THE WYOMING ARCHAEOLOGIST

VOLUME 38(1-2)

SPRING 1994

THE WYOMING ARCHAEOLOGIST

VOLUME 38(1-2), SPRING 1994

Table of Contents

LEWIS STEEGE

We must note in sorrow the recent passing of Lewis Steege of Cheyenne on February 8, 1994. Mr. Steege was one of the founding members of the Wyoming Archaeological Society and served as Society secretary for many years. While working for the Accounting Department at the Wyoming Highway Department, he still found time to participate in excavations at Glendo Reservoir, Hell Gap, Shirley Basin and the Happy Hollow Rock Shelter. Mr. Steege's interest in Wyoming's archaeology can be seen by his co-authoring Stone Artifacts of the Northwestern Plains *and writing of* Wyoming Arrowheads, A Guide to Identification. *Lewis Steege will be sadly missed by all members of the society.*

Grant Willson
Susan Carlson

PREHISTORIC OBSIDIAN UTILIZATION IN THE CENTRAL ROCKY MOUNTAINS: THE LOOKINGBILL SITE 48FR308

by
Raymond Kunselman

ABSTRACT

XRF (x-ray fluorescence) spectroscopy was used to study obsidian artifacts collected from the Helen Lookingbill site (48FR308). The site is located in the southern Absaroka Mountains, a part of the Central Rocky Mountains of Wyoming. Using XRF, the trace element proportions for artifacts were compared to trace element proportions for known sources to identify the sources of the artifacts. The artifacts were produced from four obsidian sources west and northwest of the site. The pattern of sources used allows one to consider questions about the influences in acquisition, distribution, and use of obsidian.

INTRODUCTION

The Lookingbill site is uniquely located in the Rocky Mountains close to and presumably under the influence of groups in the Plains, the Great Basin, the Plateau of the Snake and Columbia Rivers, and the Plateau of the Green and Colorado Rivers (Frison 1991; Gunnerson 1987; Jennings 1989). The site location is at 2621 meters above sea level (8600 feet) in northwest Wyoming (Figure 1). The central location of the site to the varied habitat regions is evident. About 160 kilometers (100 miles) of travel from the Lookingbill site is all that is required to get to any of these other regions.

Obsidian is a durable artifact material that exists in the archaeological record. A reasonable approach is to isolate and study what exists as directly as possible. The purpose of the present paper was to examine aspects of obsidian source utilization to study early prehistoric cultural behavior and change.

After making accurate physical measurements on the composition of the obsidian artifacts, one is better able to speculate and interpret behavior. Specifically, we need to be concerned with why the prehistoric people had the regional connections that the obsidian sourcing suggests.

The reliable data allows speculation and interpretation of models of behavior. An example of a model of possible interactions between highland and lowland peoples has been previously proposed (Kornfeld and Larson 1993). There are many questions about a band and how it interacted with neighbors that can be asked. One can ask whether a group remains in the mountains or whether a group uses both the mountains and lowlands. Perhaps there are social barriers or constraints where the group does not go. The size of the interaction region is a question that knowledge of the obsidian sources used might answer. Other questions, such as population size, depend on combining other data with the present data.

It is reasonable to assume that the durables (e.g., artifacts) represent technological organization of the groups who made them (Nelson 1991). Secondarily the durables represent and include aspects of the ideological, economical, and social organization. For example a durable steatite effigy or piece of jewelry might more likely represent an aspect of the ideological or social organization rather than economical. Obsidian is a generally uncommon lithic material that has served both utilitarian and prestige purposes.

A wide variety of terrain and resources are available close to the Helen Lookingbill site as is evident from the location in mountains near to

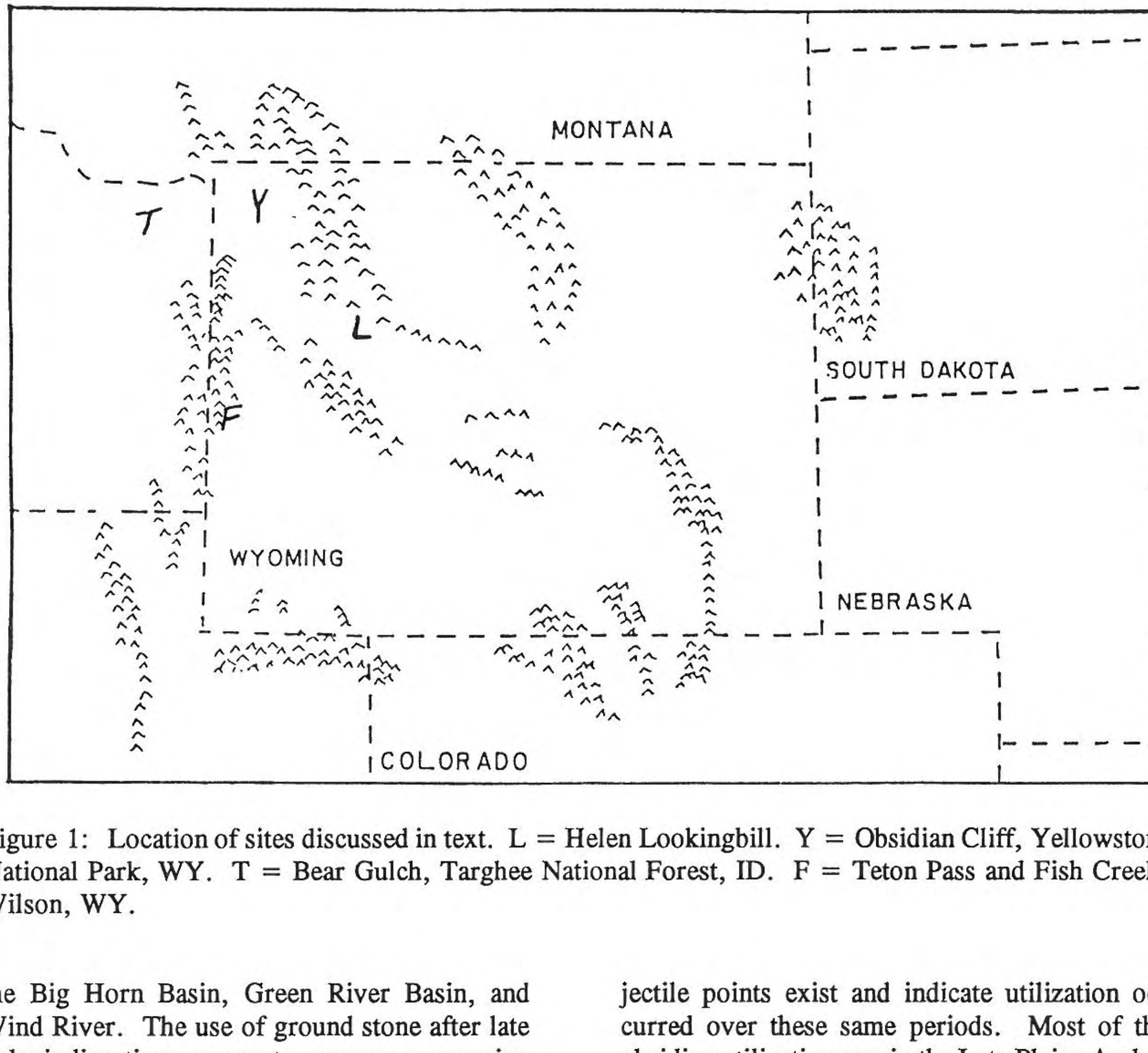

Figure 1: Location of sites discussed in text. L = Helen Lookingbill. Y = Obsidian Cliff, Yellowstone National Park, WY. T = Bear Gulch, Targhee National Forest, ID. F = Teton Pass and Fish Creek, Wilson, WY.

the Big Horn Basin, Green River Basin, and Wind River. The use of ground stone after late Paleoindian times suggests resource processing probably of plants and small animals (Shepherd 1992). Cultural affiliations, based on diagnostic bases of point types, indicate intermittent occupancy of the site over about the last 10000 years. Kornfeld and Larson (1993) reported the chronology at the site from the combined projectile point material types of obsidian, opalitic chert, and Upper Morrison quartzite. Paleoindian lanceolate and fish-tail were about 20%, Early Plains Archaic side-notched about 52%, Late Plains Archaic corner-notched about 12%, and Late Prehistoric about 5%. Obsidian projectile points exist and indicate utilization occurred over these same periods. Most of the obsidian utilization was in the Late Plains Archaic. The ecology and further details about the site have been discussed previously by Larson (1991) and Frison (1982). The Late Prehistoric components can reasonably be assumed to play a small role for the site.

The Helen Lookingbill site is on a connection over two mountain ranges between the Plains and the Basin that would be interesting to understand completely (Kornfeld and Larson 1993). An understanding of the role the Lookingbill site played in the total system of the region might be attempted if one knows what lithic sources were used.

Most of the lithic material from the Lookingbill site is the local chert and quartzite. Obsidian is a minor material, whether it was for utilitarian or ceremonial purposes. Obsidian can be sourced by XRF spectroscopy of the homogeneous trace element content. Chert is more difficult to source because of large variations in the elemental content. Visual identification can be unreliable for obsidians of similar colors and textures, or cherts of similar colors and textures. Chert is not as homogeneous as obsidian because it is produced as a sediment, rather than as a single igneous event.

The most important potential sources of obsidian close to Lookingbill are the volcanic fields to the west. These fields along the Snake River Plain to the Yellowstone hot spot are on a track that has shifted over the last 15 million years as the North American plate moved across a hot spot (Pierce and Morgan 1992). The hot spot has been under the Yellowstone volcanic field for the last 600 thousand years. A geologic source has a unique geochemistry because of the differences in the underlying geology of the regions and the differences of thousands of years for the magma to mix. The data thus allows one to connect the artifacts made at a specific site area to the obsidian geological source.

Importance of obsidian sourcing: This paper reports on part of an ongoing project designed to distinguish the distribution and utilization of durable resources such as obsidian. A goal is to distinguish whether the obsidian artifacts represent logistical organization with collection as part of specific collecting trips, foraging behavior with collection during yearly cycles or migrations, or trade and exchange with other groups. It is assumed that prehistoric peoples either consciously or unconsciously organized and optimized their behavior to achieve their goals. Provenience and source information might be used to understand the kinds and amounts of contacts between prehistoric peoples. The utilization of stone tools was almost a prehistoric necessity. It was thus a motivation to cause groups to come together for trade or exchange of lithic materials or for information on acquisition of lithic materials. Contacts would have allowed exchange of ideas both directly and by behavior observation during any meetings. The dispersion of ideas might thus appear indirectly in the archaeological record. Inferences on ideas might answer questions on why behavior occurred.

The source of an object is one of several pieces of information that one could desire to know about an object. Other information might include the function, the date of utilization, and where the object ended up (provenience). Dating can be done by several methods including stratigraphy, hydration, and projectile point base typology. The function can sometimes be determined by form or from use wear.

The purpose here is to focus on a particular subsystem trying to analyze the part it played in the lifeway. By isolating the obsidian utilization subsystem the explanations will be limited but more reliable. The obsidian utilization subsystem was a part of technology organization, lithic resource procurement, economic issues, trade and exchange, and perhaps political, social, and ideological organization. It is likely that every component of the lifestyle affected all other parts. It is not possible to imagine a model with a subsystem for behavior that would be independent of every other subsystem. Some subsystems will have more positive or negative feedbacks than others. One goal will be to see how far the idea of focusing on a single subsystem can be reasonably pursued.

The data would be most interesting and useful with the artifacts sorted by function and by period. With a limited sample, the data only allow indications. It might be that a particular source was used for only one purpose or by only one group. Acquisition and distribution of material goods is of interest for study of prehistoric cultures. Mechanisms of acquisition and distribution require arguments to build models for explanation from the physical measurements (Binford 1983). Cultural conclusions one can reach are not complete and undisputable. Physical measurements provided here are on the sourcing of obsidian artifacts. Determination of sources of obsidian artifacts is only evidence to help evaluate various models.

Finding the geographic locations of the origin of lithic tools is an important line of research of prehistoric organization. The occurrence of artifacts from geographically distinct sources underlies understanding of exchange networks and mobility patterns (Dixon et al. 1968; Renfrew 1977; Sheets et al. 1990;). Identification of raw material source areas provides the basic data for study of prehistoric economics. Once raw material sources are identified, then why materials were transported or not transported is more difficult to learn. Inferences about trade and exchange, procurement tactics, procurement efficiency, and mobility patterns all require source identification. Source identification is only one step in investigations of prehistoric economies. A next step for the archaeologist is to learn the behavior that resulted in distinct distributions of materials.

METHODOLOGY

The method involves comparing the element composition of obsidian artifacts with obsidian sources. The method relies on directing incident x-rays at the obsidian and observing both the scattered incident x-rays and fluorescence x-rays from the obsidian. The data is then normalized to the scattered x-rays to correct for variations due to differing size objects. The most diagnostic elements are rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb), with titanium (Ti) and iron (Fe) being secondarily useful. The XRF procedure used at the University of Wyoming is described more thoroughly elsewhere (Kunselman 1991).

Obsidian utilization produces sharp edges for tools and many by-product flakes. Every piece of artifact obsidian is useful for providing sourcing information whether it was a tool or not. The 137 artifacts available for analysis from the ongoing excavation project at Lookingbill are listed (Appendix 1). The artifacts were put into one of four flake or tool types listed in the second column. The source of the obsidian determined from the XRF analysis is listed in the third column. A complete tabulation of the XRF elemental data is included (Appendix 2).

For the present study, an XRF (x-ray fluorescence) analysis of the trace element content of the obsidian artifacts was conducted to learn the source that has matching trace element content. Obsidian and the related material ignimbrite from a single source can appear with a range of textures (smooth, bumpy), colors (glossy black, dull black, brownish, reddish, grey, olive greenish), and inclusions (bands, bubbles, perlite centers). The materials are produced with the same element composition for different colors at the same source. Different obsidian sources contain different proportions of elements. One uses XRF to determine the proportions of the elements as a source signature from one volcanic magma event.

The information wanted on the source of the obsidian artifacts is to help answer questions on prehistoric behavior. The actual quantities of each trace element is of no concern. This use for the data leads to a few requirements in the procedure. A non-destructive analysis procedure must be used. A flexible apparatus and procedure is necessary to analyze both large artifacts and small flakes because they all provide source information. A reliable XRF procedure must be established to not have a false identification that would lead to a wrong statement about behavior. A simple procedure that is quick, cheap, and able to be repeated is needed to resolve ambiguities (Kunselman 1993). The data are recorded and saved on magnetic disks so that the XRF spectrum of an artifact can be viewed later.

The criteria for analysis are met by normalizing the raw XRF data for trace elements to the Comptom scattering. This represents elastic scattering of the incident x-rays from the total number of electrons. This normalization is more reliable than time because it considers differences in amount of fluorescence x-rays from different size artifacts. Fluorescence happens when the incident x-ray non-elastically removes an inner shell electron that is then refilled by an electron to produce a final x-ray called a fluorescence x-ray. From the point of view of the source, the detector, and the processing electronics that produce the spectra, the sub-microscopic atomic physics of the artifact is indistinguishable for the scattered and fluorescence x-rays.

With a small, thin artifact, some of the incident x-rays will not be absorbed and go all the way through the artifact. These produce no fluorescence x-rays to go to the detector. The ideal artifact is several millimeters thick and produces as many x-rays to the detector as an infinitely thick artifact.

The XRF energy spectrum is the data produced using the detector. The peaks in the region of main interest with the five trace elements (Rb, Sr, Y, Zr, Nb) are each about 100 to 300 ppm (parts per million). This is small compared with other elements such as Fe with about 5%. In order to collect a statistically reliable sample of the intensity of the trace elements, the samples were run for 20 minutes.

The region of the five trace elements of the spectra of four selected sources found to be used at the Lookingbill site can be displayed (Figure 2). Artifacts from these four different sources do not produce identical signatures. One can visually distinguish differences between the four sources by the height of the five peaks due to the amounts of the five elements Rb, Sr, Y, Zr, and Nb. The actual decision whether a source and artifact match is based on each of the seven diagnostic elements. The criterion is that each element must individually agree to within two standard deviations. I cannot allow that only six of the seven element intensities match. All must match.

A bivariate plot of the Rb and Zr relative contents for artifacts from Lookingbill was constructed (Figure 3). There is a clustering of the element contents of the artifacts into four groups, each of a size and shape that agrees with the clustering of the contents of known source material. It is interesting that the large range of variation for Zr of the upper cluster, which is Obsidian Cliff, was also noted by Davis (1991). The two lower groups from the Teton Pass/Fish Creek area are barely separated into two clusters with these two elements.

RESULTS

The results of the XRF analysis are presented (Table 1). There are 137 obsidian artifacts in this study and 55.5% are from the Bear Gulch source in the Centennial Mountains of Idaho. This is the source with the furthest distance from the Lookingbill site at 215 kilometers or 130 miles on a direct line. The least frequent sources, at 18.2%, are from the closest Teton Pass/Fish Creek sources near Wilson, Wyoming in Jackson Hole at 115 kilometers or 70 miles on a direct line.

The obsidian material was broken down into four function types for the present investigation (Table 1). The frequency of flakes varies from a low of 62.5% for the Fish Creek/Teton Pass source to a high of 72.4% for the Bear Gulch source. A statistical chi-square test shows these four percentages do not represent significant variations from equivalent distributions for the four sources. The number of identified cores among the artifacts was a low of 11.1% for the Yellowstone source to a high of 14.5% for the Bear Gulch source. A statistical chi-squared test shows that these four percentages do not represent significant variations from equivalent distributions for the four sources.

The obsidian source material from Bear Gulch was obtained in 1990 from Skip Wellington, Forest Archaeologist for Targhee National Forest. Wellington reported a large alluvial fan being a workshop covered with debitage, but did not locate the geological outcrop. Later material was obtained from Jim Woods of the Herrett Museum of Twin Falls, Idaho. The Obsidian Cliff material was collected in 1991 with a National Park collecting permit. The cliff is a large impressive feature. The acres of quarry

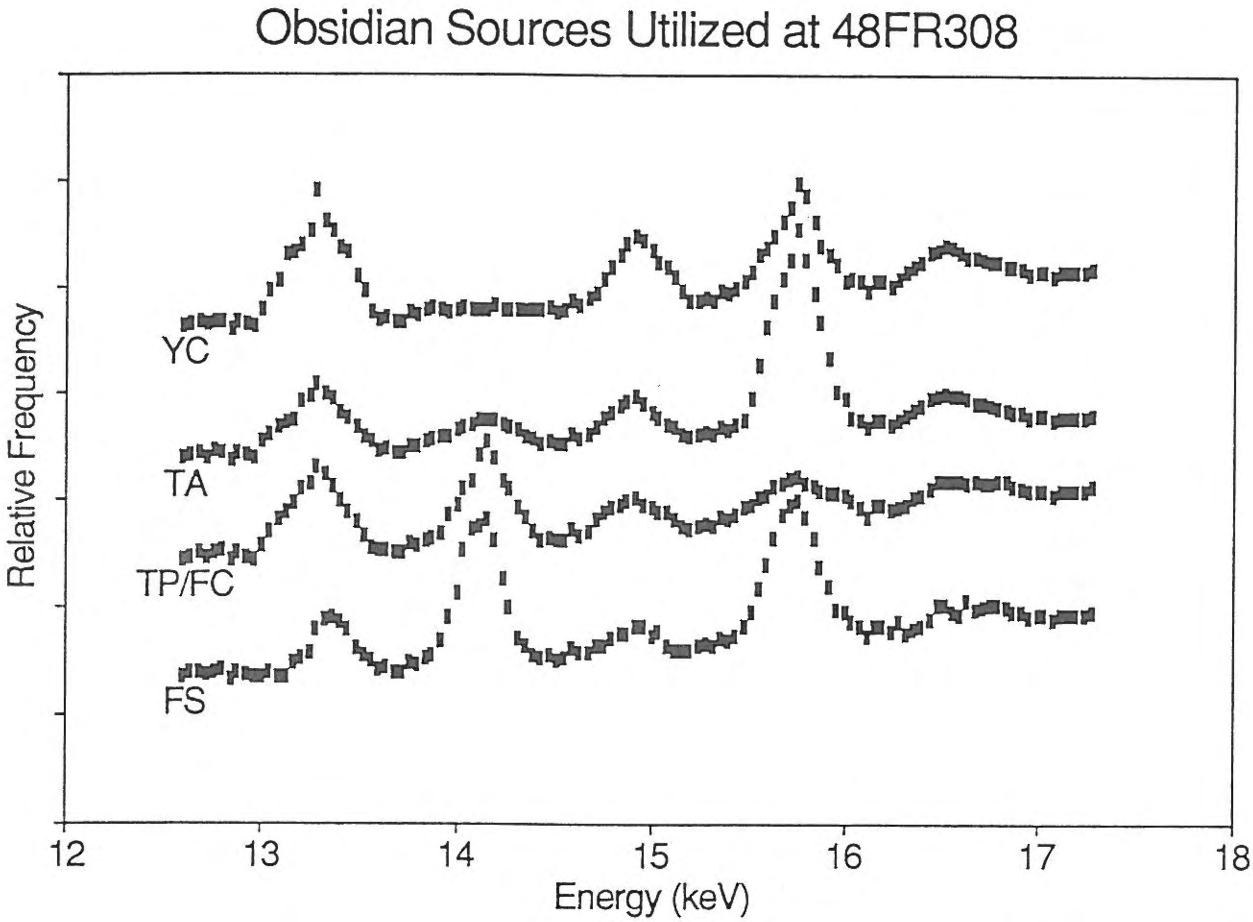

Figure 2: Expanded spectral region of five trace elements from four obsidian sources used at Lookingbill. Differences between the sources can visually distinguished.

pits are reminiscent of the Spanish Diggings of the Hartville Uplift. The Teton Pass material was collected with the guidance of George Frison in 1990. The two Fish Creek varieties also were collected in 1990 near Wilson Wyoming with George Frison. These were the first sources to the beginning of obsidian sourcing studies.

The hypothesis was considered that the obsidian utilization was independent of the distance from Lookingbill. For an $\alpha=.05$, one would reject the null hypothesis that the amount of utilization is constant independent of distance if X^2 is greater than 5.99. The calculated X^2 is 21.27, therefore it is not consistent that utilization was constant or independent of distance (Mendenhall et al. 1990). A reasonable hypothesis might next be that there was a preference for the particular Bear Gulch obsidian source. The next question was why that source could be preferred.

The various flakes from each of the four sources represent an unknown number of nodules and visits to the sources. The obsidian

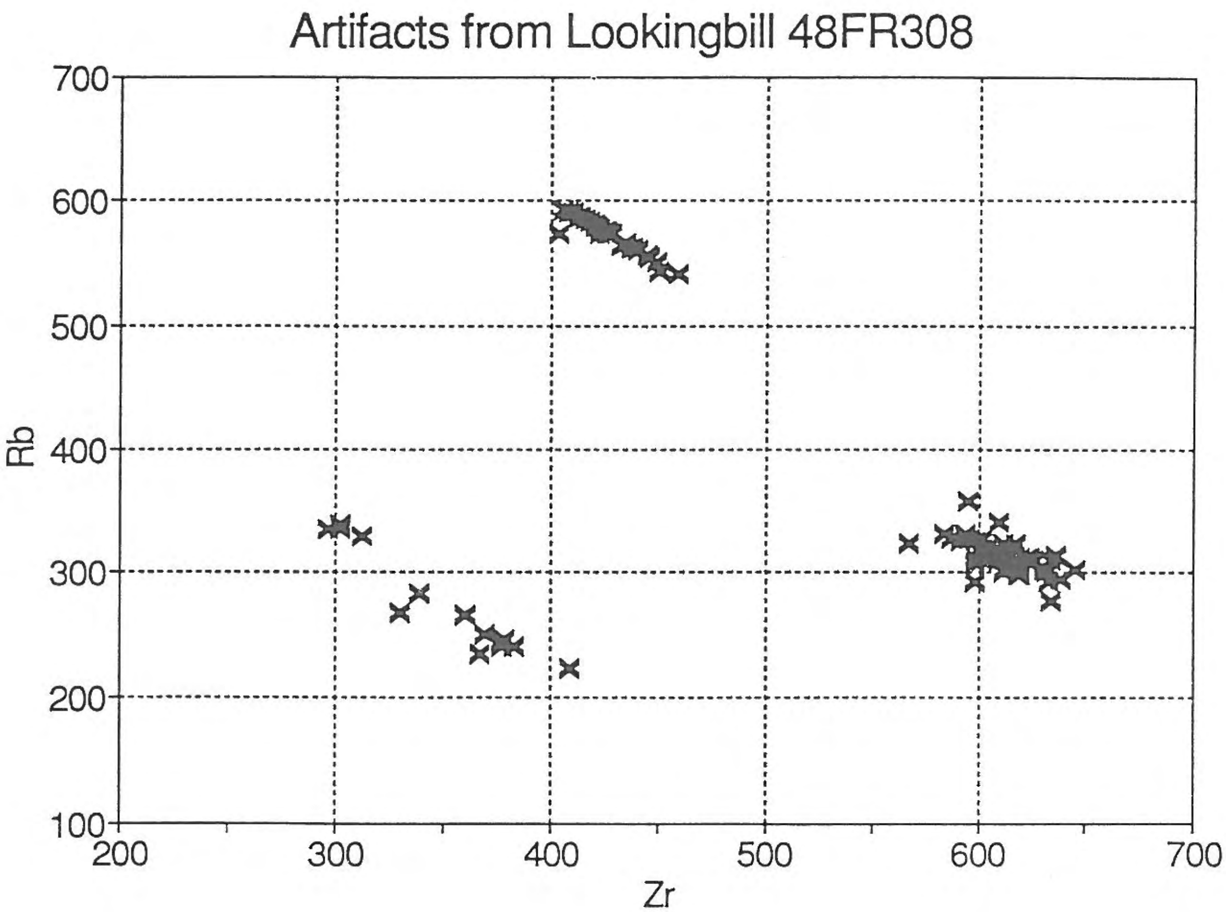

Figure 3: Bivariate plot of Rb and Zr relative proportions for artifacts from Lookingbill. Note clustering of artifacts into four source groups.

could be flakes from as few as one nodule, but it is assumed this is unlikely. It is also assumed the frequencies from each sources suggests that connections between Helen Lookingbill site and Bear Gulch were larger than the other three combined. The question of the kinds of connections appears to be a matter that is speculation and will be left for the discussion.

DISCUSSION

At the present, the seasonal hunting of mountain sheep, deer, rabbits, and elk, and the collection of a few of the many available edible plants are an attraction to only a few people. By analogy, it would be expected that some forms of large and small game and plants would have existed in these mountains since the end of the Pleistocene. Because of available edible resources, it also would be expected that prehistoric groups would have existed in these mountains. These people would have been able to use a larger array of resources than modern groups.

The mountains might have served as an Altithermal refuge as well as for seasonal high

Table 2: Summary of XRF analysis results for functional tool types and sources. Note that 55.5% are from Bear Gulch source in Centennial Mountains of Idaho, 215 kilometers (130 miles) from Lookingbill site.

SOURCE	DISTANCE (km)	F	C	P	PT	TOTAL
Bear Gulch, Targhee NF	215	55	11	5	5	76
Fish Creek, Teton Pass	115	5	1	1	1	8
Fish Creek, second variety	115	11	2	0	4	17
Obsidian Cliff, YNP	165	24	4	8	0	36
Total		95	18	14	10	137

F = flake or uniface; C = core, biface, or tool; P = projectile point or base; PT = projectile point without base or non-diagnostic. Distance is direct distance from Lookingbill site to obsidian source.

altitude living (Kornfeld and Larson 1993). It is possible that high altitude wintering sites may be undiscovered nearby. The successful use of the horse for buffalo hunting probably would make the high altitude mountains that are accessible for a few months per year not so desirable for the late Late Prehistoric cultures. These speculations could explain why Paleoindian and Archaic projectile points have been discovered more frequently. If the early prehistoric projectile points are more numerous, then one might assume the early prehistoric group occupations to have been more numerous at Lookingbill.

It is interesting there are several obsidian sources that were not found to be used at Lookingbill. The site is close to Bear Creek in a basin draining into the Wind River. The next drainage basin to the west is Horse Creek. Obsidian nodules exist on many ridges at the head of Horse Creek, but none of the material has been found at Lookingbill. Obsidian also occurs as nodules over parts of the Green River Basin but none has shown up at Lookingbill.

The excellent quality material from Wright Creek north of Malad in eastern Idaho does not occur at Lookingbill but provided the material for the Fenn Cache (Kunselman 1991). This Wright Creek material was transported great distances to southeast Wyoming (Reher and Kunselman 1990). The use of obsidian in the Greater Yellowstone area reported by Cannon (1993) included the sources found at Lookingbill plus material from American Falls in eastern Idaho. Montana site 24MA342 excavated by Stephen Aaberg north of Bear Gulch and west of Obsidian Cliff contained American Falls source material and the sources used at Lookingbill. The sources used on the Northwest Plains were the same as Lookingbill (Davis 1972).

The utilization of obsidian from sources west and northwest of the Lookingbill site, the more frequent occurrence of Bear Gulch source material, and the non occurrence of other sources must represent some form of a preference. We can only speculate on whether there were preferred connections or preferred materials. There also may have been regions that were forbidden or preferred either by other hostile social groups or less likely by natural barriers. It seems unreasonable to argue that the sample size of 137 Lookingbill artifacts is small. It remains hard to imagine why four nearby sources would be absent and four others used for all cultural periods.

The connection between Lookingbill and Bear Gulch could be a direct or an indirect connection. If the connection was direct, it could have taken place over more than one year so that the greater than 130 mile distance would not be a prohibitive condition. The trip might be made by a small subgroup and might not be for economic reasons. The trip might be for social reasons to visit relatives or persons of importance, or to deliver a bride exchange. The trip might be for ideological reasons to visit an important person or place or for an important material such as the obsidian.

If the connection was indirect, it could be exchange or trade (Dixon et al. 1968; Renfrew 1977). It could be that the material was brought back for curiosity or for non-egalitarian reasons. A site on the western slope of the Bighorns, the Laddie Creek site, has much of the lithic material being the local phosphoria chert, all of the obsidian is the Bear Gulch variety (Larson 1990). It is interesting that no clearly identifiable exotic phosphoria has been found at Lookingbill even though the Big Horn Basin is only over the Bear Creek drainage and down the east slope. Exotic Green River Basin chert has been identified (Jim Miller, personal communication, 1993). It would be interesting to know if the obsidian was considered more exotic and retained longer than chert lithic materials.

It would not be an easy task to go on a direct line in the mountains of northwest Wyoming. One would expect that a route would be along valleys and waterways that would require less effort and provide water and food on the way. Since it is not likely that anyone would go from Lookingbill to one of the four source areas on a straight line, non-direct distances were estimated. The pathways were assumed to follow drainages and to go over passes. A variety of routes were examined and the distances measured. A reasonable guess of the increase of distances over the direct distances from Lookingbill is 96 rather than 70 miles for Fish Creek, 140 rather than 100 miles for Obsidian Cliff, and 130 rather than 90 miles for Bear Gulch. The only relative change is that Obsidian Cliff is 4% shorter relative to Fish Creek and Bear Gulch, but this route was directly over the central Yellowstone Plateau. The distance would be slightly increased if the group went around the plateau as the present highway. However, the three relative distances would be about the same whether on a straight line or a circuitous route.

The hypothesis was also considered that the obsidian utilization was inverse to the distance from Lookingbill. For an $\alpha=.05$ (probability criterion), one would reject the null hypothesis of amount of utilization proportional inversely to distance if X^2 is greater than 5.99. The calculated X^2 is 79.37, hence it is not consistent that utilization was inversely to distance (Mendenhall et al. 1990). A reasonable hypothesis remains that there was a preference for a particular obsidian source. The question remains to explain why that source could be preferred.

A popularly expressed expectation is that Obsidian Cliff of Yellowstone National Park is immense and provided most of the regional obsidian source material for artifacts. The obsidian is good quality, plentiful and a major source, even for distant Hopewell culture artifacts (Wright and Chaya 1985). The reasoning could have been that if so much material was found so distant from the source, then surely much was transported lesser distances. The observation of Obsidian Cliff being predominant is true for close to Yellowstone such as the Beartooth Mountains (Kunselman and Husted 1991) and far from Yellowstone at the Hopewell sites (Wright and Chaya 1985). Yellowstone material is not predominant at Lookingbill.

High altitude adaptations are critical locations for understanding the connections between peoples of the region. Winter (1983) presented relevant discussions in New Mexico where a good quality, large quantity, source is available in the Jemez mountains along with lesser sources. The change was from direct acquisition as utilitarian material in Paleoindian times to later controlled trade as ritual material (Winter 1983). The pattern of changing control was much the same with the obsidian source areas of the Mexico City basin area and the Guatemala highland area (Braswell 1992; Nelson 1985; Sheets et al. 1990). The utilization between Yellowstone and the lesser sources with the changing time periods could be of similar interest for Lookingbill when more samples with good dates are available.

Cooperation and managing risk: A cultural system will also be assumed to display desires and ambitions for things other than food, mates, and safe sleeping places. Human behavior displays ambitions to understand the world, explain the world, pride in workmanship, curiosity to try new things, and social cohesion. It is clear that food, mates, and sleep are necessary but much, and possibly more, free time is spent with ideological activities, unnecessary technology (e.g., Folsom point fluting), social visiting, and exploring. These activities can be said to contribute to future food procurement but are not directly done for monitoring, scheduling, and gathering.

Several authors have considered risk in understanding behavior (Boone 1992; Halstead and O'Shea 1989). Risk can be defined as uncertainty in food procurement that can prove to be dangerous. In the face of uncertainty, humans group together and form coping strategies such as mobility, diversity, storage, and exchange (Halstead and O'Shea 1989). A manifestation of these strategies is pooling and sharing of resources.

The connection could be in time of need (Halstead and O'Shea 1989). We do not know if the obsidian was brought to Lookingbill by the usual residents or if it was left at Lookingbill by outside visitors. The resources might occasionally have more favorable production one place or another. Groups might need to cash in credits for pooling and sharing for hard times whether resources or wives were exchanged to keep the connections (Boone 1992). Bear Gulch is located on Camas Creek and camas is a desirable edible bulb.

Storage and diversification are strategies against the risk of food unavailability. Storage might be indirect social storage with women for wives exchanged or the resources might be transformed to something of value that can returned to food if needed. The value can also be exchanged prestige items as social hierarchy develops. The more fortunate or ambitious individual gains economic power for the future and is less likely to get into debt. The prestige and tokens that are leading to hierarchy and stratification can lead to control and manipulation. One can inflate tokens or remove them from the system as in burials (Halstead and O'Shea 1989). The elite then spend time trying to control risk and unpredictability of resources.

Resource fluctuation leads to problems seasonally, inter-annually, and long term with storage and pooling/sharing being short term solutions. No storage pits have been reported at Lookingbill (Larson 1991). Physical storage conflicts with mobility so that social storage was important when spatial variation was considerable. Social storage includes the obvious dispersal of relatives in the mating network so that visitation would be an obligation in time of need. Extended families covered non-biological relations in order to maximize security.

CONCLUSIONS AND FUTURE DIRECTIONS

XRF spectroscopy was used to compare trace element proportions of obsidian artifacts collected from the Helen Lookingbill site (48FR-308) to trace element proportions for known sources. The artifacts were produced from four sources of obsidian west and northwest of the site (Table 1). More than half the obsidian artifacts are from the Bear Gulch source in the Centennial Mountains of Idaho that is the furthest source from the Lookingbill site. The fewest number of artifacts are from the closest Teton Pass/Fish Creek sources near Wilson Wyoming in Jackson Hole. Several regional sources were apparently not used.

The groups that visited the Lookingbill site over the years used obsidian from sources that suggest distant connections. The reasons for the connections are speculations. The speculations would be improved with source utilization information as a function of occupation time, i.e., obsidian artifacts with chronological information from context. Further excavations at Lookingbill will not guarantee increases in the amount of obsidian artifacts in context. The patterns of obsidian utilization at other sites in the region would more likely answer questions about why connections and group mobility were to certain locations and not other locations.

REFERENCES CITED

Binford, Lewis R.
1983 *In Pursuit of the Past*. London, Thames and Hudson.

Boone, James L.
1992 Competition, Conflict, and Development of Social Hierarchies. In *Evolutionary Ecology and Human Behavior*, (Eric Alden Smith and Bruce Winterhalder, eds.). Pp. 301-338. Aldine de Gruyter, New York.

Braswell, Geoffrey E., and Michael D. Glascock
1992 A New Obsidian Source in the Highlands of Guatemala. *Ancient Mesoamerica* 3:47-49.

Cannon, Kenneth P.
1993 Paleoindian Use of Obsidian in the Greater Yellowstone Area. *Yellowstone Science* 1(4):6-9.

Davis, Leslie B.
1972 *The Prehistoric Use of Obsidian in the Northwestern Plains*. Unpublished Ph.D. dissertation, Department of Archaeology, The University of Calgary, Calgary, Alberta, Canada.
1991 Yellowstone Obsidian Cliff: National Registry. Paper presented at the 19th Montana Archaeological Society Conference, Billings.

Dixon, J.E., J.R. Cann, and Colin Renfrew
1968 Obsidian and the Origins of Trade. *Scientific American* 218(3):38-46.

Frison, George C.
1991 *Prehistoric Hunters of the High Plains*. Second Edition. Academic Press, New York.
1982 The Lookingbill Site, Wyoming, 48FR308. *Tebiwa* 20:1-16.

Gunnerson, James H.
1987 *Archaeology of the High Plains*. Colorado State Office, Bureau of Land Management, Denver, Colorado.

Halstead, P., and J. O'Shea
1989 Introduction: Cultural Responses to Risk and Uncertainty. In *Bad Year Economics* (Paul Halstead and John O'Shea, eds.). Pp. 1-7. Cambridge University Press, Cambridge.

Jennings, Jesse D.
1989 *Prehistory of North America*. 3rd edition, Mayfield Publishing.

Kornfeld, Marcel and Mary Lou Larson
1993 Looking Out From Lookingbill. Paper presented at the 1st Annual Meeting, Rocky Mountain Anthropological Conference, Jackson, Wyoming.

Kunselman, Raymond
1991 Durable Paleoindian Artifacts: XRF Variability of Selected Wyoming Source Materials. *The Wyoming Archaeologist* 34(1-2):15-25.
1993 Obsidian Utilization Studies: Source Variation at the Jackson National Fish Hatchery site 48TE1291. Paper presented at the 1st Rocky Mountain Anthropological Conference, Jackson, Wyoming.

Kunselman, Raymond, and Wilfred Husted
1991 Obsidian XRF Trace Element Sourcing: Transport and Utilization in the Beartooth Mountains, Montana. Paper presented to the Montana Archaeological Society, Billings, April, 1991.

Larson, Mary Lou
1990 *Early Plains Archaic Technological Organization: The Laddie Creek Example*. Unpublished Ph.D. Dissertation, Department of Anthropology, University of California, Santa Barbara.
1991 1991 Excavations at 48FR308, The Helen Lookingbill Site: Preliminary Report. *The Wyoming Archaeologist* 34(3-4):69-82.

Mendenhall, William, Dennis D. Wackerly, and Richard L. Scheaffer
1990 *Mathematical Statistics With Applications*. PWS-Kent Publishing, Boston.

Nelson, F. W.
1985 Summary of Results of Analysis of Obsidian Artifacts From the Maya Lowlands. *Scanning Electron Microscopy* 2:631-649.

Nelson, Margaret C.
1991 The Study of Technological Organization. In *Archaeological Method and Theory*, (Michael B. Schiffer, ed.). Pp. 57-100. University of Arizona Press, Tucson.

Pierce, Kenneth L. and Lisa A. Morgan
1992 The Track of the Yellowstone Hot Spot: Volcanism, Faulting, and Uplift. *Geological Society of America, Memoir* 179:1-53.

Reher, Charles A., and Raymond Kunselman
1990 Obsidian Source Use in the High Plains of Southeast Wyoming. Paper presented at the 48th Annual Meeting, Plains Anthropological Society, Oklahoma City, Oklahoma.

Renfrew, Colin
1977 Alternative Models for Exchange and Spatial Distribution. In *Exchange Systems in Prehistory*, (Timothy K. Earle and Jonathan E. Ericson, eds.). Pp. 71-90. Academic Press, New York.

Sheets, Payson, Kenneth Hirth, Fred Lange, Frod Stross, Frank Asaro, and Helen Michel
1990 Obsidian Sources and Elemental Analyses of Artifacts in Southern Mesoamerica and the Northern Intermediate Area. *American Antiquity* 55(1):144-158.

Shepard, Ruth A.
1992 *A Cultural Model for Ground Stone Use in the Middle Rocky Mountains: The Helen Lookingbill Site*. Unpublished Master of Arts thesis, Department of Anthropology, University of Wyoming, Laramie.

Winter, Joseph C.
1983 Jemez Mountain Obsidian Exchange - A View From Redondo Valley. *USDA Forest Service, Southwest Region, Cultural Resource Management Report* 2:91-107.

Wright, G. A., and H. J. Chaya
1985 Obsidian Source Analysis in Northwestern Wyoming: Problems and Prospects. *Plains Anthropologist* 30(109):237-242.

APPENDIX 1: The 137 obsidian artifacts available for analysis from Helen Lookingbill site are listed in the first column. Artifacts were put into one of four flake or tool types listed in second column. Source of obsidian determined from XRF analysis is listed in third column.

CATALOG NUMBER 48FR308-	CHIPPED STONE TYPE	PROBABLE SOURCE
18.2	C	Bear Gulch, Targhee NF
18.3	C	Bear Gulch, Targhee NF
18.4	P	Bear Gulch, Targhee NF
22	C	Bear Gulch, Targhee NF
54.87	P	Bear Gulch, Targhee NF
85	F	Bear Gulch, Targhee NF
85.2	F	Bear Gulch, Targhee NF
993	C	Bear Gulch, Targhee NF
1886	F	Bear Gulch, Targhee NF
2463	F	Bear Gulch, Targhee NF
2633	F	Bear Gulch, Targhee NF
2685	F	Bear Gulch, Targhee NF
3215.6	F	Bear Gulch, Targhee NF
3221.1	F	Bear Gulch, Targhee NF
3241.6	F	Bear Gulch, Targhee NF
3254.16	F	Bear Gulch, Targhee NF
3261.74	F	Bear Gulch, Targhee NF
3436.1	F	Bear Gulch, Targhee NF
3483.11	F	Bear Gulch, Targhee NF
3504.7	F	Bear Gulch, Targhee NF
3504.8	F	Bear Gulch, Targhee NF
7281	C	Bear Gulch, Targhee NF
7339	C	Bear Gulch, Targhee NF
7438	F	Bear Gulch, Targhee NF
7468	F	Bear Gulch, Targhee NF
7511	F	Bear Gulch, Targhee NF
7518	PT	Bear Gulch, Targhee NF
7683	F	Bear Gulch, Targhee NF
7866	F	Bear Gulch, Targhee NF
7871	F	Bear Gulch, Targhee NF
7937	F	Bear Gulch, Targhee NF
7982	F	Bear Gulch, Targhee NF
8066	F	Bear Gulch, Targhee NF
8263	F	Bear Gulch, Targhee NF
8317	P	Bear Gulch, Targhee NF
8319	F	Bear Gulch, Targhee NF
8331	F	Bear Gulch, Targhee NF
8452	F	Bear Gulch, Targhee NF
8464	F	Bear Gulch, Targhee NF
8604	C	Bear Gulch, Targhee NF
8605	PT/C	Bear Gulch, Targhee NF
8811	C	Bear Gulch, Targhee NF
8812	F	Bear Gulch, Targhee NF
8853	F	Bear Gulch, Targhee NF
8905	F	Bear Gulch, Targhee NF
8966	C	Bear Gulch, Targhee NF
9260	F	Bear Gulch, Targhee NF
9484	F	Bear Gulch, Targhee NF
9571	F	Bear Gulch, Targhee NF
9617	PT/C	Bear Gulch, Targhee NF
9745	F	Bear Gulch, Targhee NF

CATALOG NUMBER 48FR308-	CHIPPED STONE TYPE	PROBABLE SOURCE
9799	F	Bear Gulch, Targhee NF
9857	F	Bear Gulch, Targhee NF
9858	F	Bear Gulch, Targhee NF
9900	F	Bear Gulch, Targhee NF
10092	C	Bear Gulch, Targhee NF
10768	F	Bear Gulch, Targhee NF
12614	C	Bear Gulch, Targhee NF
13175	F	Bear Gulch, Targhee NF
13808	F	Bear Gulch, Targhee NF
13812	F	Bear Gulch, Targhee NF
13813	F	Bear Gulch, Targhee NF
14185	F	Bear Gulch, Targhee NF
14461	F	Bear Gulch, Targhee NF
14462	PT	Bear Gulch, Targhee NF
14746	F	Bear Gulch, Targhee NF
14891	F	Bear Gulch, Targhee NF
15972	F	Bear Gulch, Targhee NF
16097	F	Bear Gulch, Targhee NF
17268	F	Bear Gulch, Targhee NF
17268.2	F	Bear Gulch, Targhee NF
35049	F	Bear Gulch, Targhee NF
35214.2	PT	Bear Gulch, Targhee NF
35216	F	Bear Gulch, Targhee NF
35395	P	Bear Gulch, Targhee NF
35420	P	Bear Gulch, Targhee NF
22.2	PT	Fish Creek, second variety
132	C	Fish Creek, second variety
1906	F	Fish Creek, second variety
7793	PT	Fish Creek, second variety
8332	F	Fish Creek, second variety
8333	F	Fish Creek, second variety
8334	F	Fish Creek, second variety
8868	F	Fish Creek, second variety
9386	F	Fish Creek, second variety
9695	F	Fish Creek, second variety
11203	PT	Fish Creek, second variety
14186	F	Fish Creek, second variety
15772	C	Fish Creek, second variety
16084	F	Fish Creek, second variety
17268.1	F	Fish Creek, second variety
35048	PT	Fish Creek, second variety
35193	F	Fish Creek, second variety
1885	F	Fish Creek/Teton Pass
7369	F	Fish Creek/Teton Pass
12380	F	Fish Creek/Teton Pass
35041	P	Fish Creek/Teton Pass
35047	F	Fish Creek/Teton Pass
35196	F	Fish Creek/Teton Pass
35217	PT	Fish Creek/Teton Pass
35244	C	Fish Creek/Teton Pass
18	C	Obsidian Cliff, YNP
46	F	Obsidian Cliff, YNP
87	P	Obsidian Cliff, YNP
996	P	Obsidian Cliff, YNP
2304	F	Obsidian Cliff, YNP
2633	F	Obsidian Cliff, YNP
3241.6	F	Obsidian Cliff, YNP

CATALOG NUMBER 48FR308-	CHIPPED STONE TYPE	PROBABLE SOURCE
3241.73	F	Obsidian Cliff, YNP
3261.75	F	Obsidian Cliff, YNP
3261.76	F	Obsidian Cliff, YNP
3261.77	F	Obsidian Cliff, YNP
3330.15	F	Obsidian Cliff, YNP
3431.5	F	Obsidian Cliff, YNP
3466.9	F	Obsidian Cliff, YNP
6783	F	Obsidian Cliff, YNP
7503	F	Obsidian Cliff, YNP
8429	F	Obsidian Cliff, YNP
8624	P	Obsidian Cliff, YNP
8663	F	Obsidian Cliff, YNP
8664	F	Obsidian Cliff, YNP
8725	F	Obsidian Cliff, YNP
8768	C	Obsidian Cliff, YNP
8981	P	Obsidian Cliff, YNP
10051	C	Obsidian Cliff, YNP
13794	F	Obsidian Cliff, YNP
14707	F	Obsidian Cliff, YNP
15446	F	Obsidian Cliff, YNP
15572	F	Obsidian Cliff, YNP
35041.2	P	Obsidian Cliff, YNP
35194	F	Obsidian Cliff, YNP
35212	F	Obsidian Cliff, YNP
35214	F	Obsidian Cliff, YNP
35215	F	Obsidian Cliff, YNP
35218	C	Obsidian Cliff, YNP
35293	P	Obsidian Cliff, YNP
35386	P	Obsidian Cliff, YNP

KEY TO CHIPPED STONE TYPE: F = flake or uniface; C = core, biface or tool; P = projectile point or base; PT = projectile point without base or a non-diagnostic base

APPENDIX 2: Data produced from XRF analysis. Disk and run number are given in columns 1 and 2. Amount of elements are given in columns 3 to 9. Sums of Rb, Sr, and Zr are given in column 10. Relative amounts for five diagnostic elements are given in columns 11 to 15. Artifact catalog number given in column 16.

DISK	RUN	Rb	Sr	Y	Zr	Nb	Ti	Fe	sum	r	s	y	z	n	CAT. NO.
119	1	926	219	394	1746	399	1523	6975	2891	320	76	136	604	138	9260
119	2	747	219	329	1518	393	1259	6202	2484	301	88	132	611	158	9900
119	3	770	159	380	1533	404	1165	6081	2462	313	65	154	623	164	8263
119	4	935	260	389	1800	564	1320	6404	2995	312	87	130	601	188	14185
119	5	918	220	376	1816	495	1342	6588	2954	311	74	127	615	168	8905
119	6	847	257	393	1641	451	1308	6792	2745	309	94	143	598	164	1886
119	7	734	212	327	1408	378	1155	6026	2354	312	90	139	598	161	2685
119	8	486	770	172	760	299	612	5711	2016	241	382	85	377	148	1906
119	9	891	251	393	1801	497	1377	7157	2943	303	85	134	612	169	8605
119	10	958	246	452	1827	555	1293	6674	3031	316	81	149	603	183	9617
119	11	552	838	157	846	275	797	6588	2236	247	375	70	378	123	14186

DISK	RUN	Rb	Sr	Y	Zr	Nb	Ti	Fe	sum	r	s	y	z	n	CAT. NO.
119	12	1226	421	457	2160	558	1600	7324	3807	322	111	120	567	147	8853
119	14	888	229	420	1923	558	1362	6796	3040	292	75	138	633	184	14746
119	15	613	932	296	906	228	701	6078	2451	250	380	121	370	93	8868
119	16	1000	260	411	1913	440	1425	7452	3173	315	82	130	603	139	8966
119	17	556	740	240	665	338	573	5619	1961	284	377	122	339	172	16084
119	18	1054	252	430	2100	486	1560	7215	3406	309	74	126	617	143	993
119	19	1304	54	721	917	474	291	5213	2275	573	24	317	403	208	15446
119	20	922	193	431	1845	438	1399	7490	2960	311	65	146	623	148	13808
119	21	883	219	420	1757	532	1220	6942	2859	309	77	147	615	186	15972
119	22	767	124	271	1559	399	1082	5353	2450	313	51	111	636	163	13813
119	23	1147	0	513	856	389	292	4080	2003	573	0	256	427	194	13794
119	24	548	861	185	877	195	766	5658	2286	240	377	81	384	85	15772
119	25	930	200	281	1709	362	1423	5834	2839	328	70	99	602	128	13812
119	26	1248	0	508	864	397	311	3937	2112	591	0	241	409	188	8663
119	27	478	791	164	876	238	669	5354	2145	223	369	76	408	111	9695
119	28	840	170	310	1589	393	1134	5896	2599	323	65	119	611	151	9484
119	29	1142	0	498	800	412	296	4050	1952	588	0	256	412	212	15572
119	30	855	182	264	1654	487	1229	5873	2691	318	68	98	615	181	14891
119	31	1255	0	621	926	447	275	4410	2181	575	0	285	425	205	10051
119	32	490	754	156	756	247	573	4752	2000	245	377	78	378	124	7793
119	33	848	160	197	1623	366	1270	5483	2631	322	61	75	617	139	9571
119	34	1179	0	483	813	413	304	4039	1992	592	0	242	408	207	14707
119	35	741	125	312	1578	432	1141	5521	2444	303	51	128	646	177	9799
119	36	846	127	101	1515	298	1232	4746	2488	340	51	41	609	120	12614
119	37	1207	0	510	865	406	277	3858	2072	583	0	246	417	196	8664
120	1	879	254	378	1709	445	1423	6544	2842	309	89	133	601	157	14462
120	2	1280	0	720	984	533	287	5153	2264	565	0	318	435	235	8725
120	3	1397	0	764	1121	486	342	5268	2518	555	0	303	445	193	8768
120	4	833	206	361	1644	400	1231	6595	2683	310	77	135	613	149	8812
120	5	652	183	318	1353	325	807	4468	2188	298	84	145	618	149	3241.6
120	6	873	188	362	1813	453	1399	6870	2874	304	65	126	631	158	7518
120	7	622	143	239	938	256	1273	6740	1703	365	84	140	551	150	8317
120	8	483	816	186	754	243	668	5829	2053	235	397	91	367	118	11203
120	9	1206	2	619	888	325	273	4999	2096	575	1	295	424	155	8624
120	10	829	228	361	1718	498	1248	6633	2775	299	82	130	619	179	10768
120	11	915	220	380	1787	496	1328	6840	2922	313	75	130	612	170	35420
120	12	1332	0	662	966	438	342	5315	2298	580	0	288	420	191	996
120	14	949	244	346	1725	472	1357	6954	2918	325	84	119	591	162	8604
120	15	975	222	381	1908	447	1446	6980	3105	314	71	123	614	144	7339
120	16	985	213	389	1994	508	1572	7390	3792	309	67	122	625	159	8811
120	17	994	181	393	2031	500	1560	7432	3206	310	56	123	633	156	10092
120	18	1029	246	395	1897	450	1623	7385	3172	324	78	125	598	142	13175
120	19	651	690	228	581	195	599	5044	1922	339	359	119	302	101	1885
120	20	995	218	421	1971	507	1522	7174	3184	313	68	132	619	159	9858
120	21	959	204	427	2000	508	1779	7268	3163	303	64	135	632	161	16097
120	23	940	235	357	1915	660	1226	6406	3090	304	76	116	620	214	9745
120	35	982	237	439	1977	506	1497	7274	3196	307	74	137	619	158	8331
120	36	608	666	249	538	282	449	4637	1812	336	368	137	297	156	7369
120	37	892	201	389	1809	515	1393	7037	2902	307	69	134	623	177	9857
120	38	962	206	416	1935	435	1324	6702	3103	310	66	134	624	140	14461
120	39	952	217	394	1991	552	1397	6997	3160	301	69	125	630	175	7281
120	40	548	767	207	742	240	640	5671	2057	266	373	101	361	117	9386
120	41	876	222	399	1788	471	1260	7006	2886	304	77	138	620	163	54.87
120	42	1339	0	714	990	437	314	5375	2329	575	0	307	425	188	8981
120	43	983	216	411	1924	465	1466	7375	3123	315	69	132	616	149	8319
120	44	933	226	418	1848	508	1219	6805	3007	310	75	139	615	169	9484
120	50	1324	0	718	1120	547	246	5018	2444	542	0	294	458	224	2304
120	51	1302	0	674	944	447	307	5257	2246	580	0	300	420	199	6783

DISK	RUN	Rb	Sr	Y	Zr	Nb	Ti	Fe	sum	r	s	y	z	n	CAT. NO.
121	3	1431	0	752	1114	524	309	5276	2545	562	0	295	438	206	2633
121	4	597	650	259	568	312	464	4966	1815	329	358	143	313	172	12380
121	5	861	231	398	1729	511	1185	6776	2821	305	82	141	613	181	2463
121	6	900	0	486	700	340	163	3774	1600	563	0	304	438	213	121.6
121	7	690	748	318	622	207	524	5143	2060	335	363	154	302	100	35217
121	8	961	260	401	1865	507	1301	7062	3086	311	84	130	604	164	3261.74
121	9	1287	0	670	915	433	272	5164	2202	584	0	304	416	197	3261.75
121	10	1154	0	637	885	439	257	5009	2039	566	0	312	434	215	3241.6
121	11	1300	0	666	948	464	279	5324	2248	578	0	296	422	206	3241.73
121	12	847	316	445	1731	503	1142	6650	2894	293	109	154	598	174	17268
121	13	1239	0	664	971	441	258	5043	2210	561	0	300	439	200	3431.5
121	14	1264	0	673	994	506	301	5260	2258	560	0	298	440	224	3466.9
121	15	989	245	360	1932	529	1362	7254	3166	312	77	114	610	167	3254.16
121	16	1267	0	711	982	436	287	5381	2249	563	0	316	437	194	3330.15
121	17	802	210	350	1415	350	1165	6598	2427	330	87	144	583	144	3483.11
121	19	462	692	173	568	110	560	5367	1722	268	402	100	330	64	3436.1
121	20	663	175	273	1191	273	1093	6149	2029	327	86	135	587	135	17268.1
121	22	940	236	365	1774	502	1330	7054	2950	319	80	124	601	170	17268.2
63	13	896	174	437	1915	482	1289	7124	2985	300	58	146	642	161	85
63	14	921	203	494	2025	463	1421	7336	3149	292	64	157	643	147	63.14
63	15	1045	254	439	1999	537	1372	6963	3298	317	77	133	606	163	35049
63	16	972	250	423	1896	447	1475	7565	3118	312	80	136	608	143	22
63	17	565	921	239	953	257	665	6695	2439	232	378	98	391	105	63.17
63	18	900	58	525	1896	436	922	6863	2854	315	20	184	664	153	35195
63	19	573	949	258	940	256	579	5956	2462	233	385	105	382	104	132
63	20	1332	14	742	1005	416	266	5276	2351	567	6	316	427	177	18
63	21	835	218	317	1794	457	1069	6632	2847	293	77	111	630	161	63.21
63	22	828	225	359	1731	433	1062	6355	2784	297	81	129	622	156	63.22
63	23	888	189	392	1806	463	1090	6737	2883	308	66	136	626	161	63.23
63	24	1450	0	706	994	474	247	5255	2444	593	0	289	407	194	35214
63	25	934	220	411	1952	510	1199	7188	3106	301	71	132	628	164	63.25
63	26	1292	0	723	931	511	248	5230	2223	581	0	325	419	230	35218
63	27	959	236	459	1993	433	1561	8641	3188	301	74	144	625	136	35216
63	28	1310	0	699	973	461	230	5053	2283	574	0	306	426	202	35293
63	29	657	780	261	597	234	403	5010	2034	323	383	128	294	115	35244
63	30	1332	0	781	1015	413	196	5422	2347	568	0	333	432	176	35215
63	31	527	870	271	734	89	467	6106	2131	247	408	127	344	42	35048
63	32	547	667	342	655	212	407	4971	1869	293	357	183	350	113	35217
63	33	599	601	301	559	194	339	4288	1759	341	342	171	318	110	35041
63	34	1300	0	663	980	409	227	5164	2280	570	0	291	430	179	35041.2
63	35	1241	0	663	972	411	193	5092	2213	561	0	300	439	186	35212
63	36	1289	0	674	923	398	209	5180	2212	583	0	305	417	180	46
63	37	253	203	65	286	363	116	1955	742	341	274	88	385	489	35121

Raymond Kunselman
Department of Physics and Astronomy
University of Wyoming
Laramie, WY 82071

THE WYOMING ARCHEOLOGICAL SOCIETY JOSEPH CRAMER GRANT AND THE 1990 ARCHAEOLOGICAL INVESTIGATIONS AT 48CR4001: THE ESPY-CORNWELL SITE, CARBON COUNTY, WYOMING

by
James A. Truesdale

INTRODUCTION

Archaeological excavations and research at 48CR4001 have been conducted from 1983 to 1993. The site, located approximately 16 miles south of Rawlins, Wyoming, is situated on the east face of a north-south trending exposure of Lance Formation sandstone. It is at an elevation of 2195 meters (7200 feet) above mean sea level (AMSL). Vegetation on the site is characteristic of a low sagebrush-grassland community.

In 1990, the archaeological investigations and subsequent research was generously funded by a Joseph Cramer Grant through the Wyoming Archaeological Society.

1990 ARCHAEOLOGICAL INVESTIGATIONS

The 1990 archaeological investigations at the Espy-Cornwell site concentrated on the excavation of two surface firepits (Feature 1 and 2) and continued excavations in the Rockshelter locality. The Grant paid for supporting studies such as radiocarbon dates of samples collected from Features 1 and 2, their respective macrofloral analyses, and curatorial supplies such as "riker" mounts, film and film processing.

Feature 1 was a shallow basin rock lined firepit that measured 40 centimeters in diameter and five to ten centimeters in depth. Charcoal from the feature was identified as sagebrush (*Artemisia* sp.) and yielded a radiocarbon date of 1020 $\pm$ 70 years B.P. (Beta-39787).

Feature 2 was a shallow basin firepit measuring 38 centimeters in diameter and eight to ten centimeters in depth. Charcoal from the feature was identified as sagebrush and willow and yielded a radiocarbon date of 950 $\pm$ 60 years B.P. (Beta-39786).

Macrofloral analysis of Features 1 and 2 at 48CR4001 did not recover any charred seeds that could be interpreted as indicating subsistence or economic activity.

SUMMARY OF 1993 ARCHAEOLOGICAL INVESTIGATIONS AT 48CR4001

The Espy-Cornwell site (Figure 1) contains two *Bison* sp. bone beds, four prehistoric primary interments (Burials A, B, C, and D), a rockshelter locality with two buried intact cultural components, and two surface firepit features (Features 1 and 2). The upper *Bison* bone bed dates to 780 $\pm$ 60 years B.P. (Beta-49987) and represents a discard zone (dump) of a butchered *Bison* vertebrae column. The lower *Bison* bone bed is a kill/butchery episode radiocarbon dating to an age of 1280 $\pm$ 80 years B.P. (Beta-49988). Excavation of 33 square meters in the lower bone level has recovered 545 complete or fragmented *Bison* bones representing a minimum of (MNI) eight individual animals. One Avonlea projectile point, one corner-notched projectile point, and three flake tools were also recovered.

As stated above, the site includes the remains of four prehistoric primary human interments (Burials A, B, C and D). Burial A is a

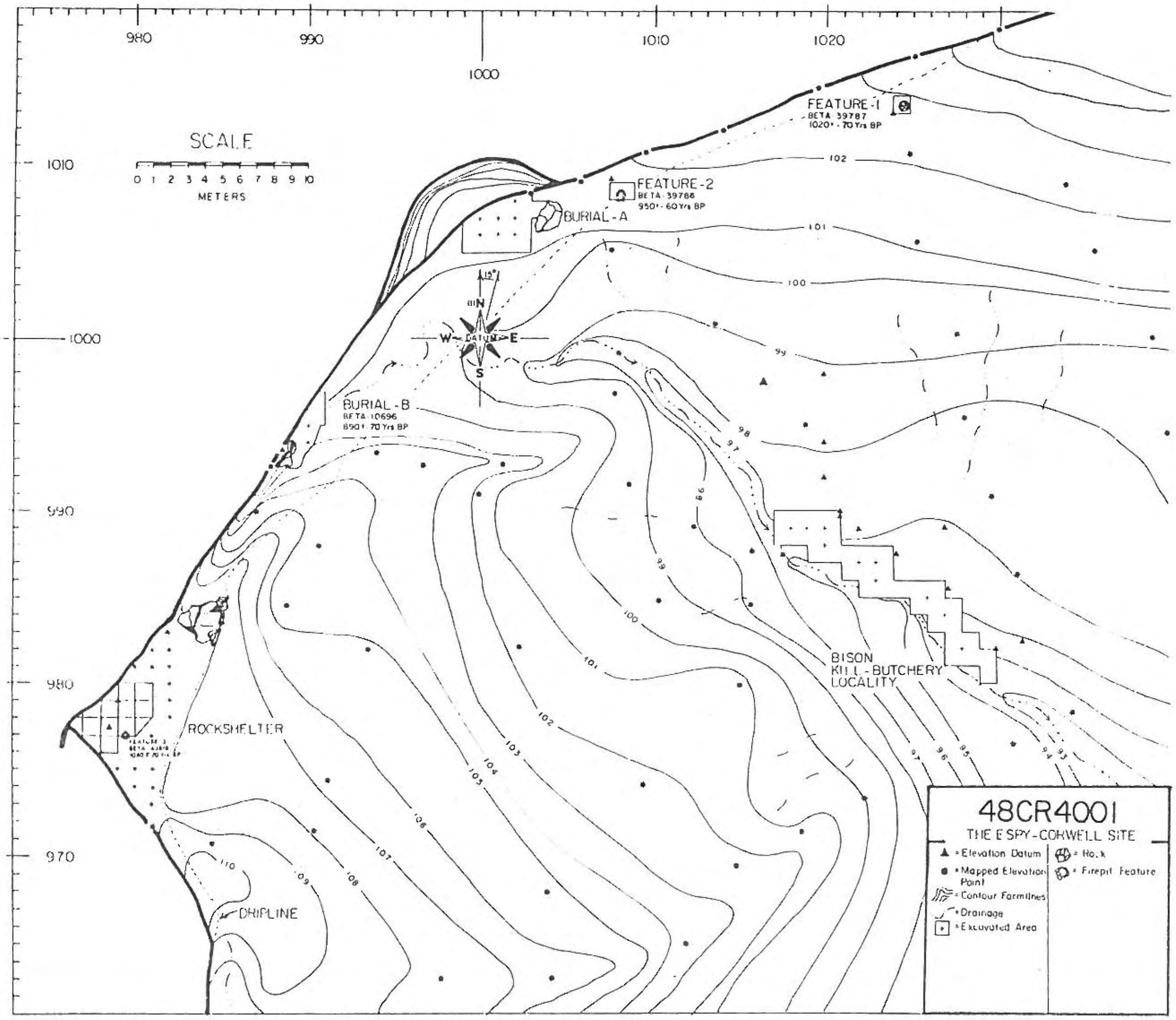

Figure 1: Espy-Cornwell site (48CR4001) site map, showing excavated areas and features.

four and a half year old child. The type or mode of burial and associated attributes is unknown. The original position of the human remains and associated artifacts were disturbed by a local collector. Artifacts associated with Burial A recovered by the collector and subsequent excavation, include twelve bone, teardrop-shaped, pendants, six bivalve shell (*Lampsilis* sp.) pendants, one (*Olivella* sp.) shell bead, 21 tubular bone beads, 20 lignite disc beads, 21 juniper (*Juniperus* sp.) seed beads, and three chipped stone flakes.

Burial B was a primary crevice interment of a 3.5 year ± 6 month old child. Excavation of the Burial B area recovered 1000+ tubular bone beads, 1000+ Juniper seed beads, 55 lignite disc beads, 47 limestone tubular beads and one ceramic sherd. Petrographic analysis of the ceramic sherd indicates the vessel was tempered using a crushed granite porphyry. The orientation of the temper particles and voids parallel to the surface of the vessel suggests the sherd came from a vessel that was thinned by the paddle and anvil method. These ceramic attributes are similar to Numic-Ute-Shoshone ceramics. A sample of juniper seed beads were radiocarbon dated to 890 ± 70 years B.P. (Beta-10696). Burial C is a primary crevice interment of an eleven to twelve year old child. Burial D is a primary crevice interment of an adult. The remains of Burial C and D individuals were recovered during excavation of the rockshelter locality. The original position of the interment of either Burial C or D is not known. Artifacts assumed to be associated with Burials C and D include 51 lignite disc beads, 52 complete and twelve fragmentary bone disc beads, 14 tubular bone beads and one juniper seed bead.

The Rockshelter locality (Figure 1) is a small alcove measuring 20 meters (north-south) across the front, and eight meters in depth from the drip line to the back wall. Part of the alcove interior is filled with aeolian and colluvial silty sand deposits reaching a depth of over two meters. The shelter contains two buried intact cultural levels, and Burials C and D. The upper cultural level has yielded over 1000 pieces of chipped stone debitage, three retouched flakes, one preform, one abrading stone, and five Late Prehistoric (tri-notched) projectile points. The recovery of the large number of tiny tertiary biface thinning flakes suggests that tool and projectile point manufacturing or maintenance activities were occurring at this location. Two projectile points from the upper cultural level were made from Obsidian Cliff and Teton Pass obsidian sources, located in the northwestern portion of Wyoming (Dr. Raymond Kunselman, personal communication, 1993). The lower cultural level contains an intact firepit (Feature 3) radiocarbon dating to 1080 $\pm$ 70 years B.P. (Beta-63818). Artifacts recovered in association with Feature 3 include 66 pieces of chipped stone debitage, and burnt and unburnt *Bison* sp. bone. Fill from Feature 3 suggests that sagebrush was burned as fuel and that processing chenopodium or amaranth seeds may have occurred. The firepit also contained fragments of charred and uncharred bone.

SUMMARY AND CONCLUSIONS

Archaeological data gathered at 48CR4001 offers us a glimpse of the hunter-gatherer lifeway between 780 and 1280 years ago. Archaeological data recovered from Espy-Cornwell contains significant information addressing many regional and local archaeological research topics.

The Joseph Cramer Grant supported the site's chronology, and filled a temporal data gap between the age of the lower *Bison* bone level and Burial B. These dates helped support data suggesting a continual use of the site over 500 years. In addition, important data about the use of Features 1 and 2 have resulted. The grant also helped purchase riker mounts so that all of the chipped stone and ornamental artifacts recovered at the site may be adequately preserved and protected.

Archaeological investigations at Espy-Cornwell have occurred for over ten years. Besides the support of the Joseph Cramer Grant, excavation, data recovery and the on- going research at the Espy-Cornwell site is the product of the strong archaeological community in Wyoming and the Rocky Mountain Region. Archaeological investigations at 48CR4001 have been supported by many members of the professional and amateur archaeological community, the Wyoming State Archaeologist's Office, the Wyoming Archaeological Society, Western Wyoming College Archaeological Services, the Wyoming Bureau of Land Management, and the National Park Service Rocky Mountain Regional Office.

The final season of archaeological excavations at the site will be in 1994. The laboratory research and archaeological interpretation of the data for development of a final manuscript have begun. The author would like to thank all of the individuals who helped and continue to support my archaeological efforts. In addition, I would especially like to thank the Espy family in Rawlins, Wyoming for allowing my access to their land.

THANKS AGAIN FOR YOUR SUPPORT

James A. Truesdale
825 Center Street
Rock Springs, WY 82901

THE MOUNTAIN MEADOW RANCH BURIAL FROM SOUTHEASTERN WYOMING

by
James A. Truesdale and George W. Gill

ABSTRACT

Salvage excavations of a Late Prehistoric burial found in a small overhang of a sandstone outcrop in southeastern Wyoming produced remains of an old-aged female Native American Indian of unknown biological affinities. Previous excavations by collectors recovered 86 tubular bone beads, eight corner-notched projectile points and one fresh water bivalve shell pendant. The Late Prehistoric age is suggested by the projectile points found in association with the human remains and their similarity to points recovered at sites with dated assemblages.

INTRODUCTION

On July 5, 1986, the senior author was directed to the burial site location described here by Rick Wilson of Laramie, Wyoming. The burial location is on the 7.5' U.S.G.S. Sodergreen Lake, Wyoming quadrangle map. This site, called the Mountain Meadow Ranch Burial (48AB459), is located in the extreme south-central portion of Albany County, Wyoming, at an elevation of 1970 meters (6460 feet) above mean sea level (AMSL) (Figure 1). The human remains were located on sandstone outcrops 366 meters (1200 feet) south of the Laramie River. The outcrops are 4.8 kilometers (3.0 miles) northeast of Woods Landing, Wyoming. The burial site is situated at the base of the northeast end of Jelm Mountain.

Human bones were exposed on the ground surface. A small pile of sandstone covered the top of the skull. It appeared that additional human bone could be located beneath the small pile of sandstone rocks. A decision to salvage the interment was made based on criteria enumerated in an earlier report (Truesdale et al. 1986), and at the request of the landowner. On July 21, 1986, an archaeological recovery team consisting of the authors plus Dr. Mark E. Miller (Wyoming State Archaeologist), David Eckles (Office of the Wyoming State Archaeologist), Lori Tigner-Wise and Christi Gillam excavated the interment.

BURIAL DESCRIPTION

The burial was in a small overhang of a sandstone outcrop (Figure 2). The human remains had been covered with several small sandstone slabs by the collectors who discovered the grave. In order to describe the original context of the burial, the authors had to rely first on discussions with the collectors and their records; and second, on our own archaeological excavation records.

Initial disturbance: The initial disturbance by collectors occurred on November 20, 1984. According to the collectors, the skull was partially exposed and phalanges were eroding downslope to the south. The human remains were not covered by sandstone slabs. While uncovering the human remains, they noted the bones were in the surface root zone and small rootlets had intertwined with the remains. The human remains were articulated from the skull to the pelvic region with little displacement of smaller bones (phalanges, rib fragments, carpals). The leg and foot bones were absent. The collectors located eight corner-notched projectile points situated above the sternum, and 86 tubular bone beads around the neck. A fresh water bivalve shell pendant was located on the sternum. All of the beads, projectile points and shell pendant were collected. The skeletal remains were placed back under the overhang, and

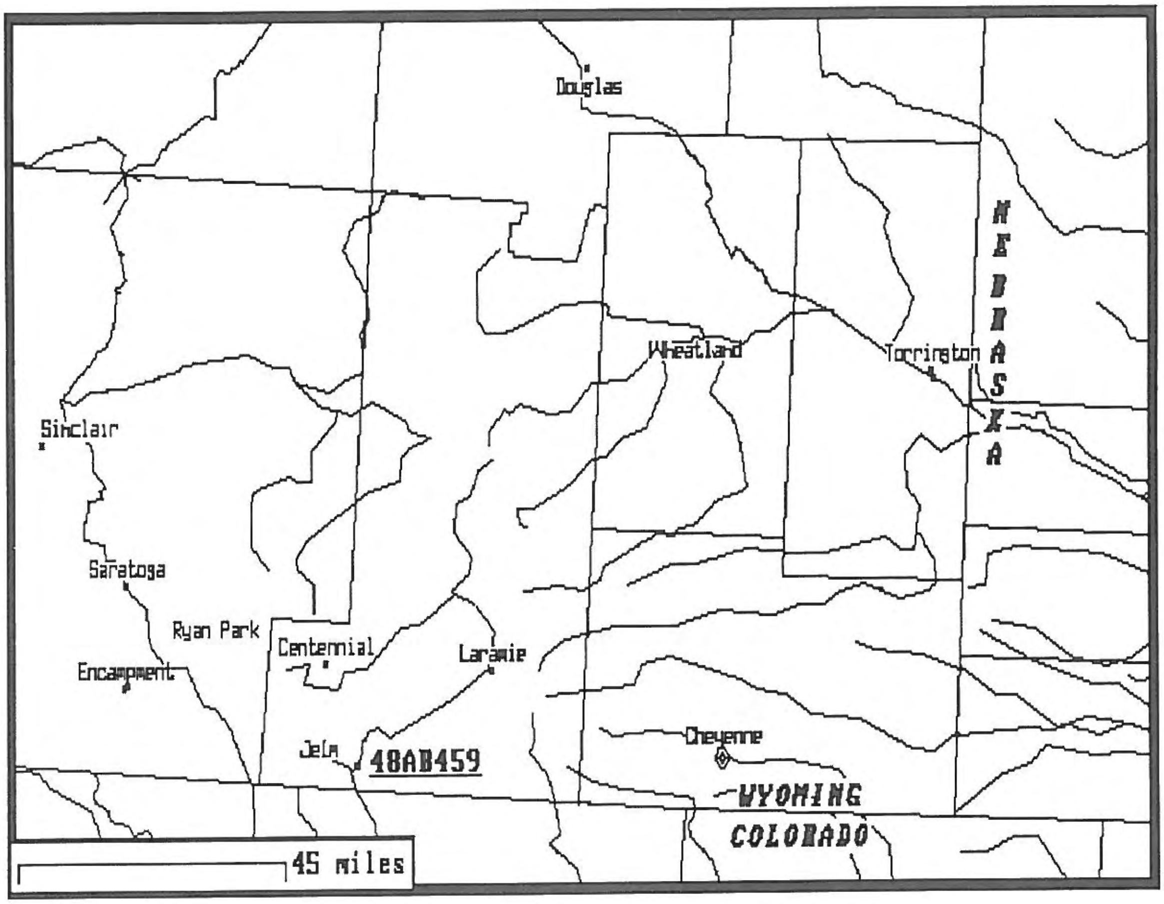

Figure 1: Location of the Mountain Meadow Ranch Burial (48AB459-HR0136).

then covered with sand and several small sandstone slabs to stabilize the human remains. The slabs positioned over the disturbed human remains by the collectors are shown (Figure 2).

Excavations: The excavation crew first removed the small sandstone slabs placed over the human remains by the collectors. They then set up a one meter by one meter grid and an elevation control datum at 104° and 205 centimeters from the southwest corner of the mapping grid. Elevations were taken periodically throughout the excavation.

Sediments around the human remains consisted of loosely compacted tan silty sand and small pieces of sandstone colluvial gravels. The excavations showed not all of the human remains had been disturbed by the collectors. Undisturbed deposits occurred approximately 15 centimeters below the surface. In and around the undisturbed human remains, the sediments consisted of a moderately compacted light brown to tan silty sand with heavy amounts of rootlets. Below these levels was white to tan sandstone bedrock.

Figure 2: Location of 48AB459, Mountain Meadow Ranch Burial, in small overhang of sandstone outcrop.

After the small sandstone slabs on the surface were removed, the sediments were brushed from around the bones exposing the skeleton (Figure 3). Several clusters of bone could be recognized. Most arm bones had been placed on top of all other bones. A concentration of 46 human bones consisting of ribs, phalanges and carpals were situated toward the back of the overhang and at the bottom of the bone pile (Figure 4). The skeleton was mostly disarticulated, except for the vertebral column from the fifth cervical vertebra to the eleventh thoracic vertebra.

Additional artifacts were found during screening of the enclosing sediments. These included seven tubular bone beads and 18 shell fragments. The shell fragments are probably from the bivalve shell pendant.

Projectile point assemblage: Eight whole or partial projectile points were found in association with the Mountain Meadow Ranch Burial (Figure 5). The projectile points recovered from the burial are a Late Prehistoric period type. These points are characterized by corner-notches that create distinctive oblique shoulders and expanded stems. The tips are very sharp. Most of the blade edges are recurvate with one being straight and the other convex. All blade edges are delicately serrated. The bases are slightly convex to straight with seven (87.5%) convex.

Tool stone material types appear to be from two sources and are similar to material types recorded from the projectile point assemblage at the nearby Willow Springs Bison Pound (48AB-130). The Willow Springs Bison Pound is located 24.1 kilometers (15 miles) southeast of the Mountain Meadow Ranch Burial. The predominate material type at the Mountain Meadow Ranch Burial (87.5%) appears to be from source locations in North Park area of northern Colorado. Bupp (1981:91) states that this source is hypothetical. However, it is characterized by several grades of clear to white, pink with round inclusions, clear dendritic, grey, carmel, chalcedony and mottled pink chert. A quarry site (5GA1172) has been recently investigated and those color grades of chert were recorded (Metcalf et al. 1991). The second raw material represented at the Mountain Meadow Ranch Burial is similar to materials from a

Figure 3: Mountain Meadow Ranch Burial as found by excavation crew, following removal of sandstone slabs.

quarry near Marshall, Wyoming, located in the northeast portion of the Shirley Basin (Bupp 1981:89). This source from Marshall is characterized by red to brown, pink to purple, brown and grey dendritic opaque cherts (Bupp 1981:89).

All of the Mountain Meadow Ranch Burial points are morphologically similar. Studies using point attributes and measurements to make intra- and inter-assemblage comparisons have been performed by Eckles (1982a, 1982b). These attributes and measurements were used in the analysis of the projectile point assemblage from the Mountain Meadow Ranch Burial. Additional studies comparing intra- and intersite assemblage variation in projectile point morphology have emphasized the measurement of certain attributes hypothesized as significant in finding morphological similarities and differences (Ahler 1971; Benfer 1967; Bupp 1981; Calabrese 1972; Eckles 1982a; Fawcett 1980; Reher and Frison 1980).

Attributes in this analysis include height, width, thickness, blade width, haft (on stem) segment length, haft width, notch width, notch depth, mid blade width, and notch angle. All measurements were taken with metric calipers. Metric and non-metric data and raw material type of each point are presented (Table 1).

Visually and statistically, the Mountain Meadow Ranch Burial point assemblage is quite homogeneous. Similar corner-notched points have been found in dated archeological contexts in Wyoming and Colorado (Benedict 1975a, 1975b; Bupp 1981; Eckles 1982a, 1982b, 1983, 1987; Frison 1991, personal communication 1993; Grey 1963; Irwin-Williams and Irwin 1966; McCracken 1978; Moe and Todd 1983; Mulloy and Steege 1967; Reher 1971; Truesdale 1986; Wood 1967). The projectile point attribute data were obtained from most of the assemblages, whether from analysis of materials in hand or from published sources (Eckles 1982b).

The data show a wide range of variation between site assemblages, but a range of variation in which each appears to overlap the others. The assemblages that are most similar to the Mountain Meadow Ranch Burial include Robbers Gulch (Eckles 1982a), Willow Springs (Bupp 1981), Elk Mountain (Eckles 1983), Scratching Deer (Benedict 1975b), Bluegrass Creek (Eckles 1987), and Sweetwater Rocks (Truesdale 1986). The Robbers Gulch and Willow Springs assemblages are the largest and have the widest range of variation. The Elk Mountain, Scratching Deer, Bluegrass Creek and

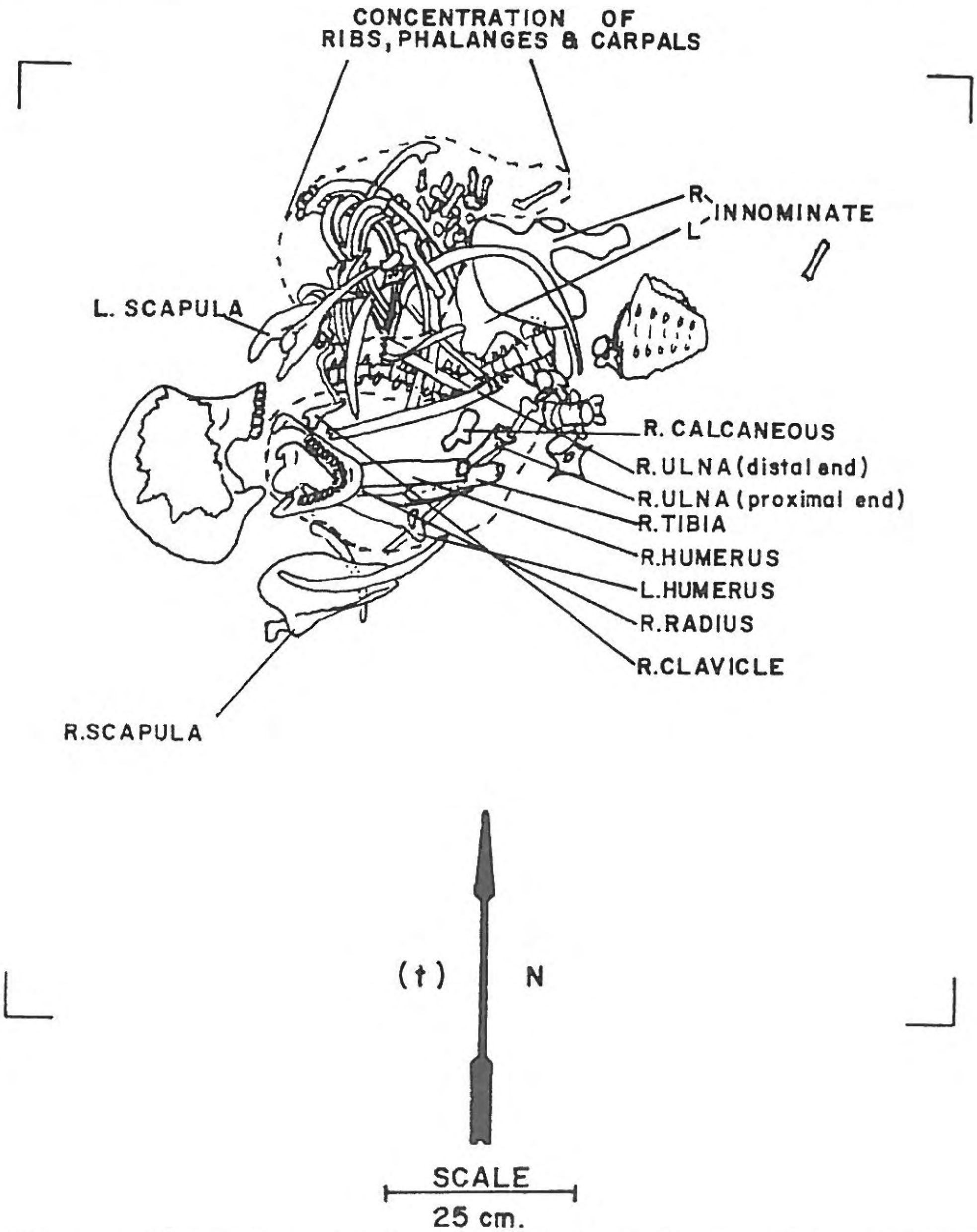

Figure 4: Plan view of Mountain Meadow Ranch Burial, showing location of two concentrations of bone with articulated vertebral column between concentrations.

48FR2230 assemblages are the most similar to the Mountain Meadow Ranch Burial in all categories. All of the northwestern Wyoming assemblages are larger than the Mountain Meadow Ranch Burial and the southern Wyoming and Colorado assemblages.

The above discussion was intended to establish a range of morphological variation into which the Mountain Meadow Ranch Burial assemblage might fit. No attempt was made to control for site function or to find significant parameters that would suggest the Mountain

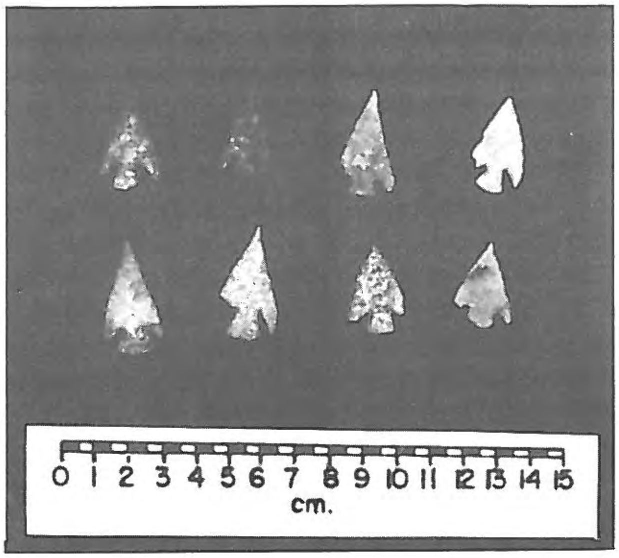

Figure 5: Projectile points recovered by collectors from Mountain Meadow Ranch Burial.

Meadow Ranch Burial point types are necessarily culturally related to any other assemblage. These data do show that there are general morphological similarities over a broad area. Frison et al. (1974:109-110) have emphasized that there seems to be interregional variations in artifact styles in the archeological record and that certain projectile points do appear to be characteristic of certain areas in the Northwestern Plains. Without posing the question of style versus function in terms of culture, it may be possible to deal with similar projectile point types in terms of stratigraphic typologies (Frison et al. 1974:111).

The data presented above may then be seen as indicating typological similarities, or similar ranges of variation across a large area. Thus, we would conclude the Mountain Meadow Ranch Burial assemblage is similar to most of the dated assemblages compared and that we therefore make a case for this assemblage falling into a range of possible dates. For the Mountain Meadow Ranch Burial assemblage, the most reliable information from other dated assemblages suggest that a range of 1300 to 1000 years B.P. is possible. This is consistent with early to middle Late Prehistoric dates assigned to corner-notch points in Wyoming by Frison et al. (1974:120; see also Frison 1991).

Tubular bone bead assemblage: Ninety-three tubular bone beads were recovered in association with the human remains at the Mountain Meadow Ranch Burial (Figure 6). The bone beads can be sorted into two morphological groups. The first group of beads are long, large tubular beads that range in length from 33.5 to 21.2 millimeters and widths of 13.1 to 5.2 millimeters and 9.7 to 4.6 millimeters. Measures of maximum width and diameter were taken perpendicular to each other giving an accurate description of the oblong diameters of each specific bead. The second group of beads consisted of small to tiny bone tubes that were less than 2.8 millimeters long and 2.5 millimeters wide. These tiny bone beads also had one to three incised grooves occurring around the exterior surface of the bead.

The tubular bone beads recovered at the site are similar morphologically to other bone bead assemblages from sites in Wyoming. These sites include the Espy-Cornwell site (Truesdale 1984); Mummy Cave (McCracken 1978); Pictograph Caves (Mulloy 1958:45); Spring Creek Cave (Frison 1965); John Gale site (Brox and Miller 1974); Big Goose Creek site (Frison et al. 1978); Hagen site (Mulloy 1942); Sand Creek Burial (Scoggin 1978) and Stone Fence Burial (Miller and Gill 1980). All these sites have small samples except Espy-Cornwell. Espy-Cornwell contains over 1000 tubular bone beads associated with a prehistoric American Indian infant burial that has been radiocarbon dated at 890 $\pm$ 70 years B.P. (Beta-10696) (Truesdale 1984).

A controlled experiment was performed on a sample of the Espy-Cornwell bone bead assemblage to define species of origin (Lessard 1985). This statistical analysis was inconclusive, probably due to aspects of the T-tests used and data extraction technique problems. A graphic analysis however suggested that certain bone beads from the burial appear to have been made from white-tailed jackrabbit (*Lepus townsendii*)

Table 1: Mountain Meadow Ranch Burial, projectile point attributes.

ATTRIBUTE / POINT	1	2	3	4	5	6	7	8
Raw Material	reddish-pink opaque mottle chert	brown mottle chert (Hartville like)	gray chert with white patination	milky white chert	yellowish tan (trans-lucent) chert with black dendrites	yellowish tan (trans-lucent) chert	yellowish tan (trans-lucent) chert with black den-drites	yellowish tan (translu-cent) chert with black dendrites
Broken	—	—	Ear	Ear	—	Ear	—	Ear
Reworked	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Serrated Blade	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Base Shape	Convex	Convex	Straight	Convex	Convex	Convex	Convex	Convex
Length	28.1	25.6	31.5	29.1	35.0	34.5	21.5	25.7
Width	17.8	16.2	17.0	16.0	18.3	18.0	12.0	17.7
Thickness	2.9	2.5	3.2	3.0	2.8	3.2	2.8	3.2
Blade Length	26.9	25.0	30.6	27.2	31.3	32.6	23.6	24.9
Blade Width	17.8	16.2	17.0	16.0	18.3	18.0	12.0	17.7
Haft Length	7.6	7.1	5.8	8.3	7.3	9.5	6.5	5.6
Haft Width	7.9	6.8	8.4	8.2	11.7	10.3	7.8	7.8
Notch Width	4.1	4.4	4.9	3.2	5.5	4.9	4.1	5.9
Notch Depth	6.7	5.7	4.9	6.2	5.9	7.3	4.8	3.6
Neck Width	—	—	—	—	—	—	—	—
Mid-blade Width	13.7	11.8	10.7	12.0	12.8	14.8	13.4	11.0
Notch Angle	31°	17°	25°	17°	33°	17°	31°	32°

skeletal elements (Lessard 1985). This does not mean that the beads from the Mountain Meadow Ranch Burial were solely made from rabbit, only that there is that possibility.

Bone beads have been recovered in sites ranging from 10,000 years B.P. to Historic times. The morphologic characteristics of the bone beads recovered from the Mountain Meadow Ranch Burial are similar to all the above mentioned sites with bone bead assemblages. The data show there are general morphological similarities over broad temporal and spatial boundaries. Therefore there is a low probability in being able to fit the Mountain Meadow Ranch Burial into a dated cultural horizon or range based on the bone bead assemblage. However, using Lessard's (1985) study mentioned earlier, it may be possible to address hunter-gatherer adaptation through specific faunal resources available that are being used in various lifeway activities (food consumption, clothing, tool or ornament manufacture).

Shell pendant: One complete side of a fresh water bivalve muscle shell was recovered in association with the Mountain Meadow Ranch Burial (Figure 7). The shell had a hole drilled on one end of the dorsal side and showed eight grooves incised on the interior ventral edge of the shell. The precise taxon of this shell cannot be identified due to inability to acquire the specimen from the collector for analysis. However, several sites in Wyoming have produced fresh water shell in their assemblages. These sites are Espy-Cornwell (Truesdale 1984); River Bend (McKee 1988); Robber's Gulch (Martindale and Gill 1983); and Butler-Rissler (Miller and Waitkus 1989). The shells from the Butler-Rissler site have been identified as *Lampsilis* cf. *ovata vertricosa* and may have their origin in the North Platte River and its tributaries.

It is possible that the occurrence of shell materials found in prehistoric site artifact assemblages may reflect several ideas about hunter-gatherer adaptation and mobility as do bone artifacts. The occurrence of shell may show possible subsistence and settlement activities close to major rivers with fresh water bivalve shell resources available. It also may suggest

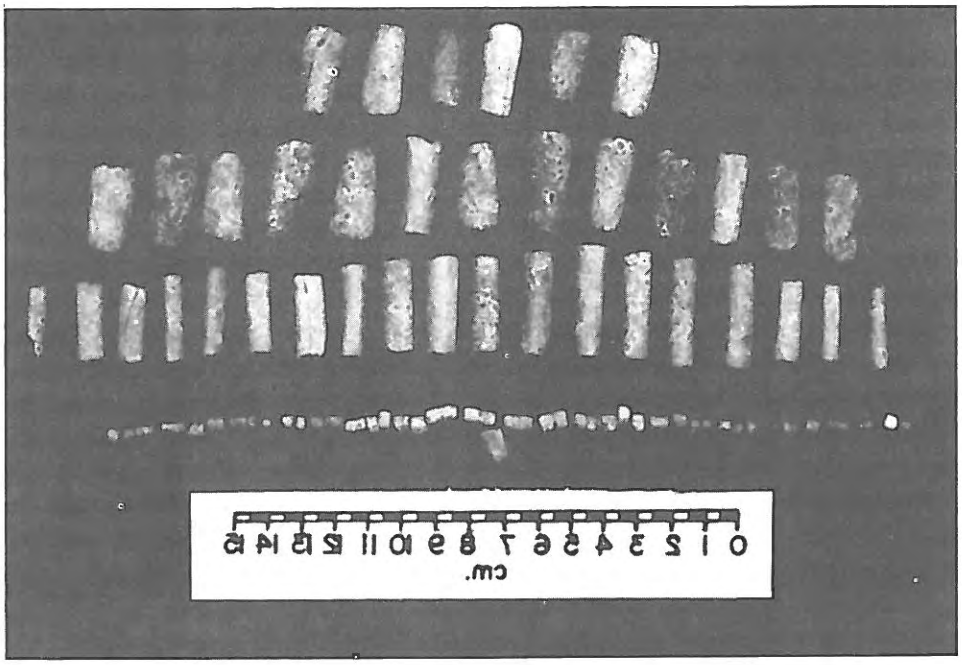

Figure 6: Tubular bone beads recovered by collectors from the Mountain Meadow Ranch Burial.

the possibility of acquiring the shell through trade or trade networks with prehistoric groups who live along such water courses.

Human skeleton: The Mountain Meadow Ranch Burial (University of Wyoming Anthropology Department human remains number HR136) is that of an old-aged Native American Indian female. These determinations have been made from the nearly complete mandible and skull (Figures 8 and 9), a nearly complete pelvis, a complete left humerus and a complete left radius and ulna. Other post-cranial bones present, but less pertinent to the analysis, are a fragmentary right humerus, fragmentary right radius and ulna, distal ends of the right tibia and right fibula, all ribs, complete sternum, both scapulae and clavicles, all vertebrae, six right and two left carpals, eight metacarpals, all proximal and medial hand phalanges and five distal phalanges, right calcaneus, right cuboid, left navicular, right first cuneiform, both third cuneiforms, three metatarsals and four phalanges of the feet.

Sex determination was made by examination of diagnostic features of the skull and pelvis (Bass 1987; Krogman and İşcan 1986) and observation of a few features of the long bones such as robusticity. Cranial features, such as reduced brow and mastoid, a sharp orbital margin, and a gracile nuchal line, all point strongly to female. The wide sciatic notch and wide subpubic angle also support the female assessment. Furthermore, the vertical diameter of the head of the humerus is 35.0 millimeters, which fits well into the female size range. Age has been set at 50-69 years based upon Hrdlicka's scale of attrition of the dentition (Ubelaker 1989), the deeply cupped distal ribs (İşcan et al. 1985), and the advanced stages of cranial suture closure (Krogman and İşcan 1986).

Race is clearly Native American Indian as evidenced by the simometer method (Gill et al.

Figure 7: Carved shell pendent recovered by collectors from Mountain Meadow Ranch Burial.

1988) which places the cranium well into the Native American Indian sector with 97% accuracy. This determination is consistent with other aspects of cranial and facial morphology (e.g., cranial profile, shape of nose, zygomaticomaxillary suture form, tooth form, tooth wear, etc.), and the cultural context of the human remains.

Living stature has been calculated from the complete radius recovered. This stature is 153.0 $\pm$ 4.24 centimeters or approximately five feet, and one-quarter inch, according to the Trotter and Gleser (1958) formula for female Caucasoids. By the time of death at approximately 60 years of age, the stature had probably decreased to something under five feet.

Since Neumann's formulae for female Native North American Indians (Krogman and İşcan 1986) do not include long bones other than the femur and tibia, these formulae, could not be used (both of these bones are missing from the specimen). The formulae of Genoves (1967) developed from a skeletal series of short-statured Central Mexican Indians, are also sometimes used by human osteologists working with Native North American Indians, but these produce particularly unreliable results among the taller-statured Plains Indians of the Northwestern Plains. Several stature studies conducted on Northwestern Plains skeletal series have over the years confirmed this (Gill 1976; Gill and Glass 1985). Therefore, the Genoves formulae have not been used by osteologists in this region. In fact, according to Richard Jantz (personal communication 1993), the Genoves formulae probably should not be used at all outside of central Mexico. For the time being, the best formulae for estimating stature of Northern Plains Indian females, especially when only arm bones are present, unfortunately remain the Caucasoid female formulae of Trotter and Gleser (1958).

Pathologically, the Mountain Meadow female reveals little difficulty. The long bones show no sign of injury or disease, and neither does the skull or facial skeleton, except dental caries and abscesses. A very slight lipping can be detected on the vertebral centra. Such cases of mild osteoarthritis are to be expected on individuals of her chronological age.

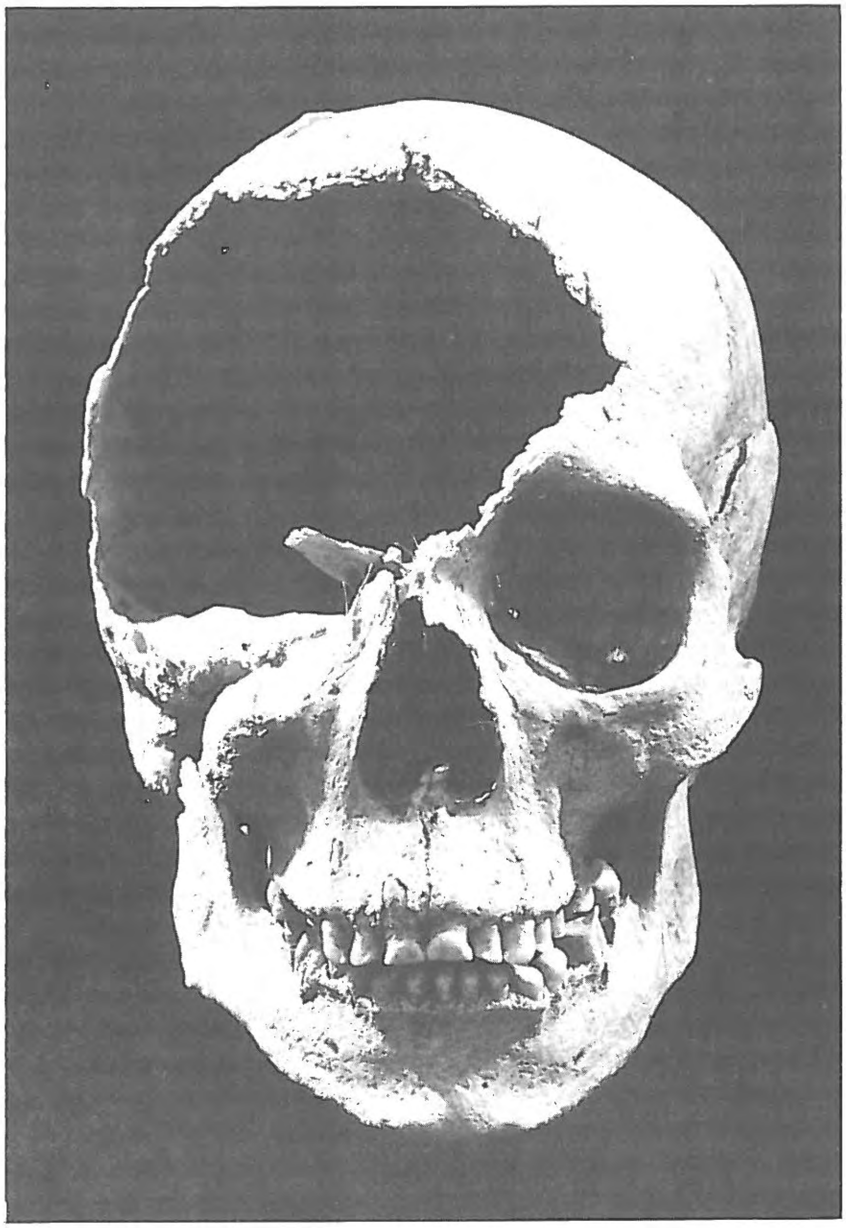

Figure 8: Frontal view of Mountain Meadow Ranch Burial cranium.

abscessing at the time of death, as was the right mandibular M1. Other than these few problems created by heavy mastication and resulting dental attrition, no dental difficulties were noted.

Results of the metric analysis of the Mountain Meadow Ranch Burial cranium are provided (Appendix One), as well as tabulation of certain discrete, non-metric traits shown (Appendix Two). Data in these tables were gathered by means of standard anthropometric and arthroscopic techniques. See Gill (1971) and Gill et al. (1988) for procedural details or definitions.

All indices are calculated according to Bass (1987). The few measurements not defined by Bass (1987) or Gill et al. (1988), such as the foramen magnum length, bimaxillary breadth and bimaxillary subtense, may be found in Howells (1973). Prosthion is determined according to Howells and is not used in the measurement of upper facial height that is used for the calculation of upper facial index. Nasion-alveolare is used instead for the upper facial index according to Bass (1987).

Most teeth are present for analysis, with only two maxillary and two mandibular teeth missing postmortem (the maxillary right M3 and left PM2, and the mandibular PM2 and M2). None were lost antemortem. One maxillary tooth was carious at the time of death (left M1). It and the occluding mandibular M1 were both

Examination of continuous non-metric traits such as orbital shape, palatal form, supraorbital ridge size, and nasal sill development shows a pattern of traits typical for southeastern Wyoming. The orbital form of the Mountain Meadow Ranch Burial specimen is square, while the auditory meatus and palatal forms are elliptic.

The elliptic palatal shape is common to this region from all periods. Chin projection is slight but noticeable. The nasal sill is dull and the nasal spine is small. The cranial height is low. This combination of features is quite common among aboriginal skeletal samples from the later periods throughout Wyoming (Gill 1981).

Biological affinities: The Mountain Meadow skeleton is close metrically to Siouan populations described by Hrdlicka (1927) and the Torrington females of Howells (1938) and Gill (1981). These are Late Prehistoric Plains Indian groups common to eastern Wyoming and the Dakotas. The Mountain Meadow female exhibits a large cranium of medium proportions and high, narrow orbits. These traits are consistent with Siouan metrics. There is less likelihood of affinity with the Red Desert and Shoshonean populations of southwestern Wyoming, which exhibit lower orbits and a smaller cranium.

At present all that can be said about the Mountain Meadow female is that she represents a population with traits of the Dakota Sioux that would later migrate into eastern Wyoming.

SUMMARY AND CONCLUSIONS

The Mountain Meadow Ranch Burial consists of the remains of an old-aged (50-69 years) Native American Indian female of unknown tribal affinities. Associated with this burial were ninety-three tubular bone beads, a fresh water bivalve shell pendant and eight corner-notch projectile points. The projectile points are similar to other radiocarbon dated assemblages from Wyoming that range from 1300 to 1000 years B.P.

First impressions from excavation of the

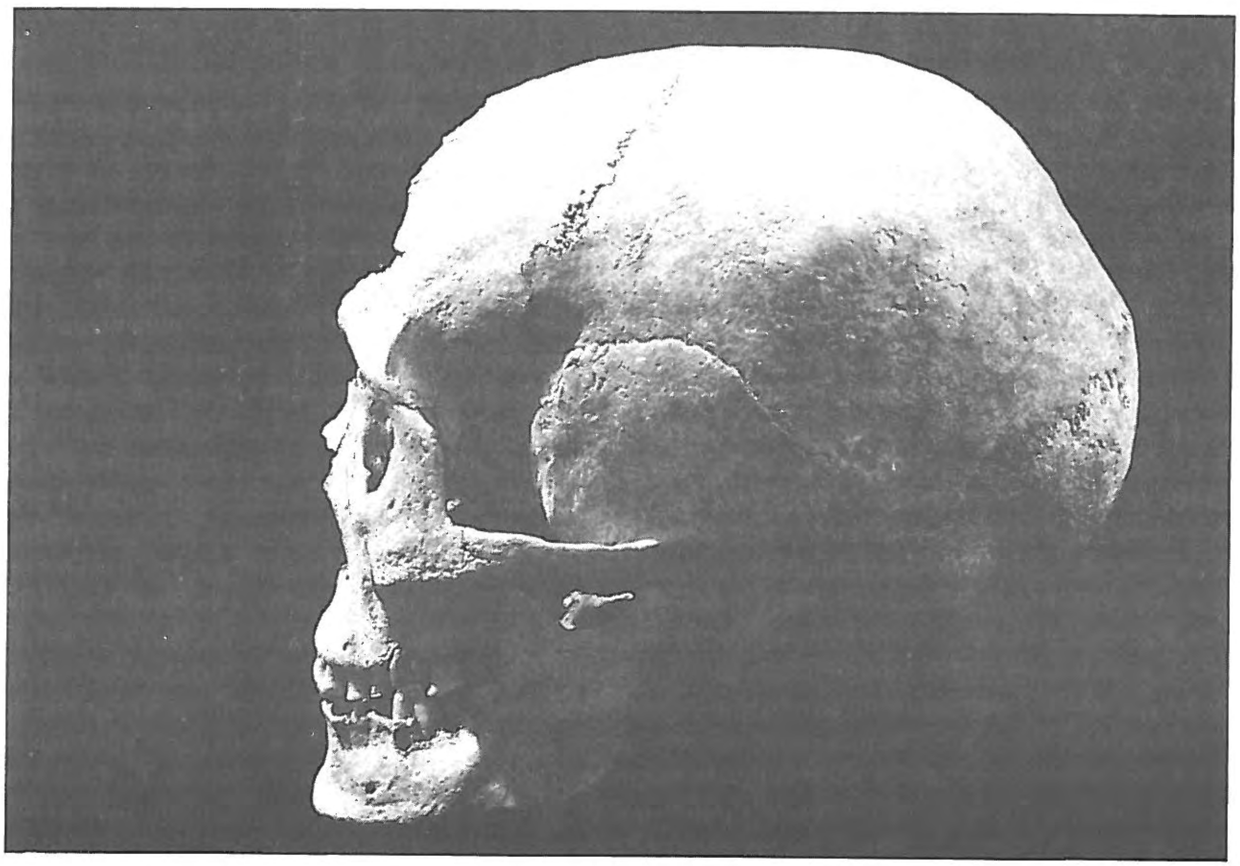

Figure 9: Left lateral view of Mountain Meadow Ranch Burial cranium.

human remains suggested that the burial was a secondary interment or bundle burial. However, after reviewing notes and having conversations with the collectors, the burial is now considered to have more likely been a primary interment situated under the overhang.

The human remains were at once fully articulated and extended, on the back, with the head to the west and face pointing north. To prove this, taphonomic features were critically reviewed. These features include the articulated vertebral column and its apparent *in situ* context, the placement of the already mentioned bone concentrations, and the recovery of several foot bones located east of the main grid, and the appearance of weathered (bleached white) bone found below the surface. The Mountain Meadow Ranch Burial appears to show a relatively high number of complete bones with some articulation, from the skull to the pelvic region.

Truesdale (1987) studied Wyoming burials and their attributes and found that two types of disposal vehicle, a pit (38.2%) and crevices (8.8%), were used in the Late Prehistoric period. Truesdale (1987) also noted an increase in attribute variables used (degree of flex, position of arms, rotation of head, disposition and associated artifacts) in the Late Prehistoric from the previous Archaic. This increase was hypothesized to be the result of increased mobility of people during this time, subsequent cultural contacts and the exchange of ideological and mythical interpretations of the afterlife. Other burials from Wyoming show similarities to the Mountain Meadow Ranch Burial with regard not only to biological affinities, but form and location of interment, and articulation and position of human remains (Rickey 1984; Truesdale 1984, 1987; Truesdale and Gill 1987). The artifacts associated with this burial are not unusual, especially when compared to certain other burials from this region that have yielded such abundant quantities of material (Rickey 1984; Truesdale 1984).

On the Plains, subsistence depends largely upon hunting and gathering with some occurrences of horticulture, which usually require migration from place to place at different seasons of the year. The local group consists typically of several families who habitually camp together. This community or band then becomes the focus of associative life. Every member is ordinarily acquainted more or less intimately with every other member, and has learned through association to adapt his or her behavior to that of other fellow members. This results in the group being bound together by a complex network of interpersonal relationships. Binford (1971) notes that mortuary rituals vary significantly with the organizational complexity of the society as measured by different forms of subsistence practices. Thus, the artifacts and special treatment of the Mountain Meadow Ranch female may be correlated with her sex, age, and her relationship (status and role) within the group's social environment. Environmental factors such as the season also may affect the vehicle of disposal used (Truesdale 1987).

The interment of the Mountain Meadow Burial may reflect the settlement and subsistence activities (adaptation) of the individual's band, contact with trade networks or groups located along river corridors such as the Laramie or North Platte rivers, and her status and role within the social structure. Social dimensions of mortuary practices among hunters and gatherers during the Late Prehistoric period may also be involved.

Thus the more data that are received on burials from Wyoming, Colorado and adjacent areas in Utah, Montana, and Nebraska, the greater the possibility is of eventual emergence of significant patterns in mortuary practices and social life. We hope these patterns may reflect previously unknown activities of hunter and gatherers on the High Plains and intermountain basins.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to several individuals who participated in various stages of this project. Rick Wilson of

Laramie, Wyoming showed the location of the burial to the senior author. Mr. Wilson also allowed the artifact collection to be analyzed and photographed. Dr. Mark Miller (Wyoming State Archeologist), David G. Eckles (Director of Archeological Survey, Office of the Wyoming State Archeologist), Christi Gillam and Lori Tigner-Wise assisted in the excavation. Lori Tigner-Wise also assisted with the osteological analysis. Rick Blatchley took photographs of the human remains. A special thanks is due to Amos Bovee who owns the Mountain Meadow Ranch and allowed us access to this important archeological find.

REFERENCES CITED

Ahler, Stanley A.
1971 *Projectile Point Form and Function at Rogers Shelter, Missouri.* Missouri Archeological Society, Research Series 8.

Bass, William M.
1987 *Human Osteology: A Laboratory and Field Manual.* Missouri Archaeological Society, Special Publication 2.

Benedict, James B.
1975a The Murray Site: A Late Prehistoric Game Drive System in the Colorado Rocky Mountains. *Plains Anthropologist* 20(70):267-278.
1975b Scratching Deer: A Late Prehistoric Campsite in the Green Lakes Valley, Colorado. *Plains Anthropologist* 20(70):267-278.

Benfer, Robert A.
1967 A Design for the Study of Archeological Characteristics. *American Anthropologist* 69:719-230.

Binford, Lewis R.
1971 Mortuary Practices: Their Study and Their Potential. *American Antiquity* 36(3):6-29.

Brox, George, and Mark E. Miller
1974 The John Gale Site 48CR303: A Preliminary Report. *Wyoming Archaeologist* 17:13-26.

Bupp, Susan I.
1981 *The Willow Springs Bison Pound 48AB130.* Unpublished Master of Arts thesis, Department of Anthropology, University of Wyoming, Laramie.

Calabrese, F. A.
1972 *Cross Ranch: A Study of Variability in a Stable Cultural Tradition.* Plains Anthropologist Memoir 9.

Eckles, David G.
1982a *A Cultural Resource Survey Along the Bosler Junction to Wheatland Road in Platte County, Wyoming.* Submitted to Wyoming Highway Department. Copies available from Office of the Wyoming State Archaeologist, Laramie.
1982b The Robber's Gulch Burials (48CR3595): The Projectile Point Assemblage. Paper presented at the 40th annual Plains Anthropological Conference, Rapid City, South Dakota.
1983 Analysis of Late Prehistoric Corner-notched Projectile Points, in *The Bates Hole Site, 48CR997: A Stratified Prehistoric Site, Carbon County, Wyoming.* (Jeanne M. Moe and Sandra A. Todd, eds.). Submitted to Wyoming Highway Department. Copies available from Office of the Wyoming State Archaeologist, Laramie.
1987 *Results of a Cultural Resource Survey and Construction Monitoring Along the Bosler Junction to Wheatland Road in Platte County, Wyoming.* Submitted to Wyoming Highway Department. Copies available from Office of the Wyoming State Archaeologist, Laramie.

Fawcett, William B.
1980 *Projectile Point Variability in Late Prehistoric Sites on the Northwest-*

ern Plains. Unpublished Master of Arts thesis, Department of Anthropology, University of Wyoming, Laramie.

Frison, George C.
1965 Spring Creek Cave, Wyoming. *American Antiquity* 31(1):81-94.
1991 *Prehistoric Hunters of the High Plains*. Second edition. Academic Press, New York.

Frison, George C., Michael Wilson, and Diane Wilson
1974 The Holocene Stratigraphic Archaeology of Wyoming: An Introduction. *Geological Survey of Wyoming, Report of Investigations* 10:108-127.

Frison, George C., Michael Wilson, and Danny N. Walker
1978 *The Big Goose Creek Site: Bison Procurement and Faunal Analysis*. Occasional Papers on Wyoming Archaeology 1.

Genoves, Santiago
1967 Proportionality of the Long Bones and Their Relation to Stature Among Mesoamericans. *American Journal of Physical Anthropology* 26:67-77.

Gill, George W.
1971 *The Prehistoric Inhabitants of Northern Coastal Nayarit: Skeletal Analysis and Description of Burials*. Unpublished Ph.D. dissertation, Department of Anthropology, University of Kansas, Lawrence.
1976 Two Mummies From the Pitchfork Rock Shelter in Northwestern Wyoming. *Plains Anthropologist* 21(74):301-310.
1981 Human Skeletal Populations of the Northwestern Plains: A Preliminary Analysis. *Plains Anthropologist Memoir* 17:57-90.

Gill, George W., and Susan Lynne Glass
1985 The Utility of Stature Formulae in Racial Identification. Paper presented at the 37th annual meeting of the American Academy of Forensic Sciences, Las Vegas, Nevada.

Gill, George W., Susan S. Hughes, Suzanne M. Bennett, and B. Miles Gilbert
1988 Racial Identification From the Midfacial Skeleton with Special Reference to American Indians and Whites. *Journal of Forensic Sciences* 33(1):92-99.

Grey, Donald C.
1963 The Turk Burial Site, 48WA301, Washakie County, Wyoming. *Plains Anthropologist* 8(20):98-102.

Howells, William M.
1938 Crania From Wyoming Resembling "Minnesota Man." *American Antiquity* 3(4):318-326.
1973 *Cranial Variation in Man*. Papers, Peabody Museum of Archaeology and Ethnology 67.

Hrdlicka, Alex
1927 Catalogue of Human Crania in the United States National Museum Collection. *Proceedings, United States National Museum* 69(5):1-127.

Irwin-Williams, C., and Henry J. Irwin
1966 *Excavations at Magic Mountain: A Diachronic Study of Plains-Southwest Relations*. Proceedings, Denver Museum of Natural History 12.

Iscan, M. Yasar, Susan R. Loth, and Ronald K. Wright
1985 Age Estimation From the Rib by Phase Analysis: White Females. *Journal of Forensic Sciences* 30(3):853-863.

Krogman, Wilton M., and Yasar M. Iscan
1986 *The Human Skeleton in Forensic Medicine*. Charles C. Thomas, Springfield, Illinois.

Lessard, Tom
1985 A Preliminary Investigation on Species Identification of Bone Beads

from 49CR4001. Manuscript on file, Department of Anthropology, University of Wyoming, Laramie.

McCracken, Harold, (ed.)
1978 *The Mummy Cave Project in Northwestern Wyoming.* Buffalo Bill Historical Center, Cody, Wyoming.

McKee, David F.
1988 *A Faunal Analysis of the River Bend Site (48NA202): Evidence of Protohistoric Subsistence on the Northwest Plains.* Unpublished Master of Arts thesis, Department of Anthropology, University of Wyoming, Laramie.

Martindale, Steven W., and George W. Gill
1983 A Late Prehistoric Killing in Robber's Gulch, Southern Wyoming. Paper presented at the 41st annual meeting, Plains Anthropological Conference, Rapid City, South Dakota.

Metcalf, Michael D., Ron J. Rood, Pat J. O'Brien, and Brent R. Overturf
1991 *Kremmling Chert Procurement in the Middle Park Area, Colorado: 5GA-1144 and 5GA1172.* Submitted to J.F. Sato Associates and Western Area Power Administration. Copies available from Metcalf Archaeological Consultants, Eagle, Colorado.

Miller, Mark E., and George W. Gill
1980 A Late Prehistoric Bundle Burial From Southern Wyoming. *Plains Anthropologist* 25(89):235-246.

Miller, Mark E., and Brian R. Waitkus
1989 The Butler-Rissler Site: Plains Woodland Occupation Along the North Platte River, Wyoming. *Wyoming Archaeologist* 32(1-2):1-38.

Moe, Jeanne M., and Sandra M. Todd
1983 *The Bates Hole Site, 48CR997: A Stratified Prehistoric Site, Carbon County, Wyoming.* Submitted to Wyoming Highway Department. On file, Office of the Wyoming State Archaeologist, Laramie.

Mulloy, William T.
1942 *The Hagen Site.* University of Montana, Publications in Social Sciences 1.
1958 *A Preliminary Historic Outline for the Northwestern Plains.* University of Wyoming, Publications in Science 22(1).

Mulloy, William T., and Louis C. Steege
1967 Continued Archaeological Investigations Along the North Platte River in Eastern Wyoming. *University of Wyoming, Publications in Science* 33(3):169-233.

Reher, Charles A.
1971 *A Survey of Ceramic Sites in Southwestern Wyoming.* Unpublished Master of Arts thesis, Department of Anthropology, University of Wyoming, Laramie.

Reher, Charles A., and George C. Frison
1980 *The Vore Site, 48CK302: A Stratified Buffalo Jump in the Wyoming Black Hills.* Plains Anthropologist Memoir 16.

Rickey, Don G.
1984 *Sage Creek Mountain Historic Indian Burial Artifact Evaluation.* Submitted to Bureau of Land Management, June 5, 1985. Copy in possession of senior author.

Scoggin, William E.
1978 The Sand Creek Burial from Central Wyoming. *Wyoming Archaeologist* 21(3):10-30.

Trotter, M., and G. C. Gleser
1958 A Re-evaluation of Estimation of Stature Based on Measurements of Stature Taken During Life and of Long Bones After Death. *American Journal of Physical Anthropology* 16(1):79-123.

Truesdale, James A.
1984 A Preliminary Report on Excavations at 48CR4001 (The Espy-Cornwell Site). Paper presented at the 42nd annual meeting, Plains Anthropological Conference, Lincoln, Nebraska.
1986 *Wyoming Project PREB-020-2(24), Muddy Gap-Lander Road, M.P. 13.0-23.0, Fremont County; Results of a Class III Cultural Resource Survey and Inventory*. Submitted to Wyoming Highway Department. Copies available from Office of the Wyoming State Archaeologist, Laramie.
1987 A Review of Wyoming Burials and Their Attributes. Paper presented at the 45th annual meeting, Plains Anthropological Conference, Columbia, Missouri.

Truesdale, James A., and George W. Gill
1987 The Bridger Gap Burial From Southwestern Wyoming. *Plains Anthropologist* 32(115):17-28.

Truesdale, James A., George W. Gill, Lori Tigner-Wise, and David G. Eckles
1986 The Mountain Meadow Ranch Burial From Southeastern Wyoming (48AB459-HR136). Paper presented at the 44th annual meeting, Plains Anthropological Conference, Denver, Colorado.

Ubelaker, Douglas H.
1989 *Human Skeletal Remains*. Aldine Publishing Company, Chicago.

Wood, John J.
1967 *Archaeological Investigations in Northeastern Colorado*. Unpublished Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.

APPENDIX ONE: Measurements and indices, human skeleton from Mountain Meadow Ranch Burial. Measurements in millimeters unless noted. ( ) = closely estimated measurement or an index derived from estimated measurements. --- = measurement of trait not available because of missing bone.

LANDMARK	MEASUREMENT	
	RIGHT	LEFT
CRANIAL		
Cranial length	(180)	
Cranial breadth	(136)	
Basion - bregma	126	
Endobasion - nasion	96	
Endobasion - prosthion	91	
Maximum frontal breadth	---	
Minimum frontal breadth	---	
Biarticular breadth	---	
Auricular height	110	
Foramen magnum length	32	
FACIAL		
Nasion - prosthion	61	
Nasion - alveolare	65	
Bizygomatic breadth	(122)	
Nasal height	(46)	
Nasal breadth	26	
L. orbit height	35	

LANDMARK		MEASUREMENT	
	RIGHT		LEFT
L. orbit breadth (maxillofrontal)		39	
Biorbital breadth		—	
Cheek height		23	
Maxillofrontal (interorbital breadth)		—	
Maxillofrontal subtense		—	
Zygoorbital breadth		—	
Zygoorbital subtense		—	
Alpha chord		—	
Alpha subtense		—	
Bimaxillary breadth		—	
Bimaxillary subtense		—	
Porion - nasion		88	
Porion - subnasale		84	
Porion - prosthion		90	
MANDIBULAR			
Symphyseal height		29	
Bigonial diameter		99	
Ascending ramus height		50	
Ascending ramus breadth		29	
Corpal length		67	
Gonial angle		38°	
POSTCRANIAL (maximum length)			
Clavicle	(111)		115
Radius	—		207
Ulna	—		(227)
Humerus	—		260
Femur	—		—
Tibia	—		—
Fibula	—		—
CRANIOFACIAL INDICES			
Cranial index	(75.56)		medium
Cranial module	(147.33)		
Cranial length-height	(70.00)		low medium
Mean basion height	(79.75)		low medium
Upper facial index	(53.28)		medium
Nasal index	(56.52)		broad nose
Orbital index	(89.74)		narrow orbits

APPENDIX TWO: Discrete traits, human cranium from Mountain Meadow Ranch Burial. + = presence of trait. o = absence of trait. - = trait cannot be assessed.

CRANIAL TRAITS	OCCURRENCE	
	Left	Right
Lambdoidal ossicles	+	+
Parietal notch bone	o	+
Coronal ossicle	+	-
Asterion ossicle	o	o
Tympanic dehiscences	o	o
Double anterior condylar canal	o	o
Accessory lesser palatine foramina	+	+

CRANIAL TRAITS	OCCURRENCE		
	Left		Right
Accessory infraorbital foramina	o		o
Supraorbital foramen	-		o
Frontal foramen	-		o
Suture into infraorbital foramen	o		o
Malar foramen	-		+
Fronto-temporal articulation	-		o
Parietal foramen	+		o
Os japonicum	-		o
Frontal groove	-		o
Mandibular torus	o		o
Mylo-hyoid bridge	o		o
Accessory mental foramen	o		o
Epactal ossicle		o	
Inca bone		o	
Sagittal ossicles		+	
Bregmatic bone		o	
Metopic suture		o	
Palatine torus		o	
Rocker mandible		o	
Pharangeal fossa		o	
Superior sagittal sinus - left			

James A. Truesdale
825 Center Street
Rock Springs, Wyoming 82901

George W. Gill
Department of Anthropology
University of Wyoming
Laramie, Wyoming 82071

BOOK REVIEWS

LOGGING THE ROCKIES. By Patricia Langendorf. Spruce Gulch Press, Rome, New York. 1992. 268 pp., photographs. $40.00 (cloth), $22.50 (paper).

While this book it titled "Logging the Rockies," it is actually three different accounts of the author's family history. The first part recalls her father's childhood in Michigan before he moved to Wyoming. It also details her mother's side of the family and their life in Lonetree, Wyoming. The second section describes life in the Medicine Bow logging camps of the early 1900s. The final part of the book deals with the author's life after her family left the logging camps to live in La Porte and Walden, Colorado.

The family history portion is hard to follow as it skips from person to person, but the description of life in Lonetree and Michigan is full of interesting tidbits. Much valuable information can be gleamed from the description. In the preface, the author does say that the many names and family ties are confusing, but that she kept them as simple as possible. Langendorf has strong opinions and leaves little doubt about her political views. As a result, she placed comments that are not relevant to the story in "shaded boxes" so readers can skip them if not interested.

The second part of the book is more valuable as it describes life in the logging camps of southern Wyoming during the early part of this century. The author depends upon interviews with her father and other family members to supplement her memories. While the stories are interesting and informative, they also are colored by her close relationships with the people interviewed. Her high regard for her father is evident in the glowing accounts of his honesty, integrity, and knowledge of logging and fire fighting. However, some people who worked with her father apparently were not held in as high an esteem.

The portion of the book devoted to life in Walden, Colorado should be of interest to people of that area. The workings of the Michigan River Timber Company are discussed, as is life in Walden after World War II. Much information about life in the timber camps can be extracted from the book, but care must be taken to separate fact from the childhood the author wants to remember. The book is easy to read and contains many previously unpublished photographs.

Jim Heid
Medicine Bow National Forest
Laramie, Wyoming 82070

WINDOW IN TIME: THE STORY OF THE DISCOVERY OF THE CASPER SITE. By Roderick D. Laird and illustrated by John T. Gilman. 1992. Jelm Mountain Press, Laramie, Wyoming. 32 pp.

Through the education of our youth may we hope to preserve our history. *Window in Time* will certainly go a long way in this education. According to the cover, the book is "a book of Western history and prehistory." While it does not indicate the age of the readership, this reviewer definitely believes it was written for the juvenile audience, and quite appropriately.

The Casper site was located in a deflating blowout in the sand dunes at the north edge of the city of Casper, Wyoming, near Interstate 25. The site, a Hell Gap cultural complex site, was dated at 10,000 BP. Excavations were conducted in 1971 and 1974 by crews from the University of Wyoming, led by Dr. George Frison, who was at that time the Wyoming State Archaeologist. Frison late published *The Casper Site: A Hell Gap Bison Kill on the High Plains*, a report about the archaeological excavations. Bison were driven into the dune where they were slaughtered and butchered. Material recovered included faunal remains and stone and bone butchering tools.

Laird leads the reader through the discovery of the site, the story of how the hunt may have taken place, and an epilogue. In each section, the excitement can be felt with the colorful language used. And although the point is made that the cultural material was covered back up and the appropriate experts were notified, there is mention of artifact hunters digging in the sand. Perhaps this portion could have been tempered a bit so as not to encourage digging by amateurs.

While the illustrations are appropriate and fit the story like a glove, the overkill of the artist's name displayed on each one is highly distracting. The artist's name is prominent on the cover and title page and becomes annoying on each of the illustrations.

This book should be on the well-used shelf in the room of each inquisitive young mind showing any interest in our ancestor's way of life.

Carolyn M. Buff
1617 Westridge Terrace
Casper, Wyoming 82604