AN ARCHAEOLOGICAL SURVEY
OF THE RADIUM SPRINGS AREA, SOUTHERN NEW MEXICO

edited by

Thomas R. Hester

with contributions by

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ERRATA

Page 15. Third paragraph, line 2: "such" should be "some".

Page 21. Fourth paragraph, line 8: "hugh" should be "huge".

Pages 21 and 22 should be reversed.

Page 26. Third paragraph, line 4: "1800" should be "1800s".

Fourth paragraph, line 3: "Espedjo" should be "Espejo".

Page 37 should begin with the following:

"*Lithic Scatters*

During the 1976 survey, eight lithic scatters were recorded (Table 2). The"

Page 55. Third paragraph, line 3: "weights" should be "weighs".

Page 86. Caption for Figure 23: "RX029" should be "RS029".

Page 119. Line 9: "Table II" should be "Table 11".

Page 130. Under XIV in Table: "Tm" should be "T_n".

Page 140. Line 2: "menbers" should be "members".

Line 5: "qreas" should be "areas".

Page 150. First line under Turquoise Bead Pendants:

"(Fig. 29)" should be "(Fig. 39)".

Page 158. First paragraph, line 7: "baed" should be "bead".

Page 163. Fourth paragraph, line 4: "or" should be "of".

ACKNOWLEDGEMENTS

Many people contributed to the success of the Radium Springs Archaeological Survey. Mr. Daniel C. B. Rathbun, District Manager, and Ms. Karen L. Way, District Archaeologist, of the Las Cruces District Bureau of Land Management (BLM), were most helpful in the orientation phase of the project. They provided written introduction to the ranchers in the survey area and a variety of useful literary source material, and made available to us BLM publications, maps, and their own special knowledge of the local geology, ecology, and archaeology. The help of Mr. Richard Meninger, contracting officer in the Bureau of Land Management's Denver office, in the administration of this project is greatly appreciated.

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Field director for the project was Col. Thomas C. Kelly, Research Associate of the Center for Archaeological Research.

The survey crew, all graduate-level archaeologists, consisted of crew chiefs Stephen Black and Erwin Roemer, and crew members Michele Nicklow, Roger Filson, Robert Wilkerson and Steve Vollmer. They walked more than 1600 miles in 26 days over terrain that varied from bad to impossible with the weather ranging from burning heat to snow.

Dr. Joel D. Gunn, James Ivey, and Lynn Highley handled the computer programs. Thomas Kelly, Stephen Black and Erwin Roemer conducted the laboratory analysis, microwear studies, and photography, and helped prepare many sections of the report. Editing of chapter drafts and overall supervision of the project were handled by Dr. Thomas R. Hester, Dr. Joel D. Gunn and Dr. Paul R. Katz.

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I. INTRODUCTION

Thomas R. Hester

During October and November 1976, the Center for Archaeological Research of The University of Texas at San Antonio carried out an archaeological survey of the Radium Springs area in southern New Mexico (Fig. 1). This survey was conducted under the terms of a contract (YA-512-RFP6-80) between the Center and the Bureau of Land Management (BLM). Dr. Thomas R. Hester, Director of the Center, was Project Administrator, and Dr. Joel D. Gunn and Dr. Paul R. Katz served as Principal Investigators. Fieldwork was under the supervision of Dr. Gunn, with direct field responsibilities handled by Col. Thomas C. Kelly, Research Associate of the Center. Contract Officer for the BLM was Richard Meninger (Denver), and the Contract Officer's Authorized Representative was Karen L. Way (Las Cruces).

The Radium Springs survey was initiated because the BLM desired information on the cultural resources of the region for inclusion in the "Radium Springs Geothermal Leasing Environmental Analysis Record." Thus, the survey was designed to provide an assessment of cultural resources within selected areas owned by the government. A major objective of the fieldwork was to provide the BLM with a statistically valid estimate of cultural resource densities within various environmental zones in the project area.

The Center prepared, and submitted for BLM approval, a technical proposal outlining the goals of the archaeological survey (this was sent to Mr. Meninger on September 15, 1976). The research and sampling design outlined in that proposal (see Section II of this report) followed closely the specifications set forth in Section F of YA-512-RFP6-80, pages 22-25. In general, the specifications called for an intensive survey of a minimum of 32 square-mile sections of land controlled by the BLM. The sample units were to be drawn by a stratified random sampling procedure, designed at a 10% level, with regional applicability in southern New Mexico. In addition, a thorough literature review was also required. Specific field survey requirements were set forth by the BLM, and a set of criteria was provided for the documentation of sites.

The Center's efforts were, we believe, successful in achieving those objectives set forth by the BLM. In actuality, we were able not only to accomplish the required survey goals, but also to survey intensively one additional square-mile section and to record a series of six important sites lying outside the boundaries of the sampling units specifically chosen for field study. Our literature survey involved not only published materials but also the study of unpublished notes and manuscripts on file at the Las Cruces BLM office, The University of Texas at El Paso, and other institutions. If it was felt that certain published or unpublished items would be useful to future researchers working in this region, even if we did not specifically cite them in the text of this report, they were included (and appropriately marked) in the bibliography (see Section IX).

This report contains the results of the Radium Springs archaeological survey. It represents a collaborative effort, in both the fieldwork and analysis

phases, involving many of the staff members of the Center. Some research initiated during this project, such as trace element analysis of obsidian artifacts (see Appendix III) and further studies of shell species found at one site, are not yet complete; however, they should represent substantial contributions to the archaeology of the region when published at a later date.

The reader will note that we have not included detailed site locations or site maps for the Radium Springs area (Fig. 1 provides an outline of the area in which sample sections are located). This has been done to prevent, as far as possible, the acceleration of relic-collecting and pothunting in the area. Many of the sites had been extensively surface-collected prior to the visit of the survey team, who noted potholes and other evidence of uncontrolled excavation at some of the larger sites. Archaeologists working in southern New Mexico will find site survey forms, USGS maps, a table of UTM coordinates for sites, and other locational information on file at the Museum of New Mexico (Santa Fe); duplicates are also retained at the Center for Archaeological Research. This arrangement for the deposit of detailed site locational data has been worked out with the BLM Las Cruces office (Daniel C. Rathbun, letter to Thomas R. Hester, January 3, 1977).

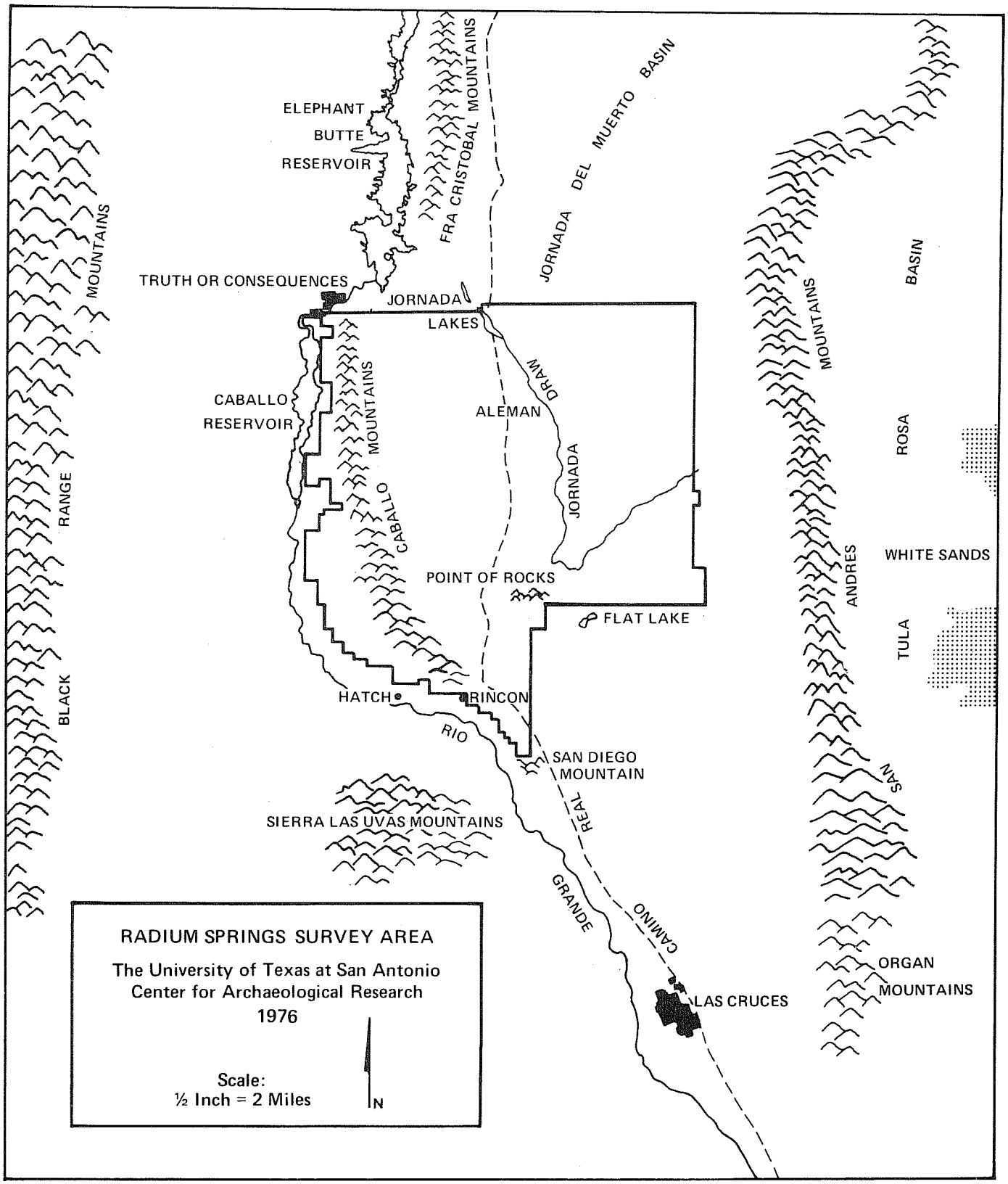


Figure 1. *The Radium Springs Survey Area.* Approximate boundaries of the survey area indicated by bold black lines.

II. RESEARCH DESIGN AND FIELD PROCEDURES

Joel D. Gunn, James E. Ivey and Thomas C. Kelly

Sampling and Survey Technique

Bureau of Land Management specifications (YA-512-RFP6-80) called for the drawing of a 10% stratified random sample from which 5% would be surveyed within the 640 BLM-controlled sections in the Radium Springs project area (BLM Las Cruces District 3). These specifications were successfully met, with only some minor alterations as discussed later in this chapter.

Stratification of the samples was based on two models of the study area. The first is an ecological-physiographic zonation based on topographic and vegetation maps. The second is locally held knowledge of the distribution of cultural materials in the study area derived from resident informants. The ecological-physiographic data are most important to the sampling distribution and will be discussed first. Adjustments in the sampling distribution on cultural considerations are a secondary level of stratification and involve minor alterations in the pre-established zone concept.

The sampling method employed during the project was a "disproportionate stratified random sample" (Mueller 1974:32). In addition to utilizing this sampling strategy, the field crew conducted its fieldwork in accordance with the "Field Survey Requirements" outlined on pages 23-25 of Section F of YA-512-RFP6-80. To facilitate research and sampling design, and to speed the processing of the field data, the crew used a specially developed form designed for computer coding (Appendix I).

After a preliminary literature review, and a review of physiographic and ecological criteria for the study area, we divided the area into four environmental zones:

> Zone I: Zone I is defined by the 5003-foot contour line above sea level. Within Zone I the land starts to rise eastward toward the San Andres Mountains. Vegetation begins to grade toward broadleaf deciduous woodland.
>
> Zone II: Zone II is defined on the east by the 5003-foot contour line and on the west by the foothills of the Caballo Mountains. It is an intermontane valley called the Jornada del Muerto. The vegetation is primarily grama grass with shrubs and dwarf shrub forms. Some areas of the valley floor are over 50% sand.
>
> Zone III: Zone III is the foothills and highlands of the Caballo Mountains. It is bordered on the west by the Rio Grande Valley. The vegetation is sub-humid grassland, primarily grama grass with some broadleaf evergreen.
>
> Zone IV: Zone IV is in the Rio Grande Valley west of the Caballo Mountains. Vegetation is bunchgrass-oak in the northern section, grading to broadleaf evergreens and shrub forms in the south.

Drawing a sample of 33 square miles (32 square miles were required by the BLM contract) from the study area was complicated by the interspersion of privately-

owned land into the midst of the predominantly BLM-owned lands. The following procedure was used. A map was traced from the one supplied in YA-512-RFP6-80 showing the boundaries of the area and the privately-owned lands within that area. To this map the boundaries of the four environmental zones as defined above were added. Next the survey units of one square mile each were numbered sequentially within each zone. Table 1 shows how the number of survey units to be surveyed were apportioned among the zones.

Once the survey units were apportioned, the units to be surveyed were selected using a table of random numbers. Before drawing the sections to be surveyed the design was altered slightly to tailor it to expected field conditions. While the adjustments are small, it was considered by the BLM and project archaeologists to be in the interest of cultural research to disproportion the sample in favor of areas of known cultural intensity. To assure scientific control those areas thought to contain fewer cultural materials were systematically sampled but on a less intensive scale.

Our model for disproportioning the sample was developed from the experience of local informants. Discussions with inhabitants of the project area revealed that they classify sites on the basis of size and age. About a half dozen sites in the Jornada del Muerto are considered to be large and are recognized on an individual basis. Small sites are not recognized as discrete entities but are known in clusters or concentrated areas of occupation. At our request, big sites were marked by local informants on maps with x's roughly commensurate with the size of the site. Concentrations were outlined as large areas.

In the local typology, the age of sites was judged on the basis of the presence or absence of ceramics. Older, non-ceramic sites were believed to be close to the playas and lakes at the center of the Jornada. Younger ceramic sites, some with pithouses, were on the San Andres slopes.

Construction of the maps showed that most of the sites and concentrations of sites occur in Zone I and II with a notable concentration toward the south end of the San Andres Mountains, and outside the project area. In fact, most of the large sites are immediately adjacent to the study area to the south. To accommodate this pattern the sample was first disproportioned downward 10% in the Caballos and West Caballo Slopes zones and upward 10% in the Jornada del Muerto and west San Andres Slopes. Table 1 displays the draws made for the various zones.

The amount of disproportioning is exactly quantifiable as either a negative or positive number of sections. The probability of a given section in the project area being selected for survey is modified to the extent that it is 10% less probable it will be selected in the western zones and 10% more probable it will be selected in the east.

Since only 5% of the 10% sample was to be surveyed, selection of draws to be surveyed was done with the knowledgeable advice of our local informants. In the interplay between the table of random numbers, the archaeologists, and the informants, with the table guarded against a totally biased selection, the archaeologist advocated as wide a coverage as possible in the confines of the random sample, and each local informant advocated use of his or her experience as to site distributions.

TABLE 1

RADIUM SPRINGS ARCHAEOLOGICAL SURVEY
Random Samples Stratified by Zones and Disproportioned Toward the East

Underscored numbers were surveyed.

Zone 1. 71 Sections, 11% Total, 7.04 Section + .704 Sections (+10% Disproportion) = 7.744 = 8 Sec.

8 Random #'s between 1 and 71 inclusive, without replacement

12 61 59 63 50 42 15 62

Zone 2. 332 Sections, 52% Total, 34.32 Sect. + 3.432 (+10% Disproportion) = 37.752 = 38 Sections

38 Random #'s between 1 and 332 inclusive, without replacement

135	200	266	213	317	307	236	175	11	139	110	205
15	93	277	80	276	20	87	268	252	72	108	41
192	21	286	297	29	182	72	210	55	320	37	117
82	217	186	284								

22 substituted for 20 which is partially private property
259 substituted for 277

Zone 3. 190 Sections, 30% Total, 19.8 Sections - 1.98 (-10% Disproportion) = 17.82 = 18 Sections

18 Random #'s between 1 and 190 inclusive, without replacement

156	137	91	86	122	190	71	187	51
58	139	64	93	102	121	3	160	114

85 substituted for 86 which was sheer shale mountain
115 mistaken for 175 Zone II

Zone 4. 48 Sections, 7% Total, 4.62 Sections - .462 (-10% Disproportion) = 4.158 = 4 Sections

4 Random #'s between 1 and 48 inclusive, without replacement

48 24 38 44

2 substituted for second draw
others inaccessible

Some biasing factors lay beyond our control. The privately-owned property in the Jornada del Muerto is the better watered and more fertile land. Prehistoric inhabitants probably favored these areas and any clear understanding of their habits would require a survey of these areas.

Survey Procedure

Survey procedure was guided in its most general aspect by an agreement with the BLM to walk transects every 50 meters in the sections selected for survey. Funding was provided for 26 days of survey with a crew of nine persons.

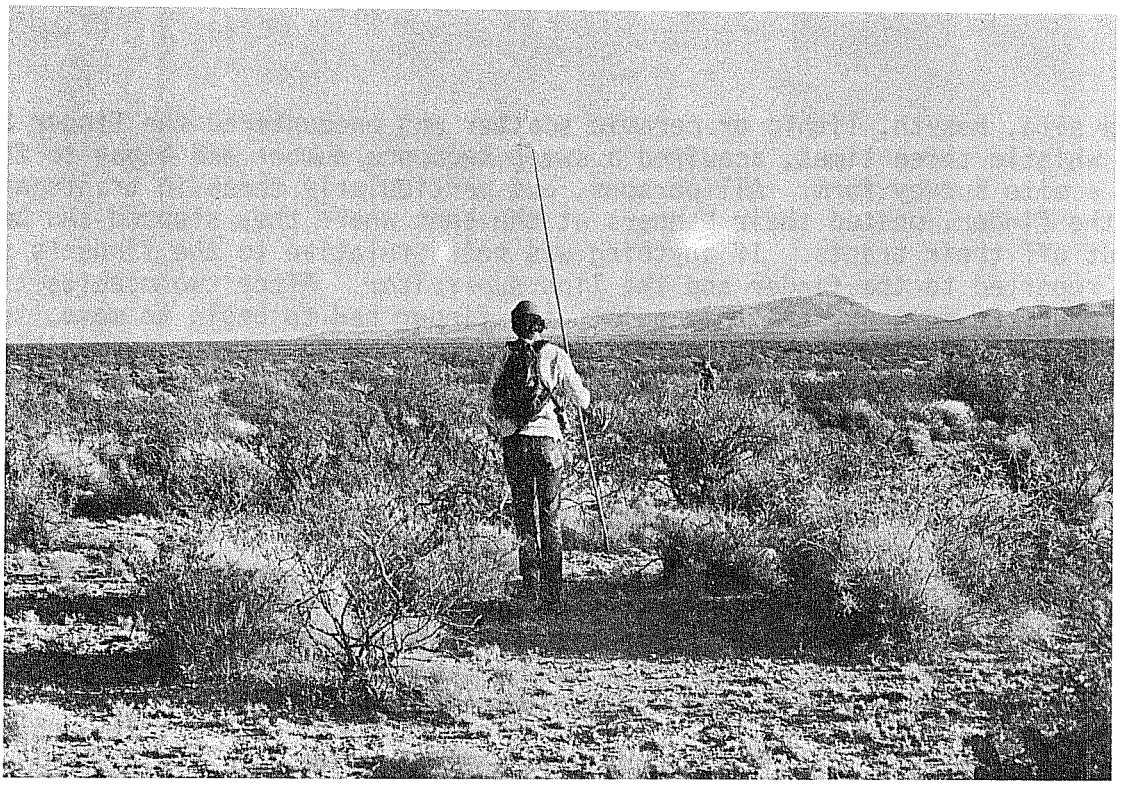
Survey of each section was initiated by determining its location. While considerable difficulty was encountered in locating them, 30 of the 33 sections were located through the use of USGS section markers, two were tied to markers within one mile, and one at Apache Gap was laid out from map study and triangulation. Flags were placed every 0.2 mile around the section to guide the survey crew, usually by counting paces and following a Silva compass.

These flagging devices were fashioned from cane poles with plastic tap streamers or triangular flags (Fig. 2,a). Orange was found to be the best color. Blue streamers were added to corner and half-mile markers to insure their identification.

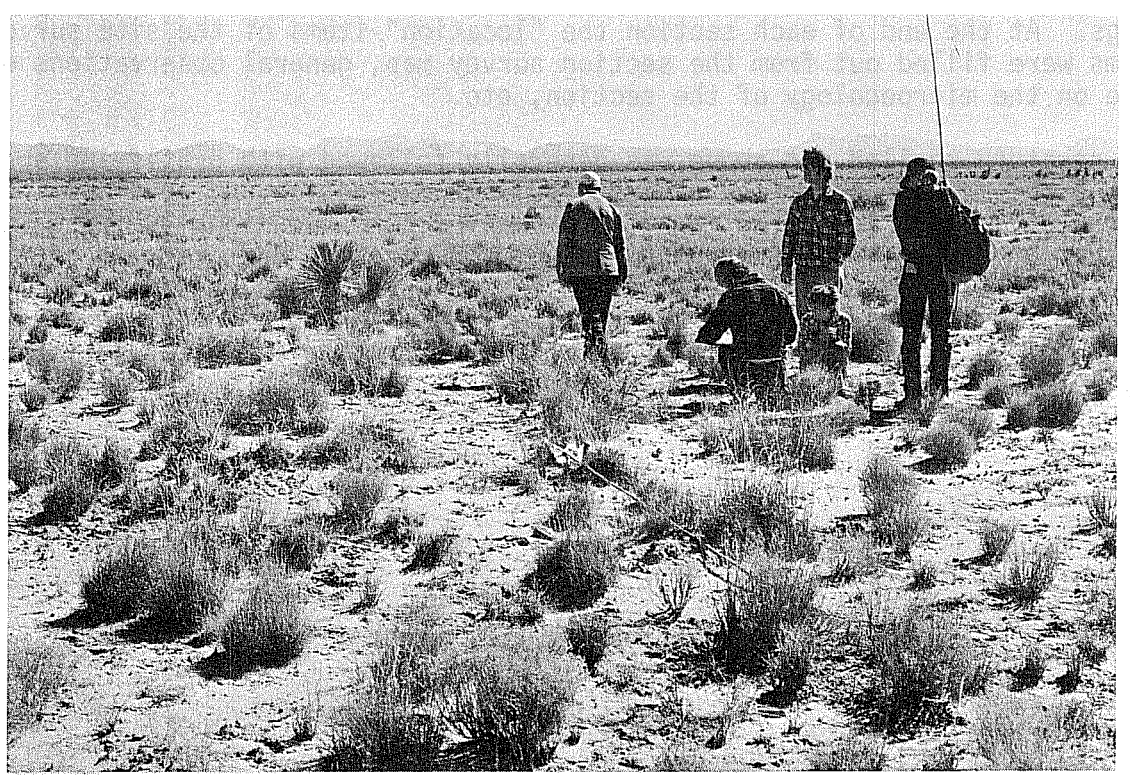
Once the section was laid out, the survey crew was lined up along a side of the section at 50 meter intervals. Each individual carried a cane pole with streamers, a police whistle, paper bags and site survey coding forms on a clipboard. Two persons carried CB radio transceivers. These were invaluable for communication relative to keeping the survey line straight and instrumental in the method adopted for site location recording.

The persons carrying the radio transceivers were located in the next-to-last position at each end of the line. One person on the end of the line carried a Brunton compass and informed the nearby transceiver bearer of the course of the line and the bearing of its length. Since the line was the instrument of measurement it was imperative that it be aligned with the relevant cardinal direction. The progress of the line was under the control of the line supervisor, who carried one of the radio transceivers and a section survey map.

As the line moved into a sweep the line supervisor was advised as to the status of the line by the compass person and commanded the necessary corrections to maintain course by means of the transceiver. If an individual artifact was found the finder informed the line supervisor as to the transect, or tract, it was on and the nature of the artifact by calling out or by relay through the other transceiver. The line supervisor would then respond with a sweep sequence number and record it on the section survey map, at the point and row which the finder was reporting. The finder collected the artifact and if it was of an interesting nature, such as a projectile point, filled out a site survey coding form on it. If a form was to be filled out the finder blew the whistle twice and the line stopped for two minutes. At the end of two minutes the timekeeper would initiate the resumption of the survey.



a



b

Figure 2. *Views of Survey Procedures.* a, survey crew in Jornada del Muerto (note walking flags and scrub brush vegetation); b, group consultation (looking east toward San Andres Mountains).

If a site, hearth, lithic or ceramic scatter was encountered the finder blew the whistle three times, acquired a sweep sequence number and began to fill out a site survey form. All persons, but particularly those in tracts adjacent to the finder, posted their banners at the spot where they stopped and began to scout off their tracts. If anything was noted relative to the finder's site it was reported to the finder and the line supervisor. After two minutes the line was urged to move on. At this point, the finder had to begin to move, to record and to collect simultaneously. This was a challenging but not impossible task which usually became unnecessary as experience facilitated recording efficiency.

Some sites were larger than 50 meters. In this case a different mode of recording was used. The person on whose tract the site was first encountered would maintain the site survey form. All reporting of artifacts, artifact concentrations, hearths and so on were subsequently reported to the line supervisor who recorded locations on the section survey map with a standard set of symbols. No stops were made after the first site survey form was filled out. In this way the location and content recording of large sites was accomplished rapidly and systematically. Topography of larger sites was obtained later by overlaying site survey maps with enlargements of topographic sections.

At the end of each sweep the line supervisor called in the sweep sequence numbers in order of their issue, checked site survey forms for completeness, labeled bags, assigned trinomial site numbers and discussed the results of the sweep (Fig. 2,b). After five minutes the timekeeper informed the crew of the passage of time and the new tracts were stepped off, keyed to the preset .2-mile flags. At the end of each section the "location" items of the site survey forms were filled out from the section survey map, general observations were made on the microecology of the section, etc.

The strategy spelled out above was generally followed with gratifying success. Some problems were sometimes encountered with navigation and coverage. For instance, strong, localized magnetic anomalies were occasionally found to deflect Brunton compasses as much as 30°. On occasion the progress of the line was broken by dense vegetation which would not allow passage. Normally, however, the terrain was passable and the vegetation open enough to allow the required coverage. Checks by the field supervisor indicated that few, if any, sites were missed by these procedures.

III. ENVIRONMENTAL SETTING

Stephen L. Black

Topography and Geology

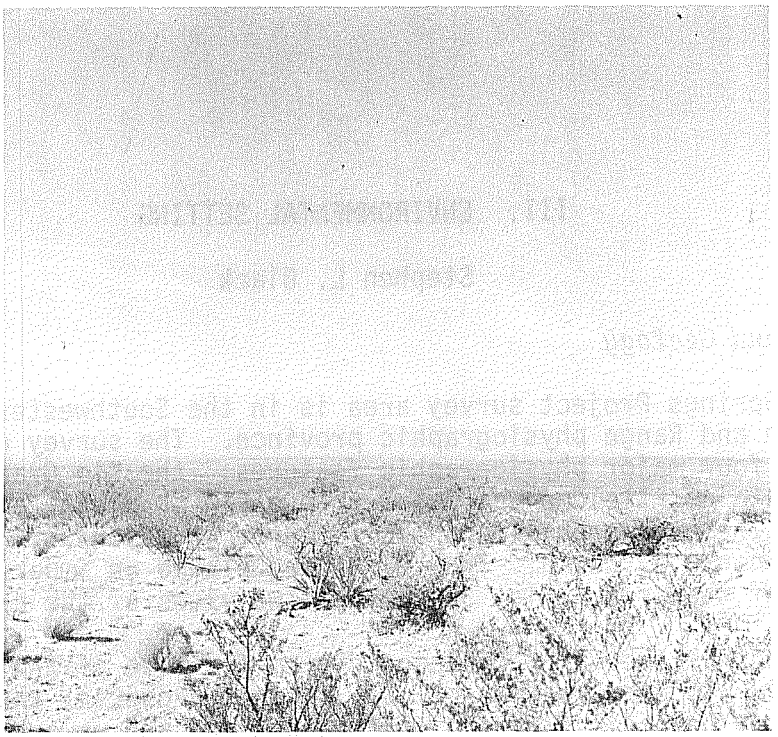
The Radium Springs Project survey area is in the Southwestern United States Basin and Range physiographic province. The survey area borders or includes four major physiographic features: the Rio Grande Valley, the Caballo Mountains, the Jornada del Muerto basin or plain, and the San Andres Mountains. These four physiographic features or major environmental gradients run roughly north to south. They have long played an important role in man's occupation of the area. Fig. 3 provides two views of the area.

The Rio Grande is the major drainage system for much of the state of New Mexico. Prior to construction of dams along its course, the Rio Grande Valley was subject to periodic flooding which deposited and reworked silt, sand, and gravel enriching the valley soils. Today much of the valley is under intensive cultivation and irrigation. The valley produces large quantities of fruits, nuts, vegetables, and cotton. Caballo Reservoir forms the western boundary of the northern half of the survey area. The Caballo Mountains rise abruptly on the east side of the Rio Grande, preventing the formation of a wide floodplain on the east side of the valley. The Caballos also served to route the river, creating a long bend.

The Caballo Mountains lie almost entirely within the survey boundaries. The Caballos (also known as the Sierra Caballos, the Spanish Mountains, and the Horse Mountains) range from four to 10 miles wide and run north to south for approximately 35 miles. Elevations range from 4400 to 7554 feet. The Caballos are very rugged; the lack of heavy vegetation has left the Caballos severely eroded and covered with many deep arroyos and steep slopes. A series of peaks range from Caballo Cone (6091 feet) in the northern end of the range to Brushy or Timber Mountain (7554 feet) at the southern end. The Caballos can be divided into a northern and southern ridge by Palomas Gap (4760 feet). Palomas Gap was a major historical route (undoubtedly of importance in prehistoric times as well) crossing the Rio Grande and providing access to Jornada del Muerto prior to construction of Caballo Reservoir.

Structurally the Caballo Mountains are a tilted fault block with a gentle east slope bisected by many small arroyos and a steep western face which drops to the Rio Grande. Most of the range consists of various limestone and shale formations. Precambrian formations are exposed at the base of the western face. The Caballos are not minerally rich; however, small deposits of gold, lead, copper, and vanadium have been mined. Fluorspar mines active in recent decades are located in the northern end of the range.

The foothills of the San Andres Mountains form the eastern boundary of the survey area. The San Andres Mountains are six to 18 miles wide and



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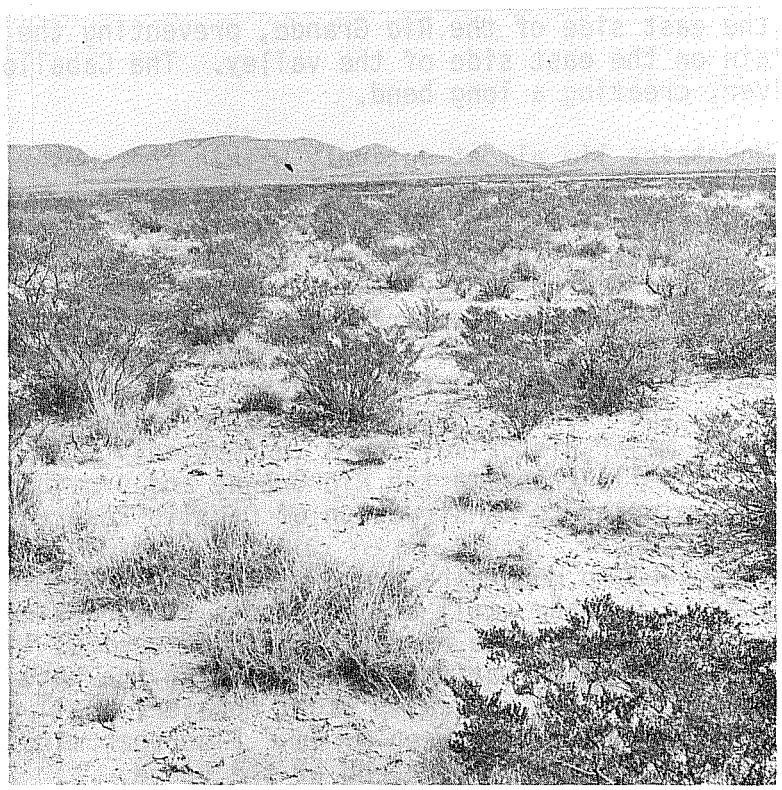

b

Figure 3. *Topography and Vegetation in Radium Springs Survey Area.* a, Facing west across Jornada del Muerto Basin from foothills of the San Andres Mountains (note creosote vegetation, grasses, yucca and rabbit bush); b, AR095, High Lonesome Windmill Site. Beads scattered on surface in foreground.

extend for approximately 80 miles. The San Andres range is a westward tilted fault block made up largely of sedimentary formations which dip westward under the Jornada Plain. The range has a gradual western slope and an abrupt eastern face, and divides the Jornada del Muerto Basin or plain on the west and the vast Tularosa Basin or valley on the east. The drainage divide falls close to the western edge of the range. This results in the majority of precipitation on the San Andres draining into the Tularosa Basin. Many small arroyos dissect the west side of the range and empty into the Jornada Basin.

The San Andres Mountains range in elevation from 4600 to 8958 feet and offer more of a barrier to human travel than do the Caballos. Three peaks in the San Andres rise to more than 8000 feet: Greer Peak (8005), Salinas Peak (8958) and San Andres Peak (8239). The San Andres have more vegetation than the Caballos, but it is still rather sparse and erosion gives the mountains a rugged appearance. Human travel across the mountains would have been through one of the many passes at the heads of the major canyons. Major passes adjacent to the survey area from north to south are Cottonwood Canyon (6310 feet), Sulphur Canyon (5920 feet), Hembrillo Pass (5790 feet), Deadman Canyon (5740 feet) and San Andres Canyon (5350 feet).

The majority of the survey area lies between the Caballo Mountains on the west and the San Andres Mountains on the east in the large basin known as the Jornada del Muerto. The Jornada extends north to south 140 miles from the Bosque de Apache Grant (near Socorro) to the Dona Ana Mountains (near Las Cruces). It varies in width from 15 to 30 miles and in elevation from 4000 to 5000 feet. The Jornada del Muerto Basin is often referred to as a plain because of its flat character. The Jornada Basin actually has interior drainage with few small relief drainages into the Rio Grande at the southern and northern ends. In geologic terms the Jornada is "an asymmetrical syncline with the deepest part on the west side and with a southward plunge" (Kottlowski *et al.* 1956:74). This syncline has been filled with unconsolidated detritus eroding from the San Andres and Caballo Mountains which reaches a depth of over 300 feet (thickness). This alluvial fill grades from very coarse near the mountains to very fine near the center of the basin. Aeolian sand and clay deposits derived largely from the Rio Grande have contributed to the basin fill. The prevailing southwestward winds have deposited these aeolian sediments along the eastern side of the Jornada Basin, often taking the form of large sand dune ridges that have a distinct red hue.

Minor topographic features within the survey area include Point of Rocks, San Diego Mountains and several smaller hills all of which are volcanic or igneous plugs or intrusions.

Water Resources

The Jornada del Muerto is quite renowned for its "waterless" character. Permanent water sources in the survey area are limited to the Rio Grande and a few springs, with the former undoubtedly the most reliable water source in the surrounding area. Heavy prehistoric and historic occupation

along the Rio Grande Valley bears witness to this fact. Many writers have characterized the Jornada del Muerto as being completely without surface water, and while today this is generally true, it has not always been so. Along the center of the basin is a low drainage labeled Jornada Draw on modern maps. Jornada Draw is actually a series of depressions some of which are playas. During times of excessive rainfall these depressions fill up and become shallow lakes. Major playas in the survey area are Flat Lake and Jornada Lake or Laguna del Muerto. These large, essentially extinct playas have been known to hold water for several months of the year, a fact noted as recently as the 1920s. Evidence suggests that during cooler, wetter periods of the Pleistocene these playas were large lakes which held water year-round. These cooler-wetter intervals last occurred 8,000-13,000 B.P. and would have provided early inhabitants of the area with sufficient water resources (cf. Wendorf and Hester 1975). In addition to playas and the Rio Grande, several springs are known to have been active in the Caballo Mountains. McRae Canyon at the extreme northern end of the Caballos was the largest and most reliable of these springs and often attracted travelers. Occasional springs can be found in the San Andres Mountains in the large canyons which drain into the Tularosa Basin. Water or the lack of it must, of course, have played an extemely important role in prehistoric land utilization patterns within the survey area.

Climate

The climate of the survey area is typical of the Chihuahuan Desert: extremely variable precipitation, low humidity, high evaporation, extreme temperature ranges between day and night, and abundant sunshine. Precipitation averages eight to 10 inches annually within the survey area but varies locally and annually. A majority of the annual rainfall occurs during July-September in the form of localized torrential thunderstorms which cause a rapid runoff on sloping terrain and ponding in flat terrain and small depressions. Annual rainfall records kept at the Jornada Experimental Range, just south of the survey area, indicate an annual precipitation average (1915-1972) of 8.93 inches (Ares 1974). Annual averages range from 17.74 inches in 1941 to 3.03 inches in 1952. It is of interest to note that less than one-third of the annual averages fall within one inch of the 58-year mean. An average of 52% of annual rain falls during the July-September period. Periodic droughts, often lasting for several years, are well documented. During the 1951-1956 drought, annual rainfall averaged only 5-1/2 inches, of which only 2.8 inches fell during the critical July-September period. In short, rainfall in the survey area is sparse, localized and extremely variable.

Daily temperature ranges generally exceed 30°. Mean maximum temperature for July ranges from 80° in the San Andres Mountains to 95° in the Jornada Basin. Mean minimum January temperatures range from 22° in the basin and San Andres Mountains to 28° along the Rio Grande. Sunshine occurs 75-80% of the total possible hours. Relative humidity is usually very low, averaging 30% or less annually and ranging from 40-50% in the early morning hours to 15-30% during the afternoon. Winds are usually light but vary seasonally. The combined effect of low humidity, high afternoon temperature, and abundant sunshine results in an annual evaporation average of 89.45 inches, 80% of which occurs during the frost-free season. The average annual number of frost-free days ranges from

200 to 220. Frost-free days cannot be interpreted as a growing season, as Buffington and Herbel (1965:142) point out, since "moisture conditions are such that normally growth occurs only from 90 to 100 days."

Considerable seasonal variation in climate is noted for the area. Winters are sunny with cool to warm days and cold nights. Snow occasionally falls in the area but normally melts on contact with the ground. Late winter and spring are normally the windiest with strong winds and gusts up to 25-35 miles per hour. When these winds occur the Jornada Basin is hazy with windblown loess. Summer brings hot afternoons and cool nights, very high evaporation rates and localized thunderstorms.

Prehistoric climatic conditions in the immediate area have not been carefully documented. However, such inferences can be drawn from surrounding areas. Wimberly and Eidenbach (1972) suggest that the climate in the adjacent Tularosa Valley has remained essentially the same for the past 4000 years. Climatic inferences prior to 4000 B.P. are not available in adjacent areas. Judge (1973), after reviewing a number of sources on paleoenvironments, concludes that the central Rio Grande area (approximately 100 miles north of the survey area) during Paleo-Indian occupation was cooler and wetter. It may be inferred that during Paleo-Indian times (ca. 8,000-13,000 B.P.) many of today's extinct playas in the survey area contained water.

*Soils**

Detailed soil maps of the survey area do not exist. The soils of the Jornada Experimental Range have been mapped and provide the closest comparisons. Buffington and Herbel (1965) include a review of the Soil Conservation Service soil survey of the range and include 30 soil types, many of which have a very spotty distribution. Major types present on the range and occurring in the survey area include: Verhalen clay, Russler loam, Dona Ana complex soils, Banbar soils, Coppice duneland sands, Goldenberg sands, and Cacique loamy fine sand. Of interest, Goldenberg sands were extensively occupied by peoples who Buffington and Herbel refer to as "Pueblo Indians." Goldenberg sands are aeolian sands which take the form of large sand dunes and were deposited over piedmont soils. Goldenberg sand formations occur in the northeastern part of the range which is adjacent to the San Andres Mountains. Similar sand formations occur within the survey area. In general, soils of the survey area range from rocky silty loams on alluvial fans adjacent to mountains to fine sands such as the Goldenberg and Coppice duneland sands which frequently form small to large dunes and ridges. Clays occur on and around playas, along the Jornada Draw, and are visible underlying sands in the cutbanks of many arroyos.

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*Since this section was written, Gile (1977) has published additional data on the soils of southern New Mexico, just south of the study area.

Fauna

Detailed studies of the survey area fauna are apparently lacking. The following partial list of common names includes fauna observed during the 1976 survey and serves only to indicate most common species present today: mule deer, antelope, jackrabbit, cottontail rabbit, badger, skunk, hawk, owl, quail, duck, dove, buzzard, roadrunner, rattlesnake, lizard, coyote and kangaroo rat. Fauna not observed but reported to us as being present in the area include: eagle, grey fox, bobcat, mountain lion (occasionally) and porcupine. Prairie dog towns were once quite extensive on the Jornada Plain, according to early travelers and surveyors. Desert bighorn sheep can be found just southeast of the survey area in the San Andres National Wildlife Refuge. Numerous aquatic species as well as migratory birds frequent the Rio Grande. Prehistoric fauna, especially during the Pleistocene, must have included many species no longer present in the area and many now-extinct forms. Bishop Cap Cave located 10 miles southeast of Las Cruces was the site of a questionable association of human bones with extinct Pleistocene fauna reported in 1929 (Davis 1969). Among species identified in cave deposits were extinct bison, sloth, horse, camel, cave bear and others dating prior to 8000 B.P. when cooler and wetter climatic conditions prevailed.

Flora

The vegetation of the survey area is typical of the lower and upper Sonoran biotic zones defined for the area by Bailey (1913). The Caballos and most of the Jornada Basin are characterized as lower Sonoran. The Point of Rocks and San Andres Mountains are typically upper Sonoran. The vegetation is generally sparse except along drainages and along the Rio Grande. Typical vegetation today consists primarily of desert scrubs (mesquite and creosote), cacti, yucca and short grasses. Considerable evidence suggests that domination of mesquite and creosote has primarily occurred within the last 100 years. Similar mesquite and thorny brush "invasions" have been noted in Texas, southern Arizona, and the Plains (cf. Bogusch 1952; Harris 1966; Reeves 1973). Early travelers generally described the Jornada Basin as a dry, grassy plain, but their descriptions of it varied considerably due to seasonal variations, frame of mind, and actual experience in the area, as the following selected quotes illustrate.

On August 1, 1840, Wislizeuus (quoted in Buffington and Herbel 1965:140) reported:

> In the rainy season there is generally plenty of water on the Jornada . . . a high plain in the elevation of from 4,000 to 5,000 feet above the seas, with dry, hard soil, tolerable grasses and an abundance of mesquite and palmillas [*Yucca elata*]. They later grow to a height of 10 to 12 feet.

Susan E. Wallace in 1888 (quoted in Little and Campbell 1943) described the Jornada del Muerto with no small degree of poetic license:

> The portion I speak of appears to have served its time, worn out, been dispeopled and forgotten. The grass is low and mossy, with a perishing look--the shrubs, soapweed, and bony cactus withering like some grisly skeleton; the very stones are like the scoria of a furnace. You vainly look for the flight of a bird . . . no bee nor fly hums in the empty air; and save the lizard (the genius of desolation) and horn frog, there is no breath of living things.

Stacy in 1857 traveled through the Jornada after rain had been falling, and his description (see Buffington and Herbel 1965:141) contrasts sharply with that of Mrs. Wallace:

> Nothing could exceed the beauty of the country we traveled over this morning. The whole extent, as far as vision reached ahead, was a level plain, covered thickly with the most luxurious grass, and filled with beautiful flowers . . . containing the greatest abundance of the finest grass in the world, and the richest soil here lying vacant, looked upon by the traveller with dread, because of its want of water.

Present-day vegetation of the survey area varies considerably, largely based on the availability of moisture. Vegetation along the Rio Grande is often dense with stands of cottonwood and willow trees. The adjacent Caballo Mountains with their steep rocky slopes are mostly sparse; creosote bush is the dominant species. Vegetation is somewhat thicker in and around the arroyos, small canyons and valleys of the Caballos and includes some thick grasses, tarbush, cacti, yucca, acacia and some mesquite. Mesquite is more common on sand dunes piled up against the western side of the Caballos. Similar vegetation is found on the steep lower slopes of the San Andres foothills. Canyons and valleys tend to be larger in the San Andres and they, as well as higher peaks, have a wider range of vegetation more typical of upper Sonoran. These include grasses, pinyon, juniper, willow, hackberry, mulberry, agave, mountain mahogany, sotol, oak and acacia. The Jornada del Muerto is no longer a grassy plain. Mesquite is the dominant, ever-increasing plant species. Vegetation patterns in the Jornada Basin include (1) mesquite sand dunes with *Yucca elata*, snakeweed and a few grasses in between; (2) low drainage areas, often quite broad, densely vegetated with thick tobosa grasses, black grama grass, tarbush, mesquite, acacia, allthorn, sumac, yucca and various cacti; and (3) playas and Jornada Draw, having black grama grass flats sparsely vegetated with *Yucca elata* and some tarbush. In general, mesquite increases in sand locales, especially sand dunes, creosote increases with slope, and grasses and vegetational variety increase in low drainages.

Excellent documentation of the relatively rapid change from grass to scrub bush occurring in the Jornada Basin as well as much of southern New Mexico is provided by two sources, Buffington and Herbel (1965) and York and Dick-Peddie (1969). Buffington and Herbel studied vegetation changes on the Jornada Experimental Range that have occurred since 1858. Comparison of vegetation patterns in 1858 to modern vegetation patterns is possible through the use of records made by the original Land Office Survey of 1858 which divided

the land into sections. In 1858, good grass (black grama and tobosa) was present on an estimated 90% of the range. In 1963 good grass was present on less than 25% of the range. From 1858 to 1963 the mesquite-dominated area increased tenfold. During the same time, creosote increased 18-fold. Tarbush increased until 1928, since which time creosote has invaded tarbush areas. It should be noted that while creosote and mesquite quickly and effectively eliminate grass cover, tarbush invades much more slowly and never completely chokes out grass. York and Dick-Peddie used similar methods (comparing land survey records to modern data) but on a much larger area--small plots on transects across southern New Mexico. Their findings are much the same. Grass cover has been rapidly lost by invasion of mesquite and creosote. The question arises: how did it happen?

The possible factors discussed as causes of rapid scrub brush invasion are: overgrazing of cattle, climatic change, periodic droughts, suppression of grassland fires (cf. Reeves 1973) and seed dispersal caused by livestock (see Wells 1970 for further discussion). While many believe that during the Indian occupation of the Jornada del Muerto Basin the prairie was periodically burned (killing shrubs and allowing grass to take over), this has not been reported by any early travelers in the area and is considered an unlikely factor. Little climatic change has occurred in the area in the last several thousand years, much less in the last 100 years. Buffington and Herbel (1965:163) conclude that "seed dispersal, accompanied by heavy grazing and periodic droughts, appeared to be the major factor affecting the rapid increase of scrubs." York and Dick-Peddie offer a slightly different conclusion which is of direct archaeological significance. They observed the association of mesquite pockets noted in 1858 with "Indian campsites." They conclude: "The speed of recent occupation by mesquite may be attributed to the effects of cattle in the presence of ideal source pockets of mesquite around old Indian campsites" (*ibid.*:165). Buffington and Herbel (1965:162) also stated that "Indian activity contributed to the early formation of mesquite dunes before domestic livestock grazed on that area." Both studies ambiguously refer to "Indians" or "Pueblo Indians" without specifying the exact nature of sites but one suspects they refer to the easily recognized Mogollon ceramic sites in the area. York and Dick-Peddie (1969) and Buffington and Herbel (1965) suggest that mesquite dispersal may have been prompted by prehistoric use of mesquite as a source of food and firewood.

IV. ARCHAEOLOGICAL BACKGROUND

Stephen L. Black

Previous Archaeological Investigations

The archaeological resources of the survey area have not been carefully studied up to the time of the 1976 fieldwork. Although many sites have been recorded along the Rio Grande River within and adjacent to the survey area, only one site description (of a petroglyph site) has been published (Davis 1976); no sites have been excavated. Several Mogollon villages have been partially excavated in the general vicinity (Lehmer's work at Las Tules 1948, the Rincon Village dug by Hammack 1962, and the Hatch Site excavated by Schaafsma 1974). A brief description of these excavations will be provided; for a more detailed summary see Marshall (1973). A search of the literature and files of the Museum of New Mexico revealed that no sites had been previously excavated and reported in the survey area. Available published and unpublished accounts of archaeological resources are very spotty and generally inconclusive. The following descriptions of work done in the area indicate that much remains to be done before the area will be understood archaeologically.

Lehmer set up a base camp in Las Cruces in 1940 and spent two years surveying and excavating sites while defining what he termed the Jornada Branch of the Mogollon (Lehmer 1948). He spent six weeks surveying "the Las Cruces district and the lower Tularosa Basin, with a few casts over a wider area" (Lehmer 1948:9).

Lehmer (1948:71) noted "Mimbres villages occasionally occur in and to the east of the Rio Grande Valley between Hatch and Caballo. In these, Mimbres black-on-white wares dominate decorated wares, and these are house mounds, typical ruins of Mimbres Phase Pueblos."

Lehmer did excavate a Mesilla Phase village at Las Tules which is located on the Rio Grande terrace above the floodplain near Las Cruces. He found two types of pithouses at Las Tules--rectangular pithouses with entrance ramps and circular pithouses with no visible entryways. One structure, house 5, was larger than other circular pithouses and had a 45-cm bench around the walls with two central postholes. Lehmer suggested that the house could have been a ceremonial structure. In addition, two smaller structures were interpreted as a possible storage pit and a sweathouse. Four recognizable storage pits were uncovered. El Paso Brown was the dominant (>85%) ceramic type found at the site. The remaining sherds were Mimbres Black-on-White, Mimbres Corrugated, San Francisco Red and Alma Plain which Lehmer says are "all native to the Mimbres Phase." Both Mimbres Boldface and Mimbres Classic were present in the collection. Few artifacts other than potsherds were found at Las Tules. These include sherd scrapers, clay pipes, *Olivella* beads, *Glycymeris* bracelets, a bone ring, finely chipped small projectile points, scrapers, one biface, oval and trough metates, manos, pestles and polishing pebbles. Lehmer (1948:13) states that Las Tules "is a typical Mesilla Phase site." Lehmer also tested a cave (La Cueva) in the Organ Mountains in which he found ceramics to a

depth of several meters in the talus slope. Due to the disturbed nature of the cave his results were inconclusive.

In 1962 Hammack excavated a pithouse village near Rincon as part of the highway salvage work along Interstate 25. The Rincon village, LA 5599, was situated on a flat, mesquite-covered mesa overlooking the Rio Grande Valley approximately one mile east of San Diego Mountain, just outside the southern boundaries of the Radium Springs survey. Hammack uncovered six pithouse structures of which he thoroughly excavated four. LA 5599, like Las Tules, had both rectangular and circular pithouses. Structure #4 was a relatively large (18.3 feet in diameter) circular pithouse which Hammack said was probably a communal structure. One small structure may have been a sweathouse. Other features at the site included three trash pits and one storage pit. Of the ceramics recovered, 88% were El Paso Brownware. The remaining ceramic types (in order of declining frequency) were Mimbres Boldface, Mimbres Classic, Three Circles Red-on-White, Starkweather Smudged Decorated, Jornada Brown and San Francisco Red. Other artifacts found included projectile points, bifaces, scrapers, a drill, flake tools, gravers, choppers, paint-grinding palettes, abraders, hammerstones, cores, metates, manos, pestles, discoidal beads, a piece of worked turquoise, an *Olivella* bead and a *Glycymeris* pendant. Hammack interprets LA 5594 as a Capitan Phase site based on its location. All other criteria--ceramics, architecture, and artifact assemblage--indicate that LA 5599 is very similar to Las Tules. In our evaluation, LA 5599 is most likely a Mesilla Phase village. Of interest, Hammack found a cache of metal arrow points on the surface of the site which can probably be attributed to the presence of Apache in the area.

In 1964 Schaafsma (1974) excavated another pithouse site known as the Hatch site (LA 3135). The site was excavated as part of salvage work along Interstate 25. The Hatch site is situated on the east side of the Rio Grande on a gravel terrace opposite Hatch, New Mexico. It is Schaafsma's opinion that the Hatch site has three components: an Archaic or "Cochise" component, a Mesilla Phase Jornada Mogollon component and a Dona Ana Phase Jornada Mogollon component. The Mesilla Phase houses were grouped at the north end of the site and the Dona Ana Phase houses at the southern end. Despite noting these distinct groupings, Schaafsma (1974:5) states that "the structures are unrelated to each other in a formal pattern, and are all scattered in such a manner as to indicate there was no village or house organization." Marshall's (1973) summary (based on an uncompleted manuscript contains much information not available in the 1974 report. The difficulties encountered when 10 years elapsed between excavation and analysis are apparent. The Archaic component of the site consists of scattered lithics collected on the surface and includes a heavy dart point. The Mesilla Phase component at the site consists of three circular pithouses which were excavated and apparently 14 other pithouses of which only two were tested. Ceramics from the Mesilla Phase component are as follows: Alma Plain (93%), Alma Scored (1.5%), San Francisco Red (1.6%), Jornada Brown (2.7%), El Paso Brown (.2%) and El Paso Polychrome (1.0%).

them to Jornada Mogollon and Apache cultures. The CRMD reports are not widely distributed but they do contain adequate descriptions of work done and are available in the CRMD office.

John Davis (1976) recorded a rock art site just north of Rincon which is within the survey area. The Rincon petroglyph site is located in a small canyon at the extreme southern tip of the Caballo Mountains. Davis mentions two small rockshelters in the canyon which have associated occupational debris. A variety of motifs are present, including geometric figures, corn stalks, circles, handprints, birds, anthropomorphic figures and various unrecognizable symbols. The most profuse motif is what Davis calls "bug-eyed Kachinas"--these are large pairs of eyes which appear all over the site. Davis notes the similarities of the Rincon petroglyph site with those at Three Rivers, New Mexico, and Hueco Tanks, Texas, and suggests they can be attributed to Mogollon artists. Several miles south of this site on the north side of San Diego Mountains is another petroglyph site known to locals and mentioned by Trost (1970) but which has not been previously recorded. A description of the Jornada rock art style of the "Desert Mogollon" of southern New Mexico can be found in Schaafsma (1972).

Almost all sites recorded in the vicinity of the survey area are along the Rio Grande Valley, evidencing heavy occupation along this permanent water source. Archaeological resources in the interior of the Jornada del Muerto are very poorly understood, as indicated by Kelly (1966:31): "Insofar as we know now, the interior [Jornada del Muerto] has attracted only transients, such permanent sites as are reported are in ecologically more favorable localities on the edges of the basin." Professionally, the Jornada del Muerto is almost unknown; local collectors have been far more active.

Ares (1974:57) mentions: "Frequently parties hunting Indian artifacts in sand hills came to the Jornada." Local ranchers report it is not uncommon to see several hundred treasure hunters or "arrowhead" hunters searching the area on weekends. Access to the land managed by BLM is practically unlimited. While most collecting is confined to searching sand hills for "arrowheads," several sites have been excavated by collectors looking for pots in the floors of pithouses. Perhaps the worst example of this occurred just south of the survey area. A hugh village site (AR092) was bulldozed by a local "pothunter" who destroyed approximately 40 acres of a Mimbres pithouse village in the process of looking for whole Mimbres bowls. The damage to archaeological sites and resources inflicted by local collectors and pothunters is severe, especially by those who do their searching in four-wheel-drive vehicles. However, experienced collectors can often offer the archaeologist useful site distribution data, as will be discussed later in this report.

The general area of south central New Mexico and the adjoining El Paso area of Texas has witnessed a phenomenal increase in archaeological investigations within the last five years. Major surveys which recently have been

Architectural features found in the Dona Ana component at the Hatch site include a double room surface structure, four circular pithouses and a rectangular pithouse with a ventilator-entrance. Ceramics from these structures indicate wider occupation time spread and include: El Paso Polychrome (35.4%), Alma Plain (34.4%), San Francisco Red (12.7%), Chupadero Black-on-White (6%) and Corrugated Smudged (Seco?, 5.1%). Minor amounts of the following ceramic types were also found: Alma Scored, Alma Incised, Alma Fugitive Red, Mimbres Incised, El Paso Brown and Jornada Brown. Schaasfma's assignment of this component to the Dona Ana Phase is apparently based largely on structural evidence (i.e., pithouses plus surface structures found together). Lehmer believed Dona Ana Phase sites would have ceramic assemblages of approximately one-half El Paso Brown and one-half El Paso Polychrome with Alma Plain as the intrusive type. Once again influence from the Mimbres area to the west is so strong that assignment of this component to the Dona Ana Phase may not be warranted.

From the three excavations described--Las Tules, Rincon Village, and the Hatch site--a pattern emerges regarding settlement along the Rio Grande Valley. Pithouse villages dating from roughly A.D. 900-1100 are present along terraces and mesas overlooking the Rio Grande. Western influence from the adjacent Mimbres area is strongly present, especially at the Hatch site. The ventilator-entrance and ceramic types indicate this influence. All three sites have a mixture of architectural types: circular and rectangular pithouses with the addition of a small surface structure at the Hatch site. All three sites have pithouses which were larger or deeper than others at the sites and suggest the existence of communal structures. Of interest, Lehmer, Hammack, and Schaasfma all noted that structures were not easily discernible from surface indications. Extensive testing was necessary to define structures.

A comprehensive survey has never been attempted in the vicinity of the project area. During the 1960s, highway salvage surveys along Interstate 25 were carried out by the Museum of New Mexico. Unfortunately, the sites encountered along the route were generally poorly recorded and no summary report on the survey work has been written. Descriptions of sites encountered along the Rio Grande Valley were usually confined to a brief comment such as "chipping station," "factory site," "lithic, some pottery," etc. Most site forms indicate that the sites were "not worth excavation." Of the few sites marked as worthy of excavation or testing, only the Hatch site and the Rincon Village site were excavated. Cultural affiliations indicated on site forms are generally either Archaic or Mogollon; no Paleo-Indian sites were recorded. A majority of these sites were found on terrace remnant knolls on secondary terraces overlooking the Rio Grande.

The Cultural Resources Management Division (CRMD) of the New Mexico State University at Las Cruces has had several small testing and surveying contracts during the last few years in the Radium Springs project area and surrounding vicinity. Beckett (1976) recorded five sites in T16S, R1W vicinity near Cox Tank and Estes Tank No. 3. These sites were small, deflated sherd and lithic scatters associated with scattered hearths. Beckett assigned

completed or are in process of publication include McGregor Range (Beckes *et al.* 1977), Three Rivers Drainage (Human Systems Research 1977), and Hueco Bolson (Whalen 1977). Two small surveys conducted as part of the Natural Areas Survey in Texas are Hueco Mountains (Betancourt 1977) and Franklin Mountains (Way n.d.). Publication of these surveys should add considerable information to our knowledge of settlement patterns in the south central New Mexico-El Paso area. The El Paso Archaeological Society has been active in the area and has published many reports of sites, artifacts, and archaeology of the area. A field team from North Texas State University, under the direction of Pierre Morenon, has recently completed excavations of several pithouse sites near Hatch and the data should soon be published.

Cultural History

Prehistoric Occupation

The first populations to occupy the area were the Paleo-Indians of ca. 8,000-13,000 years ago. The Paleo-Indians lived in small mobile groups, including in their subsistence regime the hunting of large Pleistocene fauna such as mammoths, *Bison antiquus*, camel, wolf and horse (cf. J. J. Hester 1975). We recognize this widespread early hunting technology primarily on the basis of distinctive lanceolate-shaped projectile points such as Clovis, Folsom, Eden, etc. No Paleo-Indian sites have been previously recorded in the survey area. Local collectors, however, have in their collections many Paleo-Indian projectile points such as Clovis, Folsom, and Angostura, all collected in the general vicinity of the Jornada del Muerto. Hammack (1962) noted that Folsom camps were present along the Rio Grande Valley near Rincon. The Mockingbird Gap site, a Clovis site mentioned by Judge (1973), is located at the extreme northern end of the Jornada del Muerto. Numerous Paleo-Indian projectile points have been found in neighboring Tularosa Basin (cf. Krone 1975).

While no careful studies of Paleo-Indian sites have been done in the survey area, they can be predicted to occur. Judge (1973) analyzed data from 30 Paleo-Indian sites in the Central Rio Grande area approximately 75-150 miles north of Truth or Consequences. He found three critical factors governing the location of these sites: water, overview and hunting. "Hunting" refers to a broad open "hunting area" capable of supporting big game herds. "Water" sources utilized by Paleo-Indian hunters included playas or ephemeral ponds, permanent rivers and streams. Judge found most Paleo-Indian sites located on ridges or knolls ("overviews") overlooking the hunting area and water sources. The numerous playas found along the middle of the broad, open Jornada del Muerto plain would have attracted herds of late Pleistocene big game animals during cooler, wetter years (with intermittent dry intervals; see Wendorf and Hester 1975:12) which occurred 8,000-13,000 years ago. These playas often are surrounded by distinct ridges which would offer a good overview of the surrounding terrain. The Rio Grande Valley would have undoubtedly offered all three environmental criteria during the late Pleistocene. Sometime around 8,000 years ago the large herbivores common in the late Pleistocene became extinct. This has been variously attributed

to a gradual climatic change, from a cooler, wetter climate to a warmer, drier climate, or to the hunting pressure put on big game populations by Paleo-Indians (see Butzer 1971:507-512 and Martin and Plog 1973). Whatever the reasons, approximately 8,000 years ago the Paleo-Indian tradition was replaced by a hunting and gathering lifeway referred to as the "Archaic".

The Archaic cultures present in the southern half of the American Southwest have been described by various terms including the Cochise variant of the Desert Archaic (Sayles and Antevs 1941), the Hueco Phase of the Jornada Branch of the Mogollon (Lehmer 1948) and the Picosa (Irwin-Williams 1967). Basically, all these terms refer to hunting and gathering cultures which existed from ca. 8,000 B.P. until the introduction of ceramics ca. A.D. 1-800. These Archaic peoples exploited a wide variety of plant and animal resources with the emphasis clearly on gathering vegetal foods. These cultures are best known from rockshelter and cave deposits such as Bat Cave (Dick 1965), Tularosa Cave (Martin *et al.* 1952), Fresnal Shelter (Wimberly and Eidenback 1972) and the many caves in the Hueco Mountains (Cosgrove 1947). Open campsites, rock quarries and plant processing sites also occur but do not have many perishable items preserved. Corn was introduced during the Archaic at about 3,000 B.C. (Bat Cave) first as a wild plant and later as a domesticate. Squash and beans were added to the domestic plant list by 1000 B.C. The tool inventory included grinding stones, dart points, bifacial knives, scrapers, choppers, axes, hammerstones, drills, pestles, mortars, etc. Perishable items found in cave deposits include basketry, matting, cordage, cotton snares, netting, atlatls, digging sticks, fiber sandals, etc. Most research on the Archaic cultures in southern New Mexico has been concentrated on cave or shelter deposits at the expense of open sites; hence, overall settlement patterns are poorly understood.

Within the survey area, non-ceramic sites--presumed to be Archaic--have been recorded along Rio Grande terraces but no excavations have been carried out. Rockshelters and caves are rare in the survey area; a few small shelters occur in the Caballo Mountains (Davis 1976) but no large shelters or caves are known to exist. Quarry sites would be expected to occur in the Caballo and San Andres Mountains, as well as several igneous outcrops such as Point of Rocks. The most common Archaic site types which would likely occur in the project area are open campsites and plant processing or specific function sites. Archaic components are often recognized by archaeologists investigating later sites (Schaafsma 1974). Archaic open sites are most often defined on the basis of negative evidence, i.e., no ceramics. The Archaic hunting and gathering cultures are chronologically followed by the introduction of ceramics and the development of pithouse villages. In southern New Mexico peoples of this tradition are known as the Mogollon. In 1948 Donald J. Lehmer published the Jornada Branch of the Mogollon; he included most of the present survey area within the boundaries of his Jornada Branch. Lehmer proposed a series of phases for the northern and the southern Jornada cultural areas. His scheme follows:

*Jornada Branch of the Mogollon (After Lehmer 1948)**

Phase Names

Northern	Southern	Time Range
San Andres	El Paso	A.D. 1200-1400
Three Rivers	Dona Ana	A.D. 1100-1200
Capitan	Mesilla	A.D. 900-1100
Hueco	Hueco	Prior to A.D. 900

Lehmer based his proposed phases on surveys and excavations carried out in 1940 and 1941 and comparative notes from previous researchers. Lehmer actually excavated only a Mesilla Phase and an El Paso Phase site. Mesilla Phase sites are characteristically pithouse villages consisting of circular pithouses without entrance ramps and rectangular pithouses with entrance ramps. The type site is Las Tules, discussed earlier. The dominant ceramics are El Paso Brown with Mimbres Boldface, Mimbres Classic, San Francisco Red and Alma Plain as intrusives. Lehmer's El Paso Phase was based on the Bradfield site and the Alamorgordo sites excavated by Bradfield and Stubbs. All were surface pueblo structures consisting of continuous room blocks in either long tiers or grouped around a central plaza. The dominant pottery type was El Paso Polychrome; intrusives were more numerous than Mesilla Phase wares and included Chupadero Black-on-White, Three Rivers Red-on-Terracotta, Lincoln Black-on-Red, Playas Red Incised, Ramos Polychrome, St. Johns Polychrome and Heshotauthla Glaze Polychrome. Lehmer describes other traits and typical artifacts from both phases but the diagnostic criteria are architectural styles and ceramic types. Lehmer proposed the Dona Ana Phase as a transitional period between pithouses and surface pueblos and between El Paso Brownware and El Paso Polychrome. Northern phases were proposed by Lehmer on the basis of a difference in ceramics he found on surface sites in the northern half of the Jornada cultural area. Despite the rather tenuous nature of Lehmer's phase assignments, based largely on surface collections, 29 years have elapsed and no one has seriously challenged Lehmer's basic outline. Marshall (1973) provides a good summary of excavated sites of the Jornada Mogollon area.

Excavated sites of the Jornada Mogollon consist of pithouse villages, surface pueblos, and a few shelter deposits with ceramics in upper levels; all of these represent occupational sites. Other types of Jornada Mogollon sites known largely from surface indications include rock art sites (petroglyphs and pictographs; see Schaafsma 1972 for a discussion of the "Jornada Style" of rock art in New Mexico), temporary campsites, isolated sherd scatters and isolated caches. Petroglyphs occur at rock outcrops and in canyons. Occupational sites are usually close by but not in direct association. Temporary campsites, i.e., burned rock scatters with ceramics, are widespread and are known to occur along river valleys, on basin floors, on alluvial fans, and on top of mountains. In other words, temporary campsites

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*For a more recent study of Jornada sites in the Hueco Bolson, see Whalen (1977).

occur in practically all areas. Isolated chert scatters are again found in a variety of locations. Isolated caches usually involved ornamental artifacts associated with a ceramic vessel and have been found in many locales.* Pithouse villages are known to occur along the Rio Grande Valley terraces, along mountain stream terraces and on alluvial fans in basins near mountains. Surface pueblos frequently occur in association with extinct playas on basin floors (Brook 1971). Brook also mentions that these sites occur both near the center of large basins and near the edges of basins close to mountains. Buffington and Herbel (1965) note the occurrence of a surface pueblo in association with Goldenberg sand formations in the Jornada del Muerto Basin. The above site locations indicate the known range of site types. Site settlement patterns have not been adequately studied until very recently and will presumably be better understood with publication of a number of recent surveys.

Historic Occupation

> Just above the future site of Las Cruces the *Camino Real* cut across a bend of the River [Rio Grande] and entered on a ninety-mile stretch of waterless desert--a short cut which saved distance but cost many lives, since the Indians could lurk in the mountains and pounce on their victims without warning. So many travelers were killed that this particular stretch was known as the *Jornada del Muerto* - the day's journey of the dead man (Sonnichsen 1958:49).

The Jornada del Muerto has also been interpreted as "journey of death" and "journey of the dead" and the implication is clear--this passage was a dangerous one for almost 300 years from Spanish exploration in the late 1500s until Anglo settlement in the latter half of the 1800.

The first Europeans to explore the survey area were the Spanish who passed through the area frequently while settling the greener upper Rio Grande. The Chamuscado expedition in 1581 and the Espedjo expedition in 1583 were the first Europeans to view the survey area. Both expeditions followed the Rio Grande and did not cross the Jornada del Muerto; they did report unnamed nomads living in grass huts along the river. Oñate in 1598 led the first Spanish expedition to cross the Jornada del Muerto. Oñate mentioned that a group termed Mansos were encountered in the vicinity of Rincon. The Mansos were apparently a small group, perhaps related to the Apache. However, Basehart (1973a:123) points out that "attempts to relate the Mansos with later peoples in this general area are difficult." Several early Spanish accounts refer to a group of "Apaches del Perrillo" present in the Jornada del Muerto. Schroeder (1973) notes that the Perrillo Apache attacked expeditions which tried to get water from a spring located in a narrow canyon west of the Jornada del Muerto (probably McRae Canyon). The Perrillo Apache were reported on the east bank of the Rio Grande near the Caballo Mountains in the 1620s. Schroeder also points out that other writers such as Opler and Opler (1950) have linked the Apache del Perrillo with the Mescalero Apache. The reported presence of the Mansos and Perrillo Apache indicates that nomadic groups were in the survey area when the early Spanish expeditions passed through. Detailed descriptions of these peoples are not available; and archaeologically, they have not been recognized.

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*See Appendix II.

The Mescalero Apache, whose descendants survive today, are much better known. The term "mescalero" has been used to collectively describe many individual bands of Apaches who inhabited a vast area centered around their homeland, the Sierra Blanca region, where today the Mescalero Reservation is located. Groups of Mescalero Apache ranged north to Gran Quivira and beyond, west to the Rio Grande, south into Mexico and Texas, and east into the Staked Plains (Llano Estacado). Most historical accounts of Indians in the survey area can be attributed to the Mescalero Apache. Schroeder (1973) provides an excellent summary of historical accounts of the Mescalero in the Tularosa Basin and surrounding vicinity.

The Mescalero Apache lived in small autonomous bands which ranged widely and depended largely on hunting and wild plants for survival. When the Spanish introduced the horse in the Southwest, the Apache quickly became excellent horsemen who depended on the horse for survival. Much of the Apache culture was related to raiding. The Mescalero Apache raided the Pueblo Indians, the Spanish, the Mexicans, and finally the Anglo settlers. The raids provided the Apache with horses, metal for arrow points, blankets, guns, knives, food, etc.; in other words, raiding enabled the Apache to maintain a much higher standard of living than would have been possible by relying solely on hunting and gathering. Eventually the raiding caused the United States Army to almost destroy the Mescalero Apache. Controlling the Mescalero was a long and difficult process which was not successful until the late 1800s.

The Mescalero Apache were present in the survey area during the 18th and 19th centuries. "Lieutenant Whiting reported in 1849: 'their winter towns are extensively upon its banks [the Rio Grande], their spring and summer retreats are found in the mountains . . .'" (Sonnichsen 1958:17, quoting "Report to Secretary of War for 1849":239). Basehart (1973b) reports ethnographic accounts which mention that the Mescalero frequented the San Andres Mountains in search of blacktail deer, mountain sheep, pinyon nuts and yucca. Undoubtedly, the Apache utilized other resources available in the San Andres and elsewhere in the survey area. Basehart provides a good ethnographic review of Mescalero subsistence patterns.

During the 17th and 18th centuries the Spanish traveled frequently through the Jornada del Muerto. This trail was known as the Camino Real (the King's Highway). The Camino Real linked the Spanish settlements on the Upper Rio Grande (Santa Fe, Sandia, Albuquerque, etc.) with Chihuahua and Mexico City. Teams of oxen pulled wagons loaded with Spanish goods up the trail to Santa Fe and returned with loads of hides and wool to Mexico. These trains were normally large enough and sufficiently well-armed to avoid attack while traversing the broad Jornada del Muerto. The Spanish were normally attacked only when in smaller groups or when forced to seek water in narrow canyons in the mountains west of the Camino Real. Most travelers who journeyed through the Jornada del Muerto moved during the night, thus avoiding the hot summer temperatures which made daytime travel across the waterless plain practically unbearable.

Early accounts of Spanish travels through the Jornada del Muerto are few when compared to the many accounts of the perilous crossings during the 1800s. From the 1820s until the 1870s Anglo settlers, miners, soldiers and travelers were often attacked while crossing the Jornada del Muerto. The Anglos often traveled in smaller groups than the Spanish and were attacked quite frequently.

Fort Selden near Radium Springs and Fort McRae near Truth or Consequences were established during the mid-1800s to protect travelers. The 90-mile stretch between these points continued to endanger travelers. John C. Cremony traveled along the Camino Real during the 1850s. He described the trail as a "hard and splendid natural road which runs through four-fifths of the Jornada" (Cremony 1969:75). Cremony describes being chased some 70 miles by a band of Apaches.

Several stops along the Camino Real within the survey area were mentioned by travelers. The first stop for travelers heading south from Socorro was the Laguna del Muerto, now known as Jornada Lakes. These ephemeral playas held rainwater during certain times of the year. If the Laguna del Muerto was dry then water could be found at a spring in McRae Canyon just east of present-day Truth or Consequences. McRae Canyon is probably the narrow canyon west of the Jornada where Perrillo Apache attacked Spanish expeditions. Near the Cutter siding on the AT&SF Railroad the small feature known as Black Hill was occasionally used as an overnight campsite. Cutter was, during the late 1800s, a stagecoach stop. One of the most often mentioned stops along the Camino Real was Aleman Camp. Aleman was first another rainwater playa and later the site of the first well in the Jornada del Muerto. In 1857, Jake Martin, "white chief of the Jornada," hired men to hand dig a 12-foot wide well to a depth of 180 feet. Martin maintained the well and pumped water with a force pump which apparently broke down frequently. A fee was charged to all travelers who desired a drink of precious water.

Fifteen miles farther down the trail was one of the most dreaded milestones along the Camino Real. As the trail passed just west of the Point of Rocks, a rugged igneous protrusion, bands of Apache frequently ambushed passers-by. Sonnichsen notes that in 1861 when Union troops were abandoning forts in New Mexico because of the Civil War, the Mescalero Apache who had been temporarily under control began raiding again. "Bands of warriors headed for sheep ranches in Pecos country, for the traditional ambush site at Point of Rocks on the Jornada del Muerto, and for exposed ranches and settlements in the Rio Grande Valley" (Sonnichsen 1958:101). From Point of Rocks the Camino Real turns east and follows the Rio Grande.

The Mescalero were finally brought under control in 1878 but not until after many years of battles and Indian campaigns by such men as Col. Edward Hatch and Kit Carson. Among the more famous Apache chiefs was Victorio, subject of a massive manhunt which ended after several years when Victorio and a handful of surviving warriors were killed in Mexico. At one point Colonel Hatch attacked Victorio in Hembrillo Canyon in the San Andres only to have him escape by riding across the Jornada del Muerto, over the Caballos at Palomas Gap, across the Rio Grande and into the Black Range. By the time the Mescalero were finally subjugated the survey area was the home of several ranchers who raised large herds of cattle on the lush grasslands. The eventual environmental impact of cattle, horse, and sheep grazing on the Jornada del Muerto was documented earlier. In 1881 the Camino Real was replaced by the AT&SF Railroad between Albuquerque and El Paso, signalling a close to the colorful era of the Camino Real.

V. SITE DESCRIPTIONS

Stephen L. Black, Thomas C. Kelly and Erwin Roemer, Jr.

This section contains the results of the Radium Springs survey. During the intensive survey conducted within the selected sampling units (sections), 90 sites were documented. In the course of locating the sample sections, six additional sites were recorded outside the selected areas.

In compliance with the BLM specifications under which we were working, certain types of data were recorded for all sites. These data have been tabulated and are presented here in Tables 2-4. As mentioned in Section I, specific site locations are not given.

We have sorted the 96 recorded sites into 10 categories (see Table 3). Some sites had been extensively eroded, exposing a variety of cultural debris; at others, a more limited range of materials was observed. Thus, we cannot, with any great degree of certainty, place each and every site within a specific *functional* category. In the following pages, we provide definitions of these 10 categories. These can be tested and refined during the course of future archaeological investigations in the region.

Cain Quarry Site

The Cain Quarry Site (AR094) is a lithic resource procurement area located .25 mile northwest of Lewis Cain's ranch headquarters R1WT16S, Section 10. This section is five-eighths BLM-controlled, one-eighth state land, and one-quarter deeded to Mr. Cain. We believe the site is on the BLM-controlled portion, but not enough time was available to locate a USGS section marker and verify its location.

The site is in the outwash area on the north side of a steep hill at 4525' elevation. Drainage is to the north into Jornada Draw a mile away. Soil is sandy clay mixed with the detritus from the hillside and gray in color. Fist-size nodules of bluish-gray-white rock (identified as being felsitic rock of igneous origin by Dr. Richard McGehee, UTSA Associate Professor of Geology) cover an area 100 meters east-west by 150 meters north-south. The vegetation is mostly creosote bush and grama grass.

Aboriginal knappers have altered most of the felsite nodules at the site. Quarry blanks, crude bifaces, broken preforms, large modified flakes, flakes, and knapping debitage cover the area. While no controlled collection was made, the sample that was picked up had a high percentage of primary cortex flakes, a characteristic of lithic resource procurement areas (Kelly and Hester 1975:20).

Quarry blanks, preforms, scrapers and utilized flakes of this material were found in AR007 four miles north; AR062, a village site five miles north, and in AR002 six miles northeast.

This was the only lithic procurement area identified in the Radium Springs survey and is of considerable archaeological importance. We believe it should be nominated to the National Register of Historic Places.

TABLE 2

Types of Sites Found During the Radium Springs Survey*

1	Quarry site	(AR094)
1	Petroglyph site	(AR096)
1	Historic cemetery	(AR091)
2	Bead caches	(AR095, AR086)
2	Ceramic scatters	(AR013, AR036)
5	Unassociated hearths	(AR017, 018, 025, 067, 074)
5	Ceramic villages	(AR001, 062, 068, 089, 092)
8	Lithic scatters	(AR022, 041, 054, 058, 084, 087, 088, 090)
33	Lithic campsites	(AR002, 005, 006, 007, 008, 010, 012, 016, 019, 020, 021, 023, 026, 027, 029, 031, 032, 038, 040, 043, 045, 047, 079, 083, 064, 065, 069, 070, 077, 079, 083, 085, 093)
38	Ceramic campsites	(AR003, 004, 009, 011, 014, 015, 024, 028, 030, 033, 034, 035, 037, 039, 042, 044, 046, 048, 049, 050, 051, 052, 053, 055, 057, 059, 060, 063, 066, 071, 072, 073, 075, 076, 078, 080, 081, 082)

*90 sites were documented in sample sections; six others were located outside the sections.

San Diego Mountain Petroglyph Site

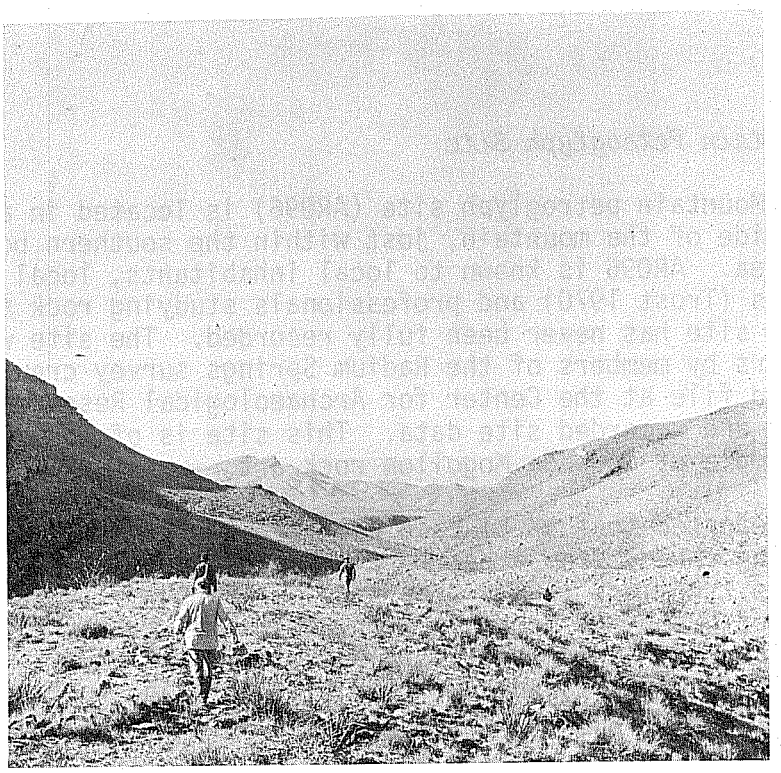
The San Diego Mountain petroglyph site (AR096) is located in a narrow canyon on the north side of the mountain, just within the southern boundary of the 1976 survey area. AR096 is known to local inhabitants, local amateur archaeological groups (Trost 1970) and professionals studying rock art (Schaafsma 1972), but the site has never been fully recorded. The site was visited during off-hours by members of the Radium Springs survey crew. They took photographs (on file at the Center for Archaeological Research and the Museum of New Mexico) and recorded site data. This site is of considerable interest as a local example of Jornada Mogollon rock art.

Trost (1970) reported that an El Paso Polychrome mortuary vessel was uncovered while collecting sherds from a nearby site which he believed was related to the petroglyphs. Hammack (1962) excavated the Rincon Village site (LA5599) one mile east of San Diego Mountain. An additional nearby pithouse village was reported to us by local pothunters but we did not have time to document it. None of these sites can be directly linked to the rock art but the presence of numerous Mogollon villages within a few miles of AR096 is probably significant.

The San Diego Mountain petroglyphs were pecked on drab brown igneous boulders which are strewn along the bottom and sides of a rugged canyon. Vegetation is very sparse and consists primarily of creosote. The petroglyphs number in the hundreds, if not thousands. The dark patina of the boulders nicely contrasts the lighter-colored pecked designs. Design motifs include both anthropomorphic and geometric styles. Recognizable elements include birds, mountain goats, fish, quadrupeds, hands, legs, feet, masks, human profiles, corn plants, snakes, concentric circles and squares, step-fret motifs, checkerboard designs, parallel lines and many others. Several large boulders contain many designs which are often superimposed. Schaafsma (1972) indicates that AR096 has two distinct styles of petroglyphs: the Desert Mogollon Abstract Style and the Eastern Jornada Style. The Desert Mogollon Abstract Style is earlier and is characterized by geometric designs. The Eastern Jornada Style overlies many of the earlier designs and is characterized by anthropomorphic and realistic designs. Schaafsma states that AR096 is very similar, in stylistic terms, to a petroglyph site some 40 miles to the west in the Mimbres area. Schaafsma (1972) illustrates many photographs and drawings of the San Diego Mountain petroglyph site (AR096).

Bead Caches

Two bead caches were recorded during the 1976 survey. The High Lonesome site (AR095) is described in Appendix II of this report. AR086 (Fig. 4,b) is a large rock cairn which had been potholed. One calcite bead and a mussel shell pendent were visible on the surface. A few flakes were found in the vicinity but no ceramics were observed. Possible explanations for AR086 include a cairn burial or a bead cache. No faunal material was observed in or around the pothole. The depth and size of the pothole suggests that little of the original feature would be uncovered by testing.



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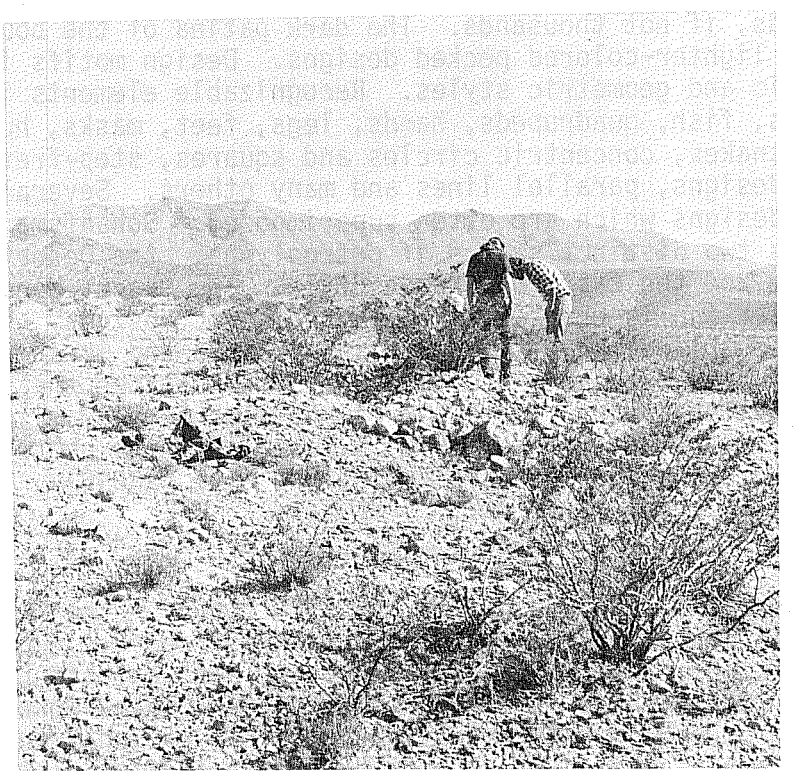

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Figure 4. *Panoramic Views of Two Sites in Survey Area.* a, Apache Gap looking west; b, AR086--pothunted site; Caballo Mountains in background not far from Truth or Consequences, New Mexico.

Historic Cemetery

A small historic cemetery (AR091) was recorded near present-day Salem, New Mexico. The cemetery contains approximately 25 rock-covered graves. Most graves are not marked and are overgrown with vegetation. A few graves are marked by bleached wooden crosses and one grave is surrounded by a wooden picket fence. No permanent markers of metal or carved stone monuments were found. This cemetery is not marked on USGS maps. Several knowledgeable inhabitants of nearby Salem were questioned but no information was available concerning who is buried there, or when the cemetery was used. The deteriorated condition of the cemetery, lack of local knowledge and lack of permanent markers suggest this cemetery has not been in use for the last 30 years or more. It is conceivable that this site dates to the early 1900s. Historic research into local records and extensive interviews with older local residents may eventually reveal details on AR091 (see Fig. 5).

Ceramic Scatters

Two sites (see Table 2) were recorded which contained only scattered ceramics. Both sites were situated on or near sand dune areas. Both sites were small and contained two or more types of ceramics but no associated lithics or burned rock. It is quite likely that additional cultural debris is present but was covered by the shifting sand dunes (see Fig. 7,b [site AR013]).

Unassociated Hearths

These sites (Table 2) were burned rock concentrations or hearths around which artifacts were not found. The lack of associated cultural remains can conceivably be accounted for by the following possibilities: (1) debitage or artifacts were present but not observed by survey crew; (2) these burned rock features were used for a short duration and no cultural debris was left behind; (3) artifacts had previously been collected; (4) artifacts were present but buried; and (5) artifacts and debris eroded away leaving only the heavier burned rock. In any case, there are sites present in the survey area which do not contain any readily visible cultural material and are marked only by the presence of eroding hearths. All of these sites are small and most were found on or around sand dune ridges. AR067 is a site which consists of distinct hearths exposed from 1.2 meters below the existing ground surface; these were noted in the cutbank of several small arroyos. One hearth is slab-lined and all are marked by burned rock and charcoal-stained soil. Several of these hearths contain charcoal. If these features are tested prior to destruction by erosion, associated cultural debris may be found and radiocarbon dates might be obtained.

Ceramic Villages

During the 1976 survey five sites (Table 2) were recorded which are known to be or are likely to be Mogollon villages. In addition, many of the large ceramic-bearing campsites may have been villages. Two of the known villages were recorded on BLM land off the designated study sections. All the

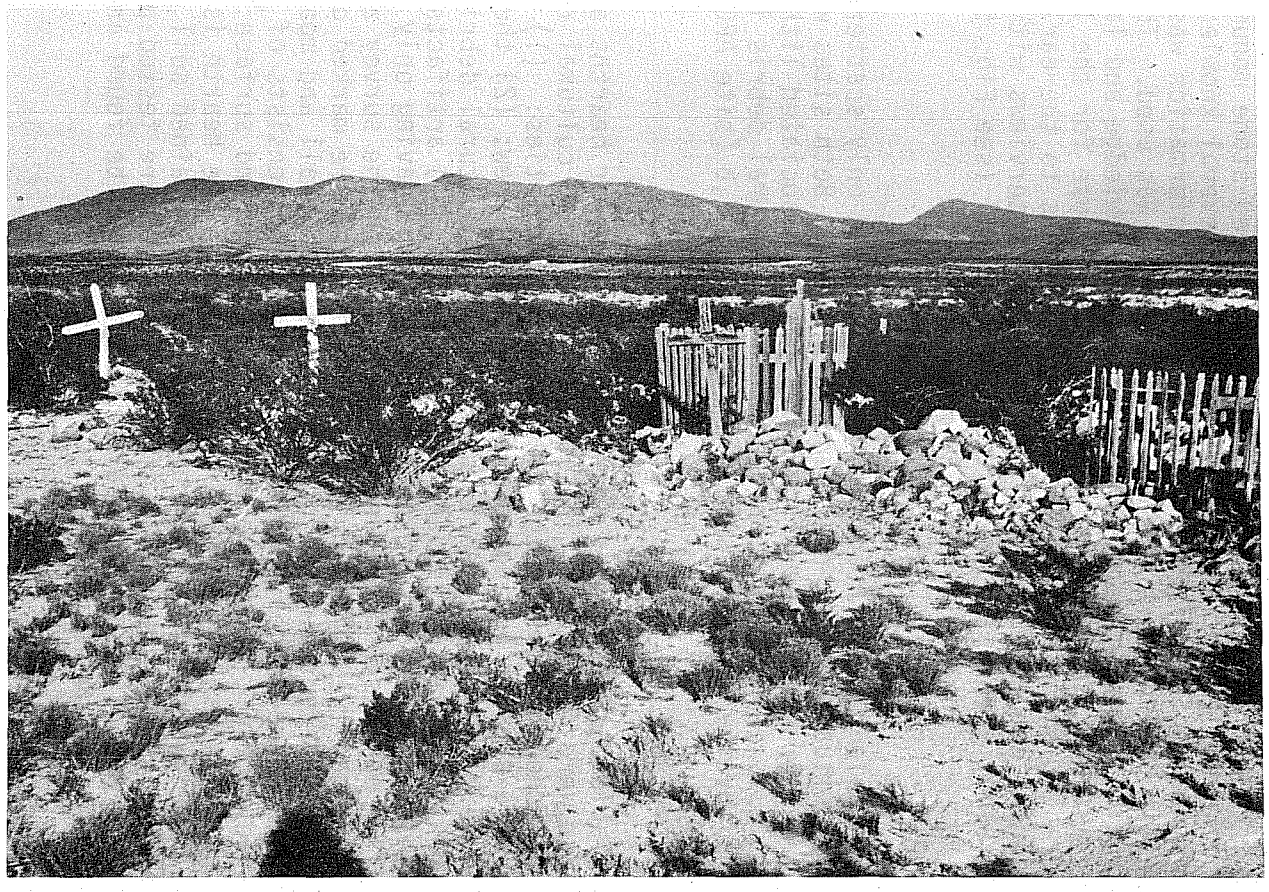


Figure 5. *Archaeological Site AR091.* Unidentified historic grave site. Looking east across Rio Grande Valley with Caballo Mountains in background.

village sites are 30,000 m^2 or more in horizontal extent and contain relatively high ceramic and lithic densities. Three of the sites have been partially destroyed by pothunters excavating in pithouses. All five village sites are considered important and should be investigated further. All five are recommended for consideration for nomination to the National Register of Historic Places. Several of the sites are rapidly being destroyed and are in need of emergency salvage work while intact portions of the sites still exist. Descriptions of all five village sites, in addition to the data in Tables 2 and 3, follow:

AR001 is a large pithouse village located on a flat alluvial outwash (edge of fan) several miles west of the San Andres Mountains. This site is known to local collectors who have excavated several rectangular pithouses; these reportedly contained burned roof beams. A human skull was reported from the site. Lithic debitage is widespread but tools are rare--a fact which can be attributed to intensive surface collecting by relic-hunters. Ceramics observed at the site indicate that it may have been occupied during the Mesilla and Dona Ana phases of the Jornada Mogollon. Despite the damage AR001 has received from pothunting, collecting, sheet wash, and road construction, the site still contains significant buried cultural material and steps should be taken to insure that the remaining deposits are not destroyed (see Fig. 6,a).

AR062 is a large ceramic site situated in a sand dune area in the middle of the Jornada Basin. The large size and dense concentrations of burned rock, ceramics and lithics suggest that AR062 is a village. This site is one of the few sites encountered on the survey which did not appear to have been extensively collected or vandalized. Local collectors were apparently not aware of the site. Deflation in the sand dunes has exposed much of the site including a diverse lithic and ceramic inventory. Ceramics date the site to the Dona Ana phase or later. No evidence of structures was observed but buried features no doubt exist. The quantity and variety of artifacts present on the surface suggest that the site was occupied for a lengthy time period.

AR068 is another large ceramic site which is interpreted as a Mogollon village. The site is located on a flat sheet wash even on the edge of an alluvial fan of the Caballo Mountains (east of Caballos). Six square miles were surveyed in the vicinity of AR068 but no sites were found. AR068 contains dense concentrations of ceramics, lithics of many types, manos and several large boulder metates. No evidence of potholing was observed and local collectors were unaware of this, or any other large site, in the area. Size, quantity and types of artifacts present suggest AR068 is an early Jornada Mogollon (Mesilla phase) village. Sheet wash has exposed much of the site but significant buried deposits may well be present.

AR089 is an early Mogollon pithouse village located in the Rio Grande Valley near Salem, New Mexico. This site is fairly small but definitely contains buried pithouses, several of which have been excavated by

local pothunters who found five complete vessels in the floor of one rectangular pithouse. The five vessels were Mimbres Boldface, San Francisco Red and three smudged, neck banded plain culinary jars. These ceramics are relatively early types. Mimbres influence is strong, suggesting the site may not be Jornada Mogollon. Pithouse floors were baked adobe and were 50 cm to 1 m below the surface. Despite road construction and vandalism of the site by untrained excavators, substantial buried features still remain. The men who removed five pots from the site believe that 10 to 15 pithouses remain undisturbed. This site faces imminent destruction.

AR092 (Bruton Bead Site) is a huge Mimbres Mogollon village site (covering over a square mile) which lies just outside the survey boundaries but on BLM-controlled land. It is situated on rolling sand dunes along a major arroyo draining out of the San Andres Mountains. The drainage pattern is such that fairly flat sandy areas would be well watered by the San Andres runoff, providing a good agricultural setting. AR092 has been known to collectors as the "Bruton Bead Site" for many years because of the numerous beads found at the site.

While local collectors have been active at the site for a long time, the major destruction of the site occurred quite recently. A pothunter "excavated" much of the site using a bulldozer to outline house floors, in order to permit the removal of Mimbres bowls. Such sickening wholesale vandalism is perhaps the worst example of the massive destruction of archaeological sites in the survey area created by uncontrolled access to the land.

Identifiable house floors were observed surrounded by thousands of potsherds. AR092 is the richest site, in terms of artifact density, recorded during the 1976 survey and has by far the greatest concentration of sherds. Ceramics found at the site indicate a wide time span and suggest that the site was occupied over a very long period. Predominant pottery types are Mimbres Boldface and Mimbres Classic, suggesting that AR092 is one of the Mimbres villages which Lehmer (1948:71) mentioned for the area.

No Mimbres villages have been excavated or recorded east of the Rio Grande. AR092 is an important site which may well represent a major Mimbres population in the Jornada Basin. Large quantities of beads found at the site suggest that it may have served as a bead-manufacturing or distribution center. Ceramics occur at the site which indicate trade from many other areas, including Cibolo White Ware, Playas Red Incised, Chupadero Black-on-White, San Andres Red-on-Terracotta, Three Rivers Red-on-Terracotta, El Paso Polychrome and others. Despite the massive destruction of AR092 further work including mapping, controlled collection and excavation is recommended as an emergency step to salvage what remains. The Bureau of Land Management should take steps to save what is left of what was possibly the largest and most important Mimbres village in the Jornada area.

majority of these sites were located on dunes or knolls affording a view of the Rio Grande Valley or Jornada Basin. Lithic scatter sites were small and consisted only of flakes, tools or ground stone with no associated ceramics or burned rock. These sites probably represent special activity locations utilized for short durations. Sites such as AR087 contain flake debris, tool fragments and hammerstones, and likely represent knapping stations. The tendency for these sites to be located on knolls or ridges affording an overview of the surrounding area is of interest. None of these sites appeared to contain significant buried deposits.

Lithic Campsites

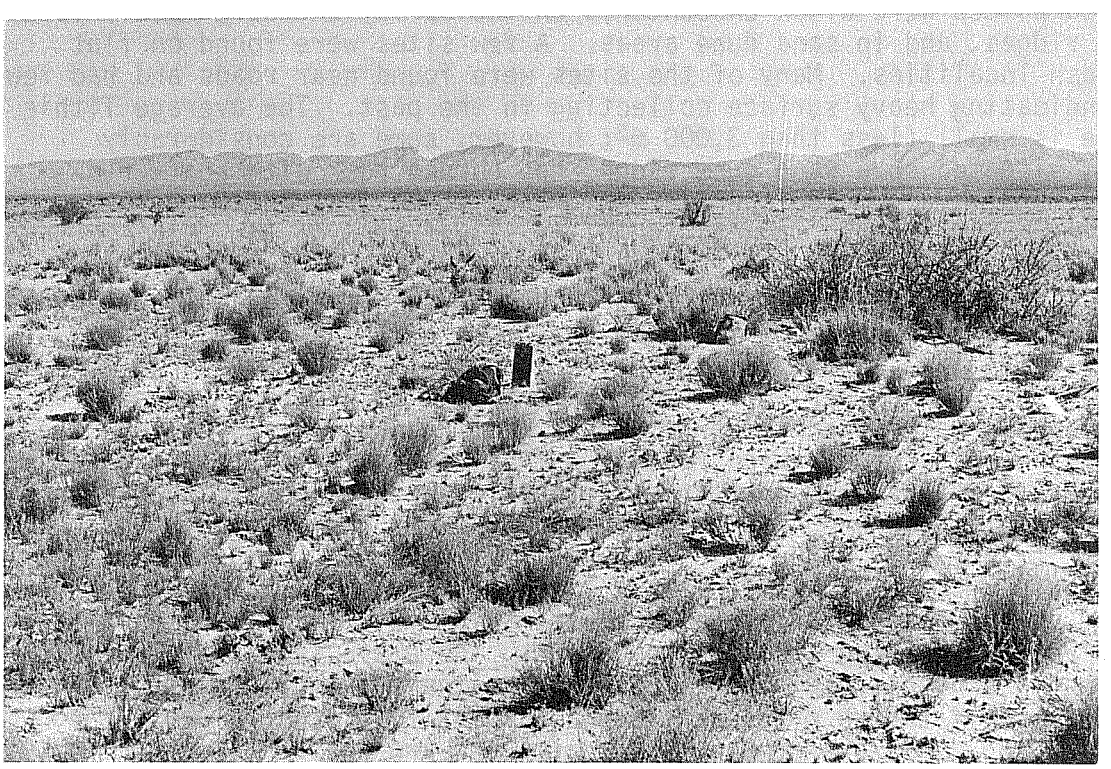
Thirty-three sites were recorded on the 1976 survey which are categorized as lithic campsites (Table 2). These sites are characterized by (1) the presence of lithics, (2) the absence of ceramics, and (3) the presence of burned rock scatters or features. They range in time from Paleo-Indian (AR093) to Archaic to perhaps Apache. It is quite likely some of the sites can be attributed to Jornada Mogollon peoples who occupied such sites for specific purposes of short duration, leaving no ceramics behind. It is also possible ceramics were present at a few of the sites but were either buried or not observed. Dating of these lithic campsites is possible only on the basis of surface observation--if a diagnostic artifact such as a dart point is found. Even then it is impossible to assign such sites to any limited time span (e.g., to within a thousand years or more).

Lithic campsites were often encountered on the survey and were mostly found on sand ridges, and in sand dune areas. A few sites were found on flat sheet wash localities. Many of the sites were found near roads and had few tools indicating heavy surface collecting in the past. The average lithic campsite is small (less than 3,000 m^2; however, some are considerably larger), situated on a sand dune ridge, has burned rock with scattered lithic debitage, a few tools and a few ground stone fragments. Burned rock features are rarely intact. AR007 is illustrated in Fig. 6,b.

The small size of the lithic campsites, the sparse nature of cultural debitage and scattered burned rock suggest that most of these sites were used for limited activities. AR061 and AR079 are larger lithic campsites which were utilized for a longer period of time, as indicated by numerous burned rock features and greater quantities of lithic debitage, tools and ground stone. Five sites were recorded which, although they are small, contain intact burned rock features or dense concentrations of lithic debris and warrant further study; these are AR002, AR056, AR077, AR083 and AR085.

AR093 (the Flat Lake Ranch Site) is a lithic campsite located in a sand dune blow-out on the south edge of a large extinct playa which has been dry for the past 30 years, according to local residents. The playa is below 4350' elevation and has no outlet. The 4375' contour line surrounds it at distances of from one-half to two miles and is the largest flat area in the Jornada Basin. Moving dunes are common in the area and are up to 9.3 meters in height.

a



b

Figure 6. *Views of Two Archaeological Sites in Radium Springs Area.* a, AR001: circular burned rock features; b, AR007: site in foreground, looking across Jornada Draw toward San Andres Mountains.

A blow-out approximately 3.1 meters deep between two dunes with tops approximately 6.2 meters above the edge of the lake has exposed a thin scatter of knapping debris, an Angostura point base, an end scraper (made on a blade) and scattered burned sandstone rocks.

Vegetation is scarce and consists of yucca, sotol, dwarf mesquite, and an occasional tuft of grama grass.

The Angostura point and the Folsom point found just three-fourths of a mile to the northeast are the only traces of Paleo-Indian occupation observed by us in the area. Both are dune sites overlooking playas and fit into the patterns Judge (1973:125) describes for the central Rio Grande Valley. From these small campsites, game could be spotted for a great distance across the flats, and hunts could be efficiently planned.

We have classified the projectile point from AR093 as Angostura (Fig. 9,b), as it is identical to points in the typology collection in the Center for Archaeological Research, and to specimens illustrated in Suhm and Jelks (1962:167). However, Judge (1973:87) has established the tentative classification of Belen for the second most numerous point found in his central Rio Grande Paleo-Indian survey. Two of these appear identical to the AR093 artifact. Angostura has been dated in central Texas ca. 5000-6000 B.C. at the Levi Rockshelter (Alexander 1963). Belen has not yet been dated but Judge places it as earlier than the Cody Complex.

There were 21 total flakes, sorted in the following groups: one primary cortex, three secondary and 17 interior flakes. The implications are that the chert used in the site was decorticated elsewhere and brought to the site as quarry blanks or preforms. The predominant material was a poor quality gray-white felsite identical to that of the Cain quarry site (AR094) which is 12 miles north of Flat Lake.

We believe that this site should be nominated to the National Register of Historic Places.

Ceramic Campsites

Thirty-eight ceramic campsites were recorded during the 1976 survey, the largest number of sites in any single category (Table 2). Ceramic campsites were sites which (1) contained ceramics, (2) contained burned rock and (3) lacked conclusive evidence of use as a village. Ceramic campsites ranged from very small (less than 500 m^2) to very large (greater than 20,000 m^2; see Table 4). Smaller sites are probably short term occupations. Larger sites were either occupied repeatedly for short durations or occupied over a longer period, i.e., as habitation sites. Many of these larger sites may be village sites which are badly eroded and have been previously collected. Ceramic campsites are usually situated on sand dune ridges, on sandy rises or in a sand dune area. A few ceramic campsites were located on flat sheet wash areas and steeply sloped foothills. Most of the ceramic campsites are badly eroded or deflated and often damaged by collecting, road construction, vehicular off-road traffic and cattle. The sites

listed below either do not fit the typical ceramic campsite pattern or obviously contain buried deposits. All are recommended for further field excavation or for nomination to the National Register of Historic Places.

AR015: Large site, low ceramic density, and proximity to Point of Rocks suggest this site has general components including Archaic, Mogollon and Apache.

AR081: Large site, high ceramic density and variety. This site may contain buried pithouse structures.

AR080: Small site with two large burned rock features with charcoal-stained soil. May be a plant processing locality.

AR060: Small site situated in low drainage area. Site exhibited ceramic, lithic, and ground stone artifacts and burned rock. It probably has buried features.

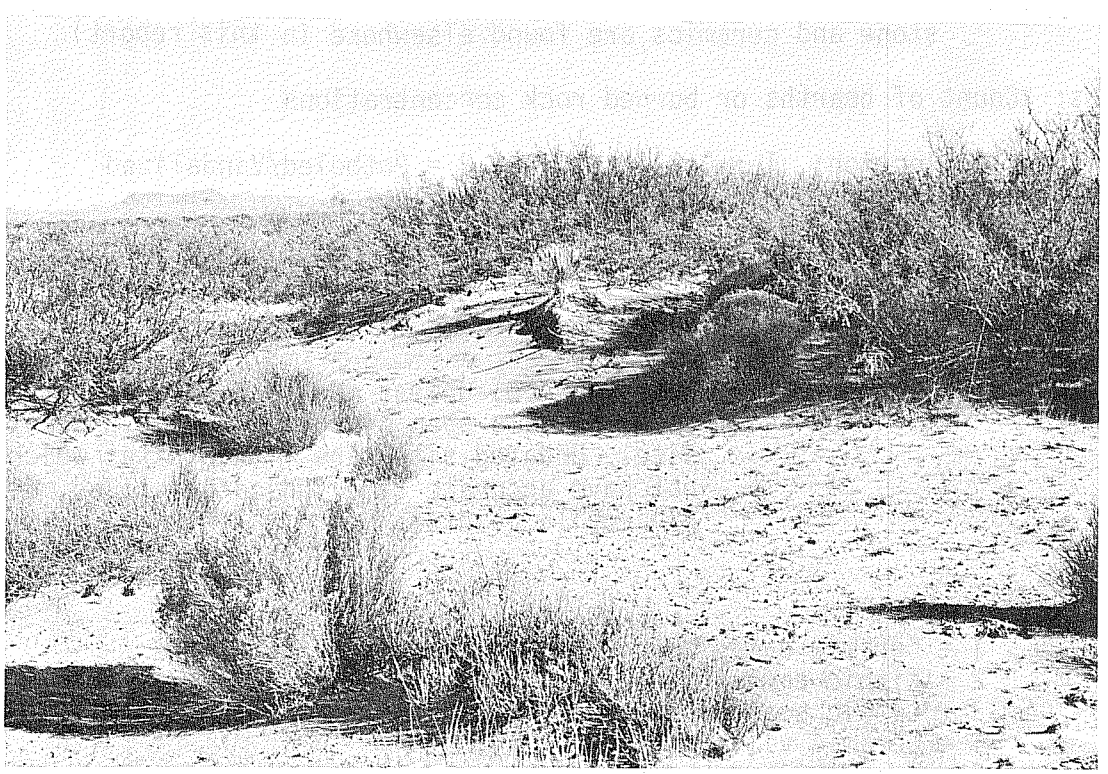
AR050: Similar to AR060 except located in low dune area.

AR009 and AR049: Larger campsites with abundant ceramics, lithics and burned rock features. Buried deposits are likely.

AR011, AR057, AR011: Larger campsites with eroded cultural debris. May contain buried features.

AR063 is another ceramic campsite, at which a metate was found (see Fig. 7,a).

a



b

Figure 7. *Archaeological Sites in Radium Springs Survey Area.* a, AR063: note metate broken in two pieces (pieces originally found 4 feet apart); b, view of AR013 looking northeast (note sparse vegetation and mesquite-covered dunes).

TABLE 3

1976 Radium Springs Survey Site Descriptions

Key to the Table:

Site Number: AR001 - AR096

Land Form: Major land form on or within one mile of site

1 = Isolated butte or hill or group of hills
2 = Major drainage
3 = Mountains
4 = Foothills
5 = Runoff slopes
6 = Mountain pass

Intermittent Streams: Number of intermittent streams shown on USGS maps within one mile of site

Zone: Environmental sampling zone (refer to Section II)

Ground Stone: 1 = Absent 2 = Present (data on distribution of chipped stone and ceramics are found elsewhere in this report)

Hearths: Count of hearths or burned rock concentrations

Severity of Collection: 1 = Collected 2 = Potholed/Vandalized
3 = Not previously collected

Economic Activity: Damage to site by cattle industry, road construction, vehicular travel, etc. 0 = Undisturbed
1 = Badly disturbed 2 = Moderately disturbed

Earliest Date - Latest Date: Dates in A.D. unless marked B.P. Dates indicate time span of pottery types present on site. Undated sites are lithic sites which do not have accurate time indicators (i.e., distinct projectile points).

Site Type I:

1 = Ceramic campsite
2 = Lithic campsite
3 = Lithic scatters
4 = Ceramic villages
5 = Unassociated hearths
6 = Ceramic scatters
7 = Bead caches
8 = Historic cemetery
9 = Petroglyph site
10 = Quarry site

Table 3 (continued)

Site Type II:

1 = Small (<10,000 m^2) Non-ceramic sites
2 = Large (>10,000 m^2) Non-ceramic sites
3 = Small (<10,000 m^2) Ceramic sites
4 = Large (>10,000 m^2) Ceramic sites

Site Area: Expressed in square meters. Based on area of an ellipse: 1/2 length x 1/2 width x 3.14 (Pi) = area (m^2)

Elevation: Feet above sea level at approximate center of site.

Vegetation: Dominant Form

1 = Mesquite
2 = Mixed mesquite and creosote with black bush or yucca
3 = Creosote
4 = Grasses with black bush or yucca

Soils:

1 = Sand
2 = Rocky sand
3 = Silts (fine powder aeolian and loam)
4 = Clay (hard packed)

Recommendations:

1 = No further action (probably totally eroded and scattered)
2 = Further field evaluation if site is to be disturbed
3 = Needs immediate precautions to protect site. Site about to be destroyed and contains valuable information. Preservation measures should include nomination to the National Register of Historic Places.
4 = Contains significant information and should be nominated to the National Register

TABLE 3

1976 RADIUM SPRINGS SURVEY SITE DESCRIPTIONS

Site No.	Landform	Intermittent Streams	Zone	Ground Stone	Hearths	Severity of Collecting	Economic Activity	A.D. Date Earliest	A.D. Date Latest	Site Type I	Site Type II	Site Area (M^2)	Elevation	Vegetation	Soil	Recommendations
1	5	6	2	2	30	2	2	750	1350	4	4	125660	5075	2	3	3
2	5	5	2	1	0	1	2	?	?	2	1	1257	4950	2	3	2
3	4	3	1	1	0	1	2	750	1350	1	2	3004	5575	3	3	1
4	4	3	1	1	0	1	1	900	1350	1	2	628	5610	2	3	1
5	2	1	2	2	0	1	1	?	?	2	1	982	4605	2	1	1
6	2	1	2	2	0	1	1	?	?	2	1	785	4605	1	1	1
7	2	1	2	2	0	1	1	?	?	2	1	1178	4575	1	1	1
8	2	1	2	1	2	1	1	?	?	2	1	2827	5550	4	1	1
9	2	1	2	2	3	1	2	900	1400	1	4	12723	5585	2	1	2
10	2	1	2	2	0	1	1	?	?	2	1	785	5550	1	1	1
11	2	1	2	2	3	1	1	900	1350	1	4	17671	5560	1	1	2
12	2	1	2	2	1	1	1	?	?	2	1	1767	5540	1	1	1
13	2	1	2	1	0	1	2	900	1350	6	2	1963	0	1	1	1
14	2	3	2	1	1	1	2	1150	1400	1	2	1257	4340	1	1	1
15	2	3	2	2	30	1	2	?	?	1	4	376980	4380	1	1	2
16	2	3	2	1	8	1	2	?	?	2	3	38876	4360	1	1	1
17	2	3	2	1	2	1	2	?	?	5	1	353	4360	1	1	1
18	2	3	2	1	2	1	2	?	?	5	1	628	4360	4	1	1
19	2	3	2	1	4	1	2	?	?	2	1	3141	4360	1	1	1
20	2	3	2	1	1	1	2	?	?	2	1	157	4400	2	1	1
21	2	3	2	2	5	1	2	?	?	2	1	9817	4410	1	1	1
22	2	3	2	2	0	1	2	?	?	3	1	707	4440	2	2	1
23	5	2	2	2	3	1	1	?	?	2	1	1178	4625	2	1	1
24	5	2	2	2	0	1	1	1100	1300	1	2	785	4625	2	1	1
25	5	3	2	1	7	1	1	?	?	5	1	1178	4615	1	1	1
26	5	4	2	2	4	1	1	?	?	2	1	5498	4610	2	1	1
27	5	5	2	1	10	1	1	?	?	2	3	15707	4610	1	1	1
28	5	3	2	2	26	1	2	900	1400	1	4	39229	4650	1	1	2
29	5	5	2	2	18	1	1	?	?	2	3	47122	4670	1	1	1
30	5	5	2	2	40	1	1	900	1350	1	4	86391	4630	2	1	1
31	5	6	2	1	2	1	1	?	?	2	1	314	4620	2	1	1
32	5	6	2	2	3	1	0	?	?	2	1	707	4645	2	1	1
33	5	6	2	2	9	1	1	900	1400	1	4	19634	4650	2	1	1
34	5	6	2	2	12	1	0	900	1400	1	4	18849	4670	2	1	1
35	5	6	2	2	25	1	1	900	1350	1	4	26506	4635	2	1	1
36	5	6	2	1	0	1	1	1200	1350	6	2	79	4660	2	1	1
37	5	6	2	2	12	1	0	900	1350	1	2	4418	4665	2	1	1
38	5	6	2	1	7	1	1	?	?	2	1	6872	4690	2	1	1
39	5	6	2	1	10	1	1	900	1350	1	2	3848	4700	1	1	1
40	5	4	2	2	0	1	2	?	?	2	1	7854	4615	1	1	1
41	5	5	2	2	0	1	1	?	?	3	1	79	4620	2	2	1
42	5	5	2	2	0	1	1	900	1350	1	2	3829	4625	1	2	1
43	5	5	2	2	2	1	1	?	?	2	1	353	4640	2	2	1
44	5	5	2	2	1	1	1	900	1350	1	2	491	4825	2	1	1
45	5	5	2	2	10	1	1	?	?	2	1	8835	4825	2	1	1
46	5	5	2	2	15	1	1	900	1350	1	4	10210	4835	2	1	1
47	5	5	2	2	3	1	1	?	?	2	1	1060	4800	2	2	1
48	5	5	2	2	3	1	1	900	1400	1	2	6774	4775	2	1	2
49	5	5	2	2	4	1	1	900	1400	1	2	7068	4825	2	2	2
50	5	5	2	2	2	1	1	900	1350	1	2	707	4815	2	1	2

51	5	5	2	2	5	1	1	900	1350	1	2	707	4845	2	2	1
52	5	5	2	2	6	1	2	900	1350	1	2	942	4845	1	1	1
53	5	0	2	2	0	1	0	900	1350	1	2	1178	4770	1	1	1
54	5	0	2	1	0	1	2	?	?	3	1	785	4880	1	2	1
55	5	0	2	1	1	1	1	?	?	1	2	79	4790	1	2	1
56	5	0	2	2	4	1	1	?	?	2	1	314	4755	1	1	2
57	5	0	2	2	4	1	1	?	?	1	2	4712	4712	1	1	2
58	2	1	2	1	0	1	0	?	?	3	1	785	4750	1	1	2
59	2	1	2	1	0	1	1	900	1350	1	2	314	4750	1	1	1
60	5	1	2	2	2	1	0	775	1350	1	2	314	4650	4	1	2
61	5	1	2	2	8	1	1	?	?	2	3	20616	4725	1	1	2
62	5	2	2	2	10	3	1	300	1400	4	4	29452	4675	1	1	4
63	5	2	2	2	6	1	2	900	1350	1	4	10995	4660	1	1	2
64	5	2	2	2	0	1	1	?	?	2	1	491	4650	2	1	1
65	5	2	2	1	2	1	1	?	?	2	1	1963	4630	2	1	1
66	6	3	3	1	0	1	1	900	1350	1	2	785	5650	3	3	1
67	6	3	3	1	4	1	0	?	?	5	1	314	4760	3	3	2
68	5	4	3	2	0	3	0	900	1350	4	4	37934	4690	3	3	4
69	5	0	2	1	8	1	0	?	?	2	1	471	4425	1	1	1
70	5	2	2	1	2	1	0	?	?	2	1	1767	4455	1	1	1
71	5	2	2	2	0	1	1	900	1350	1	2	314	4465	2	1	1
72	5	1	2	2	2	1	0	900	1350	1	2	1257	4465	1	3	1
73	5	2	2	1	1	1	2	900	1350	1	2	314	4500	1	1	1
74	5	2	2	1	3	1	2	?	?	5	1	471	4520	1	1	1
75	5	1	2	2	4	1	1	900	1350	1	2	2945	4525	2	1	1
76	5	1	2	2	3	1	1	900	1350	1	2	314	4800	1	1	1
77	5	1	2	2	2	1	2	?	?	2	1	884	4800	4	1	2
78	5	1	2	2	0	1	2	1000	1350	1	2	707	4775	1	1	1
79	1	3	2	2	1	1	1	?	?	2	3	141367	4400	2	3	2
80	1	3	2	1	2	1	1	900	1350	1	2	491	4450	2	3	2
81	1	6	2	2	15	1	2	300	1350	1	4	94245	4470	2	3	2
82	3	4	4	2	0	1	1	1150	1400	1	2	393	4920	3	3	1
83	3	4	4	1	4	1	0	?	?	2	1	4712	4840	2	3	2
84	3	4	4	1	0	1	1	?	?	3	1	353	4920	3	3	2
85	3	4	4	1	1	1	0	?	?	2	1	1	4590	2	3	2
86	3	4	4	1	0	2	0	?	?	7	3	314	4640	3	3	2
87	2	3	4	1	0	1	1	?	?	3	3	11781	4240	3	4	1
88	2	3	4	1	0	1	1	?	?	3	1	1963	4240	3	3	1
89	2	2	4	2	0	2	2	750	1350	4	4	13744	4130	2	3	3
90	2	3	4	1	0	1	1	?	?	3	1	314	4320	3	2	1
91	2	3	4	1	0	3	1	1900	?	8	–	1963	4160	2	3	2
92	2	3	2	2	9	2	2	700	1400	4	4	2,000,000+	4500	1	1	3
93	2		2	1	0	1	2	9000BP	7000BP	2	1	400	4395	1	1	4
94	1	3	2	1	0	1	2	?	?	10	2	11812	4500	3	3	4
95	5	4	1	1	0	3	2	700	1300	7	3	314	5245	2	1	1
96	1	4	2	1	0	1	2	900	1300	9	4	31415	4300	3	3	4

TABLE 4

Mean Areas of Certain Site Categories

Site Category*	N			
Lithic scatters	8	2,095.969	1,398.062	3,954.317
Lithic campsites	32**	10,301.930	4,640.906	26,252.938
Ceramic campsites	38	20,052.887	10,226.973	63,043.305

*Because of the very limited samples in the first seven site categories (quarry site, petroglyph site, historic cemetery, bead caches, ceramic scatters, unassociated hearths and ceramic villages), mean data could not be computed.

**These represent sites for which valid observations were available.

VI. THE ARTIFACTS

In this section, the two major classes of artifacts found during the Radium Springs survey--lithics and ceramics--are described and illustrated. Lithic analysis was done by Stephen L. Black and Thomas R. Hester and ceramic studies were carried out by Erwin Roemer, Jr. and Paul R. Katz.

The emphasis during the fieldwork was on observation and recording, and in line with BLM specifications large samples of artifacts were not collected, except in unusual circumstances. An example of the latter is site AR095 where a cache of beads had been exposed. Only by collecting these materials could they be properly analyzed and evaluated (Appendix II); had they been left in place, they would have become trophies for the next relic-collector to happen along.

Artifact sampling was done primarily to aid in the evaluation of site temporal span and cultural affiliation. In addition, "type" specimens, e.g., of pottery or of particular kinds of rock used in tool manufacture, were collected.

We have prepared a number of line drawings and photographic illustrations of the collected artifacts and hope that their publication in this report will be of aid to future workers in the area. The specimens themselves are stored at the Center for Archaeological Research and are available to qualified researchers for further study.

LITHICS

Stephen L. Black and Thomas R. Hester

Introduction

During the 1976 Radium Springs survey a variety of lithic artifacts were observed on sites in the area. As specified by the BLM contract, sampling was strictly limited to diagnostic artifacts and a few type samples. As a general rule, all projectile points were collected and representative examples of other tool types present on sites in the area were picked up. This limited sampling strategy served to indicate the range of lithic artifacts encountered within the survey area. The surface density of ground stone and chipped stone tools was estimated for each site by the survey crew. Time limitations did not allow careful examination of entire site areas, and thus these density figures reflect minimum numbers of lithics present on sites. Many sites may have considerable buried cultural deposits. As has been previously pointed out, "arrowhead" hunters frequent the survey area and are particularly interested in complete points, bifaces, metates, pestles, and well-made tools of any type. This factor adds a further bias to the nature and frequency of lithic artifacts left on site surfaces.

The lithics observed or collected during the 1976 survey have been divided into morphological and/or functional categories. It should be noted that lithic descriptions in New Mexican archaeological reports--especially those in early reports--are often quite vague and leave much interpretation to be done. A variety of terms have often been used to describe a given artifact; for example, concave scraper, hollow scraper and spokeshave have been applied to notched lithic artifacts. Projectile points have not been sorted into types as done in Texas (cf. the *Handbook of Texas Archeology* of Suhm, Krieger and Jelks 1954). This is largely due to the emphasis placed on ceramic cultures by Southwestern archaeologists and perhaps reflects, in part, a general lack of widespread distinctive projectile point styles (cf. Fitting 1972:45). A detailed description of the projectile points found during the survey is provided to facilitate comparison of survey area specimens with those in other areas of New Mexico. In some previous studies in nearby areas (cf. Levine and Mobley 1976:59, Skinner, Steed and Bearden 1973), Texas type descriptions (most of which have specific temporal, spatial and cultural attributes) have been loosely applied to projectile points in central New Mexico and far west Texas.

The artifacts are described in terms of range of variation observed in field and collected samples. Because the lithic sample collected was so small the actual numbers of these specimens are not indicated for each group. Rather, these descriptions serve to indicate the kinds of lithic tools that can be expected to be found during the course of future research in the area. Descriptions include: material types used, size range, shape range, workmanship, transverse sections, and functional interpretations based on wear patterns. Transverse sections were described using DiPeso's (1974:Vol. 7) terminology. In a number of categories, we have provided a description of what a "typical specimen" generally looks like.

Artifact Descriptions

In the brief artifact descriptions that follow, an effort has been made to present a maximum amount of descriptive data with a minimum of verbiage. Thus, we have used incomplete sentences in many instances.

Bifacial Artifacts

Quarry blanks (Fig. 8,3-g)

Description: Thick unfinished bifaces. Represent initial stages of bifacial reduction--making thick blanks roughly shaped but not appreciably thinned. Some of these specimens may have been made from flakes; others, on cobbles. Generally oval shaped. Transverse section: plano-convex, bi-plano and bi-convex. Materials mostly low grade chert and felsite. A few are made from glossy chert and one of agate.

Measurements: Length: 7.8-4.7 cm; width: 3.3-6 cm; thickness: 1.5-2.4 cm; weight: 29.2-76.7 gm. Typical specimen: 6.5 cm x 4.8 x 2 cm; 51.3 gm; felsite.

Function: First stage of bifacial reduction.

Preforms: (not illustrated)

Description: These bifaces represent further reduction; they have been partially thinned and shaped. Most of these are broken, presumably during manufacturing. Rectangular and rounded bases; bi-convex transverse sections. A few specimens have marginal retouch indicating use after breakage. Materials: glossy and dull cherts, felsite and basalt.

Measurements: Length: 3-5 cm (broken specimens indicate greater range); width: 2.5-6.8 cm; thickness: 1.8-1.4 cm; weight: (complete) 5.5-26.7 gm, (broken) 6.7-43.5 gm, indicating range in weight much greater.

Function: Probable second stage of bifacial reduction; thinning and final shaping along edges not completed. Most specimens appear to have been broken during manufacturing due to flaws within material or mistakes by the knapper.

"Finished" bifaces (Fig. 8,a-d)

Description: These bifaces are marginally retouched and appear to have been finished to form sharp and thin cutting edges, with low edge angles. Shapes ovate, rectangular-based, and rounded base. Most specimens are broken. Materials: glossy gray chert (over 60%), a glossy and semi-glossy cherts. Material much better than blanks or preforms.

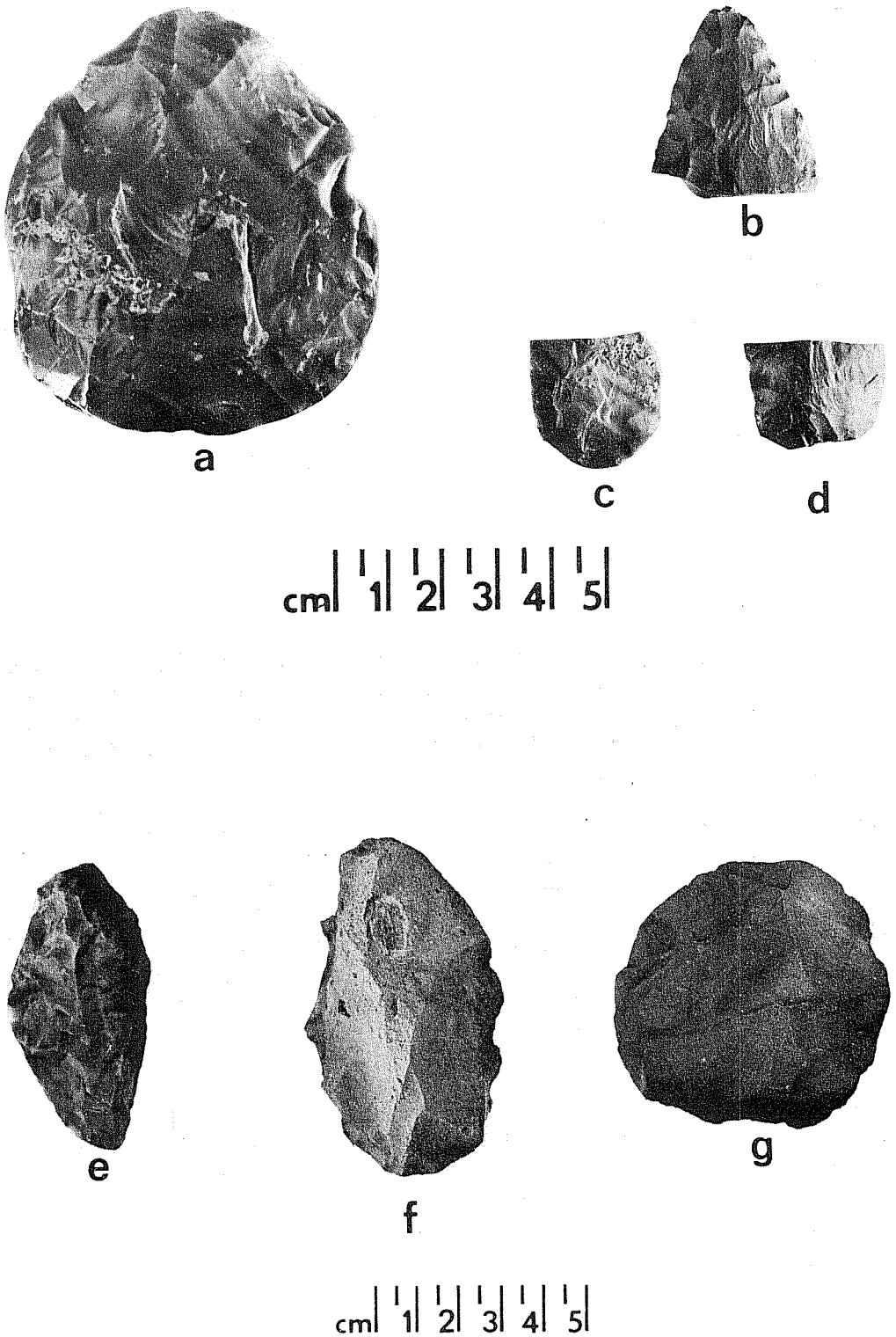


Figure 8. *Bifacial Artifacts.* a-d, finished bifaces (AR009; AR062; RS031, SW4; R032, SW4); e-g, quarry blanks (AR063, AR094, AR056).

Measurements: Two complete specimens, both are ovate. Dimensions of first: 8 x 6.8 x 1.6 cm; 1-1.2 gm; bit angle 41-49°. Second specimen: 4.2 x 3.3 x .8 cm; 12.5 gm; edge angle 44-48°. All broken bifaces fall within range indicated by two complete examples.

Function: Used as cutting tools as indicated by parallel striations and step fractures observed microscopically on both faces along edges.

Projectile Points

In the following descriptions, all linear measurements are in centimeters, and weights are expressed in grams. Measurements of fragmentary specimens are enclosed in parentheses. General provenience data are also provided, and the following abbreviations are used: RSO__ (programmed survey section; no specific site found and specimens are isolated surface finds); SW__ (indicates the "sweep" number during which the specimen was collected); ARO__ (specific site recorded during survey activities). One specimen was found during the process of delineating one of the survey sections; its provenience here is recorded in terms of township and range. More detailed provenience data are on file at the Center for Archaeological Research.

Folsom (Fig. 9,a). The specimen is a basal fragment of a Folsom fluted point made of light gray chert. Fluting is present on both faces; while the base is fragmentary, a portion of a basal "nipple" (striking platform) is apparent. Fine parallel flaking is present on the body perpendicular to the flutes. Length of the fragment is (2.8) cm; width is 2.1 cm; thickness is 14 cm; and it weighs 3.2 gm. Prov.: RSO27, SWI.

Angostura (Fig. 9,b). This basal fragment of a lanceolate late Paleo-Indian point appears to fall within the Angosturea type as defined by Suhm, Krieger and Jelks (1954). It has a slightly concave base; the lateral edges are dulled. Flake patterning is difficult to discern due to weathering. The material of manufacture is a dull pink to beige chert. Length is (1.9) cm; width, 2.0 cm; thickness, .5 cm; and it weighs 2.1 gm. Prov.: ARO93.

Expanding Stem Points (Figs. 9, 10). There are a series of projectile points, apparently dart points (although some, like Fig. 10,o, may have been arrow points) with expanding stems formed by corner notching. These range from large, well-flaked specimens such as the example shown in Fig. 9,c to smaller and more crudely worked specimens, as exemplified by the specimen in Fig. 10,c. Of particular interest is the point shown in Fig. 9,e. It bears a great deal of resemblance to early stemmed dart point forms found in the late Paleo-Indian and pre-Archaic phases in central and southwestern Texas (cf. Sollberger and Hester 1972).

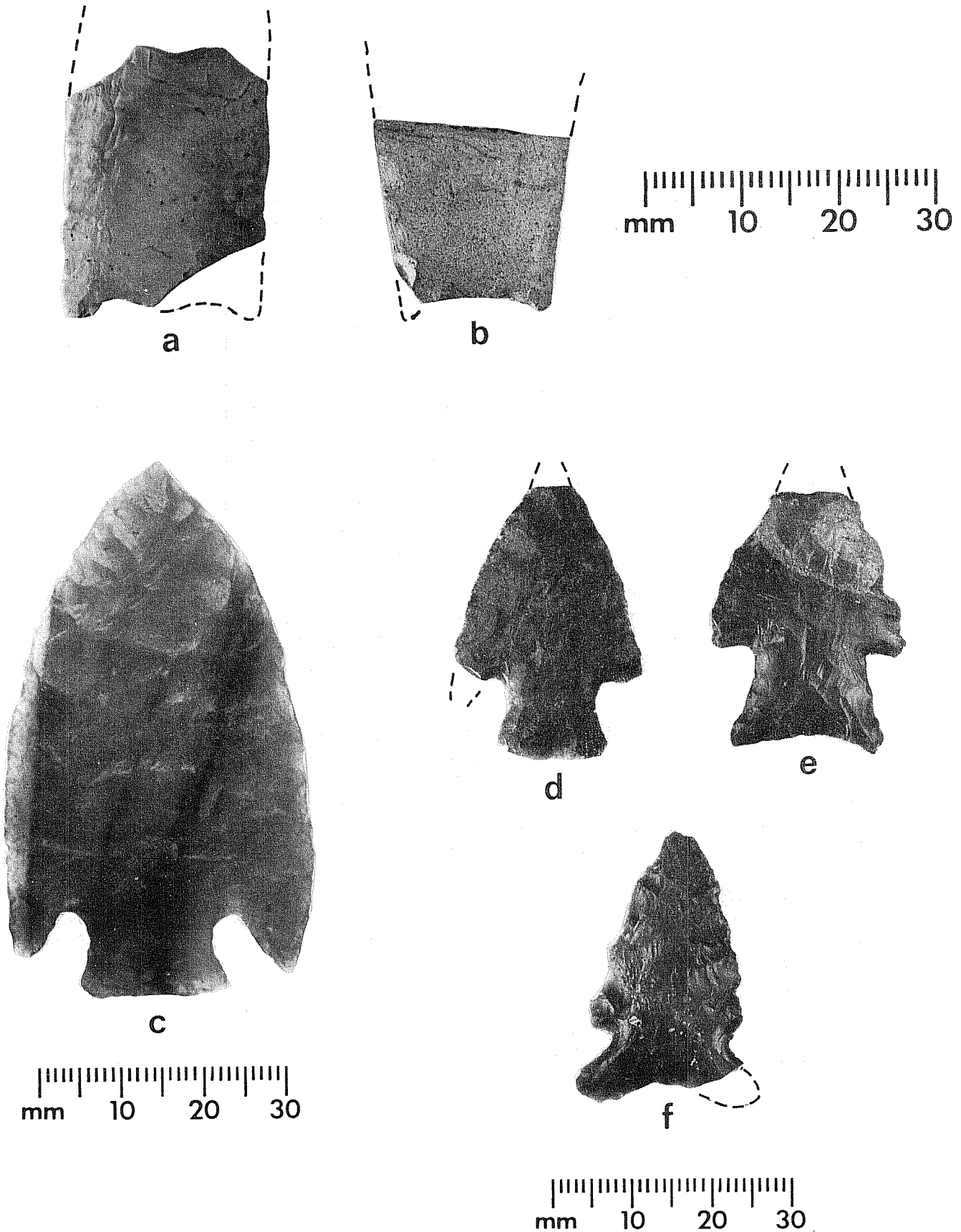


Figure 9. *Projectile Points from Radium Springs Survey Area.* a, Folsom, RS027 SW1; b, Angostura, AR093; c, AR023; d, AR004; e, AR077; f, AR012.

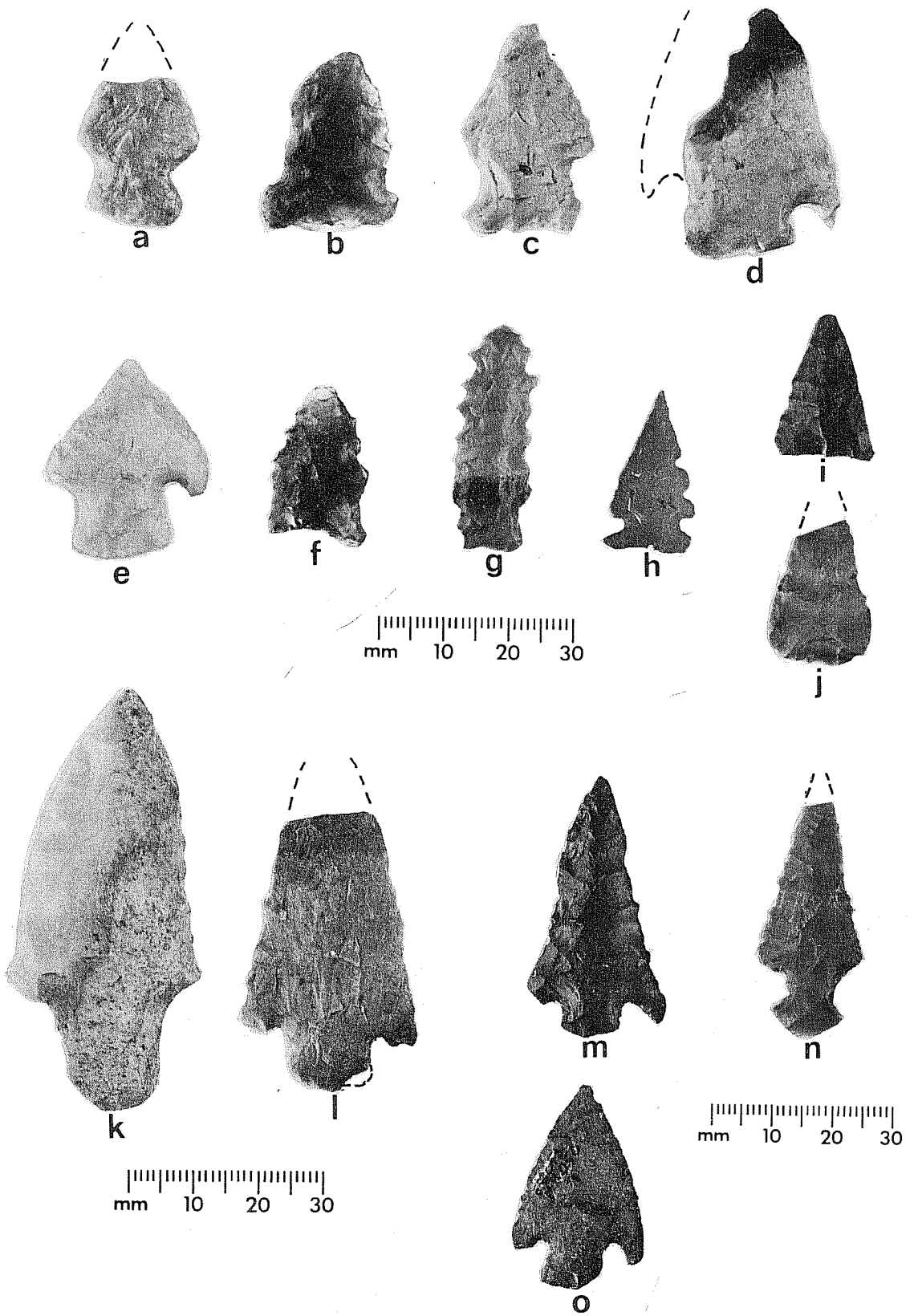


Figure 10. *Projectile Points from Radium Springs Survey Area.* a, AR063; b, AR007; c, RS015, SW2; d, AR002; e, AR062; f, RS019, SW4; g, AR061; h, AR062; i, AR062; j, AR042; k, T14S, R1F, Section 10; l, RS023, SW1; m, RS013, SW3; n, AR020; o, AR050.

Dimensions and comments regarding these expanding stem dart points are given below:

Fig. Ref.	L (cm)	W (cm)	T (cm)	Wt (gm)	Material	Prov.
9,c	6.3	3.7	.65	15.3	light gray, translucent chert	AR023
9,d	(3.4)	(2.3)	.4	3.2	dark gray chert	AR004
9,e	(3.2)	2.4	.6	4.3	dark gray chert	AR077
10,c	3.2	2.1	1.0	3.3	white-gray chert	RS015 SW2
10,d	3.9	(2.4)	.6	5.0	white-gray chert	AR002
10,e	3.0	2.4	.6	3.7	white chert	AR062
10,o	3.2	2.1	.4	2.2	black-mottled brown chert	AR050
not illus.	2.7	1.6	.4	1.8	white-gray chert	RS019 SW4
not illus.	(2.0)	2.0	.5	1.9	black chert	RS006 AR006

Side-Notched Points (Figs. 9, 10). The side-notched points series includes specimens which functioned as dart and arrow points. The specimen in Fig. 9,f is side-notched, and has a concave basal edge; it appears to be a dart point. Others, like the smaller specimens illustrated in Fig. 10,a,b and the side-notched, bulbous stem point in Fig. 10,n, may have been arrow points.

Descriptive data for these specimens follow:

Fig. Ref.	L (cm)	W (cm)	T (cm)	Wt (gm)	Material	Prov.
9,f	3.4	(2.1)	.5	2.6	dark gray chert	AR012
10,a	(2.3)	1.8	.5	2.2	gray-white mottled chert	AR063
10,b	2.7	1.9	.6	2.8	brown-gray chert	AR007
10,n	(3.7)	1.6	.4	2.1	dark gray chert	AR020

Rectangular-Stemmed Points (Fig. 10,k,l). Two large dart points have rectangular stems and broad triangular bodies. The complete specimen shown in Fig. 10,k is made of white-gray chert. It is 6.9 cm long, 2.3 cm wide, 1.1 cm thick and weighs 20.6 gm. Prov.: T14S, R12, S10. The second specimen is fragmentary, lacking the distal tip and a portion of the stem. It is made of light gray chert. Parallel flake scars are noted on the body. Length is (4.1) cm; width, 2.9 cm; thickness, .6 cm; and it weighs 7.8 gm. Prov.: RS023, SW1.

Lozenge-Shaped Points (not illustrated). Two unstemmed projectile points are lozenge-shaped in outline, with their size and weight indicative of use as arrow tips. One specimen is complete. It is made of gray-white translucent chert; length is 3.8 cm; width, 1.5 cm; thickness, .5 cm; and it weighs 2.7 gm. Prov.: RS003, SW2. The second specimen lacks the distal tip; flaking is crude and there are denticulations along a section of one lateral edge. It is made of white chert. Length is (3.4) cm; width, 2.0 cm; thickness, .4 cm; and it weighs 2.7 gm. Prov.: AR070.

Small Triangular Points (Fig. 10,i,j). Both are small arrow points. The complete specimen is made of pale gray chert; it is 2.2 cm long, 1.5 cm wide, 15 cm thick, and weights 1.3 gm. Prov.: AR062. The second specimen has a somewhat rounded base and is lacking the distal tip. It is made of light brown-gray chert. Length is (2.2) cm; width, 1.5 cm; thickness, 3 cm; and it weighs 1.0 gm.

Serrated Points (Fig. 10,f,g,h). The three specimens in this series have serrated lateral edges. Perhaps a better characterization of the treatment of one lateral edge on Fig. 10,h is "multiple side-notching." It somewhat resembles the Temporal type defined as a diagnostic of the Jornada Branch of the Mogollon (Brook 1972).

Descriptive data for the three points are given below:

Fig. Ref.	L (cm)	W (cm)	T (cm)	Wt (gm)	Material	Prov.
10,f	2.3	1.0	.6	1.9	translucent black obsidian	RS015
10,g	3.4	1.2	.5	2.2	light gray chert	AR061
10,h	2.5	1.4	.4	1.0	red chert	AR062

Fragmentary Stemmed Point (Fig. 10,m). This specimen is barbed, has a triangular body, and a slightly expanding stem. However, the basal edge is broken, and the original stem configuration cannot be determined. It is made of black chert. Length is (4.0) cm; width, 1.7 cm; thickness, .5 cm; and it weighs 3.4 gm. Prov.: RS013, SW3.

Drills and Perforators (Fig. 11,d-h)

Description: This group of bifacial tools was carefully manufactured for a specific purpose--boring or punching holes. All these tools which have

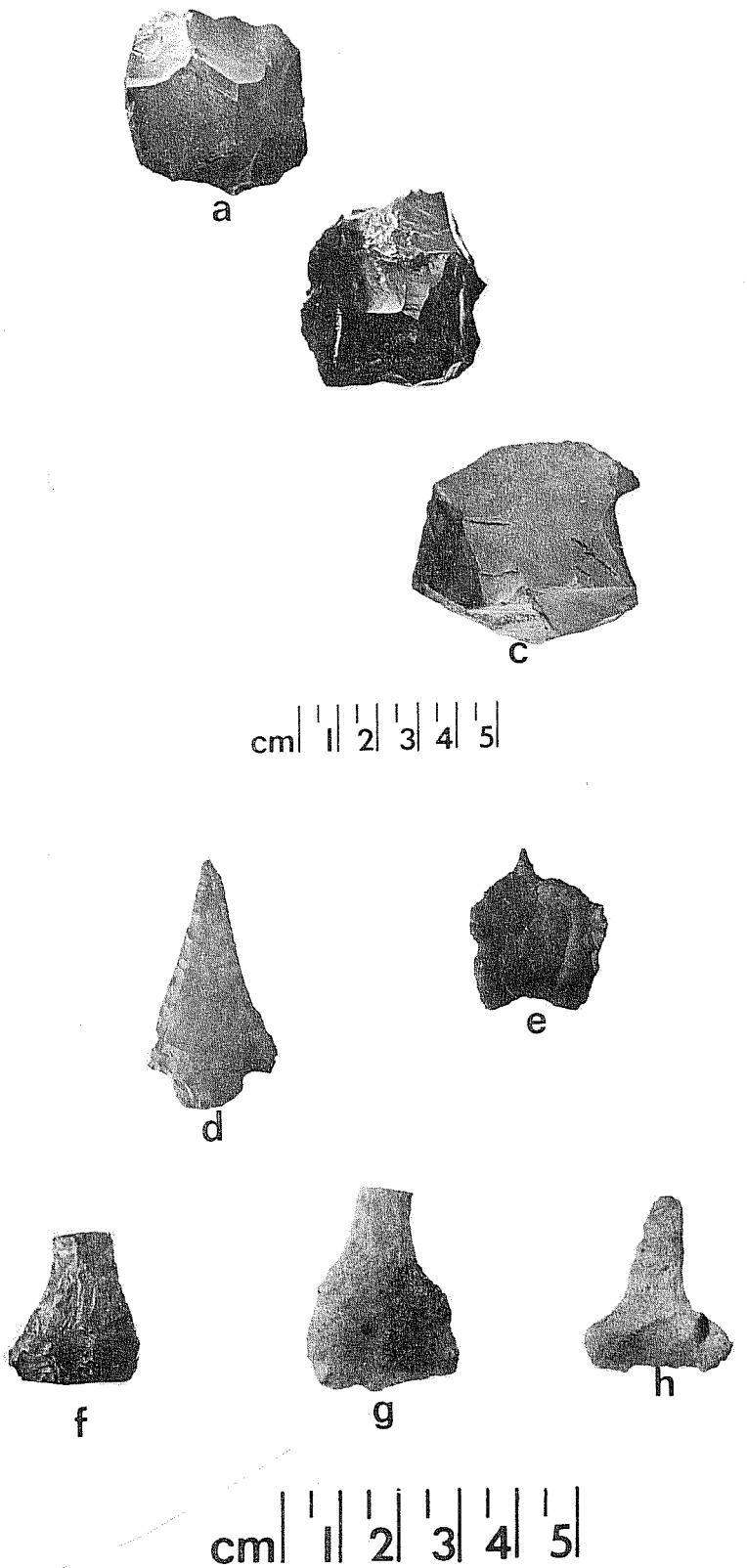


Figure 11. *Cores and Drills.* a-c, cores (AR068; AR080; RS032, SW1); d-h, drills (AR068; AR011; RS032, SW3; AR044; AR030).

intact base segments have flaring bases which would facilitate either hafting or gripping with hands. Transverse sections are usually asymmetrical and bi-convex. Several of these tools (Fig. 11,d) appear to be reworked projectile points. All of these tools are carefully made of glossy to semi-glossy cherts and silicified wood. Most exhibit considerable wear suggestive of long use. Many of these tools are broken, presumably during usage. Tip sections of drills are usually very thick in relation to width of tip.

Measurements: Length: (complete) 2.7-4.1; width of base: 1.2-2.5 cm; thickness: .4-18 cm; bit length: 1.1-1.9; bit maximum thickness: .15-.6 cm; bit maximum width: .4-1.1 cm.

Function: All but one example have rotary wear patterns typical of drills. This pattern is indicated by step fractures occurring on opposite faces of opposite edges. These edges are dulled, occasionally polished, with many minute step fractures and nibbling (see Fig. 21). The one specimen without rotary wear is a triangular biface with a needle sharp point. Step fractures and flake scars occur only on one face or tip indicating that it was never used in rotary fashion. This tool may have been used to punch holes in some soft material, such as leather.

Cores and Flakes

Cores (Fig. 11,a-c)

Description: Cores were made from many types of material. Flakes were removed for use in making other chipped stone tools. Fitting (1972) has divided cores from Mimbres area survey into four types: Block, Plano-convex, Bi-convex and Small. All four types are represented in survey area but a majority of these artifacts would be termed "blocky" in Fitting's typology. Little of the cortex remains on these artifacts. Most are blocky cores having had flakes removed from various surfaces at many angles. Many cores are very small, probably exhausted. Two cores appear to have prepared platforms. Materials include glossy-dull, banded-mottled cherts, basalt, and cherty limestone. In general, larger cores are poorer quality; small cores are fashioned of better quality glassy cherts.

Measurements: Length: 3.5-8 cm; width: 2.4-6.8 cm; thickness: 1.7-5.4 cm; weight: 15-206 gm. Typical specimen: 6.1 x 5.1 x 4.1 cm; 110.6 gm.

Function: Production of flakes.

Utilized Flakes. Flakes which show wear (nibbling or step fractures) or edge damage but do not appear to have been purposefully retouched. These are perhaps the most numerous artifacts observed on the sites. Most flakes except the very small specimens have a few tiny flakes removed from edge. They were presumably used as cutting or scraping tools for a brief time and discarded. Utilized flakes range from very small to very large and include all types of materials found on survey.

Core Trimmers. Occasionally flakes were found which had battering marks, and/or flake scars (similar to scraper wear) on dorsal edge. These flakes were

removed to change angle or direction of core platforms or to create a new platform for removing flakes from cores. Materials include glossy, dull and banded cherts. The term "core rejuvenation flake" could also be used in describing these artifacts.

Debitage and Chunks. Lithic waste in the form of flakes and chunks was very numerous and represents all types of raw material found on survey. These materials were not collected due to sampling restrictions.

Unifacial Artifacts

"Pulping Plane" (Fig. 12,a,b)

Description: Large heavy unifacial tools made from oblong, angular chert, and basaltic chunks. Material is uniformly of poor flaking quality. Typically, one edge is flaked the entire length of tool. Opposite working edge is a perpendicular face giving the tool a "backed" effect. Transverse sections: Wedge, bi-plano, trapezoidal and irregular.

Measurements: Length: 10-17 cm; width: 4-8 cm; thickness: 1.2-4.3 cm; bit angle: 55-80°; weight: 160-600 gm. Typical specimen: 15 cm x 7 cm x 3.3 cm; 500 gm; bit angle 70°.

Function: Wear patterns inconclusive. All flake scars removed from one face; no striations. Step fractures on worked face only. May have served as chopping or scraping tool or both, probably as hand held tool (see Hester and Heizer 1972 for a discussion of similar tools, which they term "scraper planes").

End Scrapers (Fig. 12,h)

Description: Flake tools with worked edge on end or ends of flake only. Bit angles tend to be steep. Worked end always convex. Transverse section is plano-convex. Variety of material used included chert, quartzite, and felsite.

Measurements: Length: 2.3-7 cm; width: 2.3-6 cm; thickness: .9-1.8 cm; weight: 7.2-55.8 gm; bit angle: 50-79°. Typical specimen: worked on one end; quartzite; bit: 2.5 cm long; 5.7 cm x 3.6 cm x 1.7 cm; 32 gm; bit angle 60-68°.

Function: As the term implies, this tool form was used for some sort of scraping task. Step fractures on bit. No striations observed under microscopic study.

End-Side Scrapers (Fig. 12,i,j)

Description: Flake tools worked on one or both ends, and one or both lateral edges. Most often one end and adjacent sides are worked producing a working edge of semi-circular outline. These tools usually exhibit very careful workmanship. Transverse section is plano-convex. Most of these

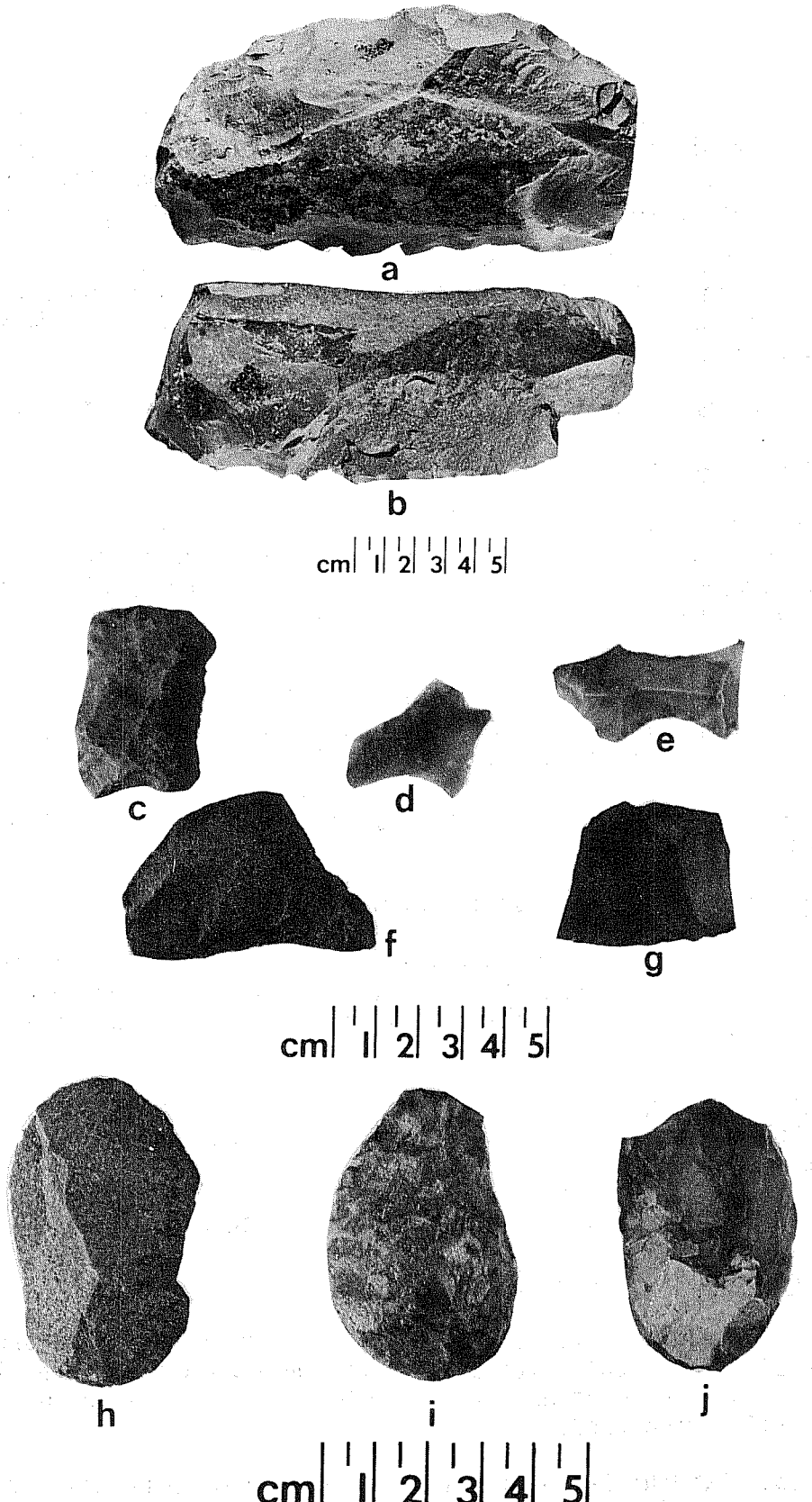


Figure 12. *Unifacial Artifacts*. a, pulping plane (AR011); b, pulping plane (RS013, SW2); c, multi-purpose scraper (AR035); d, concave scraper (AR044); e, concave scraper (AR062); f, side scraper (AR062); g, side scraper (AR001); h, end scraper (AR084); i, end-side scraper (AR068); j, end-side scraper (RS033, SW1).

tools were worked on all available edges, and usually on dorsal face. Occasionally, tool is worked on alternate faces of opposite lateral edges. Materials are glossy and grainy cherts, fine grained quartzite. Flaking quality of material usually very good.

Measurements: Length: 3.1-7.4 cm; width: 2.3-5.7 cm; thickness: .6-2.1 cm; weight: 7.2-84 gm; bit angles : 50-85°. Typical specimen: worked on one end and both sides; convex bit outline; mottled glossy chert; 5.1 cm x 3.4 cm x 1.1 cm; 20.7 gm; bit angle 60-70°.

Function: Apparently similar to that of the end scraper category.

Multipurpose Scrapers (Fig. 12,c)

Description: Unifacial tools having several types of trimmed edges, usually including one or more concave bits and one or more convex or straight bits. Irregularly shaped and sized but all are characterized by at least two different types of working bits. Material includes glossy chert to cherty stone.

Measurements: Length: 3.4-10 cm; width: 3-4.5 cm; thickness: 1-3.8 cm; weight: 15-138 gm; bit angles: 60-90°. Sample was too small to permit description of a "typical" specimen.

Function: Given the variation in bit types and angles, multi-functional scraping tasks are presumed.

Oval Plano-Convex Scrapers (not illustrated)

Description: Oval outline, with thick plano-convex transverse section. Worked on all edges of dorsal face. Material, size, and workmanship vary considerably. Materials are cherty limestone to glossy chert; most are coarse quality cherty material.

Measurements: Length: 3.8-8.5 cm; width: 1.5-6.5 cm; thickness: 1.1-2.8 cm; weight: 9-202 gm; bit angles: 65-85°. Typical specimen: 6 cm x 3.5 x 2.4 cm; 60 gm; bit angle 66-84°.

Function: Step fractures on ventral face indicate probable use as scraper.

Concave Scrapers (Fig. 12,d,e)

Description: These are also called "hollow scrapers" and "spokeshaves." They are small flake tools with a distinct, well-worked concave bit on one or two edges. Most specimens have two such bits. Materials include glossy cherts and silicified wood.

Measurements: Length: 2-4.5 cm; width: 1.9-3.1 cm; thickness: .3-1.1 cm; weight: 2-8.1 gm; bit angle: 60-77°; bit lengths: 1.8-3 cm. Typical specimen: 3.8 cm x 3.0 cm x .3 cm; 2.5 gm; bit angle 70-75°.

Function: Often assumed to be woodworking tools, perhaps shaft smoothers. No definitive wear patterns were seen under high magnification.

Side Scrapers (Fig. 12,f,g)

Description: Includes all unifacial tools worked on one or more edges and not fitting within above categories. As would be expected, these tools range widely in all respects--size, material, shape, bit angle, etc. A majority of these tools are well to fairly well worked on longest edge of tool. All are worked on dorsal surface. Materials vary from glossy to dull cherts, felsite, basalt, and quartzite.

Measurements: Length: 2.9-8 cm; width: 2.2-5.2 cm; thickness: .7-2 cm; weight: 6-76.5 gm; bit angles: 55-75°. Typical specimen: semi-glossy grey chert carefully worked on entire length of longest edge; 5.8 cm x 3.7 x 1.4 cm; 30.9 gm; bit angle 69°.

Function: Step fractures on worked face only; no striations observed.

Flake Scrapers (not illustrated)

Description: Flakes and flake fragments carefully worked on one face along one or two edges. Bit angles tend to be lower than other scrapers. Some flakes have serrated or partially serrated edges. These tools vary considerably with respect to shape, size, material, etc.

Measurements: Length: 2.8-9.5 cm; width: 2.2-5.8 cm; thickness: 4-2.4 cm; weight: 7-8.7 gm; bit angles 45-80°. Insufficient sample for the description of a "typical" specimen.

Function: Most appear to have functioned as scrapers while some serrated examples were used as cutting or sawing tools.

Miscellaneous Chipped Stone Artifacts

Grooved and Shaped Obsidian Fragment (Fig. 13,d)

This unusual artifact is made of dark gray obsidian. Exterior surface is rough and has been shaped. A groove has been worn into this object approximately .7 cm in length and shows linear striations and polish evidencing extensive usage. Fragmentary nature of artifact precludes understanding of original shape or purpose.

Saws (Fig. 13,a-c)

Several serrated and semi-serrated flakes and one biface were collected which were clearly used in cutting or sawing functions. Wear patterns visible on these tools show well-worn working edges with striations and some polish parallel to edge on both faces. Flake scars and nibbling present on both faces of tool edge. Fig. 13,c has especially heavy wear; this large serrated tool may also have been used as a graver. Fig. 13,a may have been hafted.

Hafted Scraper (Fig. 13,f)

This is a reworked projectile point suitable for hafting as a scraper. The tip of the artifact has been rounded suggesting such use.

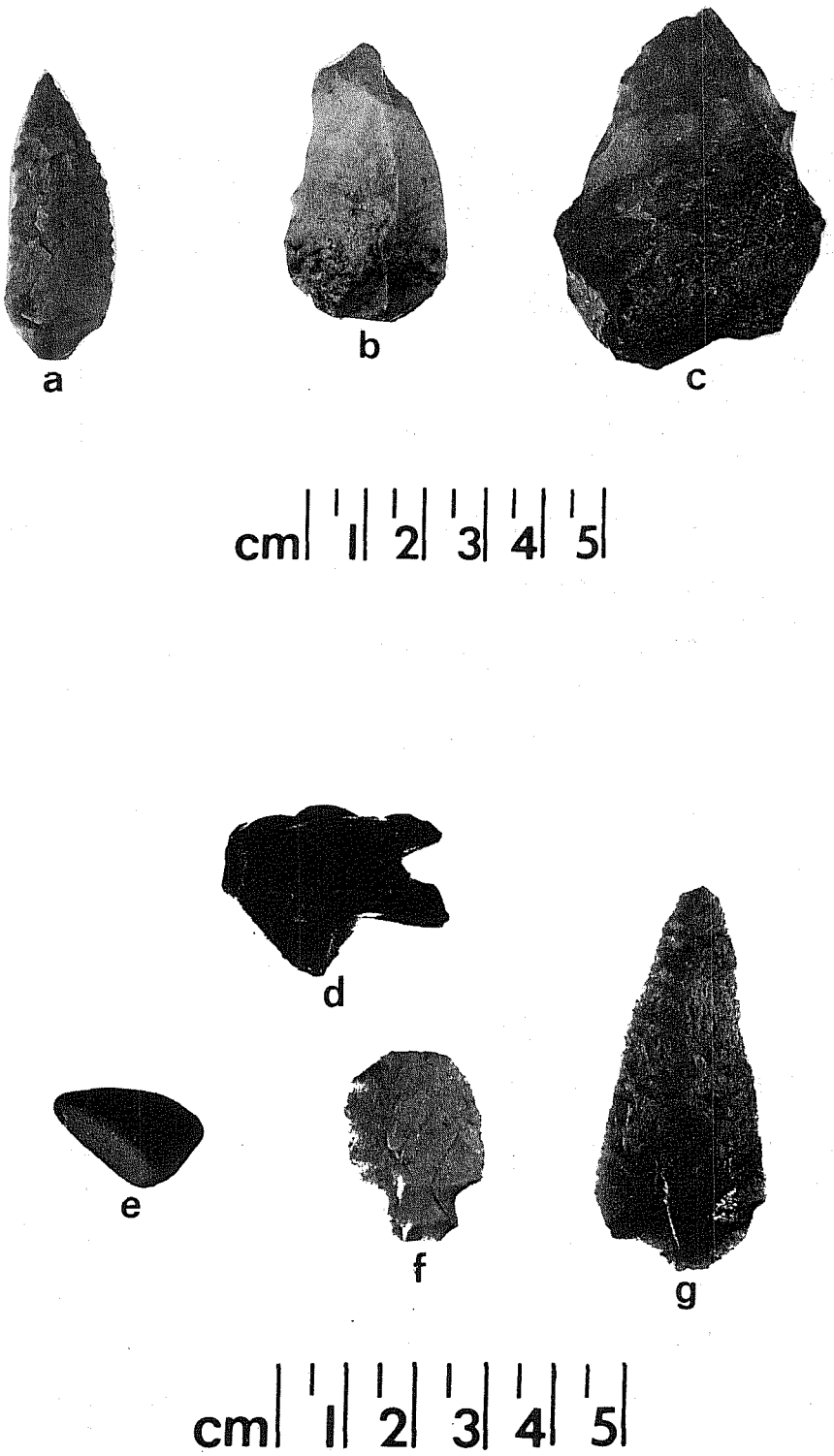


Figure 13. *Miscellaneous Chipped Stone Artifacts.* a-c, saws (AR011; RS015, SW6; AR068); d, grooved obsidian (AR012); e, polishing pebble (AR049); f, hafted scraper (RS029, SW1); g, alternately-beveled flake tool (AR009).

Alternately Beveled Flake Tool (Fig. 13,g)

This artifact has a steep bevel on opposite faces of both edges.[e] There is very little wear of any kind visible along edges. Function of this artifact is unknown.

Ground, Pecked and Polished Stone Artifacts

Metates (Fig. 7,a)

Metates were not collected at all except for several small broken fragments of unusual material. All metates observed were of slab or shallow basin type. Deep basin or trough metates are known in area but none were observed on survey. Materials utilized include very coarse to medium grain sandstone, metamorphic conglomerate, basalt and felsite. A majority were made of sandstone. See Fig. 7,a as an example of a slab metate found in the field. Most metates observed were fragments.

Manos (Figs. 14-18)

Manos were not collected except for a few examples for studying material types. Materials utilized include medium grain sandstone (predominant), felsite, coarse-conglomerate sandstone and basalt. Transverse sections include wedge, convex/convex, flat/convex, slightly convex/slightly convex. Shape or outline included oval, rectangular, and circular. Most manos were of the one-handed variety but a few two-handed manos were observed. Manos were the most numerous ground stone artifact form observed on survey.

Measurements: length: 10.7-27 cm; width: 7.2-16 cm; thickness: 2.4-4 cm; weight: (490)-2,171 gm.

Hammerstones (Fig. 19,a,b)

Description: Round to subrounded cobbles exhibiting bash or batter marks on most of surface. Several specimens are broken. Hammerstones were made of dense cherty material, quartzite and felsite.

Measurements: (complete) ranges from 5.3 x 4.5 x 3.7 cm, 110.5 gm to 8.2 x 6.6 x 6.4 cm, 487.3 gm. Typical example: 6.8 x 5.9 x 5.5 cm, 283.8 gm. Dark gray cherty limestone with white impact marks on entire surface.

Function: Used in hammering tasks, probably stone-working and for plant/animal resource processing.

Polishing Pebble (Fig. 13,e)

This is a very small (2.3 x 1.6 x 1.7 cm; 4.5 gm) pebble. Material is some sort of sedimentary pink material. Pebble is plano-convex in transverse

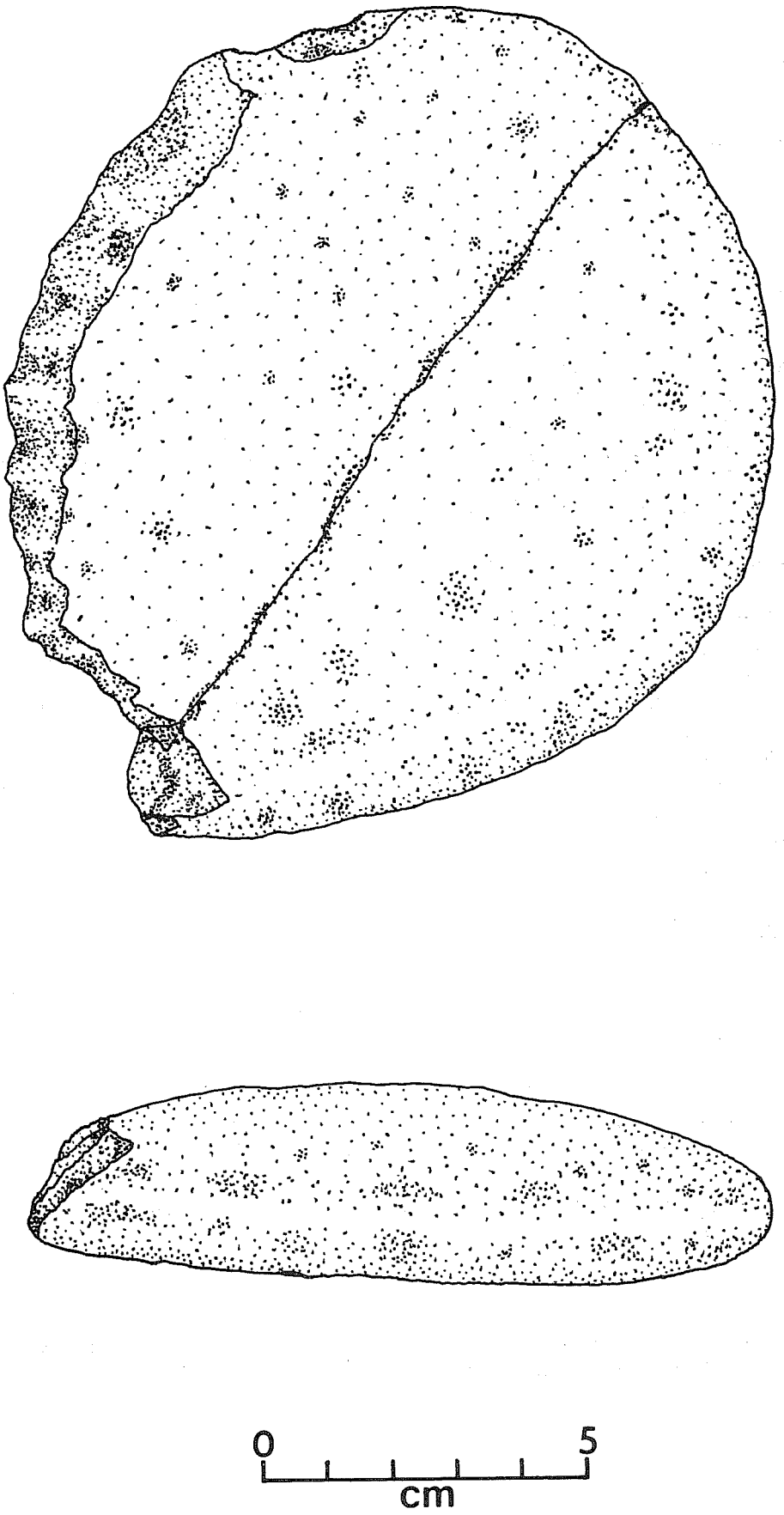


Figure 14. *Ground Stone Artifact.* Mano of porous light brown/gray

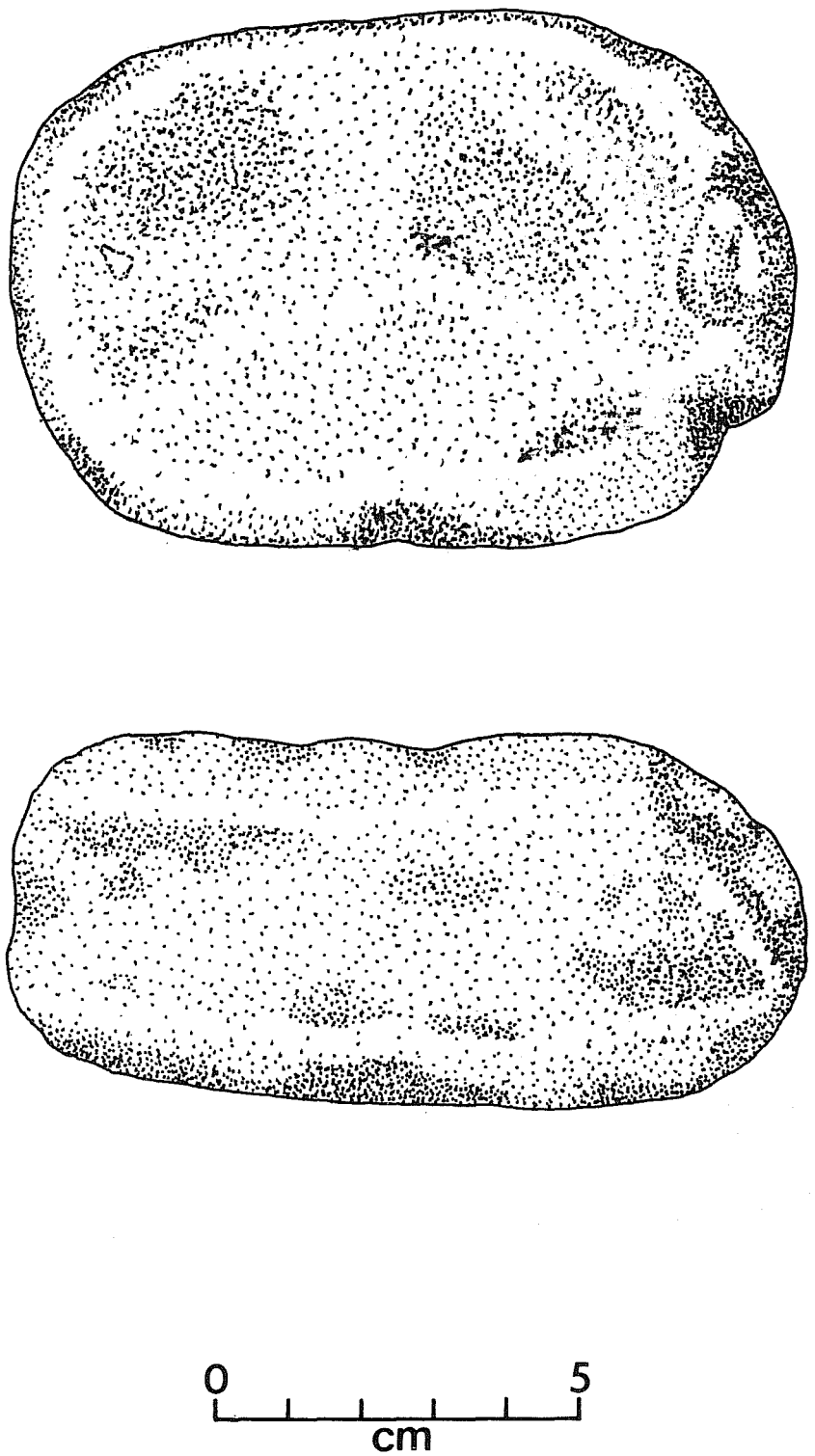


Figure 15. *Ground Stone Artifact.* Mano of brown coarse-grained sandstone, with heavy caliche encrustation. AR005.

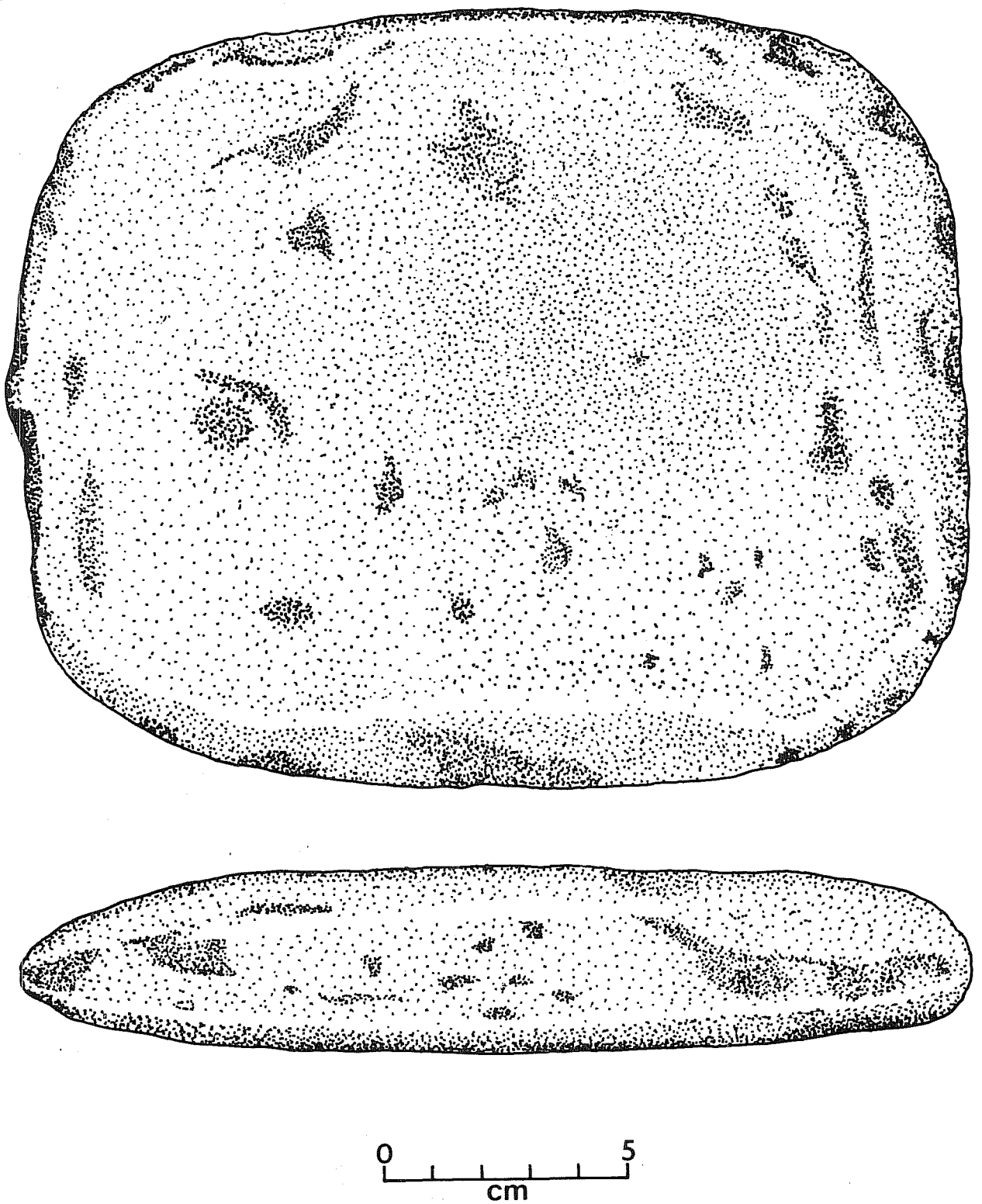


Figure 16. *Ground Stone Artifact.* Two-handed mano of brown/gray medium grain sandstone. RS001.

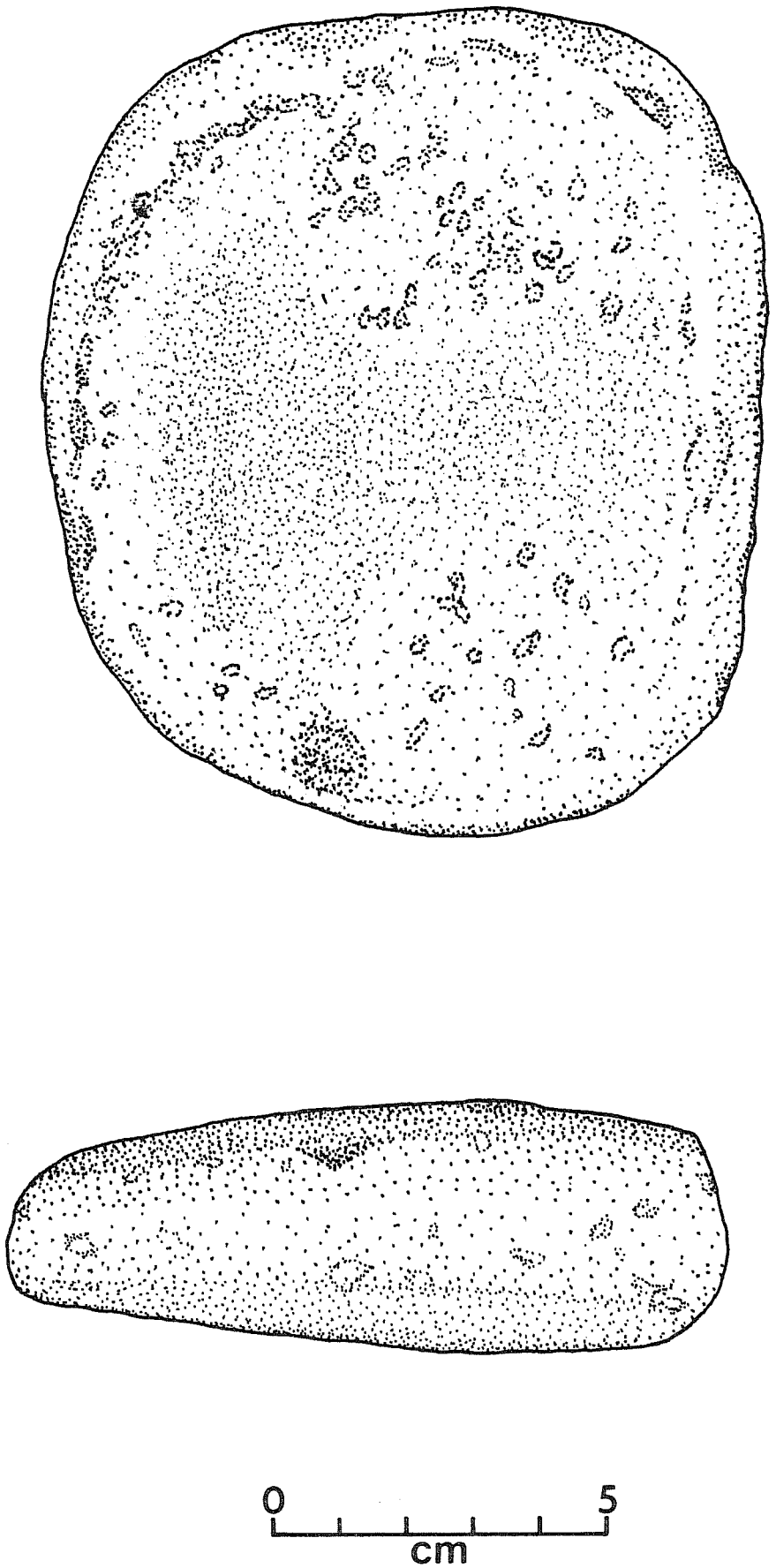


Figure 17. *Ground Stone Artifact.* Mano of brown medium-grained sandstone. Edges obviously pecked while shaping. AR078.

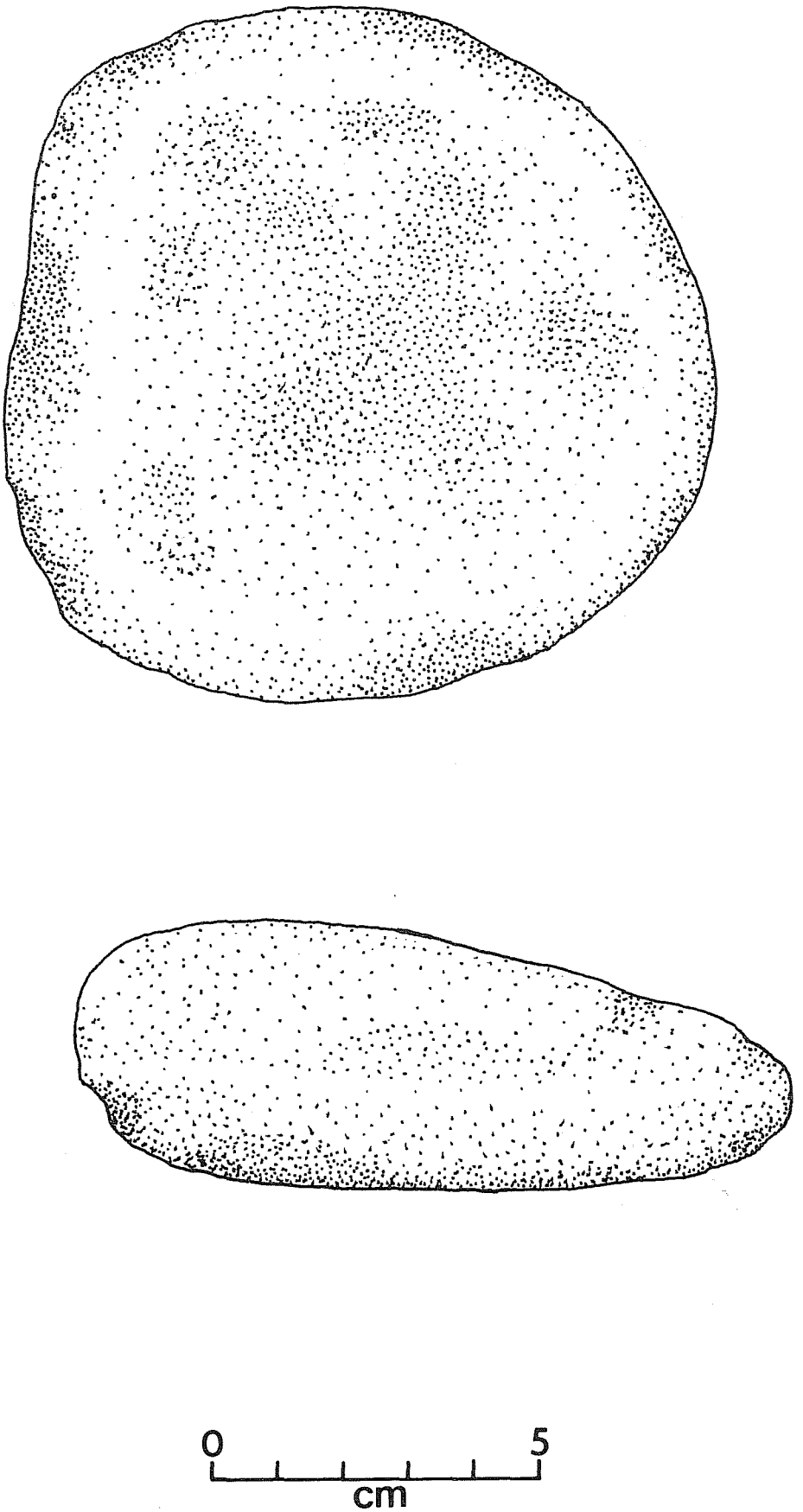


Figure 18. *Ground Stone Artifact.* Rhyolite mano with heavy use indicated on both surfaces. RS015, SW5.

section. One surface is flat and has been heavily worn. Wear striations are not parallel and run in several directions indicating pebble used in circular motion in grinding or smoothing tasks. This pebble was found at AR049, a ceramic site, and probably was used as a pottery smoother.

Rubbing Stone (not illustrated)

This artifact is an oblong quartzite stream-worn cobble. The flat sides of the tool are worn smooth, used in a circular motion to grind or polish. Edges or ends of artifact show signs of battering wear. DiPeso (1974:Vol.7) notes a Seri ethnographic account of a similar artifact called Hupf. During a six-day period the Hupf was used for 13 different functions including a hammer, an axe, a grinding stone, a projectile, a saw, a chopper and a plane. The artifact found on the survey was very similar in description to the Seri Hupf. It measures 7.8 cm x 6.7 x 4 cm and weighs 294 gm. Approximately one-third of the tool is missing. This tool exhibits several kinds of wear and undoubtedly served many functions.

Mica-Schist Artifacts

A number of specimens of various forms of schist were observed on sites in the survey area. These specimens were of a fragmentary condition; many were just thin spalls. Two forms of recognizable artifacts were found: oblong pestles and flat, thin slabs. Materials utilized were identified by Dr. Richard McGehee, UTSA geologist, and include mica-schist, garnet-mica schist, mica-garnet schist, hornblend mica-schist and muscovite schist. Similar artifacts were found at Casas Grandes by DiPeso (1974) and in the McGregor Range Survey (Beckes *et al.* 1977).

Pestles (Fig. 19,c,d)

These oblong specimens were rectanguloid in transverse section with all unknown edges rounded. Dr. McGehee stated these artifacts exhibited a pronounced linear alignment typical of minerals present in the specimens. He was also of the opinion that naturally worn mica-schist rocks downstream from the geologic source would appear much the same. Most of the artifacts collected or observed were broken on both ends. Two had intact ends (Fig. 19). Both of these exhibit battering-type wear which would be expected if used as pestles. It is suggested that these mica-schist specimens were collected from stream beds as water-worn and smoothed oblong specimens and used as pestles without further modification.

Measurements: The pestles were fragmentary. Length: (12.4)-(22) cm; width: 5.1-6.4 cm; thickness: 2-3.1 gm; weight: (209)-(556) gm.

Mica-Schist Slabs (Fig. 20)

Several specimens of mica-schist mineral were found which were of a very flat, thin, tablet form. In fact, the surface of one of these slabs was worn in the center suggesting use as very fine grinding palette, perhaps for paint

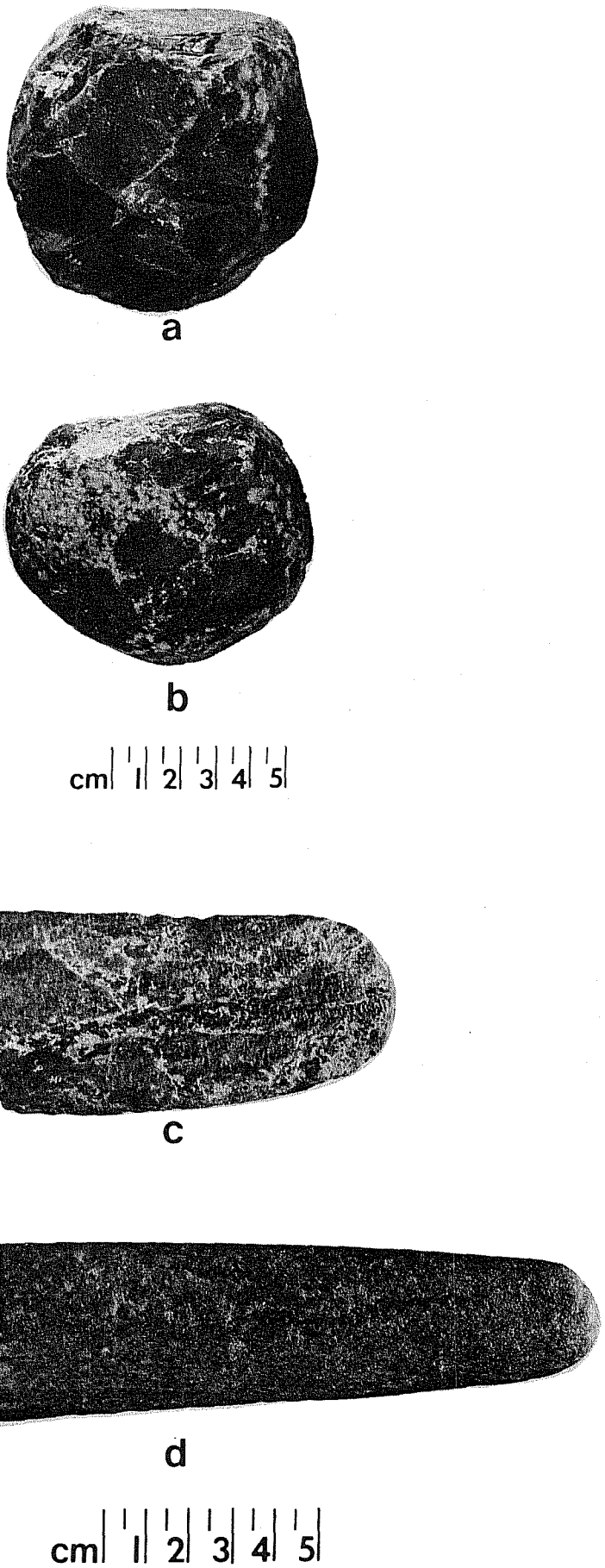


Figure 19. *Hammerstone and Mica-Schist Artifacts.* a,b, hammerstone (AR062); c,d, mica-schist pestle (AR032; AR060).

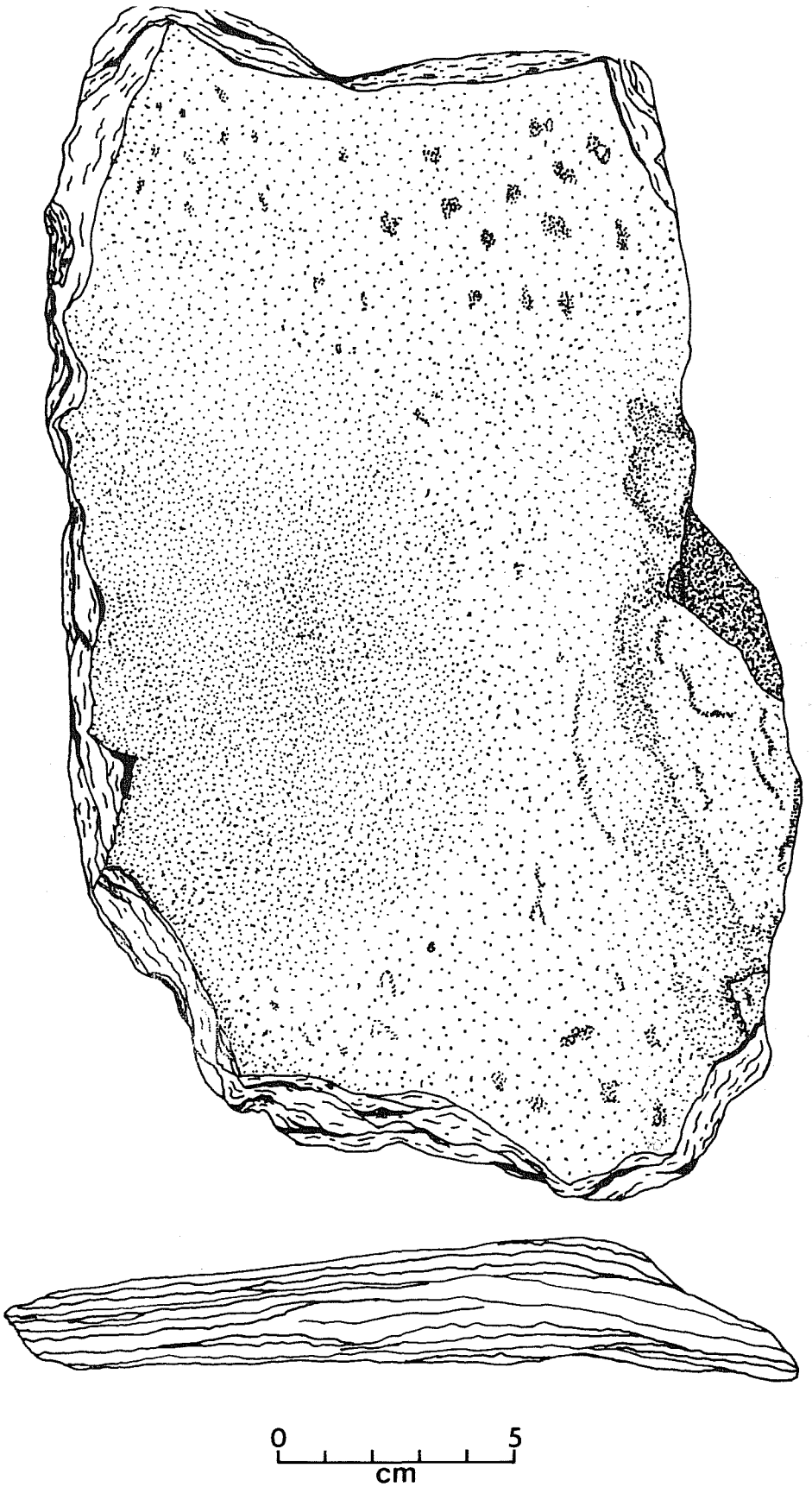


Figure 20. *Mica-Schist Artifact.* Mica garnet schist slab (densely shaded area indicates highly ground portion). AR011.

pigment. Heavy use similar to that of metates would have soon destroyed these thin mica-schist slabs. Most of the slab-type mica-schist specimens were observed in a fragmentary state, broken in thin sheets along natural cleavages. The only relatively complete specimen was 27 cm long, 15.5 cm wide, 2.4 cm thick, and weighed 1,380 gm.

Wear Pattern Examinations

Detailed wear pattern studies utilizing microscopic examination and replicative experiments are quickly becoming standard procedure in archaeological lithic research (cf. Hester and Heizer 1973 for a bibliography of published research in this field). Redman (1973:9-10) has pointed out the value in combining morphological descriptions and functional analysis by relating wear patterns to tool morphology. He has also noted the difficulty of examining total samples and recommends probability sampling for choosing representative examples of tool types for functional analysis. The small sample size from Radium Springs was not conducive to probability sampling and time limitations allowed examination of a relatively few artifacts within major tool categories, concentrating on those artifacts of particularly questionable function. Definite interpretive statements are not possible in most cases. In many cases, negative evidence suggested use of the artifact in some other function (i.e., the tool showed no edge damage typical of use as a cutting tool). A few general wear patterns were observed which are typical of a particular artifact function. Photomicrographs were taken to record certain types of wear. As other researchers have found, it proved to be difficult to obtain clear photographs illustrating details obvious to the eye. In an effort to reproduce wear patterns several large flakes removed from a single core were utilized in different tasks. A flake used as a scraper for removing fiber from a piece of seasoned wood produced wear patterns clearly distinguishable from the flake used to cut a groove into the same piece of wood.

Scraper wear was produced by using a tool unidirectionally, with the tool edge perpendicular to the material being worked. Repeated use of the tool resulted in many small flake scars (nibbling) and step fractures being removed on the dorsal face of the tool. Scraper wear tends to leave an even edge on a tool by removing all protrusions or protruding platforms from manufacture of the tool edge. Striations were sometimes visible after use of the scraper on relatively hard surfaces, where they appeared perpendicular to the scraping edge.

When a tool was used in a cutting or sawing motion a very different wear pattern was formed. Flake scars occurred on both faces along the edge used. Edges were often uneven and became very dull. Repeated usage on hard objects gave the edge a ground appearance. Flake scars and wear striations appeared at an acute angle to the edge--sometimes almost paralleling the edge. Polish appeared occasionally as a narrow band on both faces of an edge. Serrated tools showed dulling of the edge which often obscured the original flake scars.

Drills or perforators showed a very distinctive wear pattern. Flake scars, step fractures and striations occurred on alternate faces of opposite edges.

Many of these tools appear almost ground smooth, indicating heavy use (see the photomicrograph in Fig. 21). Almost all of these tools were apparently used in a rotary fashion in only one direction.

Other distinct wear patterns which were often present and usually visible to the unaided eye are battering marks and grinding surfaces. Ground surfaces obviously result from repeated contact with abrasive materials. Microscopic examinations occasionally showed curving striations resulting from usage in a circular motion. Battering marks appear on tools (such as hammerstones) as generally white or lighter colored marks caused by the crushing impact of blows to the exterior surface. Repeated use of a tool as a hammerstone leaves much of the implement battered and thus easily recognizable.

Lithic Sources

Lithic artifacts and debitage observed on Radium Springs survey sites indicate that a very wide range of lithic materials was utilized, including cherts ("flint"), jasper, agate, silicified wood, felsite, quartzite, basalt, sandstone, mica-schist, rhyolite, andesite, obsidian, calcite and limestone. It is of obvious value to recognize sources of lithic procurement as they can indicate trade relations, distance traveled to obtain material, and intersite relations. This task is much easier when the study area has a restricted lithic type availability. Katz (1976), studying Kansas City Hopewell sites, was able to distinguish between two varieties of local cherts and foreign or intrusive cherts. This enabled him to make certain conclusions regarding use of specified types and amount of imported material. R. N. Jack (personal communication) and Hester and Mitchell (1974) have carried out limited research with obsidian sources in New Mexico, utilizing trace element analysis. Several obsidian artifacts collected during this survey are presently undergoing geologic source analysis (see Appendix III). Lithics present in the 1976 survey, however, offer a much more complicated situation. A study of lithic sources available in the general survey area which would enable sources to be linked with site samples would require resources and time equivalent to that spent on the entire 1976 survey. General source areas can be noted and will indicate general availability of lithics in the survey area.

Major lithic source areas in or adjacent to the survey area include: San Andres Mountains, Rio Grande Valley, Point of Rocks, Caballo Mountains and San Diego Mountain. The San Andres Mountains offer a wide variety of cherts, sandstone and some mica-schist. The Caballo Mountains offer fine grain silicas (cherts and jasper), quartzite and sandstone. The Rio Grande Valley, especially gravel deposits, offers any mineral which can be found north of the survey area. Quartzite cobbles are especially common. Silicified wood, agate and cherts are all found in these gravel deposits. Point of Rocks is a volcanic intrusion which provides large quantities of andesite basalt. Sandstone outcrops can be found near Point of Rocks. San Diego Mountain is a volcanic plug which, as pointed out by Hammack (1962), offers a wide variety of silicates, rhyelite, and others. Obsidian is available in the Organ Mountains south of the survey area and in the Mule Creek area to the west. As can be seen, it is difficult to isolate a particular source for most lithic tools found in the area.

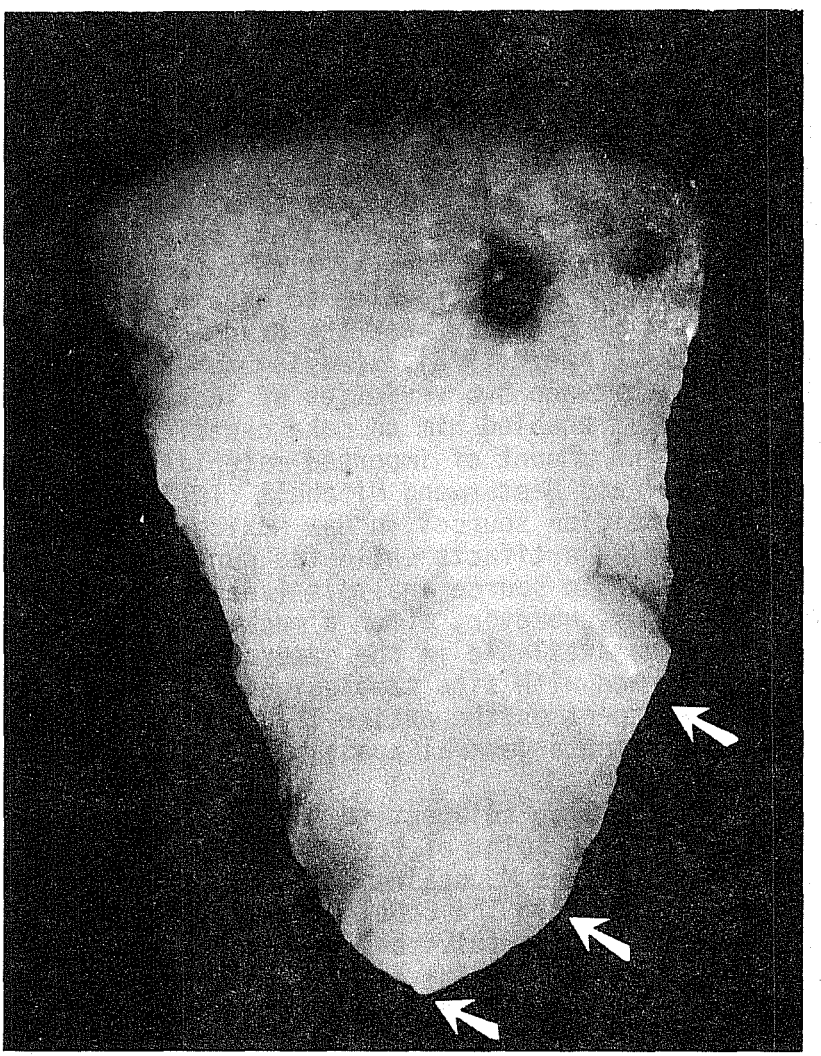


Figure 21. *Photomicrograph of Drill Tip from AR002.* Arrows indicate nibbling and polish caused by rotary usage.

Two prehistoric quarry sites were reported from adjacent areas prior to the survey. Schaafsma (1974) mentions the Treadwell Mine and LA 2999. Both apparently are along the Rio Grande Valley, but neither have been adequately reported. The 1976 survey recorded a quarry site, AR094 (the Cain quarry), located on small hills approximately nine miles north of Point of Rocks. The Cain quarry is an outcrop of felsite--a light grey-brown volcanic material. Flaking quality of the material is poor but it can be made into tools. Numerous Cain quarry felsite tools and flakes were found on sites during the survey. Four sites occurring up to 10 miles from the quarry contained this material.

Tool Type Distributions

As previously mentioned, small sample size and sampling bias do not permit broad conclusions to be made on tool distributions. However, some general trends and associations can be noted, albeit with caution.

Ceramics were present on roughly 50 percent of the sites found on the survey. The presence of ceramics indicates a fairly restricted time range and these artifacts serve as the major means of assigning cultural affiliations and chronology based on surface observations. Absence of ceramics is often taken to mean the site is older ("Archaic") in time. Other plausible explanations include (1) ceramics present but unobserved, (2) lithics left by ceramic peoples who did not leave sherds behind, and (3) lithics left by later Apache who rarely utilized ceramics. Whatever the case, distributions of tool types present on "ceramic" sites were compared to those present on "lithic" sites.

In general, lithic tools were more numerous on ceramic sites. This is expected, because these are generally the better preserved sites. Of all tool types, multipurpose scrapers, end scrapers, preforms, finished bifaces and projectile points occur more frequently at lithic sites. All other tool types occur most often at ceramic sites.

Certain tool forms most often occur together. These include end-side scrapers, side scrapers, marginally retouched flakes, hammerstones, quarry blanks, cores, manos, utilized flakes and serrated saws. This obviously indicates a wide range of tool manufacture and utilization, as would be expected at larger village sites such as AR067, AR068 and AR001. More restricted tool form variations are present at smaller sites utilized for special purposes or on an occasional basis. Future research directed at defining tool kits and comparing distribution of tool forms will of necessity involve intensive sampling using collecting methods which reduce or eliminate sampling bias. Controlled surface collections at larger sites may serve to pinpoint areas of intrasite activities.

TABLE 5

Provenience of Lithic Artifacts, Radium Springs Survey

Site Numbers	Bifacial Artifacts									Unifacial Artifacts								Miscellaneous Chipped Stone			Ground, Pecked and Polished Stone				Mica-Schist Artifacts	
	Quarry Blank	Preform	"Finished" Biface	Projectile Point	Drill and Perforator	Core	Utilized Flake	Core Trimmer		"Pulping Plane"	End Scraper	End-Side Scraper	Multipurpose Scraper	Plano-Convex Scraper	Concave Scraper	Side Scraper	Flake Scraper	Grooved Obsidian	Saw	Alternately Beveled Flake Tool	Mano	Hammerstone	Polishing Pebble	Rubbing Stone	Pestle	Slab
001							1										1									
2		5	1	2	1		1								1											
3																										
4							1																			
5	1	2	1							1											1					
6				1																						
7	3	1		2			1									1	2									
8																										
9		1	1			1	1				1					1	1			1				1		
10							1			1																
11		1			2					1	1				1		1	1							1	
12	1			1								1						1								
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41																	1				
42				1																	
43																					
44					1		4							1		1					
45							1							1				1			
46				1			1													1	
47							2									3		1			
48							1							1			1				
49						1												1	1		
50				1					1			1									
51																					1
52																					
53	2						2		1												
54							3									1					
55																					
56	1				1				1								1				
57	1	2		1		1										1					
58							2			1											
59							1											1			
60			1																	1	
61				2								1	1			1					
62	1		1	3	1	4	1	1			1	1			2	9	1	3			

53	2		1									1		3				
54																		
55		1									1	1						
56													1					
57												1						
58	2	1		1	4	9	3			1			4	7	1	2	4	
59	1					1												
70			2															
71																		
72																		
73																		
74																		
75						1												
76		1				1				1				1				
77		1	2	1						1			1	1				
78						1								1		2		
79		2				3								2				1
80	1				2									3			1	
81																	1	
82								1				1					1	
83		1	1							1								
84					1				1									
85			1															
86						2								1				
87	1					1								2				
88	1										1		1	1				
89		2				3							1					
90		1																

This lithic distribution table includes data only from sites found on selected study sections. No artifacts were collected from AR017 and AR074. Some artifacts (e.g., hafted scraper) were found in isolated situations and are therefore not listed here. In addition, the several collected metate fragments are not tabulated; such specimens were present at many sites, but only certain examples were collected (see text).

CERAMICS

Erwin Roemer, Jr. and Paul R. Katz

Introduction

This section of the report provides two basic kinds of information, both dealing with the culture history of the survey area. Pottery types and wares have been described in detail and accurately dated in adjacent regions. The identification of sherds recovered in the survey area and their assignment to known types or wares yields data relevant for both site occupation dating and the directions of either travel or influence into the area.

A discussion of collection procedures precedes a detailed description of each ceramic grouping documented in the survey area. These descriptions are admittedly paraphrased from both original and subsequent descriptions, and appropriate references are provided. Because of the culture-historical value of ceramic specimens and the relatively unknown area in which the survey was conducted, it was felt that a compendium of pottery descriptions would be of benefit to future researchers and BLM staff members working in the Radium Springs area.

Collection

Ceramic specimens, predominantly potsherds, were noted at 43 sites within the survey design area and three sites outside this designated area. This represents 49% of the 88 survey area sites recorded and 48% of the total number (96) of sites recorded.

As the purpose of ceramic collection was not to determine the proportion of each recognized type or ware, but rather to document the presence of each for culture historical purposes, a grab sample technique was employed for all but the largest sites. In the case of AR001, a series of linear transects were established for tighter control of the collection procedure.

Small samples of each identifiable type or ware were collected, and every unidentifiable sherd was collected for more detailed analysis in the laboratory. If the resulting ceramic collection is larger than was originally intended, this is not due to any lack of ability among the field crew in recognizing known types. Rather, the considerable erosion, weathering and abrasion by domestic animals which characterized most sites resulted in a high proportion of unidentifiable pottery. Whenever it was obvious that several sherds were from the same vessel and could be joined together, all were collected. Finally, several sherds were collected which were not associated with a recorded site, their assignment to an uncommon or previously undocumented type outweighing their isolated provenience.

In addition to the presence of a specific type or ware at a site, record was made of the overall ceramic density characterizing each site. To avoid the time-consuming procedure of actually counting every sherd, three categories were established and integrated into the field coding criteria. Ceramic sites were divided according to whether they had from one to nine sherds in

evidence, from 10 to 99, or more than 100 sherds. For purposes of discussion, these relative densities might be designated as Light, Moderate, and Heavy (see Table 6).

Of the 43 ceramic sites recorded in the survey design area, 24 (56%) were termed Light Density; 13 (30%) were Moderate; and only 6 (14%) were Heavy. Calculation of the number of sherds per square meter of site area resulted in very small fractions, a variation of from 0.008 to 0.3 sherds per m^2. Computer analysis provided a weak but interesting correlation, however, between sites with large areas and light to moderate sherd densities. It is suspected that the larger sites reflect multiple activities, only some of which involved the use of pottery; the smaller sites with pottery may reflect fewer activities, more of which had uses for ceramic utensils.

Concerning ceramic distribution throughout the survey area, it appears that pottery was fairly evenly represented; that is, the sites at which pottery was documented did not tend to cluster to any significant degree.

Description

JORNADA DISTRICT

Jornada Brown (ca. A.D. 800-1200, see Table 7)

Published description: (Breternitz 1966; Human Systems Research 1973; Jelinek 1967; Runyan and Hedrick 1973)

Paste: Soft, granular, and friable; color ranges from light brown, dark brown, reddish-brown to black, depending on amount of original carbon content and degree of firing; black carbon streak common

Temper: Profusion of feldspars and/or quartz, with or without some mica and magnetite; other documented combinations are: feldspar and sand, gypsum and/or sand (often with hematite and mica), quartz sand or sandstone (crushed); never limestone, bone, shell, or crushed sherds

Core: Outside light buff to light ochre red; depending on carbon content and firing, center may be gray to black

Surface treatment: Smoothed and semi-polished with considerable variation of smoothing, accomplished by scraping, wiping, rubbing, and floating; vessel color has wide range of light buff-brown to dark red, depending on clay or firing; fire clouds common

Decoration: None

Forms: Jars predominate, round-bottomed without necks, usually large (up to 20 inches) with simple direct rim edges

Distribution: Westward to Lake Valley (at the eastern foot of the Black Range); generally north of Carrizozo, New Mexico, to north of Kenna, New Mexico; south to Villa Ahumada, Chihuahua; west to New

Mexico-Arizona state line; east into the Llano Estacado, Texas, and east of El Paso up to about 150 miles; focus is in the northern Jornada area of the Mogollon

Remarks: Jornada Brown is very similar to El Paso Brown, but the former typically has finer temper, surface polishing, straight rims, and generally thinner vessel walls.

Radium Springs Survey: Identified at 19 sites, Jornada Brown is the second most common pottery type documented in the survey area.

Jornada Painted (Jornada Bichrome, Jornada Polychrome; A.D. 900-1350).

Published description: (Human Systems Research 1973)

Paste: Same as Jornada Brown

Temper: Same as Jornada Brown

Core: Same as Jornada Brown

Surface treatment: Same as Jornada Brown

Decoration: Use of crude motifs of black or red paint below rim, in some cases as a crude geometric design within a bowl interior; sometimes red pigments cover an entire interior or exterior vessel surface

Forms: Same as Jornada Brown

Distribution: Same as Jornada Brown

Remarks: This pottery type typically occurs as a very small percentage relative to Jornada Brown.

Radium Springs Survey: Specimens were present at only three sites (AR001, 48, 81), and all were badly eroded. It ranks sixth in overall popularity among recovered types, along with San Francisco Red, Mimbres Black-on-White, and Pitoche Rubbed-Ribbed.

El Paso Brown (A.D. 800-1200)*

Published description: (Human Systems Research 1973; Runyan and Hedrick 1973)

Paste: Same as Jornada Brown

Temper: Like that described for Jornada Brown, but the particles tend to be larger, ranging from fine to 3 mm (average 1.4 mm)

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*This date range, differing from the traditional A.D. 900-1350, has been suggested by recent work conducted in the region (Michael Whalen, personal communication).

Core: Same as Jornada Brown

Surface treatment: Smooth matte, with temper protruding surface; no slip or floating; considerable variation in smoothing but no actual polishing (as opposed to Jornada Brown); color range similar to Jornada Brown

Decoration: None

Forms: Jars and bowls, similar to Jornada Brown

Distribution: North of Carrizozo, New Mexico, to north of Kenna, New Mexico, south to Villa Ahumada, Chihuahua, Mexico; west to the New Mexico-Arizona state line; up to 150 miles east of El Paso, Texas, and into the Llano Estacado, Texas; focus in the Rio Grande Valley near El Paso

Remarks: The possibilities for confusion between Jornada Brown and El Paso Brown are known to all researchers in the region, although most maintain their distinctiveness in the literature.

Radium Springs Survey: Sherds identified as El Paso Brown were recovered from 29 sites, making it the most common pottery type documented within the survey area. See Fig. 22,a,b.

El Paso Polychrome (A.D. 1200-1350)

Published description: (Hawley 1950; Human Systems Research 1973; Runyan and Hedrick 1973)

Paste: Grayish-brown to black to various reds, depending on clay sources; contains much carbon material; color of paste proportional to original carbon and firing temperature; very friable

Temper: Same as Jornada Brown and El Paso Brown

Core: Same as Jornada Brown and El Paso Brown

Surface treatment: Similar to Jornada Brown and El Paso Brown, but floated

Decoration: Crude, alternating lines of black and red; massed colors, stepped patterns, mainly black and red-on-brown but in various combinations; paint is thin and the red is often fugitive; jars and ollas have upper decoration below rim, bowls have their interior rim areas painted

Forms: Bowls and jars; bowls are deep, rounded, with usually direct, flat and slightly rounded rims; jars and ollas have wide mouths, round or flat bottoms and commonly wide bodies, constricted necks recurving to a flaring lip; rims typically flare and thicken at edges, which are usually direct and either rounded or flat

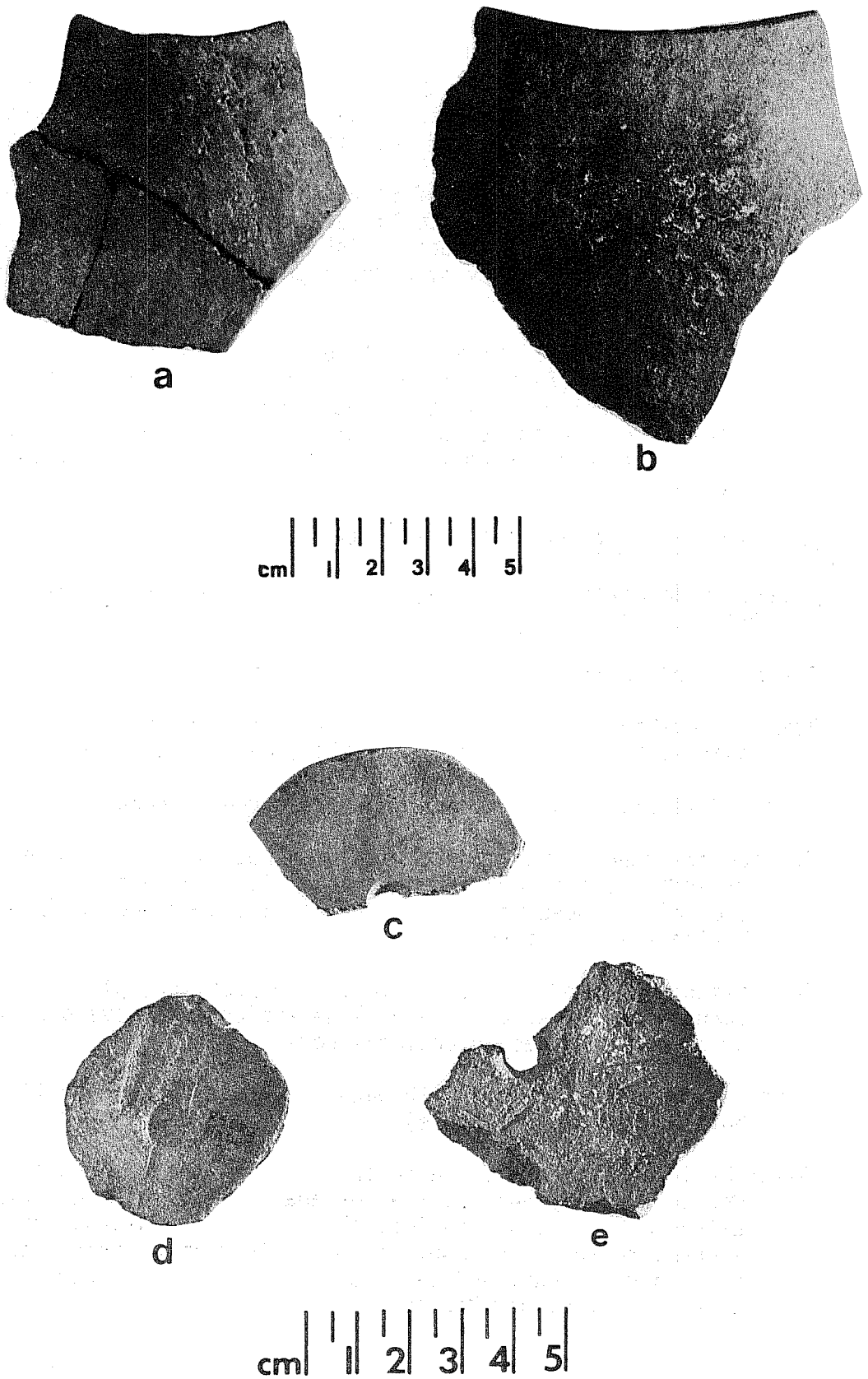

Figure 22. *El Paso Brownware Rim Sherds and Modified Sherds.* a, AR075; b, AR050; c-e, modified sherds: c, AR068; d, AR068; e, AR037.

Distribution: From the vicinity of Lincoln and Nogal, New Mexico, south to Villa Ahumada, Chihuahua, Mexico, and in the immediate southeastern area of Arizona, back to about 30 miles east of Carlsbad, New Mexico, and into the Llano Estacado of Texas

Remarks: The ubiquitousness of El Paso Polychrome in the Mogollon region and beyond suggests large-scale manufacture or trade. The apparently hasty and crude finish has been proposed by some to denote the possibility of a "no deposit-no return" use involving trade goods.

Radium Springs Survey: El Paso Polychrome sherds were identified at five sites (AR001, 36, 49, 62, 78) in the survey area, suggesting late Mogollon activity. Their abundance at El Paso phase sites to the south is not mirrored in the survey area, however. Along with Seco Corrugated, this is the fourth most prolific type documented.

Chupadero Black-on-White (A.D. 1150-1400+)

Published description: (Hawley 1950; Human Systems Research 1973; Runyan and Hedrick 1973)

Paste: Hard, well fired, uniform gray color

Temper: Combinations of small particles of stone (e.g., andesite quartz, hornblend diorite, basalt), depending on area of manufacture

Core: Uniformly light to dark gray; no carbon streak

Surface treatment: One side always smoothed, sometimes both; black mineral paint decoration on smooth side, which is usually unevenly slipped white or gray-white; unsmoothed surface often horizontally striated

Decoration: Hatched and solid lines in opposition, often showing hasty connections; also diamond outline series, negative geometrics, broad border lines, occasional dots

Forms: Bowls and pitchers with handles; bowls often have flat disc bottoms (no coils at base)

Distribution: Southern Torrance and eastern Socorro Counties, New Mexico, usually east of the Jornada del Muerto, and south of the Estancia Valley, New Mexico; throughout the Tularosa Basin and Sacramento Mountains south into the Chihuahua Basin; southeast into Chaves, Eddy, and Lea Counties, New Mexico; and from El Paso west to Deming, New Mexico