil non-arboreal pollen types of the Early Period show a varying distribution when compared to their modern pollen rain counterparts. High spine composite fossil pollen displays a higher level of occurrence during the Early Period (from 3-2%) as compared with their modern frequency (from 2 to less than 1%) throughout the Pinyon Juniper and Sagebrush zones. In the Shadscale and Hopsage Shrublands of the period, the fossil high spine pollen type decreases below that of its modern counterpart (from 2 to less than 1%) and disappears from the fossil pollen record in the Blackbrush Brushland of the Early Period. On the other hand, low spine composite pollen for the Early Period is initially lower than the modern equivalent, and gradually decreases (from 2-1%) across the zones from the Pinyon Juniper through the Sagebrush zones. However, unlike the other types of composites, the fossil low spine type increases to a maximum of 7% in the Blackbrush Brushland zone of the Early Period, which is well above the levels of the modern type, before falling to lower average percentile levels in the Alluvial zone of the Early Period. The fossil Liquliflorae pollen is not present in the Cajon Mesa vegetation of the Early Period except in the past Blackbrush Brushland and Alluvial zones, where it occurs at 2 to less than 1% levels. Fossil sagebrush pollen occurs in all vegetation zones of

the Early Period at lower levels (varying from 1-5%) than in the modern pollen rain. The only exception is a slightly higher level in the Blackbrush zone of the Early Period.

The fossil CHENO-Am. pollen type occurs at about the same percentile levels in both the Early Period and modern pollen rain (from about 5-35%). One difference, however, is that it reaches its maximum fossil pollen rain occurrence in the Pinyon Juniper and Sagebrush zones of the past, whereas in the modern pollen samples it reaches its peak in the modern Shrublands and Alluvial zones. Greasewood pollen occurs only in the Blackbrush and Alluvial zones of the Early Period and at lower levels (from about 1-5%) than are seen in the modern equivalent. Ephedra nevadensis (Jointfir or Mormon tea) type pollen recovered from the Early Period differs in percentages from the modern pollen rain by indicating lower levels (from less than 1 to 3%) in all zones, except where it increases in a portion of the Early Period in the Pinyon Juniper zone and a portion of the Early Period in the Alluvial zone. The E. torreyana (Jointfir or Mormon tea) type fossil pollen does not occur in most of the vegetation zones of the Early Period. It is only present in the Blackbrush and Alluvial zones during the Early Period and found at levels lower than in the modern pollen rain. The grass pollen in the Early Period occurs at lower yet increasing levels throughout all Early Period vegetation zones. Fossil pollen of cattail and the sedges occur in all Early Period vegetation zones at low (from about 1-3%) but constant levels, as compared with the modern pollen rain where they are mostly restricted to the Blackbrush and Alluvial zones.

Composition of the fossil pollen rain of the Late Period in Figure 66 also differs from both the modern pollen rain and the Early Period fossil pollen rain. As compared to the modern pollen rain, the Late Period pollen rain shows generally lower percentile levels and a more limited distribution of arboreal pollen throughout all vegetation zones. The exception to this latter generalization is pine pollen, which occurs in all Late Period vegetation zones, although at percentage levels lower than are found in the modern pollen rain. Similarly, the fossil non-arboreal pollen types of the Late Period vary markedly from their distribution in the modern pollen rain and vegetation zones of the present. Generally, fossil non-arboreal pollen occurs at higher levels in the Pinyon Juniper and Sage Grassland zones of the Late Period, and at lower levels in the Shrublands and Alluvial zones of this period when compared to the modern pollen rain. The only exceptions are the higher levels of fossil grass pollen in the Hopsage Shrubland of the Late Period, and the higher levels of CHENO-Am. pollen in the Blackbrush Brushland and Alluvial zones of the Late Period.

The compositions of the Early and Late Period fossil pollen rain differ from each other by the comparatively restricted occurrence of the fossil arboreal pollen rain to the most mesic habitats of the

Pinyon Juniper and Sagebrush zones during the Late Period. They also differ in the apparent overall displacement of the more xeric fossil composite pollen indicators and the CHENO-Am. types to the Shrublands and Brushlands of the Early Period, when compared to their most northward (Pinyon Juniper and Sage Grassland) distribution during the Late Period.

Paleoecological and Paleoenvironmental Implications

The differences among the fossil pollen rain of the Early and Late Periods and the modern pollen rain suggest certain types of vegetational shifts in the past and, by inference, differences in past temperatures and/or moisture levels in the Cajon Mesa region. Using the composition of the present vegetation as reflected in the modern pollen rain for a baseline, the postulated past vegetation of Cajon Mesa has experienced at least two minor alterations.

The first of these appears to have occurred toward the end of the Early Period (ca. A.D. 700 to A.D. 900) and suggests a period of higher available moisture levels. This is seen in the fossil pollen rain as indications that the northern mesa woodlands of the Early Period appear to have extended over a greater portion of the mesa than at present. This implies the extension southward of more mesic plant environments, suggested by the high percentile levels of the fossil arboreal pollen types during the Early Period such as pine, juniper, cottonwood, oak and willow, and their apparent distribution over a wider area of Cajon Mesa of the period. The presence of cattail and sedge pollen in greater amounts, and in zones where they are only weakly represented today, also suggests southward displacement of mesic plant environments during this Early Period. Similarly, during the Early Period the high spine composites and the CHENO-Am. pollen types are represented in the Pinyon Juniper and Sagebrush Grassland zones by higher levels than are seen in the modern pollen rain of those zones. The low spine composites, Liguliflorae and greasewood pollen types of the Early Period also appear to be displaced southward towards the more xeric Shrublands and Brushland zones. Finally, sagebrush and grass pollen types reach their maximum percentile levels during the Early Period in the Shrublands and Brushland zones, in contrast to their modern pollen peaks in the modern Sagebrush Grassland zone. This may be due to increased tree cover from the inferred southward extension of the Pinyon Juniper Woodland during the Early Period and the competitive advantage these plants would enjoy in an open environment which may have been present at the southern end of the mesa during this period.

During the Late Period (ca. A.D.1000 to A.D. 1300) data from the fossil pollen rain imply that an episode of environmental stress existed in the Cajon Mesa area. In contrast to the proposed more mesic plant environments of the Early period, the more xerophytic

vegetation types of the Late Period suggest a trend towards increased mesa areas of dry plant environments. The pollen diagrams in Fig 6 for the Late Period reflect lower levels of the more mesic fossil tree pollen generally, and suggest a more nearly restricted occurrence of woodlands than is seen today on Cajon Mesa. This hypothesis of a more xerophytic vegetation for the Late Period is also supported by the increase in percentages of non-arboreal pollen types throughout this period. For example, the Composite and the CHENO-Am. pollen types reach their maximums in the Pinyon Juniper and Sage Grassland zones of the Late Period, as compared to the peak occurrence of these pollen types in the modern Shrubland and Brushland zones. Also, the grass and the Artemisia pollen maximums for this period occur in the northern zones. This is to be expected if the tree cover in the northern vegetation zones were reduced by drier conditions throughout the mesa. Finally, the fossil pollen evidence suggests that the more hydric, moisture-associated plants such as cattail and the sedges were largely restricted to the more mesic northern vegetation zones during the Late Period. When considered together, all of these factors imply that the Late Period was a time that favored expansion of the more xeric plant types beyond their present zones as seen in the modern vegetation of Cajon Mesa. By inference, it is suspected that the more xeric vegetation of the Late Period resulted from higher annual temperatures, less rainfall, or both. The present environment of Cajon Mesa appears to represent conditions of intermediate moisture levels when compared to the inferred relatively wet Early Period and the relative dry Late Period. Schoenwetter (1970), for example, have noted that fossil pollen spectra from 5 southwestern regions adjacent to the Cajon Mesa area in Colorado, Utah, Arizona and New Mexico also reflect similar wet and dry trends between A.D. 700-A.D. 1300.

SUMMARY

The information derived from a study of the modern flora and vegetation, combined with the pollen analysis of 63 modern and 183 fossil pollen sediment samples from Cajon Mesa suggest the following:

1) The modern distribution of vegetation on Cajon Mesa is exceedingly complex. Although this complexity is partly caused by the disturbance to the vegetation by modern man, the primary causes of this disturbance are thought to be related to the prehistoric activities of man over a period of more than a thousand years on Cajon Mesa.

2) Fossil pollen records from the Cajon Mesa area imply a past sequence of at least two distinctive environmental periods between A.D. 700 and A.D. 1300. These have been interpreted to represent one relatively wet period between A.D. 700 to 900, and one relatively dry period between A.D. 1100 to 1300, as compared to moisture regimes on Cajon Mesa today.

3) And finally, pollen data from Cajon Mesa yielded quantitative information concerning the modern and past vegetation, while also providing qualitative information useful for speculating on changes in the available botanical resources and their past environmental relationships.

IV.5.

HOVENWEEP ROCK ART AND AGRICULTURE

By Nancy Hulbert Olsen

The purpose of this study is to consolidate all available raw data on rock are recorded at Hovenweep in order to study the possible relations of rock art with past farming patterns and food redistribution. Comparisons of the rock art with ethnographic data recorded by Fewkes and Owen (1892), Fewkes (1892,1894,1895,1896,1897,1900,1906), Colton (1949, 1960) and Forde (1931) at the Hopi mesas suggested two research questions. 1) What relationships exist between the rock art and their location in and near habitation and agricultural features? 2) What, if any, is the relationship between the documented Hopi use of symbols agriculturally, socially and ceremonially, with the symbols found at Hovenweep?

The guiding premise for the study is that since rock art is a cognitive product of selective thought patterns (Arnheim 1969), it can be used as a tool in reconstructing the economic and social aspects of the prehistoric Hovenweep culture. This premise is based on the fact that western pueblo ethnographic reports from 1892 to 1960 demonstrate that the pueblos use visual representations of agriculturally related Beings and concepts to reinforce oral tradition (Fewkes and Owen 1892, Fewkes 1892, Colton 1960, Forde 1931). Generally speaking, katchina masks, pahos, corn cones, corn meal, kiva altars with figures, sand paintings, kiva murals and shrines encode through shape, color and location the entire belief system which is embedded in the agricultural cycle of the pueblos. Specifically, each ceremony centers on one aspect of the yearly cycle, such as the need for moisture, regeneration and growth, purification and preparation for planting. Thus it is possible, for instance, to make specific information about germination, growth and fructification of plants iconographic in the Lalakonta Ceremony (Fewkes and Owens 1892).

Through the use of iconography, the vital aspects of the agricultural cycle are encoded and transmitted across generations. Consistency in choice of symbols should therefore be present in both the contemporary pueblo culture and the prehistoric, if the prehistoric culture shared the same ideology, symbolling and agricultural systems. If, in fact, past and present groups maintain the same iconography, then it might be possible to identify the agricultural information which was used and valued as important by the past culture.

Thus a secondary purpose of this report is to demonstrate that an analysis of rock art is potentially as useful a tool to archaeology in the reconstruction of a past Pueblo culture as more standard analyses, such as palynology. While palynology can reveal facts about the external environment, rock art is physical evidence of human behavior in iconographic form. As such, it reflects some of the socio-economic responses to, and religious manipulation of, the environment.

All data was gathered from Hovenweep site reports and photographs made during the two years of survey, from the Colorado State Archaeologist records of 5MT311 and 5MT312, from the Mesa Verde National Park files, and from information from the University of Colorado's Mesa Verde Archaeological Research Center. Only those figures and shapes were used in the statistical analysis which could be positively identified. More data was available, but partially obscured through distance, sand scouring or overlays of contemporary "rock artists". All of those figures will be omitted until first hand field studies can be made, during the upcoming field seasons.

As an early report, the conclusions made here should be considered as suggestive directions for developing future test hypotheses. Undoubtedly some modifications of theory will be necessary.

METHODS OF ANALYSIS

The rock art sites can first be subdivided into three groups in terms of size: figure/boulder sites, two to ten figure sites and over ten figure sites. "Figure" is used here in its broadest sense, meaning any shape, be it anthropomorphic, zoomorphic, biomorphic or random. As yet, no sites that showed the abstract complexity of Battleship Rock at Mesa Verde have been recorded although Fewkes documents one in Yellowjacket Canyon (1919). As suggested by Fetterman (1976) at Mesa Verdes, the first two subdivisions imply work that one person could probably do in a day's time. The site containing more than ten figures could be the result of two or more people, and, in fact, at 5MT311, differences in patinas of figures on the same rock face show a separation in time as well as authorship.

A second category divides the figures according to location. All of the recorded rock art occurred with other single or multi-purpose sites in major canyon, side canyons, canyon junctions, talus slopes, canyon bottoms or flood plans. Further, definite statistical relationships appear to be present between the location of certain types of symbols and certain types of site features. In addition, many rock art sites themselves appear to be located, in relation to surrounding sites, in a centralized, accessible position. Directional preferences for certain types of symbols also occur often enough to suggest predictability. These points are used to develop research questions which support a locational model for Hovenweep rock art. Moreover the greatest occurrence of rock art appears with Pueblo II and Pueblo III sites, the figures occurring directly on the walls, in some cases. Thus a tentative time frame of PII and PIII is used as it was for the rock art at Mesa Verde (Fetterman 1976).

ETHNOGRAPHIC BASE

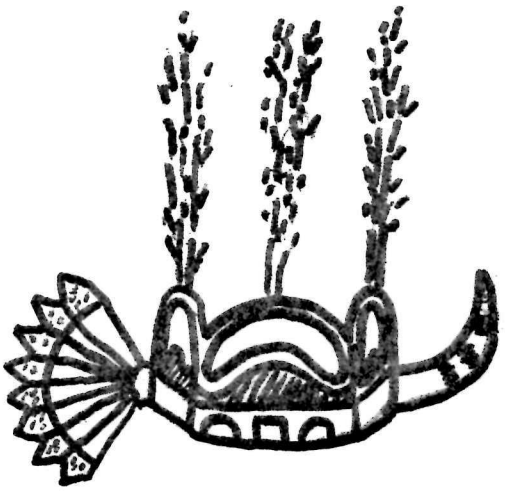
Dependence upon concrete expressions of natural phenomena, supernatural powers and being is a custom of literate as well as nonliterate cultures. Further use of smybols for self-identification or intergroup distinctions in order to define the limits of subgroups living together can be found in western society as well as the non-literage groups in other parts of the world (Levi-Strauss 1962). Field studies have showh iconography utilized by societies to reinforce their oral tradition, thus encoding their cultural values for transmission across generations (Munn 1973). Masks, embodying a non-verbalized concept such as an ogre or judge, have been used by non-literate groups as a means of social control (Seiber 1966). All religious paraphanalia, such as masks, rattles, and altar figures, when in use during a ceremony become focal points for the group and for the individual within the group to see, to have power expressed in his behalf, and through participation, to re-establish harmony or renewal with unseen forces (Wingert 1962).

Within the reports supplied by Fewkes and Owens (1892), Fewkes (1895, 1896), Colton (1949, 1960) and Forde (1931), three different uses of Hopi iconography can be identified. Ceremonial anthropomorphic figures represent agricultural phenomena, while animal, plant, insect and some abstract forms are used by clans first, for self-identification and second, for ownership of shrines and agricultural fields and to designate barriers or legal demarkations between mesas. The following ethnographic data is intended to illustrate some of the ways visual smybons have been put to use.

1. Ceremonial Figures

In 1892, Fewkes and Owens observed and described the Lalakonta Ceremony and its assorted agriculturally based symbols used in altar figures, sand paintings, headdresses, corn cones, corn meal and bundles. This ceremony, which is performed by the women's society, occurs at the end of the yearly cycle in September and is the most important in the series of three performed at that time. It is intended to close the ceremonial cycle for the year. The headdresses and altar effigies are not only useful examples of the Hopi iconography, but also are pertinent to the evidence at Hovenweep.

The headdresses (Fig 68) worn by the four senior participants are made up of five different symbolic elements: semicircular flat discs joined end to end symbolizing rain clouds; feathers and sprigs of seed grass attached to the backs of each cloud; a fan-shaped red smybol with black and white spotted ends representing a sunflower;





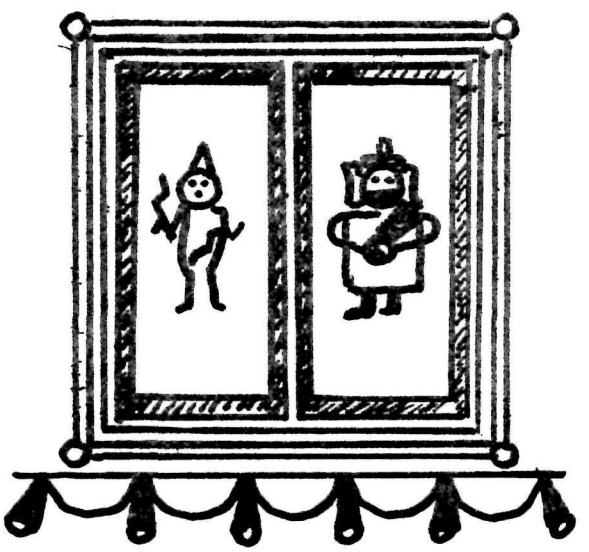


Fig 68 - Lalakonta Ceremony Figures, after Fewkes and Owens 1892 Plates I-II

green and black ringed horn on the left side; green and white rectangles across the headband, connecting all elements, intending to signify rain (Fewkes and Owens 1892:115). We can assume that the presence of the headdress in the ceremony acts as the nonverbalized idea of clouds bringing moisture which, in turn, matures the seeds.

Four altar figures, apparently, represent primary and secondary concepts of germination (Fig 68). Left to right, the Germ God, "Mu-ying-wuh", is painted black across the forehead and chin. His eyes, nose and cheek area are painted in a yellow band. A central feather in back of the head and a small gourd of water carried in the right hand are the Germ God's symbols. Next is the Lakone-mana whose face is painted identically to the Germ God's except black and white. She wears necklaces of shells and holds a wicker spiral-shaped tray. The figure to the right of the Lakone-mana was not given a name, but its presence bears intrinsic meaning for germination. The round face is yellow, eyes and mouth are indicated by three black bands. Above the head is a rectangle with two ears of corn joined end-to-end on it, above that a feather. Below the waist, the body is white, as are the shoulders. The armless torso is separated by green bands, and is divided into left, brown; right, green with little rectangles of white alternating down the center, as rain falling. The fourth figure is half the size of the other three, repeats the anthropomorphic face and paint of the Lakone-mana complete with central feather on the head, but the shoulders are green and brown and the arms are combined into an N shape with three depended small ovals and near the waist are three parallel rectangular marks similar to ones occuring on "Pu-u-kong" which Fewkes claims is a prominent Hopi demi-god (1892). Directly in front of the Germ God is placed a melon-shaped object with a convex surfact holding corn, melon and squash seeds. Coming as it does, at the end of the agricultural and ceremonial year, the relationship between the grass, corn, melon and squash seeds with the powers of fructification as represented by the Germ God and Lakone-mana, implies the need for the seeds gathered from one season's crops to be healthy and fruitful the following season.

A sand painting (Fig 68) directly in front of the Lalakonta altar carries the symbolism of fecundity further, showing a Germ God and another figure of a Lakone-mana maiden with hair whorls, surrounded by bands of yellow, white, red, and green and more symbols of rain clouds and corn cones. The iconography present as described by Fewkes and Owens apparently represents specific concepts dealing with germination, ceremonially formalized in conjunction with rain as essentials for sprouting, growth and maturity to occur. Waters (1963) further notes that the ceremony initiates eligible girls for marriage, the concept of fructification carrying over to the girls themselves. Curing appears to be a vestigal function in the ceremony, since it is owned by the Badger Clan.

2. Clan Identification

Hopis identified themselves personally by means of specialized symbols, as when Hopi men left clan symbols, acting as signatures on government sub-vouchers and on a petition to the Governor of Arizona from A.M. Stephen (Fewkes 1897). Through those documents, Fewkes was able to identify the clans present on First Mesa, the population of each clan and their affiliations with one another. Colton (1960) corroborated Fewkes' Hopi signature postulation through Hopi informants who recognized clan symbol signatures on a boulder shrine at Willow Springs near Tuba City which marked the salt gathering trips to Salt Canyon.

The shapes consist of animals in silhouette; deer, rabbits, snakes, lizards, rabbit tracks, antelope tracks, bear tracks, badger tracks, birds, bird talons, clouds, corn plants, tobacco plants, ears of corn, katchina faces, the sun and circles to represent the earth (360° of the horizon). Colton added the Red ant, spider, reed symbols, the now extinct Oak clan symbol, the strap (rope), rabbit bush (Sivapi), and Puma.

Further use of clan symbols are found in Fewkes' report of Hopi clan ownership of eagle nests, springs and shrines (1900, 1906). Fewkes visited each shrine, noting evidence of iconographic identification. Two Snake shrines at First Mesa, for example, were identified by petroglyphs of snakes along the Snake prayer sticks inside the shrine to further corroborate the oral claim. Similarly, a "Toho" shrine, made up of a mountain lion image was pecked into the rock. The outlines were incised and the heart of the animal was a depression where meal offerings were left. Colton's informants associated the mountain lion (Puma Clan) with the medicine man. Further use of the puma image occurs in sandpaintings used in "Tusayan" and "Sia" snake ceremonials (Fewkes 1895).

3. Land Ownership and Boundary Demarkations

C. Daryll Forde (1931), in studying the agricultural patterns of First Mesa noted additional uses of Hopi clan symbols and abstract symbols. The lands of First and Second Mesa, for example, were subdivided and "delimited by numerous boundary stones (kalani) placed at the corners and junction points. Many of the significant kalani which were small upright slabs or domed boulders, were engraved on their faces with symbols of the appropriate clan" (Forde 1931:357-406). A Cloud (Water)-Tobacco, a Coyote and a Corn clan symbol were identified on stones at First and Second Mesa.

Forde further noted that the boundary definitions between First and Second Mesa were boulders and natural features, such as a series of low hills. Informants reported that until a year before Forde was there, a boulder was placed on each low hill marking a boundary site. "It consisted of an upright natural rock slab facing north and

south, supported on the south by stones. The north face was incised with a horizontal T, whose leg pointed towards First Mesa" (Forde 1931; 357-406).

Evidently, then, those symbols appear to be used for specific, nonverbal information in the legal demarkation of the land, the specific arrangement and image having a semantic intention which only made sense in relation to the topography around it.

In sum, identification of symbol categories by function and location can be made from Hopi ethnographic data. Since identical symbols occur in the Hovenweep area, a similar identification of function should exist. Since similar functions for symbols exist, some of the ideology which those functions support can be isolated. For example, since clan symbols are traditionally used for self-identification and subgroup delineation, and had been as far back as Fewkes could trace (1900), then similar markings found around Hovenweep storage/granaries could be identified as known locations for clan populations and ownership. Similarly, because agricultural fields are designated by means of clan symbols on small boulders along sight lines, then evidence for farm fields could be found by clan symbols or abstract demarkations.

EVIDENCE

Distribution of rock art sites over Cajon Mesa, broken down by number of figures, revealed the following percentages (Fig 69; Table 42). Sites with only one figure occurred 26% of the time, sites with two to ten figures occurred 37%, and sites with ten figures or more occurred 32%, indicating an even distribution without any location taking precedence. It was only when the occurrence of certain figures was isolated that large percentages, indicating some predictability, resulted. Table 42 shows the breakdown of symbol occurrence and site features with which they regularly appeared. The specific symbols that recurred with specific features were the spiral with water control features, animals and hoof/paw tracks with storage/granary features, and anthropomorphic clusters with isolated, small scale habitation use sites.

The spiral and water control features were present together 75% of the time in the eight rock cut sites containing water control features. Further, the spiral symbol was 100% absent from sites without water control. Sites having granary/storage features were found to have a 71% occurrence of animal and/or hoof/paw prints accompanying them. Three single purpose sites contain clusters of anthropomorphic figures and either a combination of granary/storage or single shelter with large panels of 20+ figures, with anthropomorphic figures predominating in number. The unique combination of single purpose,

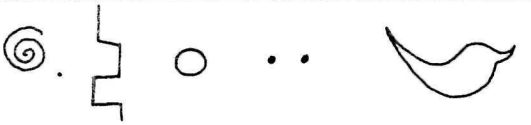
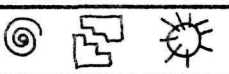
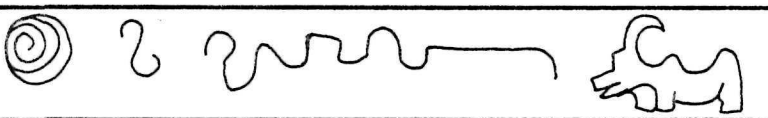
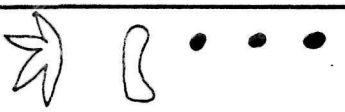
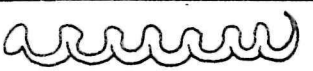
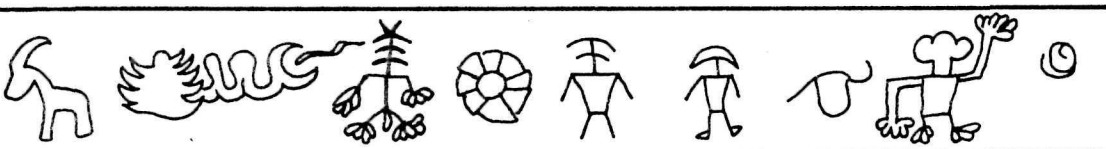
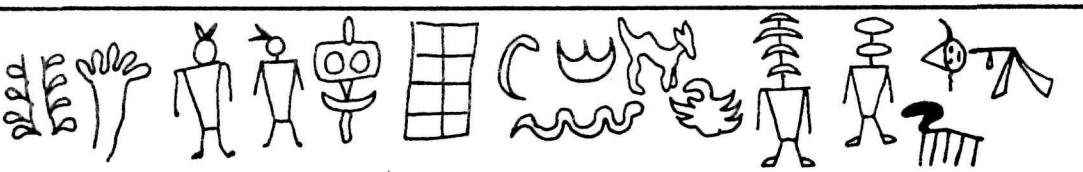
SITE	SYMBOLS
8	
15	
51-52	
57-59	
366	
536	
600	
608	
430	
480	
612	
664	
665	
5MT311	
5MT312	

Figure 69. Symbols Recorded at Each Site

TABLE 42

Specific Symbol Occurrence With Site Features

Site #	8	15	51-52	57-59	366	430	480	536	600	608	612	664	665	5MT 311	5MT 312
Multipurpose site	X	X	X	X	X				X	X					
Small Scale Habitation/Use Site						X		X			X	X	X	X	X
Site Includes Storage/Gran. Features		X	X	X		X		X	X					X	
Site Includes Water Control Feature	X		X	X	X	X			X	X			X		
Site Includes Agricultural Feature							X?				X?				
Site Includes Spiral	X		X		X	X						X		X	
Site Includes Potential Clan Symbol		X	X	X		X		X	X		X		X	X	X
Anthropomorphic Figure Cluster								X						X	X
Rock Art Faces	SE		NE		E	NE	NE			E	E	E	E		E

isolated location and anthropomorphic clusters of those three sites infer ceremonialism. Ten of the fifteen sites were facing east or near-east suggesting a ceremonial use.

Ceremonial Figures

Ceremonial implication is evident in three ways. First, all anthropomorphic figures are shown wearing apparent headdresses (Fig 70 and Objectives Chapter of Hovenweep 1975 Report and Appendices cover photos). At site 5MT312 and Hovenweep site 536, the same headdress recurs among the smaller anthropomorphs, consisting of one or two flat oval discs (like corn plants), one above the other. Unique headdresses are: one bearing lightening-like jagged symbons at site #536, one rainbow-like shape at sites 536 and 5MT311, corn-plant-like shapes at sites 5MT311 and 5MT312. Feathers occur at angles to the head and four flat semi-circular discs placed one above the other with seed grass-like radiating lines connecting the discs can be found at site 5MT312.

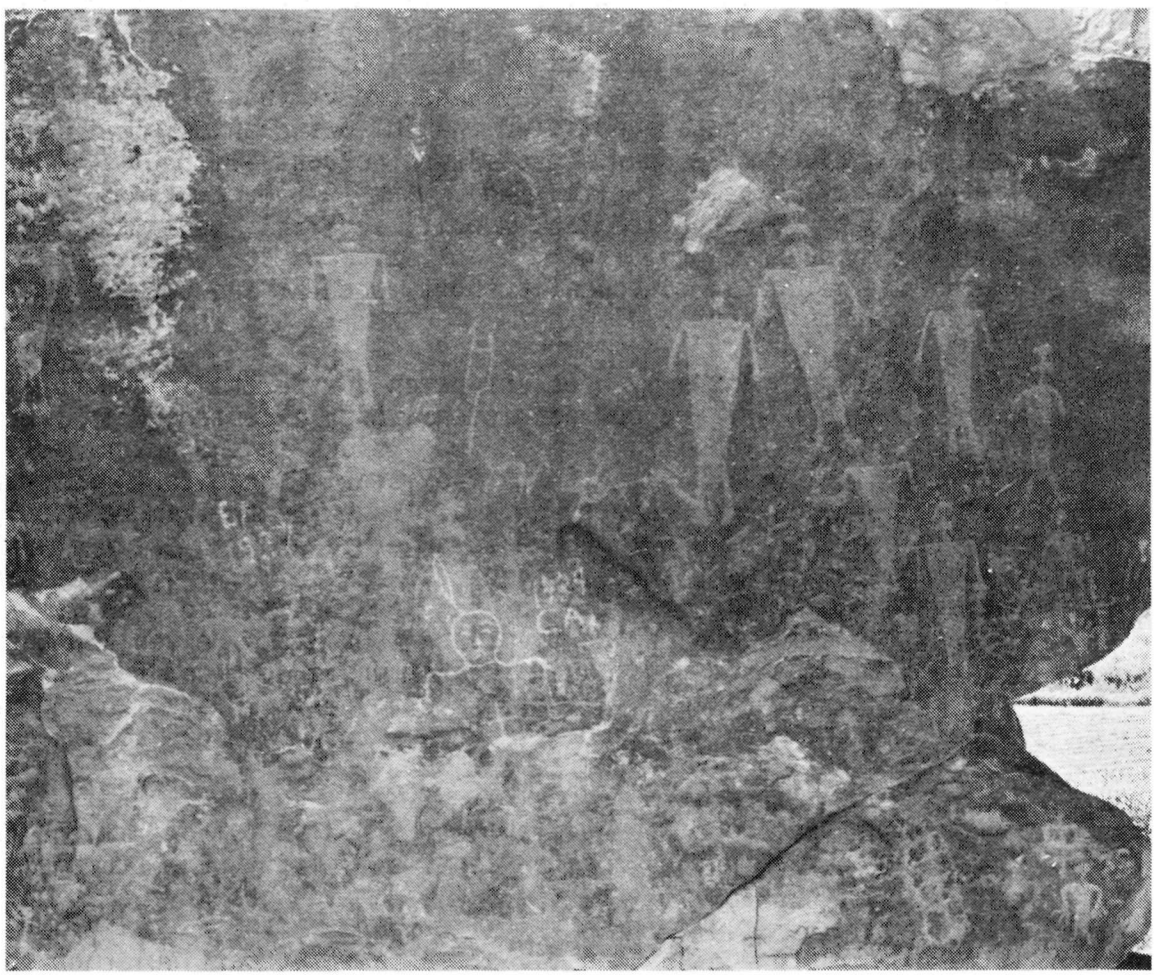
Secondly, ceremonialism is inferred in the spatial arrangement of the figures. In all three sites, the figures are grouped in a structured three dimensional manner. Figure 70 shows a semicircle of five figures with two front figures aligned, one in front of the other, with the center figure bearing the most elaborate headdress. Spaced at intervals away from the group, are two other figures bearing more oval or semicircular corn plant-like headdresses, the final figure represented in X-ray fashion in order to show a small figure with an oval headdress inside the large figure. Due to placement of figures, it is possible to infer that the subject matter is plant fertility and impregnation.

A small figure, center picture just left of the semicircular group, appears to wear a conical-shaped headdress combined with a curving horn-like shape and, with legs spread far apart, is seen bending over or sideways in a clown-like manner.

A third indication of ceremonialism in the three sites is the inclusion of objects held in the hands of important, advancing figures. Finally, apparent corn plants can be seen "sprouting" around certain of the figures.

A review of Colton's (1949) listing of Katchina masks in both Hopi and Zuni ceremonials indicates that the use of the two feathers at acute angles to the head still exists, but there is no Katchina mask containing oval or semicircular flat discs. The only location of those specific motif combinations is the Lalakonta headdress, altar figures and sandpainting. Since the central theme of the Lalakonta Ceremony is seed germination and fertility, speculation

Figure 70. Detail of Petroglyph at 5MT312 (Ismays) Showing Anthropomorphic Figures With Headdresses Arranged in a Spatial Structure



can be made that the talus boulder of 5MT312 is a shrine encoding the same elements of that ceremony, in an earlier form.

Clan Identification

Comparisons of the animals represented in the rock art of Hovenweep and the faunal remains of the animals hunted and eaten, indicate a discrepancy. Petroglyph animals and paw prints appear to be snake, deer, elk or antelope, mountain sheep, bear or badger, mountain lion or coyote, a large bird and a small bird. These animals are easily identified by the distinctive shape carried by the silhouette and by paw or hoof prints identified in Murie (1954).

The Hovenweep surface surveys and excavations of PII and PIII sites across Cajon Mesa identified the following animals. Surface scatter contained mule deer, coyote/dog, cottontail rabbit, woodrat, turkey and Navajo sheep (White 1976). The 1976 excavations produced primarily deer, blacktailed jack rabbit, squirrel, mouse species, gopher, morning dove, goldfinch, black sparrow, scaly lizard, toad, fox, porcupine, pica, cottontail rabbit, woodrat and turkey (White, Chapter IV this report).

The animals actually used and eaten during the same occupation span as the rock art are not consistent, deer excepted, with the animals shown in the petroglyphs. Conclusions in the Hovenweep 1975 reports (White 1976:80) find that "Prehistoric inhabitants of Cajon Mesa probably depended heavily on small game for their meat supply. The mule deer, even, was too rare to have been hunted intensively". It would appear, then, that the depiction of animals might not have represented animals hunted or depicted for hunting magic as is possibly the case in other parts of the Southwest (Heizer and Baumhoff 1962). Since most of those animals' remains are absent from the sites, but are included in all of the ethnographic data from Fewkes and Colton, the rock art animals may have been intended as clan symbolism.

Further evidence that the symbols are clan symbons is the fact that they occur in such a high percentile directly with storage/granary pits, generally, 1 to 4 meters from the granary location.

When plotted out on the map of Cajon Mesa, particular groups of potential clan symbons appear grouped around particular locations. Across the center of the mesa, sites #480,15,430 and 536 have only mountain sheep, deer, elk or antelope figures, with mountain sheep predominating. In Fewkes' report of the Walpi and Sitcomovi clans (1894), those clans were combined into a Horn phratry and made up one-fourth the population. To the northeast, in Hovenweep Canyon, a potential symbol for the Earth Clan is located at site 600, and due north in Cross Canyon a Bear/Badger symbol is found at site 665.

Southwest near the junction of the McElmo Creek and the San Juan River, the possible Snake symbol is found at site 612. At the junction of the McElmo Creek, Bridge Canyon and Yellowjacket Canyon, site 5MT311 shows a mountain sheep and snake symbol above the storage pits along with the ceremonial anthropomorphs, male and female, mentioned previously. Up the slope, 5MT312 shows a probable puma, a snake and a bear/badger paw along with the ceremonial figures mentioned above. The unique combination of clan groupings at those sites with ceremonial anthropomorphic iconography suggests the obvious hypothesis that the function of the site was an inter-mesa ceremonial center for redistribution of food. Ownership and participation by those clans would be a secondary consideration.

Land Ownership and Boundary Demarkation

Site #612 is a single isolated dome-shaped boulder in association with site #604 containing granary/storage pits. A long apparent snake adorns the east side, facing the McElmo Creek. 450 meters to the north and east, site #608 contains probable water control features and terrace field features. No other animal or potential clan symbol has been recorded for that complex of features. The boulder is found at the bottom of the slope and possibly identifies sites #601, 602, 603 and 604 in much the same manner as those identified by Forde (1931) as demarkation stones.

Site #480 is another single isolated boulder site with markings that are all abstract in form, the center form being a long, perpendicular line. Due to its abstract nature,the syntactical relationship between all the shapes apparently has some significance. Speculation can be made, due to Forde's (1931) observations, that the location of this boulder and the precise location of the forms on it have some demarkation significance or possibly an astronomical alignment which can be further measured and observed in the field. Hence, two boulders, matching Forde's description of Hopi farm field notations on boulders appear to be present in the Hovenweep area.

CONCLUSIONS AND UNTESTED HYPOTHESES

In answer to the questions posed, based on the above information and relationships, we can conclude that there is a definite locational relationship between rock art symbols and architectural and agricultural features, and that the iconography appears to be agriculturally based. The non-random occurrence gives the placement of the figures semantic intent. A model to explain why the non-random occurrence and semantic intent exist could be stated as follows: rock art functions as a culturally mnemonic device which, as a socio-economic response to the environment and as a religious manipulation of the environment, transmits cultural codes across generations at

cultural centers. We can also hypothesize that the relationship between documented Hopi use of symbols agriculturally, socially and ceremonially, with the past use of symbols at Hovenweep is so consistent that fragments of the prehistoric ceremonial figures and symbols for corn fertility, rain and Being can still be found embedded in the western pueblo ceremonial iconography.

Test implications are: 1) If ceremonialism, identification, ownership and boundary demarkation are mnemonic functions of rock art, then we can expect to maintain or increase the percentage of symbol/feature occurrence as we find and record more rock art sites. 2) If this is a cultural phenomena, the same set of locational relationships should apply anywhere in the Anasazi area. 3) Further investigation of location should define relationships of rock art to sites which here-to-fore have appeared to be unintelligible or random and culturally indistinct from other cultures such as the Navajo or Fremont. 4) If the Anasazi rock art can be isolated by cultural characteristics, stylistic and locational, then it would be possible to locate migrations or diffusions of cultural ideas. 5) If the rock art in the Anasazi culture is agriculturally based, we should find evidence that the socio-economic and religious iconography diffused with agriculture or was adapted to agriculture by a group's adjustment to agriculture and environment pressures.

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