Journal of California and Great Basin Anthropology
Vol. 12, No. 2, pp. 231-261 (1990).

The Late Pleistocene/Early Holocene Archaeology of Butte Valley, Nevada: Three Seasons' Work

CHARLOTTE BECK and **GEORGE T. JONES**, Dept. of Anthropology, Hamilton College, Clinton, NY 13323.

ALTHOUGH interest in late Pleistocene/early Holocene human occupation of the Great Basin goes back more than five decades, archaeological evidence relating to that time remains comparatively meager. While several factors contribute to the paucity of evidence, it is the case that few systematic regional studies, routine in Archaic research, have been undertaken. Consequently, one general purpose of the field studies reported here is to create such a regional database. Since 1986, and continuing in 1987 and 1989, we have conducted archaeological reconnaissance and systematic survey in southern Butte Valley, eastern Nevada, for the purpose of locating artifactual material of late Pleistocene/early Holocene age. Over the course of three field seasons we have located and collected 12 surface sites, yielding a total of 11,239 artifacts, and recovered a further 264 artifacts from "offsite" contexts. Significant late Pleistocene/early Holocene components are present at each of the sites, although we believe a substantial proportion of the artifacts from two of these may date to the mid-Holocene. This paper presents a synopsis of our field studies along with results of technological, lithic source, and obsidian hydration analyses applied to the site and offsite assemblages.

A NOTE ON NOMENCLATURE

Based on broad areal distribution of diagnostic projectile point forms and associated tool types, a number of cultural historical units have been constructed to refer to technological and cultural patterns during the late Pleistocene/early Holocene period. Following Bryan (1980) and Willig and Aikens (1988), we adopt "Western Stemmed Tradition" herein to refer to archaeological expressions of this age. We prefer not to use such other designations as "Western Pluvial Lakes Tradition" (Bedwell 1973) that carry more specific implications regarding these early human adaptations (Simms 1988; Willig and Aikens 1988) since our research to date has not provided sufficient information about such details (Beck and Jones 1990a). Unfortunately, comparable units covering subsequent periods have not been forwarded in this region. Consequently, our use of the term "Archaic" to refer to cultures of the mid- and late-Holocene acknowledges a disconformity in artifact style (in particular, projectile points) and possibly technology with the preceding Western Stemmed Tradition, but we intend no implications regarding other aspects of adaptation.

PROJECT DESCRIPTION

Background

The original goal of our 1986 field work in Butte Valley was to assess the potential of this area as a focus of long-term research concerning prehistoric settlement and subsistence. Though little was known of the archaeological record in this valley, studies in the larger region suggested a number of possibly fruitful research directions, including

Paleoindian occupation and late-glacial adaptations, the assumption of Archaic subsistence patterns, and the northwestern Fremont boundary question. To evaluate the potential of the area with respect to these research problems, we adopted a regional approach that was strongly conditioned by our previous field experiences in southeastern Oregon with the Steens Mountain Prehistory Project, where we had found the archaeological record to be abundant, diverse, and complex (Beck 1984; Jones 1984). Our field design was based on a similar set of expectations about the record: (1) artifactual remains would be widely distributed across a number of microenvironments; (2) a range of artifact densities would be represented; and (3) artifacts spanning the entire Holocene would be present.

To assess the distributional, chronological, and functional character of the Butte Valley archaeological record we proposed to: (1) examine the distribution and density of surface artifacts and sites across topographic and biotic zones; (2) determine the temporal affiliations of artifacts and sites located; (3) to the extent possible, note the potential for buried archaeological deposits; and (4) evaluate various sampling techniques as a means of acquiring representative archaeological samples. To meet these goals a two-phase survey strategy was designed. Phase 1 was to consist of pedestrian reconnaissance of narrow transects randomly selected from within four environmental strata defined by elevational criteria. During this phase artifacts would not be collected, but information concerning their location, density, material composition, and so on were to be recorded. Systematic surface survey and collection were to follow in Phase 2.

In June of 1986 we began reconnaissance in the uplands. After two weeks (100 person-days), transects in the three upland strata had been examined. Based on this work it was evident that our initial expectations would not be met by the field strategy being employed. To that point in our work, the record was found to be relatively sparse, predominantly late Archaic in age, and confined almost exclusively to springs in the piñon-juniper woodland, areas badly disturbed by historic land-use practices.

The remaining unsurveyed stratum, the valley floor, became the focus of reconnaissance during the remainder of the 1986 season. Eight sites, seven apparently representative of the Western Stemmed Tradition, were located. Because of the exceptional quality of this lowland record, our research design was restructured, and late Pleistocene/early Holocene land use and settlement became the focus of study for the project.

The Study Area

Butte Valley, a basin of approximately 1,870 km.^{2}, lies north of Ely, Nevada, between the Egan and Cherry Creek ranges and Steptoe Valley to the east and the Butte Range and Long Valley to the west (Fig. 1). Relief between valley and mountains exceeds 1,200 m., with elevations ranging from 1,900 m. on the valley floor to over 3,100 m. in the Egan and Cherry Creek ranges. The geologic section here is dominated by sedimentary rocks of Paleozoic age. Outcrops of Tertiary volcanic rocks occur at the south end of the valley and in the Butte Mountains.

Butte Valley contains a dry lakebed and shoreline features associated with Lake Gale, which, at its maximum extent, reached a depth of nearly 25 m. (Mifflin and Wheat 1979). No chronology has been developed for Lake Gale, but radiocarbon-dated mollusks from shorelines in adjacent Long Valley and nearby Jakes Valley (to the southwest) suggest that high stands for these lakes occurred at 17,520±570 B.P. and 12,950±330 B.P.,

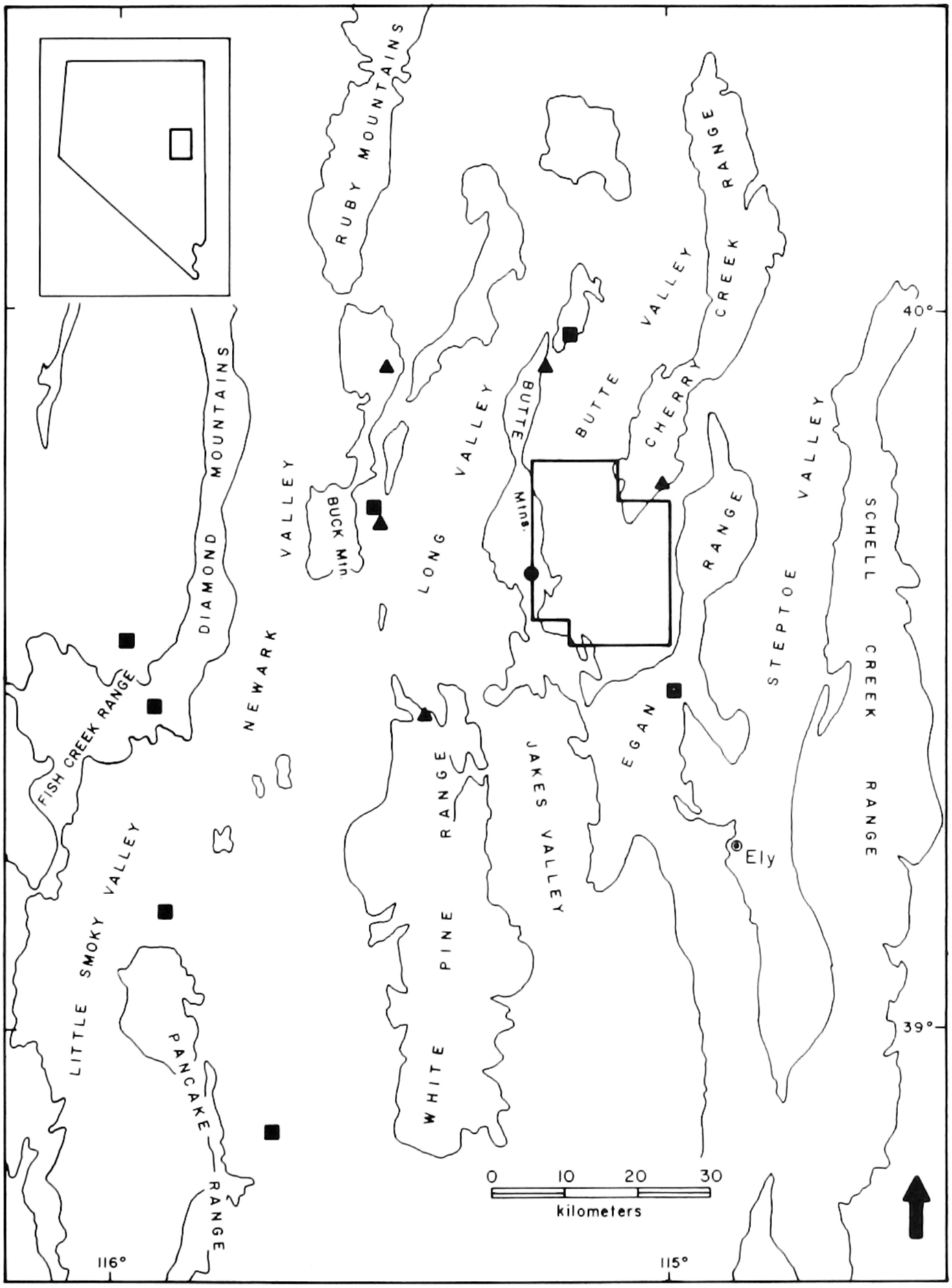

Fig. 1. Location of study area (blocked area), basalt source areas (black squares), chert quarries (black triangles), and the Butte Mountain obsidian source (black circle).

respectively (Young and McCoy 1984). To the north in Ruby Valley, Benson and Thompson (1987) reported that Lake Franklin had two deep-water stands, one roughly between 18,500 and 15,400 B.P. and another sometime before 9,800 B.P. Together these data suggest that pluvial events in eastern Nevada were broadly synchronous with Lahonton and Bonneville events. If correct, a final stillstand of Lake Gale would date to ca. 11,000 to 10,000 B.P.

Butte Valley supports a typical modern vegetation, including xerophytic shrubs and grasses in the lowlands, substantial piñon-juniper stands on the mountain slopes, and subalpine grasslands and woodlands, which include such species as aspen, fir, limber pine, and bristlecone pine at the highest elevations. Surface water is rare in the study area today; modern ground-water depth averages ca. 30 m. in the southern end of the valley, about twice the figure recorded in adjacent valleys. However, well-developed channels that cut through alluvial fans and lake features point to greater surface water in the past, suggesting that considerable hydrologic changes have occurred since permanent surface water was sustained in southern Butte Valley.

The areal focus of our field program has been in the southern end of the valley, a catchment of approximately 600 km.^{2} More specifically, since the 1986 field season and our shift in focus to the valley floor, we have concentrated work in the southern sub-basin (below 1,950 m.), covering an area of about 150 km.^{2}

Field Procedures

The Butte Valley field program is artifact- rather than site-oriented; artifacts are located and collected through systematic pedestrian survey. Areas of sharply higher artifact density are identified as "sites" and collected subsequent to survey. Thus, for our purposes, "sites" are defined on the basis of artifact density alone.

Survey. In order to obtain a statistically reliable survey sample, the valley floor was stratified by elevation into three zones: (1) the valley floor (below 1,905 m.), which includes areas beneath the lowest shoreline feature; (2) the lake shore zone (1,905-1,925 m.); and (3) the alluvial fan zone (1,925-1,950 m.). These strata were then subdivided into 250 x 250-m. quadrants for inspection. To date, 44 of these units, representing roughly a 2% sample of the project area, have been surveyed (Table 1).

Artifacts were collected by surveyors walking 10 m. apart. Each surveyor searched a one-meter-wide path, keeping a record of landform and vegetation for each 25 m.-linear interval along a traverse. Artifacts were located as precisely as possible within the 25-m. interval, collected, and given sequential field specimen numbers. A total of 264 artifacts have thus far been collected from these offsite contexts (Table 1).

Site Collection. As Table 1 shows, offsite occurrences are relatively rare in Butte Valley; average artifact density for all strata is less than one artifact per hectare. For the most part, artifacts occur in relatively dense clusters; these have been collected with their locations recorded via transit or in 2 x 2-m. grid units. Because of fairly dramatic changes in artifact density, border definition of sites is less problematic than in an area, such as Steens Mountain, where offsite density is relatively high (see Jones 1984).

Twelve sites have been surface-collected to date, yielding a total of 11,239 artifacts (Table 2).[1] Of these 12 sites, seven appear to be solely of late Pleistocene/early Holocene age, four contain both Western Stemmed Tradition and Archaic associations, and one has no temporal diagnostics. Western Stemmed Tradition sites occur on both pluvial

Table 1
SUMMARY INFORMATION FOR BUTTE VALLEY SURVEY UNITS

	1987		1989		Total	
Stratum	No. Units Surveyed	No. Artifacts Collected	No. Units Surveyed	No. Artifacts Collected	No. Units Surveyed	No. Artifacts Collected
1	4	9	2	0	6	9
2	15	84	16	159	31	243
3	5	6	2	6	7	12
Total	**24**	**99**	**20**	**165**	**44**	**264**

Table 2
SUMMARY INFORMATION FOR BUTTE VALLEY SITES

Site Number	Field Name	Elevation (m.)	Environmental Setting[a]	Number of Artifacts Collected
26-Wp-2197	CCL1	1,920.0-1,922.5	Wash/floodplain Surface	324
26-Wp-2198	CCL2	1,922.5-1,925.0	Alluvial Terrace and Wash	64
26-Wp-2199	CCL3	1,922.5	Alluvial Terrace and Wash	167
26-Wp-2193	CCL4	1,922.5-1,925.0	Alluvial Terrace	499
26-Wp-2200	CCL5	1,915.0-1,917.5	Alluvial Terrace	2,102
26-Wp-2201	CCL6	1,925.0	Alluvial Terrace	51
26-Wp-2202	CCL7	1,917.5	Alluvial Terrace	302
26-Wp-2192	HPL1	1,912.5	Beach Ridge	195
26-Wp-2194	HPL2	1,905.0-1,912.5	Spit	971
26-Wp-2203	HPL3	1,902.5-1,905.0	Spit	2,050
26-Wp-2204	HPL5	1,910.0-1,922.5	Beach Ridge	4,213
26-Wp-2195	WSWL1	1,902.5-1,907.5	Spit	301

[a] Terraces, floodplains, and washes are fluvial features while beach ridges and spits are pluvial features (see Skinner and Porter 1987).

and fluvial landforms (Table 2). Sites in the former settings are associated primarily with the 1,907.5-m. and 1,910/1,912.5-m. shorelines, but also occur on the 1,917.5 m. beach ridge. Three of these (HPL2, HPL3, WSWL1) lie in the northern end of the sub-basin on well-developed spits. HPL2 and HPL3 lie on the Hunter Point spit, and both have Archaic components, suggesting prolonged use of this vicinity. To the north, WSWL1 is associated with another spit that is somewhat lower (<1,910 m.) and shows less relief. Artifact distributions occur on top of the spit as well as on the south-facing slope and at the base.

HPL1 and HPL5 rest on beach features in the northern part of the sub-basin. HPL1 is located on the 1,912.5-m. beach ridge in the northwest section of the sub-basin. HPL5 lies about 6 km. east of HPL2 and HPL3, near the eastern end of that pluvial feature. Among the sites in lakeside settings, it rests at the highest elevation, ca. 1,917.5 m. Six sites (CCL1-5, 7) are located in the southwestern part of the valley at elevations ranging between 1,915 and 1,922.5 m., some distance south of any clearly demarcated pluvial features. Three of these sites (CCL2, CCL3, CCL4) form a cluster along a north-south trending stream terrace. CCL1 lies east of this group on a still active floodplain. CCL5 and CCL7 lie adjacent to one another, some 4 km. north of CCL1-4, also on a prominent alluvial terrace.

Each site was collected at a 100% sample fraction. The artifact distribution at WSWL1 formed clusters in three areas with light scatters in between. These were collected separately as WSWL1A, WSWL1B, and WSWL1C and tied to one another on a single topographic map. A fourth collection, made on the top of the spit, consisted of only seven artifacts. Designated WSWL1T, this "assemblage" is more likely seven isolates collected together rather than a coherent artifact cluster. Although these clusters have been treated separately in previous studies (e.g., Beck and Jones 1988, 1990b), there appear to be no temporal differences among them and thus they are treated here as a single unit.

ARTIFACT ANALYSIS AND ASSEMBLAGE DESCRIPTION

In the remaining sections of this paper we discuss a number of analyses performed on the Butte Valley material, including technological classification, toolstone type and source location, and stylistic classification of projectile points. The discussions below describe these various analyses as they have been applied to this data set.

Technological Categories

The Butte Valley material has been identified according to a set of standard technological distinctions based on the kind and extent of subtractive modification evident (Table 3). The distribution of artifacts across these technological categories in each assemblage is presented in Table 4. Several of these categories, including unmodified cortical and interior flakes, bifaces, and projectile points, received additional attention. The projectile point classification is treated in the section on chronology; the other analyses are discussed below.

Biface Reduction Analysis. The majority of bifaces, especially in assemblages that are exclusively of Western Stemmed Tradition affiliation, appear to be derived from a reduction sequence relating to the production of projectile points of the Great Basin Stemmed series (Tuohy and Layton 1977). We acknowledge the difficulty in reducing a manufacturing continuum to a set of discrete categories since, as Muto (1970:111) observed, "in an extreme sense each flake removed from the piece of raw material is a stage of manufacture." Nevertheless, a reduction sequence directed toward the manufacture of a single product consistent in size and shape is less problematic than a reduction sequence leading to a variety of bifacial products of different sizes and shapes. The classification used here, a modified form of one originally presented by Pendleton (1979) in her analysis of the Campbell collection (see Beck and Jones 1988), is as follows:

Stage 1 Biface. This initial stage of reduction usually begins with a large tabular flake. The flaking technique is percussion. Cortex and part of the striking platform may remain on the blank. Flake scars are few, large, and irregular, creating a high degree of edge sinuosity. The degree of symmetry in this stage depends less on the placement of retouch flakes than on the initial shape of the flake blank. Depending on the original shape of the flake blank, these bifaces may be, although are not necessarily, quite thick.

Stage 2 Biface. The shape begins to take on a pointed oval outline, although complete bilateral symmetry has not been achieved. Both faces are now covered with flake scars which are more regular in size and shape, reducing edge sinuosity. Thickness is reduced and cross-sectional symmetry begins to develop.

Stage 3 Biface. The shape is taking on its final form, exhibiting both cross-sectional and bilateral symmetry. Thickness is further reduced and flake scars are smaller and more uniform, again reducing edge sinuosity.

Stage 4 Biface. This final stage is a completed projectile point. Flaking is

Table 3
TECHNOLOGICAL CATEGORIES USED TO IDENTIFY THE BUTTE VALLEY ASSEMBLAGES

Category	Definition
Unmodified Cortical Flake	A flake that exhibits cortex on its dorsal surface and no edge retouch. The distinction between primary and secondary cortical flakes is not made here given the ambiguity of this distinction in the literature.
Unmodified Interior Flake	A flake that exhibits no cortex and no edge retouch.
Uniface	An artifact with retouch on only one face. This category includes, but is not limited to, those objects referred to as "scrapers."
Biface	An artifact (not a projectile point) with retouch on two opposing faces.
Core	An irregularly-shaped mass bearing negative flake scars originating from one or more platforms.
Split Pebble	A core or core fragment produced by the bipolar technique (Crabtree 1972), as distinct from other kinds of cores and core fragments.
Projectile Point	A biface that possesses consistent manufacturing properties of "point," "haft," and "bilateral symmetry." These items were analyzed separately because of their chronological usefulness.

Table 4
TECHNOLOGICAL CATEGORIES REPRESENTED IN EACH OF THE BUTTE VALLEY ASSEMBLAGES

	Technological Category														
	Cortical Flake		Interior Flake		Uniface		Biface		Core		Projectile Point		Split Cobble		Total
Unit	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N
CCL1	21	6.5	284	87.7	5	1.5	12	3.7	1	0.3	1	0.3	0	0.0	324
CCL2	13	20.3	35	54.7	2	3.1	9	14.1	0	0.0	5	7.8	0	0.0	64
CCL3	12	7.2	131	78.4	2	1.2	14	8.4	1	0.6	7	4.2	0	0.0	167
CCL4	21	4.2	461	92.4	0	0.0	4	0.8	1	0.2	10	2.0	2	0.4	499
CCL5	171	8.1	1,827	86.9	27	1.3	35	1.7	2	0.1	22	1.0	18	0.9	2,102
CCL6	27	52.9	12	23.5	2	3.9	2	3.9	6	11.7	0	0.0	2	3.9	51
CCL7	151	50.0	124	41.1	6	2.0	8	2.6	2	0.7	7	2.3	4	1.3	302
HPL1	23	11.8	143	73.3	1	0.5	18	9.2	2	1.0	7	3.6	1	0.5	195
HPL2	156	16.1	718	73.9	7	0.7	55	5.7	7	0.7	22	2.3	6	0.6	971
HPL3	262	12.8	1,669	81.4	23	1.1	46	2.2	2	0.1	39	1.9	9	0.4	2,050
HPL5	297	7.0	3,678	87.3	68	1.6	109	2.6	11	0.2	50	1.2	0	0.0	4,213
WSWL1	27	9.0	246	81.7	1	0.3	16	5.3	1	0.3	10	33.2	0	0.0	301
Total															
Site	**1,219**	**10.8**	**9,290**	**82.7**	**144**	**1.3**	**328**	**2.9**	**36**	**0.3**	**180**	**1.6**	**42**	**0.4**	**11,239**
Offsite	**45**	**17.0**	**176**	**66.7**	**6**	**2.3**	**18**	**6.8**	**6**	**2.3**	**11**	**4.2**	**4**	**1.5**	**264**
Overall	**1,264**	**11.0**	**9,466**	**82.3**	**150**	**1.3**	**346**	**3.0**	**42**	**0.4**	**191**	**1.7**	**46**	**0.4**	**11,503**

generally very uniform, almost always collateral or semi-collateral in character. Bifaces are fairly thin with little edge sinuosity and may exhibit evidence of pressure flaking. To be considered finished and a member of this stage, the biface must exhibit abraded stem margins.

The distribution of bifaces across these production stages is presented in Table 5. Examples of each stage drawn from the HPL1 assemblage are shown in Figure 2. The majority of bifaces in this sequence (91.4%, exclusive of stage 4) are made from basalt, available from sources within a 25-60 km. radius from the study area (see discussion of material use below).

The majority of bifaces not identified with this sequence are unclassifiable fragments (Table 6), though many appear to be derived from stemmed point production but cannot be

Table 5
BIFACE REDUCTION STAGES REPRESENTED IN EACH OF THE BUTTE VALLEY SITE ASSEMBLAGES

Site	Stage 1	2	3	4	Total
CCL1	1	3	4	1	9
CCL2	0	1	5	4	10
CCL3	1	3	3	6	13
CCL4[a]	0	0	2	6	8
CCL5	4	13	10	22	49
CCL6	0	1	0	0	1
CCL7	1	1	3	3	8
HPL1	2	9	5	7	23
HPL2	3	16	6	7	32
HPL3	2	6	1	5	14
HPL5	4	10	12	11	37
WSWL1	3	1	5	7	16

[a] There is one additional biface fragment in this assemblage, but because of the heavy use wear along the edge it is believed to be a tip and thus could be the tip of a point already counted; for this reason we are not counting it here.

identified as to stage. Very few other types of bifaces, such as drills, bifacial scrapers, or crescents, are present, and the majority of these occur in the HPL2, HPL3, and HPL5 assemblages. It bears noting that these large assemblages appear to reflect long occupation spans. Among other explanations, shifts in use patterns may well have influenced class richness among these particular assemblages.

Flake Analysis. Unmodified cortical and interior flakes possessing platforms were examined to determine whether they resulted from biface manufacture or from other types of lithic reduction. Biface reduction flakes are identified here as those flakes that possess a "lip" at the intersection of the platform and ventral surface and have an acute angle between the dorsal surface and the platform. Further, biface reduction flakes may also possess one or more of the following: (1) an ovate, faceted platform; (2) a thin longitudinal section that is concave ventrally; (3) a faceted dorsal surface; and/or (4) a diffuse bulb of percussion. The results of this analysis are presented in Table 7.

Raw Material Representation and Source Location

Three toolstone types – basalt, chert (i.e., sedimentary microcrystalline silicates), and glassy volcanics (e.g., obsidians, welded tuffs, hereafter referred to as obsidian) – dominate the Butte Valley assemblages. Although rare, other materials including rhyolite and quartzite also occur.

Basalt. With few exceptions, basalt is the predominant material in the Butte Valley assemblages (Tables 8 and 9). Although no detailed physical or chemical analyses have yet been undertaken, on the basis of visual criteria (e.g., color, texture, and inclusions) several basalt types have been identified and associated with three sources (Fig. 1). The first two are local sources, one located in the Egan Range at the southeastern end of Butte Valley and the other located in the Butte Mountains near Pony Springs. The third source is somewhat more distant, located on Buck Mountain at the western edge of Long Valley. Several other basalt sources in the Pancake Range (ca. 90-100 km. south of the study area) and the southern Diamond Mountains (ca. 110-120 km. west of the study area) are not believed represented in the Butte Valley assemblages.[2]

Chert. Intermediate in representation are artifacts made from chert (Tables 8 and 9). Thus far, no chemical analyses have been undertaken to establish source matches. However, based on visual criteria, it appears as though late Pleistocene/early Holocene occupants made use of some, but not all, of the known quarry areas in the region (Fig. 1). For example, artifacts made from a distinctive green chert ("Long Valley Jade"), quarried at the southern end of Long Valley some 40-50 km. southwest of the project area, are occasionally represented in the collections. Two other Long Valley cherts, however, from

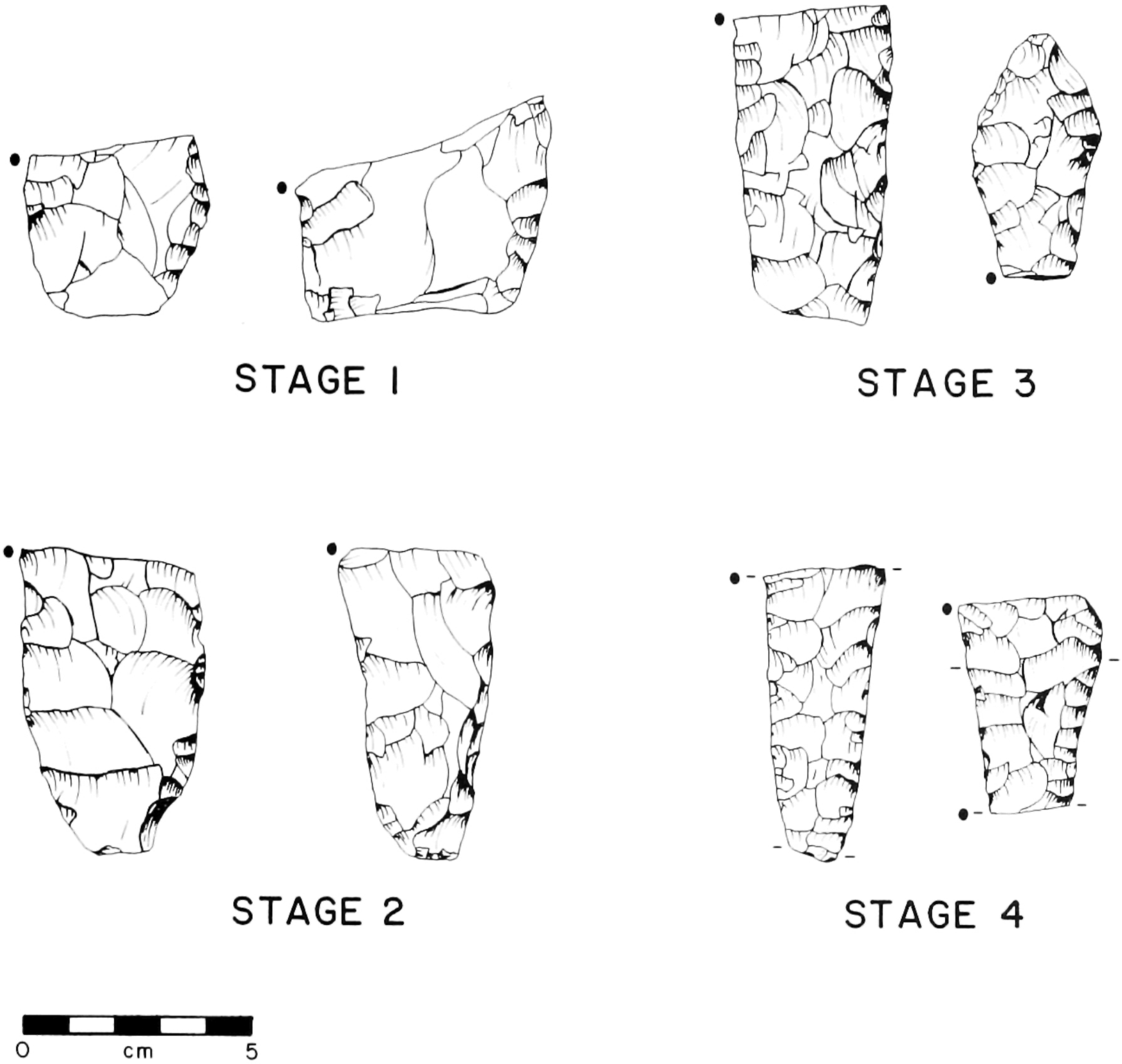

Fig. 2. Biface reduction sequence as illustrated by specimens from HPL1 (from Beck and Jones 1990b:Fig. 2). Dots show the locations of transverse breaks.

sources at Buck Mountain (the location of an exploited basalt) and at the northern end of the valley, apparently were not used. Similarly, a local chert source, located only a few kilometers northeast of the sub-basin in the Cherry Creek Range, is rarely represented among Butte Valley artifacts of late Pleistocene/early Holocene age. The most common cherts, orange-red in color and highly uniform in texture (and possibly heat-treated), are believed to have come from a rather extensive source area in the Butte Mountains just south of Pony Springs (near a second exploited basalt source area) (Fig. 1).

Obsidian. In our investigations, obsidian has received more attention than other

Table 6
BIFACES NOT IDENTIFIED WITH THE STEMMED POINT REDUCTION SEQUENCE

	Biface Type							
Site	Drill	Bifacial Scraper	Crescent	Borer	Preform	Unclass. Projectile Point	Unclass. Biface Fragment	Total
CCL1	0	0	0	0	0	0	4	4
CCL2	0	0	0	0	0	0	3	3
CCL3	0	0	0	0	0	0	8	8
CCL4	0	0	0	0	0	0	2	2
CCL5	0	0	0	0	0	1	6	7
CCL6	0	0	0	0	1	0	0	1
CCL7	0	0	0	0	0	0	3	3
HPL1	0	0	1	0	0	1	0	2
HPL2	1	3	0	0	0	6	20	30
HPL3	0	3	1	0	4	8	21	37
HPL5	2	6	0	0	0	9	65	82
WSWL1	0	0	1	1	1	1	3	7

Table 7
RESULTS OF FLAKE ANALYSIS BY RAW MATERIAL IN BUTTE VALLEY ASSEMBLAGES[a]

	Raw Material									
	Chert		Obsidian		Basalt		Other		Total	
Unit	BRF	Non-BRF	BRF	Non-BRF	BRF	Non-BRF	BRF	Non-BRF	BRF	Non-BRF
CCL1	2	3	4	7	70	10	0	0	76	20
CCL2	11	4	1	0	9	3	0	0	20	7
CCL3	8	6	0	2	25	1	1	1	34	10
CCL4	23	12	2	1	98	22	0	0	123	35
CCL5	55	32	49	42	475	64	9	2	588	140
CCL6	1	0	0	18	1	1	0	0	2	19
CCL7	3	1	6	29	7	4	0	0	16	34
HPL1	32	21	1	2	13	3	0	0	46	26
HPL2	29	63	23	62	109	57	1	0	162	182
HPL3	147	11	104	79	414	5	3	0	668	95
HPL5	498	89	93	30	334	18	5	3	930	140
WSWL1	15	29	9	11	43	15	0	0	67	55

[a] BRF = Biface-reduction flakes.

toolstone types since it provides the best opportunity for source studies. Through the chemical identification of obsidian sources it is possible to gauge both the number of sources being utilized and the distances over which material was moved (Hughes 1986). In a pilot project, trace element characterizations (by X-ray fluorescence or XRF) and hydration analyses (see below) have been performed on a sample of 115 objects recovered during the 1986 and 1987 seasons. XRF analyses identified 13 chemical types, only two of which have been identified as to source (see Jones and Beck 1990). One is a pebble source appearing on alluvial fans on the western side of Butte Valley and originating in a perlite deposit located in the Butte Mountains (Fig. 1). These pebbles are for the most part relatively small (< 5 cm. diameter) and were manipulated by bipolar reduction; rare larger

Table 8
MATERIAL REPRESENTATION IN EACH OF THE BUTTE VALLEY SITE ASSEMBLAGES

	Material												
	Chert		Obsidian		Basalt		Rhyolite		Quartzite		Other		Total
Unit	N	%	N	%	N	%	N	%	N	%	N	%	N
CCL1	23	7.1	30	9.3	271	83.6	0	0.0	0	0.0	0	0.0	324
CCL2	12	18.8	5	7.8	47	73.4	0	0.0	0	0.0	0	0.0	64
CCL3	30	18.0	13	7.8	123	73.7	1	0.6	0	0.0	0	0.0	167
CCL4	96	19.2	9	1.8	394	79.0	0	0.0	0	0.0	0	0.0	499
CCL5	237	11.3	337	16.0	1,504	71.6	21	1.0	3	0.1	0	0.0	2,102
CCL6	2	3.9	41	80.4	8	15.7	0	0.0	0	0.0	0	0.0	51
CCL7	11	3.6	220	72.8	71	23.5	0	0.0	0	0.0	0	0.0	302
HPL1	117	60.0	12	6.2	65	33.3	1	0.5	0	0.0	0	0.0	195
HPL2	203	20.9	246	25.3	516	53.1	2	0.2	4	0.4	0	0.0	971
HPL3	402	19.6	569	27.8	1,074	52.4	1	<0.1	4	0.2	0	0.0	2,050
HPL5	2,260	53.6	621	14.7	1,305	31.0	10	0.2	14	0.3	3	0.1	4,213
WSWL1	101	33.6	50	16.6	148	19.2	1	0.3	1	0.3	0	0.0	301
Site Total	**3,494**	**31.0**	**2,152**	**19.1**	**5,527**	**49.1**	**37**	**0.3**	**26**	**0.2**	**3**	**<0.1**	**11,239**
Offsite Total	**66**	**25.0**	**102**	**38.6**	**94**	**35.6**	**2**	**0.8**	**0**	**0.0**	**0**	**0.0**	**264**
Overall Total	**3,560**	**30.9**	**2,254**	**19.6**	**5,621**	**48.9**	**39**	**0.3**	**26**	**0.2**	**3**	**<0.1**	**11,503**

Table 9
TECHNOLOGICAL CATEGORIES BY RAW MATERIAL
IN THE BUTTE VALLEY SITE ASSEMBLAGES

	Material												
	Chert		Obsidian		Basalt		Rhyolite		Quartzite		Other		Total
Category	N	%	N	%	N	%	N	%	N	%	N	%	N
Cortical Flakes	246	20.9	496	42.1	434	36.8	2	0.2	0	0.0	0	0.0	1,178
Interior Flakes	3,063	32.8	1,443	15.5	4,762	51.1	26	0.3	24	0.3	3	<0.1	9,331
Unifaces	76	52.8	14	9.7	54	37.5	0	0.0	0	0.0	0	0.0	144
Bifaces	75	22.9	63	19.2	189	57.6	1	0.3	0	0.0	0	0.0	328
Cores	17	47.2	18	50.0	1	2.8	0	0.0	0	0.0	0	0.0	36
Projectile Points	17	9.4	77	42.8	77	42.8	7	3.9	2	1.1	0	0.0	180
Split Pebbles	0	0.0	41	97.6	1	2.4	0	0.0	0	0.0	0	0.0	42
Total	**3,494**	**31.1**	**2,153**	**19.1**	**5,526**	**49.2**	**37**	**0.3**	**26**	**0.2**	**0**	**<0.1**	**11,239**

pebbles served as flake cores. This obsidian accounts for 37.4% of the sample analyzed.

Comparisons with all other reported geologic sources in Nevada, western Utah, and Oregon established a match for only one other glass. This is the Brown's Bench source, which is distributed widely in northeastern Nevada and southern Idaho (see Nelson 1984). This material accounts for an additional 22.6% of the analyzed sample.

Extensive searches of Butte Valley, the Butte Mountains and other volcanic areas within a radius of approximately 100-150 km. have revealed no other obsidian sources. Collections made during the summers of 1989 and 1990 from several perlite deposits as much as 150-200 km. south of the project area are now being analyzed.[3] These results suggest that much of the obsidian in our collections was carried over great distances before it was deposited in Butte Valley, and given the fact that no exhausted obsidian cores or broken blanks have been recovered, we believe that this exotic obsidian was brought in as finished tools rather than as raw material.

CHRONOLOGY

Attributions of late Pleistocene/early Holocene age to the Butte Valley assemblages are generally based on the occurrence of projectile point types that are dated throughout the Basin and Plateau to between ca. 11,000 and 7,500 B.P. (Willig and Aikens 1988). But to date, detailed typological studies of point sequences from well-dated stratigraphic contexts have not been done. Thus we have no clear sense of (1) the duration and modal age of each type, (2) the chronological positions of types relative to one another, or (3) the regional variation attending these chronological attributes. As a consequence, on the basis of projectile points, Western Stemmed Tradition assemblages in Butte Valley as elsewhere in the Basin can be attributed only to very broad time intervals, often encompassing as much as 3,000-4,000 years.

Neither the Western Stemmed Tradition[4] nor Archaic point sequences of eastern Nevada have seen as much typological study as those in areas either to the east or to the west. Thus, while we might expect use of various styles to be broadly contemporaneous between the central Basin and surrounding areas, we are hesitant to make fine chronological inferences based on occurrences of even well-known styles. Further, among the projectile points from Butte Valley there is a wide range of morphological variation that is not encompassed by the standard Great Basin typology. For these reasons, we can make only general statements here concerning chronology based on projectile point types, separating Western Stemmed Tradition and Archaic types and referring to four broad periods: Western Stemmed Tradition, early, mid, and late Archaic. No attempt is made at this point to apply any dates to these periods.[5]

Obsidian hydration offers some potential for refining our chronological assessments. As mentioned earlier, a pilot obsidian source and hydration project was conducted in 1987-88. One of the goals of this project was to determine the feasibility of dating surface artifacts using obsidian hydration. The results of these analyses are quite promising. While sample sizes are small, compilations of hydration measurements permit us to provisionally (1) assess contemporaneity among a number of the assemblages; (2) evaluate continuity of site occupation/use; and (3) propose a chronological order of several assemblages (for a detailed presentation of these results see Jones [1988] and Jones and Beck [1990]). Typological and hydration data are presented separately below, beginning with a discussion of the projectile point typology.

Projectile Point Typology

The Butte Valley assemblages contain both Western Stemmed Tradition and Archaic styles as well as a number of morphological variants that are not part of the conventional Basin typology. For the purpose of this presentation we will use accepted nomenclature or designate individual specimens as "untyped," and we will draw only the most general conclusions concerning temporal assignment.

Great Basin Stemmed Series Types. Projectile points attributed to the Western Stemmed Tradition for the most part can be subsumed under the Great Basin Stemmed series (Tuohy and Layton 1977; see also Bryan 1980; Carlson 1983). Among points of this series, which includes such types as Cougar Mountain (Layton 1970), Silver Lake and Lake Mohave (Amsden 1937), and Haskett (Butler 1965), there is a good deal of morphological similarity. For instance, it is often quite difficult to distinguish stem sections of Cougar Mountain, Lake Mohave, and Haskett points or to distinguish even complete specimens of the Parman Type 2 and Silver Lake points. Much of the apparent variation that has led researchers to define different types may, in part, reflect changes in morphology over the use-life of the point.

Flenniken and Raymond (1986) have made this suggestion with respect to Archaic points (see also Flenniken and Wilke 1989), a controversial argument, to be sure (see Thomas 1986). We are inclined, however, to accept this idea for early stemmed points given the possibility of their multi-functional nature, leading to longer periods of curation and thus increased resharpening. Most of these early points exhibit less "pointedness" and "bilateral symmetry," are much more heavily edge-ground, and display a greater range of damage patterns on the blade than later Archaic points, suggesting they may have served a variety of functional tasks rather than having served exclusively as projectiles (see Morse [1971] and Goodyear [1979] for similar suggestions regarding early points in the eastern U.S.). On the other hand, certain broad groups within this series may differ in time, occurring sequentially during the 4,000-year period represented by the Western Stemmed Tradition (see discussion below). In any case, all of these types are identified with the Western Stemmed Tradition and can serve as markers of that period. Thus, drawing on descriptions from the Great Basin literature, we provide general characterizations of four groups within this series below.

Shouldered Points with Tapering Stems. This group contains specimens assignable to the Cougar Mountain, Lake Mohave, or Haskett types (Fig. 3A-D). While we recognize that the type definition of each was based on collections from different parts of the Basin (and Plateau), we see too many gradational examples and too much variation in typological practice to maintain distinctions among these categories. Moreover, while it is difficult enough to make assignments of complete points to these categories, it proves even more difficult to assign fragmentary specimens.

In general form these points have more or less prominent sloping shoulders and long, tongue-shaped, slightly contracting stems. Typically, the length of the stem is greater than the length of the blade, and sometimes significantly so (but see Layton 1972:3). They display broad, invasive flake scars and a thick biconvex or diamond-shaped cross-section. The stem is heavily ground on each edge and is believed to have been inserted in a socket for hafting (Bryan 1988; Musil 1988). In the Butte Valley point sample, 70 specimens have been assigned to this group (Tables 10 and 11). All are fragmentary, either complete stem segments or proximal or medial sections of the stem. They are made primarily from basalt (n = 46) and obsidian (n = 22), although two are made from rhyolite.

Parman Type 1 Points. Following Layton's (1970:257) description, Parman Type 1 points have prominent square or sloping shoulders that separate a triangular blade from a square or tongue-shaped stem (Fig. 3E-G). The stem displays edge grinding and a flat or slightly convex base; its length is generally equal to or slightly longer than that of the blade. In cross-section these points are flattened in comparison to those of the previous group. Nine specimens, manufactured from basalt (n = 3), obsidian (n = 4), rhyolite (n = 1), and chert (n = 1) have been assigned to the Parman Type 1 category (Tables 10 and 11).

Silver Lake Points. In contrast to Parman Type 1 points, Silver Lake points are "squat" with short stems. They too have well-defined shoulders, but the stem "comprises never

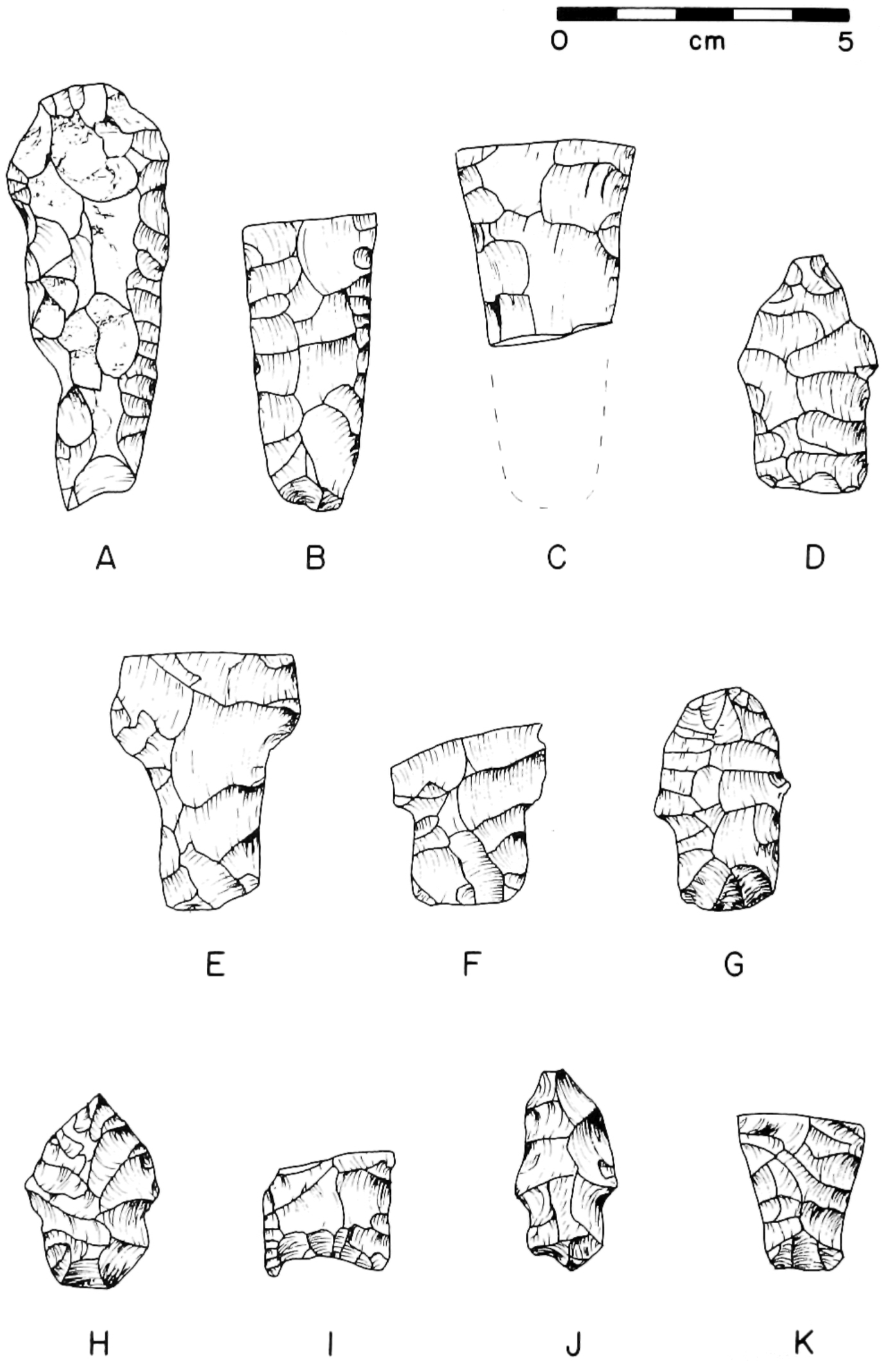

Fig. 3. Examples of Western Stemmed Tradition projectile points. A-D, shouldered points with tapering stems; E-G, Parman type 1; H, Silver Lake; I, stemmed point with convex base; and J and K, untyped early points.

Table 10
PROJECTILE POINT TYPES REPRESENTED IN BUTTE VALLEY SITE ASSEMBLAGES

	Site											
Type	**CCL1**	**CCL2**	**CCL3**	**CCL4**	**CCL5**	**CCL7**	**HPL1**	**HPL2**	**HPL3**	**HPL5**	**WSWL1**	**Total**
Late Pleistocene/early Holocene Types												
Shouldered with Tapering Stems	1	4	6	7	22	3	7	3	5	5	6	68
Parman Type 1	0	0	0	0	0	0	0	1	0	4	1	6
Silver Lake	0	0	0	0	0	0	0	3	0	2	0	5
Concave Based Stemmed	0	0	0	0	0	0	0	1	0	0	0	1
Untyped	0	0	0	0	0	0	0	4	0	4	1	9
TOTAL	**1**	**4**	**6**	**7**	**22**	**3**	**7**	**12**	**5**	**15**	**8**	**89**
Archaic Types												
Pinto	0	1	0	0	0	0	0	1	3	19	0	24
Humboldt	0	0	0	0	0	0	0	1	4	1	0	6
Elko	0	0	0	1	0	0	0	2	8	0	1	12
Northern Side-notched	0	0	0	0	0	0	0	0	1	0	0	1
Gatecliff	0	0	0	0	0	0	0	1	5	0	0	6
Rosegate	0	0	0	0	0	0	0	1	0	1	0	2
Untyped	0	0	1	1	0	4	0	4	13	14	1	36
TOTAL	**0**	**1**	**1**	**2**	**0**	**4**	**0**	**10**	**34**	**35**	**2**	**87**

Table 11
OFFSITE PROJECTILE POINT TYPES BY ELEVATIONAL STRATUM

	Elevational Stratum				
Type	**1**	**2**	**3**	**Uplands**	**Total**
Late Pleistocene/early Holocene Types					
Shouldered with Tapering Stems	1	1 (1)[a]	0	0	2 (1)
Parman Type 1	0	3	0	0	3
TOTAL	**1**	**4 (1)**	**0**	**0**	**5 (1)**
Archaic Types					
Pinto	0	1 (1)	0	0	1 (1)
Humboldt	0	0 (2)	0	0	0 (2)
Elko	0 (1)	0 (2)	0	1	1 (3)
Gatecliff	0 (1)	0	0	0 (1)	0 (2)
Rosegate	0	0	1	1	2
Desert Side-notched	0	1	0	0 (1)	1 (1)
Untyped	0	1 (3)	0	0	1 (3)
TOTAL	**0 (2)**	**3 (8)**	**1 (0)**	**2 (2)**	**6 (12)**

[a] Numbers in parentheses represent points located and drawn but not collected during the initial 1986 reconnaissance.

more than half the whole length, usually about a third" (Amsden 1937:84). The stem is parallel-sided or converges slightly distally and has a pronounced convex base. Silver Lake points are similar to many Parman Type 2 specimens (see Layton 1970:196, Fig. 33). We have identified five specimens with this type, three from HPL2 and two from HPL5 (Table

10, Fig. 3H). All are made from obsidian.

Stemmed Point with Convex Base. A single concave-based obsidian point (Fig. 3I), reminiscent of the Windust type (Rice 1972), was found at HPL2. It is a stem fragment, broken at the blade intersection. A slight flaring of the stem at the break suggests that this was a shouldered point rather than a concave based lanceolate form.

Untyped Early Points. Nine other points have been identified as belonging to the late Pleistocene/early Holocene period based on obsidian hydration results (see below) (Fig. 3J-K). Three of these (see Fig. 3J), from HPL2, were previously believed to be Archaic in age (see Beck and Jones 1988), but hydration measurements fall within the range of Great Basin Stemmed series points.

Archaic Point Types. A wide range of types known to date to Archaic times is represented in the Butte Valley assemblages, including Pinto (Fig. 4A-D), Elko (Fig. 4E-F), Northern Side-notched (Fig. 4G), Gatecliff (Fig. 4H), Humboldt (Fig. 4I), Rosegate (Fig. 4J-K), and Desert Side-notched (Fig. 4L); additionally, there are a number of points of previously undescribed morphology that we believe also are of Archaic age (Tables 10 and 11). All have a fairly limited areal distribution, occurring predominantly at HPL2, HPL3, and HPL5. Our analyses of these points are still ongoing and thus for purposes here we have made tentative identification with either existing types or have categorized them as "untyped." We will not go into detail concerning most of these since very little is known about the time periods they represent in the Butte Valley area. There are several groups of points, however, that deserve further consideration.

Pinto. In using the term "Pinto" we refer to points with morphologies matching those from the Pinto Basin site (Amsden 1935) rather than parallel-stemmed points included in the Gatecliff series by Thomas (1983).[6] Two different point morphologies are included in our Pinto category; both resemble examples illustrated by Amsden (1935), but since they do appear to differ morphologically, we prefer to keep them separate until the point analysis is complete. We distinguish these as "Group A" and "Group B."

Group A. These points possess a shape intermediate between Silver Lake/Parman points and bifurcate-base Pinto Basin points (Fig. 4A-B). In general form these points have a wide, roughly parallel stem; the length of the stem is approximately equal to or slightly less than that of the blade. The stem possesses a convex to straight base and exhibits light to moderate edge grinding. Hydration values overlap with those of Great Basin Stemmed series points, suggesting that these points date to the earlier part of the Archaic.

Group B. These points have a notched base (Fig. 4C-D). Though reminiscent of the Gatecliff Split-Stem, they are thicker in cross-section. In a recent paper, Vaughan and Warren (1987) have shown there to be significant differences between Pinto points from the Awl site in the Mojave Desert and the split-stem points from Gatecliff. They suggested that these may be regional variants of similar age, but as both Group B and Gatecliff points are present in the Butte Valley assemblages, we believe the differences may be temporal. Although we hesitate to comment further until our analyses are complete, preliminary hydration results suggest that these points also date to early Archaic times (see below).

Other Forms. A number of other point morphologies, some perhaps with diagnostic areal or chronological value, are present in the Butte Valley assemblages. Only a few of these, however, have multiple occurrences. For instance, there are 12 corner-notched

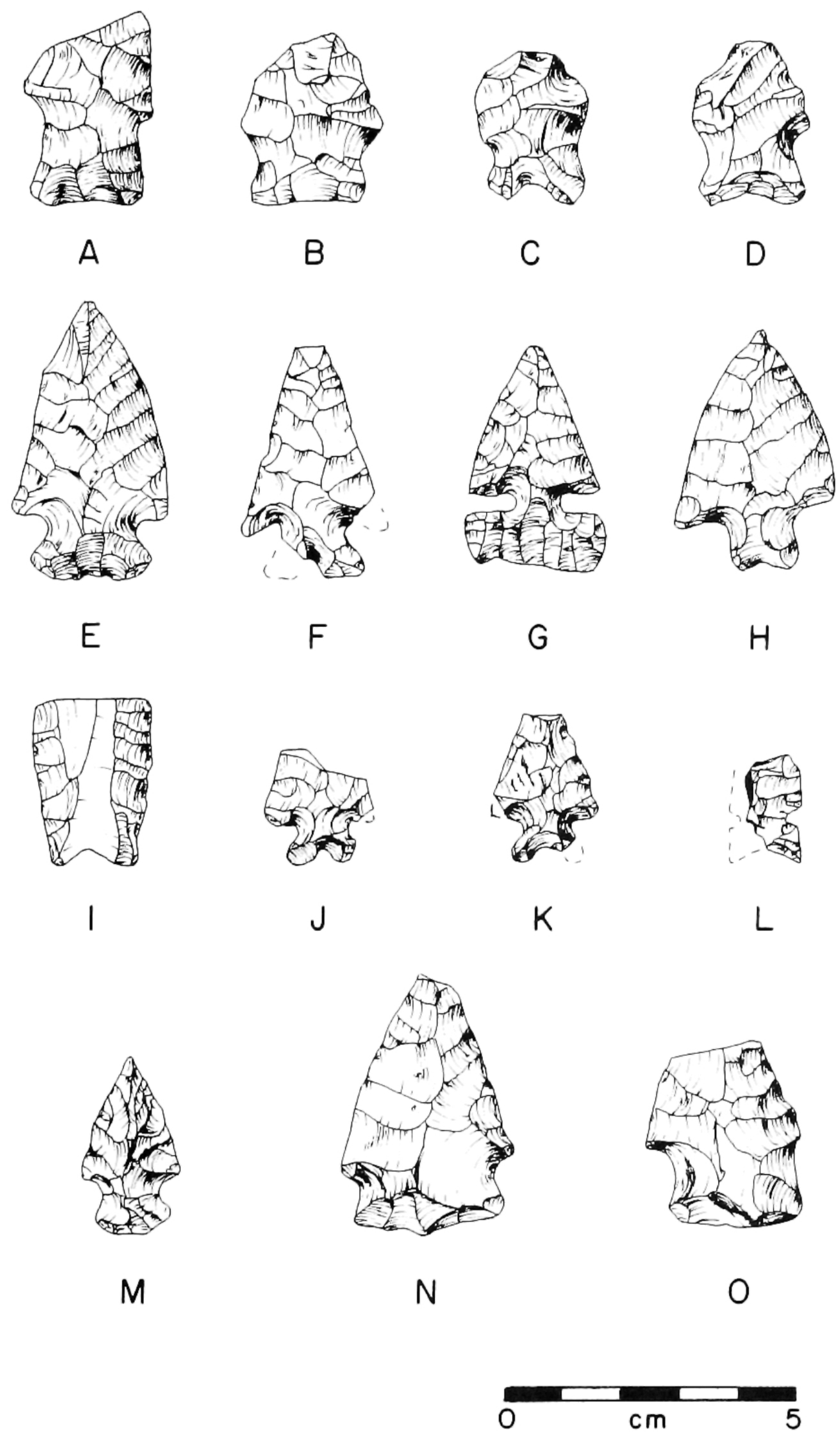

Fig. 4. Examples of Archaic projectile points. A and B, Pinto Group A; C and D, Pinto Group B; E, Elko Corner-notched; F, Elko Eared; G, Northern Side-notched; H, Gatecliff Split-stem; I, Humboldt Concave Base; J and K, Rosegate; L, Desert Side-notched; M-O, untyped Archaic points.

points at HPL3 that are quite similar in size and shape (Fig. 4M) but are not identifiable with any previously defined type. Others are similar to points described elsewhere. For instance, there are two large corner-notched points (one each from CCL7 and WSWL1) (Fig. 4N-O) that are similar to a single specimen included by Pendleton (1979:197, Fig. 18) in a group she terms "Silver Lake, flat base." Hydration results suggest that all of these points are either early or mid-Archaic in age (see below).

Typological Dating of Assemblages

On the basis of their projectile point complements, the Butte Valley assemblages can be separated into four groups: (1) those with only Western Stemmed Tradition diagnostics, especially Great Basin Stemmed series points; (2) those with Great Basin Stemmed series points and isolated occurrences of Archaic types; (3) those with large numbers of both Great Basin Stemmed series and early Archaic types; and (4) those with Great Basin Stemmed series, early-, and mid-Archaic types (Table 12). Assemblages in Groups 1 and 2 we attribute to the Western Stemmed Tradition, although the presence of one or two Archaic points in Group 2 assemblages may suggest later periodic use of these areas. Group 3 and 4 assemblages, however, appear to represent use during both Western Stemmed Tradition and Archaic times.

Among Group 3 assemblages – HPL5 and CCL7 – early Archaic points comprise roughly two-thirds of the point collection while one-third are Western Stemmed Tradition styles. The variety of types represented at Group 4 sites – HPL2 and HPL3 – suggests more prolonged use of these areas, since both early and mid-Archaic styles are represented. HPL2 occurs on top of the Hunter Point spit, at an elevation of 1,910 m.; HPL3 occurs adjacent to HPL2, in a small swale at an elevation of 1,905 m. It is interesting to note that the majority of points at HPL2 are Western Stemmed Tradition types while the opposite is the case at HPL3. It is possible that the early occupation took place primarily at HPL2 while the later Archaic occupation took place primarily at HPL3, but because of the proximity of these two sites and the obvious long-term use of the area, overlap and re-use of areas did occur. This is strongly suggested by other artifact classes in the two assemblages, such as bifaces. At HPL2, 86.2% of the classifiable bifaces are representative of the reduction sequence for stemmed points, while this is true of only 36% of the classifiable bifaces from HPL3. No detailed spatial analyses have yet been undertaken, but it is possible that spatial clustering along temporal lines may occur.

Obsidian Hydration

We have taken our chronological inquiries a step further using obsidian hydration dating. While we have reservations about the use of this method for precise chronometric assessments of surface materials (but see Leach 1988; Bettinger 1989), we believe it has merit as a relative dating tool in such contexts (e.g., McGonagle 1979; Bettinger 1980; Origer and Wickstrom 1982; Jackson 1984; Tuohy 1984; Zeier and Elston 1984). Results from our pilot study (e.g., Jones 1988; Jones and Beck 1990) show that, assembled by chemical type, projectile points fall out in a predicted manner when arrayed according to their hydration rind thickness. Though based on small sample sizes, these results show that Great Basin Stemmed series types possess thicker hydration rinds than later Archaic points. Preliminary results from our continuing obsidian studies match these earlier results. Figure 5 presents hydration values among several projectile point types comprising the three predominant obsidian types. In

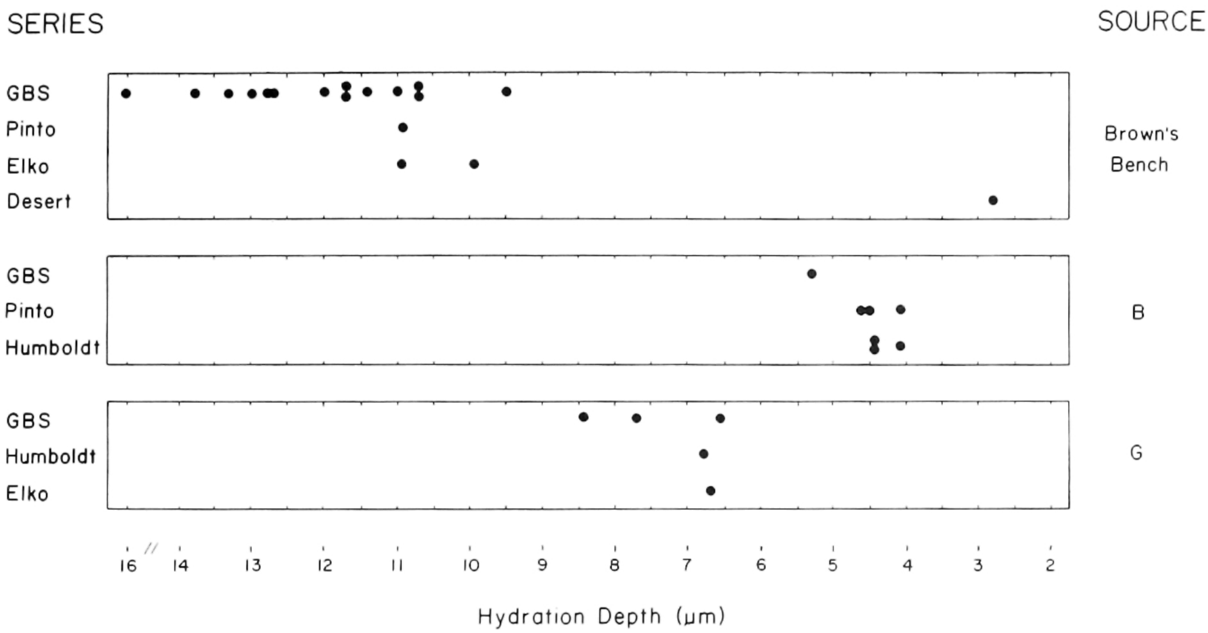

Fig. 5. Hydration values of Great Basin Stemmed series and Archaic projectile points.

Table 12
CHRONOLOGICAL ARRANGEMENT OF BUTTE VALLEY SITE ASSEMBLAGES

Group Site	Point Types Represented (N) LP/EH[a]	Archaic	Untyped
Group 1			
CCL1	1	0	0
CCL5	22	0	0
HPL1	7	0	0
Group 2			
CCL2	4	1	0
CCL3	6	0	1
CCL4	7	1	1
WSWL1	8	1	1
Group 3			
CCL7	3	0	4
HPL5	15	20	14
Group 4			
HPL2	12	6	4
HPL3	5	21	12

[a] LP/EH = Late Pleistocene/early Holocene.

each instance the hydration values of the Great Basin Stemmed series points exceed those of Archaic types, while the area of overlap is small. It is particularly noteworthy that the single Desert Side-notched point of Brown's Bench obsidian has a very thin hydration rind in contrast to Great Basin Stemmed series points, as would be expected, adding support to the validity of the point sequences displayed.

Raymond (1984-1985) has shown that a source-specific average hydration value reasonably approximates the age of a single-component assemblage. Carrying this point further, it should be possible to develop a chronological order of assemblages by arranging them according to a progression in average hydration values. Figure 6 presents an order of the hydration values compiled for ten Butte Valley sites (Table 13) using the four predominant obsidian types. Assemblages were arranged based on averages among the Brown's Bench specimens, which contrib-

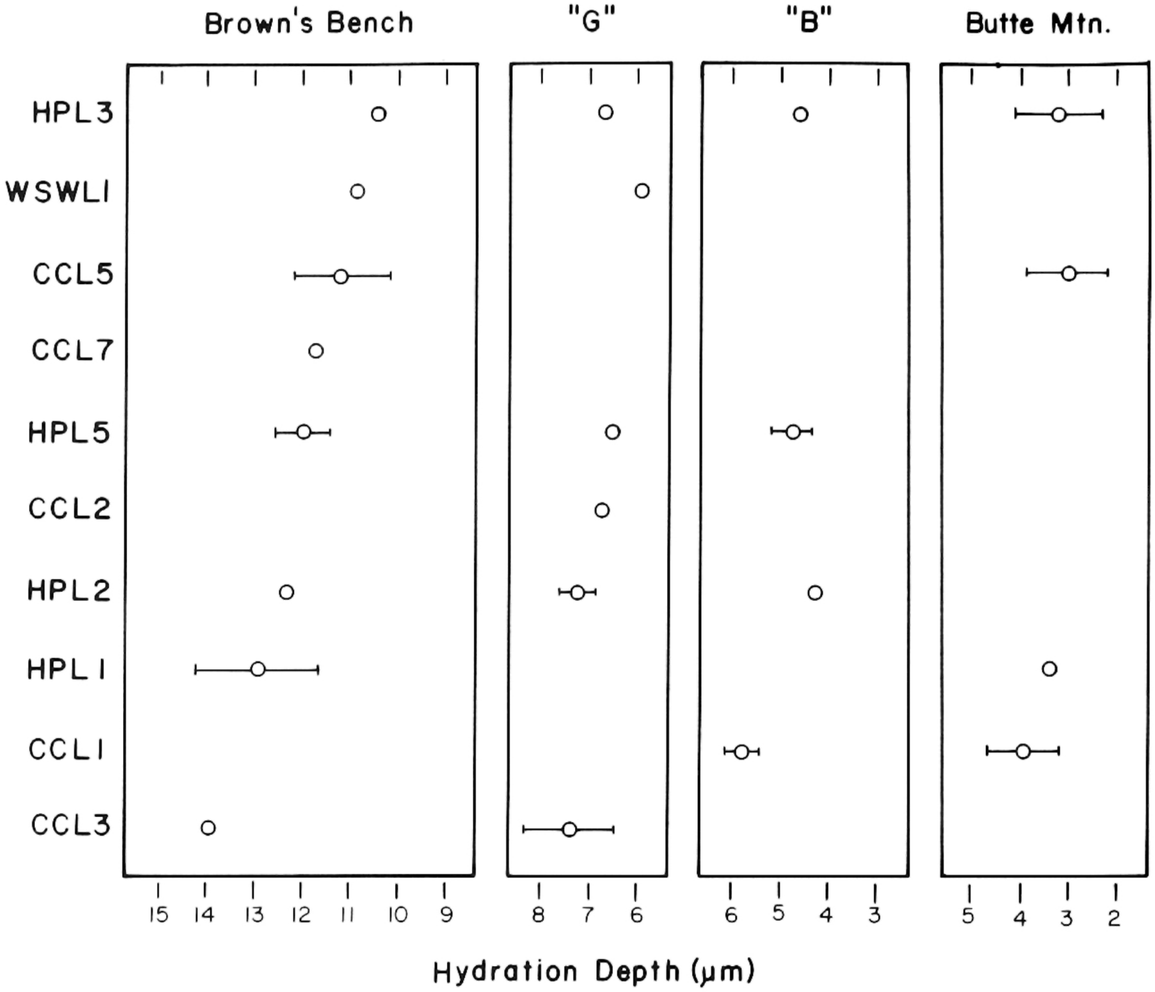

Fig. 6. Chronological order of sites based on obsidian hydration means, among four chemically determined sources.

ute the larger proportion of obsidian to the assemblages. The order shown is identical to one described in earlier papers (e.g., Jones and Beck 1990, n.d.). However, whereas the earlier studies contained no discrepancies among any of the source groups, the addition of new data has caused deviations within the other three obsidian types. The discrepancies can be traced to two assemblages, HPL3 and HPL2; in view of the long duration of use of this general locality, from Western Stemmed Tradition through the mid-Archaic times, such deviations are expected and present no problems for the rest of the order.

TECHNOLOGICAL VARIABILITY

A second purpose of this review is to expand our previous descriptions regarding biface manufacture and toolstone use by Western Stemmed Tradition populations in Butte Valley. One area of focus in our previous work has been patterns of toolstone use as displayed among various technological categories and artifact assemblages (e.g., Beck and Jones 1988, 1990b). Perhaps the most apparent pattern is contributed by the

Table 13
STATISTICAL SUMMARY OF HYDRATION MEASUREMENTS

	Site									
Source	**CCL1**	**CCL2**	**CCL3**	**CCL5**	**CCL7**	**HPL1**	**HPL2**	**HPL3**	**HPL5**	**WSWL1**
Brown's Bench										
Number	--	--	2	11	1	5	4	3	6	1
Mean[a]	--	--	13.9	11.2±1.2	11.7	12.9±1.3	12.3	10.4	12.0±0.6	10.9
Range	--	--	13.5-14.2	9.5-13.3	--	11.7-14.5	--	-	11.0-16.1	--
"B"										
Number	7	--	--	--	--	--	1	6	4	--
Mean	5.7±0.3	--	--	--	--	--	4.2	4.6±0.2	4.7±0.4	--
Range	5.3-6.3	--	--	--	--	--	--	4.4-5.0	4.2-5.2	--
"G"										
Number	--	1	7	--	--	--	3	1	2	1
Mean	--	6.6	7.3±0.9	--	--	--	7.2±0.4	6.7	6.5	5.9
Range	--	--	6.5-8.8	--	--	--	6.8-7.7	--	6.4-6.6	--
Butte Mountain										
Number	7	--	--	11	--	3	--	3	--	--
Mean	3.9±0.8	--	--	3.0±0.9	--	3.4±0.1	--	3.2±0.9	--	--
Range	3.4-5.2	--	--	1.8-4.3	--	3.4-3.5	--	2.0-4.1	--	--
Total Number	**14**	**1**	**9**	**22**	**1**	**8**	**8**	**13**	**12**	**2**

[a] Means of measurements (in microns) calculated on the basis of three or more values are given with a standard deviation.

manufacture of basalt bifaces for the replacement of broken or exhausted stemmed points. Apparently well-used, curated points made largely of obsidian were brought into the study area and replaced with points made of locally available basalt. Considering this interpretation with additional data from the 1989 field season, we find the picture becomes a little more complex. Below we summarize our earlier arguments, expanding them as these new data permit.

As Table 14 shows, nearly 60% of modified basalt artifacts are bifaces while about 24% are finished points. In contrast, 40% of modified obsidian artifacts are bifaces while 50% are finished points. A statistical evaluation of these data by chi-square suggests that this difference is highly significant (χ^2 = 130.5, $p < .001$). A comparison of the representation of the two material types across reduction stages provides additional details. Of the 189 bifaces manufactured from basalt, 128 (67.7%) are representative of the reduction sequence (stages 1-3) discussed previously (Table 15). Among these 128 bifaces, 84 are assignable to stages 1 and 2 and 44 to stage 3. Of the 61 remaining items, 49 are unidentifiable fragments, many of which also appear to be portions of early-stage bifaces in the stemmed-point sequence. Among obsidian bifaces, in contrast, only eight (12.7%) of the 63 bifaces are representative of the reduction sequence and all are stage 3 bifaces (Table 15). The largest proportion of obsidian bifaces is comprised of small unidentifiable fragments, at least two of which are possibly stage 3 or 4 bifaces. Finally, among the 35 obsidian projectile points attributed to the late Pleistocene/early Holocene period, 27 represent stage 4 in the reduction sequence (e.g., shouldered with tapering stems, Parman Type I, and Silver

Table 14
PROPORTION OF MODIFIED ARTIFACTS AND CORES REPRESENTED IN EACH MATERIAL

Category	Chert		Obsidian		Basalt		Rhyolite		Quartzite		Other	
	N	%	N	%	N	%	N	%	N	%	N	%
Unifaces	76	41.1	14	6.5	54	16.9	0	0.0	0	0.0	0	0.0
Bifaces	75	40.5	63	29.4	189	59.1	1	11.1	0	0.0	0	0.0
Cores	15	8.1	18	8.4	1	0.3	0	0.0	0	0.0	0	0.0
Projectile Points	17	9.2	77	36.0	77	24.1	7	77.8	2	1.1	0	0.0
Split Pebbles	0	0.0	41	19.2	1	0.3	0	0.0	0	0.0	0	0.0
Tabular Cores	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	**185**		**214**		**320**		**9**		**2**		**0**	

Table 15
BUTTE VALLEY BIFACES AND PROJECTILE POINTS BY MATERIAL

Biface Type	Chert		Obsidian		Basalt		Rhyolite		Quartzite		Total
	N	%	N	%	N	%	N	%	N	%	N
Stage 1	0	0	0	0	21	100.0	0	0	0	0	21
Stage 2	0	0	0	0	64	100.0	0	0	0	0	64
Stage 3	4	7.1	8	14.3	44	78.6	0	0	0	0	56
Stage 4	1	1.3	27	34.2	48	60.8	3	3.8	0	0	79
Other LP/EH Points[a]	0	0	9	81.9	2	18.1	0	0	0	0	11
Archaic Points	15	16.9	41	48.2	27	30.3	4	4.5	2	2.2	89
Drills	3	100.0	0	0	0	0	0	0	0	0	3
Bifacial Scrapers	9	75.0	1	8.3	2	16.7	0	0	0	0	12
Crescents	2	66.7	0	0	1	33.3	0	0	0	0	3
Borers	1	100.0	0	0	0	0	0	0	0	0	1
Preforms	2	25.0	3	37.5	3	37.5	0	0	0	0	8
Unclassifiable Points	9	34.6	11	42.3	6	23.1	0	0	0	0	26
Unclassifiable Fragments	45	33.3	40	29.6	49	36.3	1	0.7	0	0	135

[a] LP/EH = Late Pleistocene/early Holocene.

Lake). All of these points as well as the eight stage 3 bifaces are manufactured from extra-local obsidian. Thus, it appears that during Western Stemmed Tradition times, obsidian late-stage bifaces and points were brought into Butte Valley from elsewhere. Once they were exhausted or broken, replacements were manufactured in basalt.

Patterns among biface-reduction flakes support this interpretation. Generally speaking, biface-reduction flake size should bear a clear relationship to the predominant stages of manufacturing responsible for an assemblage (Stahle and Dunn 1982). Specifically, assemblages reflecting late-stage reduction should generally possess small flake debris while those reflecting earlier-stage reduction should contain comparatively larger flakes. Figure 7A presents a graphical model of these relationships in which Curve A relates to late-stage reduction, which yields a preponderance of small flakes, while Curve B, the inverse of A, relates to early-stage reduction. As we have suggested elsewhere (Beck and Jones 1988, 1990b) the late-stage reduction curve is likely to have empirical referents while the early-stage curve may not. This is due to the fact that during early-stage

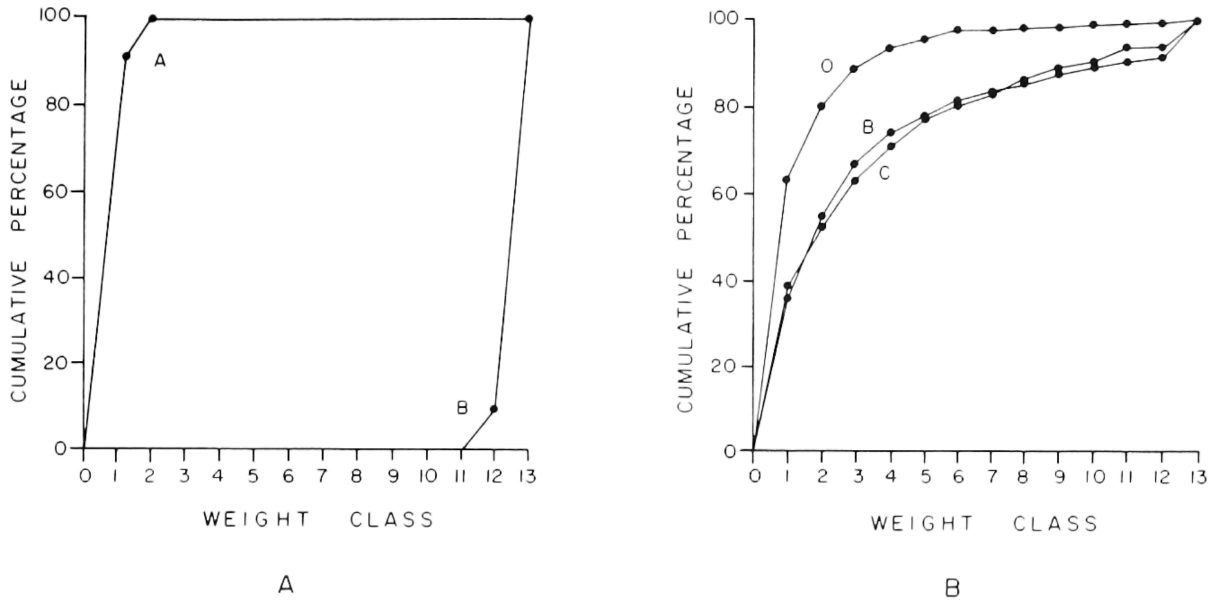

Fig. 7. Size distribution of biface-reduction flakes. 7A is an idealized model in which Curve A represents late-stage reduction and Curve B represents early stage reduction (after Beck and Jones 1988). 7B shows biface-reduction flake distribution in the Butte Valley assemblages by raw material: O = obsidian; B = basalt; C = chert. Weight classes represent 0.5-g. increments, with Class 13 representing flakes weighing more than 6.0 g.

reduction both coarse and fine debris result, due to platform preparation, shatter, etc., while in late-stage reduction large debris is generally not produced. Thus, the two curves are unlikely to be the actual inverse of one another.

Cumulative curves of biface-reduction flakes have been created for each material using 13 weight categories[7] (Fig. 7B). As this figure shows, obsidian biface-reduction flakes are much smaller, on the average, than those of basalt, suggesting late-stage manufacture and/or maintenance in obsidian but full-scale manufacture in basalt. Obviously, some of the obsidian flakes may be the result of manufacture and/or maintenance of Archaic points, 41 of which are made from obsidian. The majority of these (85.4%) are from HPL3 and HPL5, and thus a cumulative graph of obsidian biface-reduction flakes excluding flakes from these assemblages was prepared. Comparison of this curve with that in Figure 7B reveals no appreciable difference.

Assemblage Comparisons

Among the Butte Valley assemblages, differences in the representation of biface stages are apparent. Some assemblages exhibit products of late-stage manufacture and/or maintenance predominantly while others appear to derive from a fuller range of manufacturing activities. To illustrate such differences we use a graphical model employing cumulative frequencies of reduction stages (Fig. 8A) developed by Thomas (1983). Figure 8B presents cumulative curves of biface stages for 11 of the Butte Valley assemblages (CCL6 is excluded because of small sample size). In this figure three sets of profiles are evident. Five cases approximate a profile referred to by Thomas as an "idealized reduction curve" in which each stage is present in similar proportions. One assemblage, CCL4, is dominated by late-stage

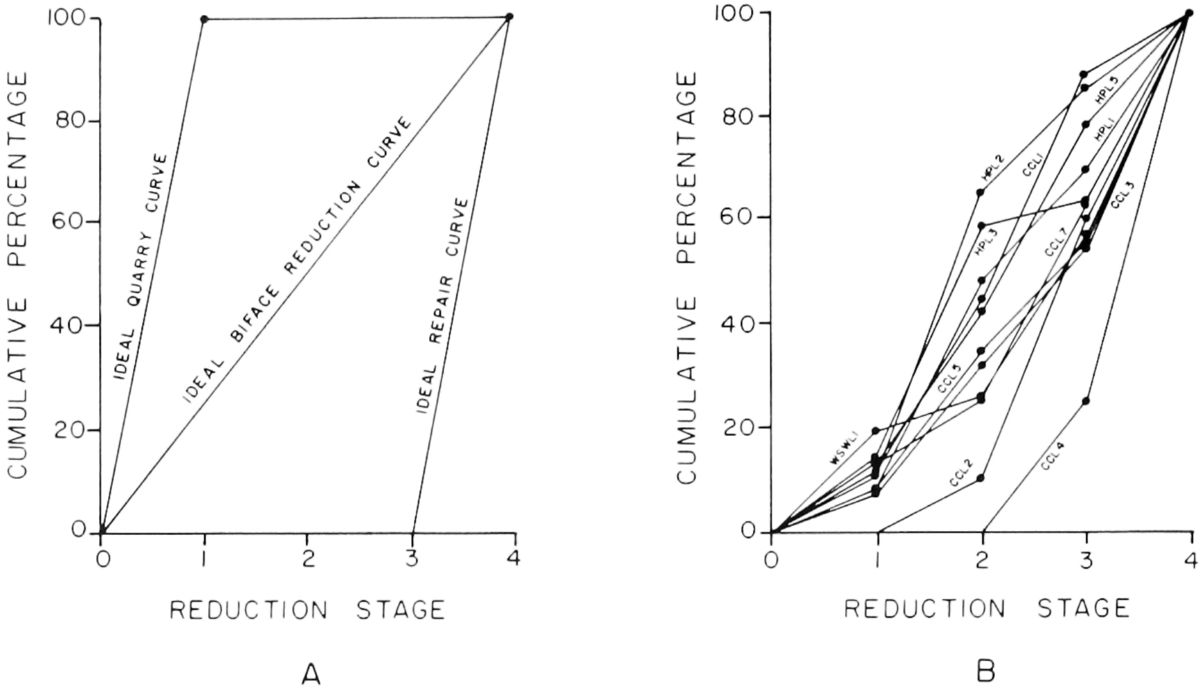

Fig. 8. Representation of biface-reduction stages. 8A is a model of biface reduction from Thomas (1983). 8B presents cumulative percentages of eleven Butte Valley assemblages.

manufacture and/or maintenance and approximates Thomas' "idealized repair curve." The remaining assemblages lie between these two idealized curves.

Patterns among biface-reduction flakes mirror those evident in the bifaces. Examination of cumulative curves (Fig. 9A) shows a progression from a fairly even distribution of flake weights in the HPL1 and CCL1 assemblages to a case driven by a very high proportion of small flakes (CCL4), the latter closely approximating the ideal late-stage reduction profile discussed earlier. In this example there also appear to be three groups, with HPL1 and CCL1 being maximally different from CCL4 and all others occurring between. Because most of the reduction occurs in basalt, cumulative curves of only basalt biface-reduction flakes were prepared (Fig. 9B) for comparison with those in Figure 9A. As this figure shows, clearly defined grouping is no longer as apparent, but it is noteworthy that the assemblages at the lower edge of the graph (i.e., having the greatest proportions of large biface-reduction flakes) are the same as those grouping around the ideal reduction profile in Figure 8B; these are followed by seven of the assemblages (CCL7 is excluded because of small sample size) in the second group in Figure 8B; and finally, by CCL4, which stands alone in both graphs.

Thus far we have discussed only the basalt and obsidian portions of the Butte Valley assemblages. In the chert artifacts we see an altogether different reduction pattern represented, apparently a more abbreviated one than that represented in basalt or obsidian. We have interpreted this pattern as resulting from the use of bifacial cores to provide large flake blanks and/or expedient flake tools, such as scrapers (Beck and Jones 1990b). This argument is based on two

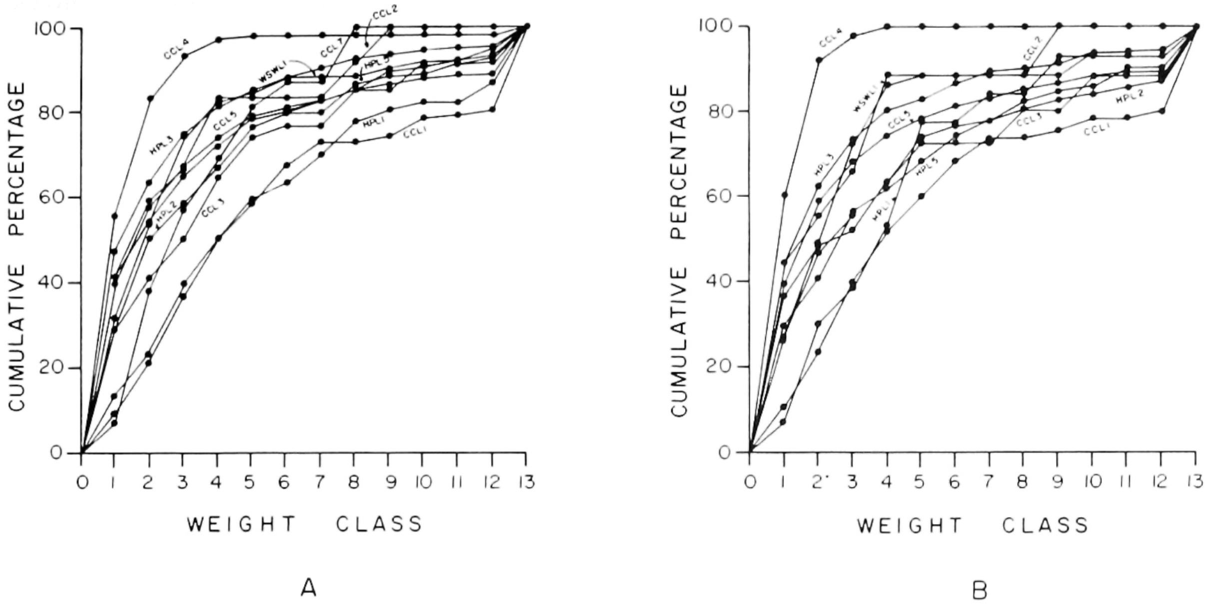

Fig. 9. Size distribution of biface-reduction flakes across eleven Butte Valley assemblages. 9A shows all biface-reduction flakes; 9B shows only basalt biface-reduction flakes. Weight classes represent 0.5-g. increments, with Class 13 representing flakes weighing more than 6.0 g.

factors. First, while assemblages contain large numbers of chert biface-reduction flakes, chert bifaces are rare. Second, the main effort in chert use appears to have gone into the manufacture of unifaces, whereas in basalt and obsidian these tools are relatively rare. A review of the Western Stemmed Tradition literature reveals a similar pattern of toolstone use in which chert appears to have been the preferred material for certain tool categories, such as scrapers and crescents (Beck and Jones 1990b).

The collection of HPL3 and HPL5 in 1989 added substantially to the number of chert bifaces in the overall Butte Valley assemblage. The fact remains, however, that several assemblages, such as HPL1, CCL4, and CCL5, contain very few or no chert bifaces but do contain relatively large numbers of biface-reduction flakes of that material. The pattern observed earlier (e.g., Beck and Jones 1990b) with respect to the formal tools is also still evident, as Table 14 shows; 41.1% of chert formal tools are unifaces while only 6.5% of the obsidian tools and 16.9% of the basalt tools are of this category. Further, of the 12 tools designated "bifacial scrapers," nine are made from chert (Table 15). A final factor supporting our argument is that all Butte Valley chert unifaces appear to have been manufactured from large tabular flakes; of these, 93.3% with platforms remaining are biface-reduction flakes. Thus, these new data tend to support our hypothesis that the pattern of chert reduction in Butte Valley is quite different from that of basalt or obsidian, the latter being directed towards biface manufacture and the former being directed at the production of large tabular flakes that were used as expedient tools or were further modified as unifaces.

SUMMARY AND FINAL OBSERVATIONS

This review has described research into the Western Stemmed Tradition and early Archaic archaeological record of Butte Valley, Nevada, conducted since 1986. These studies have progressed along several lines. First, we have attempted to establish the cultural affiliation and general age of sites in Butte Valley based on diagnostic projectile points and obsidian hydration dating. Of the 11 datable sites, seven are affiliated with the Western Stemmed Tradition and probably are older than 8,000 years, perhaps considerably older. The four remaining sites contain both Western Stemmed Tradition and Archaic components; obsidian hydration data also suggest that site components interpreted as early Archaic are themselves quite ancient, perhaps of the same age or slightly younger than the latest Western Stemmed Tradition occupation. We have presented a preliminary temporal order of sites based on the average hydration values of each assemblage.

Our second purpose has been a comparison of technological and toolstone use patterns across assemblages. Several signals are evident. A clear one in many of the assemblages is a significant level of biface reduction in basalt for the production of stemmed projectile points. This complements occurrences in these same assemblages of broken projectile points made from extralocal obsidian types. Quite clearly, local toolstone was used to replace highly curated, expended items brought into the valley. Locally available obsidian did not participate in this system. Instead, bipolar flakes of this material saw limited use as expedient tools.

Another dominant pattern concerns the selection of chert for the production of unifacial scraping tools. We attribute this association to the functional requirements of the tools together with the mechanical qualities of chert and note that although basalt also served this purpose on a more limited basis, obsidian rarely did. In the same fashion, chert was not selected for projectile points. This appears to have been for functional reasons as well, since chert sources with cobbles of sufficient size can be found in the region.

To this point, we have kept our focus rather narrowly on description and low-level interpretation. In the final pages we briefly consider the Butte Valley data base in light of several other studies in the region. We consider two dimensions, the environmental contexts of late Pleistocene/early Holocene sites and assemblage content.

Recent reviews of the Western Stemmed Tradition and early Archaic records of eastern Nevada by Price and Johnston (1988) and Zancanella (1988) provide contrasting details on the environmental contexts of sites. Considering evidence from Railroad Valley, Zancanella (1988) reported on a number of Western Stemmed Tradition sites situated on relic stream terraces and alluvial flats. He hypothesized that extensive riparian habitat supported subsistence activities in these locations, which are well north of the edges of contemporaneous lakes of this period. Price and Johnston (1988) drew similar attention to Western Stemmed Tradition sites in fluvial settings in a number of other valleys. The evidence makes a persuasive case for associations of sites and localized marshes or wet meadows along major stream channels crossing elevated sections of the valley floors.

A number of Butte Valley sites are similarly situated. CCL5, for instance, rests at the toe of an alluvial fan bordered on the south and north by large stream channels. With sufficient water discharge through these channels combined with lowered channel gradients there, this location might well have sustained significant wetlands near the site. A case for comparable habitats at the CCL2-4 cluster also could be made, since periodic ponding occurs at that location.

If correct, these interpretations broaden views of Western Stemmed Tradition land use. While they continue to emphasize the critical relationship of wetlands and early human settlement, these interpretations ask that we set aside the notions that, in eastern Nevada at least, this is predominantly a lakeside pattern. Instead, Western Stemmed Tradition sites may be more prevalent on fluvial landforms than pluvial ones.

Of course, patterns of site location are far from sufficient as regards determinants of settlement selection. Minimally, we need to confirm that environmental conditions of the sort hypothesized existed at the time of site occupation. To accomplish this, researchers must continue to search for sources of environmental information and develop means of building adequate chronologies of environmental and cultural events.

Turning our attention to published descriptions of Western Stemmed Tradition assemblages from elsewhere in eastern Nevada, we are struck by the comparatively lower richness of the artifact classes among the Butte Valley assemblages than those reported elsewhere in the region. The Butte Valley assemblages generally contain projectile points, products of projectile point manufacture (e.g., reduction bifaces and flakes), cores, and scrapers; other types of tools, such as crescents, drills, etc., are exceedingly rare.

In contrast, the Sunshine locality in neighboring Long Valley has produced a variety of classes, including a range of projectile point types, scraping tools of various forms, gravers, drills, many crescents, and large domed scrapers (Tadlock 1966; York 1974; Hutchinson 1988). Work in adjacent valleys has been on a somewhat more limited scale than ours in Butte Valley and thus accurate quantification of tool representation in these areas is not possible at this point.

It is our contention, however, that occupation of Butte Valley was just part of a larger pattern(s) of settlement and that, in all likelihood, this valley sometimes exhibited the requisite biotic productivity to support use, while during other more poorly watered episodes, better watered areas were the focus of settlement by the populations of the region. This hypothesis accords well with the typically mixed-component nature of many sites in neighboring valleys, and the narrow-component character of Butte Valley sites.

In any case, as this working hypothesis implies, we must develop the Western Stemmed Tradition records of the region and place greater emphasis on development of chronology and paleoenvironmental records. To this end our future plans involve an expansion of our work into adjacent valleys, such as Jakes, Long, Railroad, and Steptoe, in which we know there to be records of late Pleistocene/early Holocene use. Our ultimate goal is to create a regional data base collected and analyzed in a comparable manner for the purpose of studying large-scale problems such as Western Stemmed Tradition land use, mobility, and technology. We feel that, although there are many questions to be answered concerning the cultures of this early time period, we have made a good start toward answering them.

NOTES

1. Since 1986 each site discovered in Butte Valley has been named for the U.S.G.S. 7.5-minute quadrangle on which it occurs and assigned a unique number. In previous publications, we have abbreviated these field designations; e.g., Combs Creek locality 1 is referred to as CCL1. For ease of comparison with our other published work we have retained these abbreviated site names in this paper. Corresponding state site numbers are shown in Table 2.

2. Petrographic and trace element studies are currently being conducted at Hamilton College on a number of basalts in an attempt to determine if these source areas were utilized by Butte Valley inhabitants.

3. Chemical characterization (by R. E. Hughes)

of up to ten obsidian sources, and XRF (by Hughes) and hydration analyses (by R. J. Jackson) of 600 obsidian artifacts from Butte Valley are underway for the purpose of building a chronology of surface assemblages. These analyses are not expected to be completed until spring/summer 1991. We have received a few early results from both Hughes and Jackson of analyses performed on projectile points. These results are presented here as preliminary.

4. In the following discussion, projectile points of this tradition are termed "Great Basin Stemmed series points."

5. Detailed morphological, stylistic, and hydration analyses (where appropriate) of these projectile points is underway at this time and will be the topic of a separate paper.

6. We do not cite Harrington (1957) here since the Pinto points from the Stahl site are not closely matched by the points described here. Although Harrington's typology is the one most commonly cited (Vaughn and Warren 1987:200), the points in the Butte Valley assemblage most closely resemble those from the Pinto Basin site described by Amsden (1935).

7. Teltser (n.d.) has shown that in comparisons with length, width, and thickness, weight is a good indicator of flake size.

ACKNOWLEDGEMENTS

We wish to thank the Bureau of Land Management, Ely District, Nevada, and particularly Brian Amme, John Zancanella, and Sarah Johnston, for their continuing support of the Butte Valley Archaeological Project. We are also grateful to Hamilton College for a Faculty Research Grant in 1987 and to the National Science Foundation for a Grant for Exploratory Research (BNS-8915392) in 1989, both of which have provided funding for obsidian hydration dating and source analysis.

REFERENCES

Amsden, Charles Avery
1935 The Pinto Basin Artifacts. In: The Pinto Basin Site: An Ancient Aboriginal Camping Ground in the California Desert, by E. W. C. Campbell and W. H. Campbell, p. 33-46. Los Angeles: Southwest Museum Papers No. 9.
1937 The Lake Mohave Artifacts. In: The Archaeology of Pleistocene Lake Mohave, E. W. C. Campbell and W. H. Campbell, eds., pp. 50- 97. Los Angeles: Southwest Museum Papers No. 11.

Beck, Charlotte
1984 Steens Mountain Surface Archaeology: The Sites. Ph.D. dissertation, University of Washington.

Beck, Charlotte, and George T. Jones
1988 Western Pluvial Lakes Tradition Occupation in Butte Valley, Eastern Nevada. In: Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 273-301. Carson City: Nevada State Museum Anthropological Papers No. 21.
1990a Lithic Raw Material Procurement and its Relationship to Late Pleistocene/Early Holocene Population Mobility in the Central Great Basin. Paper read at the Annual Meeting of the Society for American Archaeology, Las Vegas.
1990b Toolstone Selection and Lithic Technology in Early Great Basin Prehistory. Journal of Field Archaeology 17:283-299.

Bedwell, Steven F.
1973 Fort Rock Basin: Prehistory and Environment. Eugene: University of Oregon Books.

Benson, Larry, and Robert S. Thompson
1987 The Physical Record of Lakes in the Great Basin. In: North America and Adjacent Oceans during the Last Deglaciation. The Geology of North America, vol. K-3, W. F. Ruddiman and H. E. Wright, Jr., eds., pp. 241-260. Boulder: Geological Society of America.

Bettinger, Robert L.
1980 Obsidian Hydration Dates for Owens Valley Settlement Categories. Journal of California and Great Basin Anthropology 2:286-292.
1989 The Archaeology of Pinyon House, Two Eagles, and Crater Middens: Three Residential Sites in Owens Valley, Eastern California. New York: American Museum of Natural History Anthropological Papers No. 67.

Bryan, Alan L.
1980 The Stemmed Point Tradition: An Early Technological Tradition in Western North America. In: Anthropological Papers in Memory of Earl H. Swanson, Jr., L. B. Harten, C. N. Warren, and D. R. Tuohy, eds., pp. 77-107. Pocatello: Special Publication of the Idaho State Museum.

1988 The Relationship of Stemmed Point and Fluted Point Traditions in the Great Basin. In: Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 53-74. Carson City: Nevada State Museum Anthropological Papers No. 21.

Butler, B. Robert
1965 A Report on Investigations of an Early Man Site near Lake Channel, Southern Idaho. Tebiwa 8(2):1-21.

Carlson, Roy L.
1983 The Far West. In: Early Man in the New World, R. Shutler, Jr., ed., pp. 173-196. Beverly Hills: Sage Publications.

Crabtree, Don E.
1972 An Introduction to Flintworking. Pocatello: Idaho State University Museum Occasional Papers No. 28.

Flenniken, J. Jeffrey, and Anan W. Raymond
1986 Morphological Projectile Point Typology: Replication, Experimentation, and Technological Analysis. American Antiquity 51:603-614.

Flenniken, J. Jeffrey, and Philip J. Wilke
1989 Typology, Technology, and Chronology of Great Basin Dart Points. American Anthropologist 91:149-158.

Goodyear, Albert C.
1979 A Hypothesis for the Use of Cryptocrystalline Raw Materials among Paleo-Indian Groups of North America. Columbia: University of South Carolina Research Manuscript Series No. 156.

Harrington, Mark Raymond
1957 A Pinto Site at Little Lake, California. Los Angeles: Southwest Museum Papers No. 17.

Hughes, Richard E.
1986 Diachronic Variability in Obsidian Procurement Patterns in Northeastern California and Southcentral Oregon. University of California Publications in Anthropology 17.

Hutchinson, Phillip W.
1988 The Prehistoric Dwellers at Lake Hubbs. In: Human Occupation in Far Western North America. The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 303-318. Carson City: Nevada State Museum Anthropological Papers No. 21.

Jackson, Robert J.
1984 Obsidian Hydration: Applications in the Western Great Basin. In: Obsidian Studies in the Great Basin, R. E. Hughes, ed., pp. 173-192. Berkeley: Contributions of the University of California Archaeological Research Facility No. 45.

Jones, George T.
1984 Prehistoric Land Use in the Steens Mountain Area, Southeastern Oregon. Ph.D. dissertation, University of Washington.

1988 Relative Event Chronologies in Offsite Archaeology. Paper read at the biennial meeting of the Great Basin Anthropological Conference, Park City.

Jones, George T., and Charlotte Beck
1990 An Obsidian Hydration Chronology of Late Pleistocene-Early Holocene Surface Assemblages from Butte Valley, Nevada. Journal of California and Great Basin Anthropology 12:84-100.

n.d. Chronological Resolution in Distributional Archaeology. In: Place, Time, and Archaeological Landscapes, L. Wandsnider and J. Rosignol, eds. New York: Plenum Press (in press).

Layton, Thomas N.
1970 High Rock Archaeology: An Interpretation of the Prehistory of the Northwestern Great Basin. Ph.D. dissertation, Harvard University.

1972 Lithic Chronology in the Fort Rock Valley, Oregon: An Obsidian Hydration Study from Cougar Mountain Cave. Tebiwa 15(2):1-21.

Leach, Melinda
1988 Subsistence Intensification and Settlement Change among Prehistoric Hunters and Gatherers of the Northwestern Great Basin. Ph.D. dissertation, University of California, Los Angeles.

McGonagle, Roberta L.
1979 Surface Archaeology at High Rock Lake. Reno: Desert Research Institute Publications in the Social Sciences No. 14.

Mifflin, M. D., and M. W. Wheat
1979 Pluvial Lakes and Estimated Pluvial Climates of Nevada. Nevada Bureau of Mines and Geology Bulletin No. 94. Reno: Mackay School of Mines, University of Nevada.

Morse, Dan F.
1971 The Hawkins Cache: A Significant Dalton Find in Northeast Arkansas. The Arkansas Archaeologist 12:9-20.

Musil, Robert R.
1988 Functional Efficiency and Technological Change: A Hafting Tradition Model for Prehistoric North America. In: Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 273-301. Carson City: Nevada State Museum Anthropological Papers No. 21.

Muto, Guy Roger
1970 A Stage Analysis of the Manufacture of Stone Tools. In: Great Basin Anthropological Conference 1970: Selected Papers, C. M. Aikens, ed., pp. 109-118. Eugene: University of Oregon Anthropological Papers No. 1.

Nelson, F. W., Jr.
1984 X-Ray Fluorescence Analysis of Some Western North American Obsidians. In: Obsidian Studies in the Great Basin, R. E. Hughes, ed., pp. 27-62. Berkeley: University of California Archaeological Research Facility Contributions No. 45.

Origer, Thomas M., and Brian P. Wickstrom
1982 The Use of Hydration Measurements to Date Obsidian Materials from Sonoma County, California. Journal of California and Great Basin Anthropology 4:123-131.

Pendleton, Lorann S. A.
1979 Lithic Technology in Early Nevada Assemblages. Master's thesis, California State University, Long Beach.

Price, Barry A., and Sarah E. Johnston
1988 A Model of Late Pleistocene and Early Holocene Adaptation in Eastern Nevada. In: Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 231-250. Carson City: Nevada State Museum Anthropological Papers No. 21.

Raymond, Anan W.
1984-85 Evaluating Occupational History of Lithic Scatters: Analysis of Obsidian Hydration Measurements. North American Archaeologist 6:115-133.

Rice, David G.
1972 The Windust Phase in Lower Snake River Region Prehistory. Pullman: Washington State University Laboratory of Anthropology Reports of Investigations No. 50.

Simms, Steven R.
1988 Conceptualizing the Paleo-Indian and Archaic in the Great Basin. In: Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 41-52. Carson City: Nevada State Museum Anthropological Papers No. 21.

Skinner, Brian J., and Stephen C. Porter
1987 Physical Geology. New York: John Wiley and Sons.

Stahle, David W., and James E. Dunn
1982 An Analysis and Application of the Size Distribution of Waste Flakes from the Manufacture of Bifacial Stone Tools. World Archaeology 14:84-97.

Tadlock, W. L.
1966 Certain Crescentic Stone Objects as a Time Marker in the Western United States. American Antiquity 31:662-675.

Teltser, Patrice A.
n.d. Technology and Tool Use in a Generalized Core Technology. Journal of Field Archaeology (in press).

Thomas, David Hurst
1983 The Archaeology of Monitor Valley: 2. Gatecliff Shelter. New York: American Museum of Natural History Anthropological Papers No. 58.

1986 Points on Points: A Reply to Flenniken and Raymond. American Antiquity 51:619-627.

Tuohy, Donald R.
1984 Implications of Obsidian Readings and Source Determinations for 28 Presumed "Early Man" Points from Nevada. In: Obsidian Studies in the Great Basin, Richard E. Hughes, ed., pp. 193-221. Berkeley: University of California Archaeological Research Facility Contributions No. 45.

Tuohy, Donald R., and Thomas N. Layton
1977 Toward the Establishment of New Series of Great Basin Projectile Points. Nevada Archaeological Survey Reporter 10:1-3. Reno: Nevada Archaeological Survey, University of Nevada.

Vaughn, Sheila J., and Claude N. Warren
1987 Toward a Definition of Pinto Points. Journal of California and Great Basin Anthropology 9:199-212.

Willig, Judith A., and C. Melvin Aikens
1988 The Clovis-Archaic Interface in Far Western North America. In: Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. D. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 1-40. Carson City: Nevada State Museum Anthropological Papers No. 21.

York, Robert
1974 Test Excavations and Controlled Surface Collecting in Long Valley, Nevada. Cultural Resource Report. Carson City: The Nevada State Museum.

Young, Michael A., and William D. McCoy
1984 Late Quaternary Histories of Long, Ruby, and Jakes Valleys, Nevada. Abstracts of the Biennial Meeting of the American Quaternary Association, p. 143.

Zancanella, John K.
1988 Early Lowland Prehistory in Southcentral Nevada. In: Early Human Occupation in Far Western North America: The Clovis-Archaic Interface, J. A. Willig, C. M. Aikens, and J. L. Fagan, eds., pp. 251-271. Carson City: Nevada State Museum Anthropological Papers No. 21.

Zeier, Charles D., and Robert D. Elston
1984 An Analysis of Obsidian Hydration Processes at the Sugarloaf Obsidian Quarry, Inyo County, California. MS on file at Intermountain Research, Silver City, Nevada.