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ANNOUNCEMENTS

The following meeting announcement was received from the Archaeological Society of Alberta, Canada.

> KUNAITAPII "COMING TOGETHER" is the theme of the first joint meeting of the Alberta and Montana Archaeological Societies, May 3-6, 1990 in Waterton Lakes National Park, Alberta, Canada. The two day conference features invited Native and White speakers, including religious leaders, from Alberta, Montana, adjacent states and provinces, and England, discussing archaeological topics of common interest and concern to the two cultures and nations. Areas to be examined from both Native and White perspectives during the two full days of meetings and special programs (May 4 and 5) include The Rights of the Dead, Sacred Objects and Cultural Values; Sacred Geography, Places and Spaces; Medicine Circles, First Peoples, Native Archaeological Themes of International Significance and Interpretative and Management Concerns/Issues.
>
> A field trip led by Native elders and White archaeologists to the Peigan Nation and the Head-Smashed-In Buffalo Jump, Sunday May 6 concludes the conference.
>
> For further information, write:
>
> Kunaitapii
Archaeological Society of Alberta
c/o The Alberta Historical Resources Foundation
102 - 8th Avenue S.E.
Calgary, Alberta
T2G 0K6
CANADA
>
> or phone (403) 297-7320

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ERRATA

These errata should be corrected in the following article:

Gill, George W., and Craig S. Smith, 1989 The Divide Burial from near Wamsutter, Sweetwater County, Wyoming. The Wyoming Archaeologist 32(3-4):61-80.

Page 74, column 1, lines 2 and 3:
"...in placing Euroamericans." should read "...in placing Caucasoids."

Page 74, column 1, lines 5, 6, and 7:
"...(68.5 Euroamerican/Negroid and 6.5 Euroamerican/Native American)..." should read "...(68.5 White/Negro and 6.5 White/Indian)..."

Page 74, column 1, line 8:
"...Euroamerican sector." should read "...White sector."

Page 78, column 1, line 5:
"...The person was..." should read "...He was..."

Page 78, column 1, line 8:
"...The person..." should read "...He was..."

Page 78, column 2, lines 5 and 6:
"...This person was..." should read "...He was a man..."

Page 79, column 2, line 27:
"Giles, E., and D. Elliot" should read "Giles, E., and O. Elliot"

CACHING IN ON STORES: THE EXPEDIENT USE OF CURATED TOOLS

by

Marcel Kornfeld, George C. Frison, and Kaoru Akoshima

ABSTRACT

The McKean site (48CK7) has been important for interpreting Wyoming prehistory since its original excavation in the early 1950s. A recent re-investigation resulted in the recovery of many features, including a cached tool kit. We describe this tool kit and argue that these curated tools were used expediently. The role of such caches in Northwestern High Plains technological organization is discussed and settlement and subsistence strategies are inferred.

INTRODUCTION

The purpose of this paper is to present the analysis of the McKean site tool cache and show how cultural adaptations can be inferred from such features. A recent study of the site (Figure 1) was conducted with the goal of contributing to the debate on Middle Plains Archaic or McKean period (ca. 5000-2500 B.P.) settlement and subsistence strategies. This debate generally concerns mobility patterns, group size and flexibility, foraging/collecting variation, and amount of large game versus other dietary resources of the McKean period populations (Frison 1978; Kornfeld and Todd 1985; Keyser 1986). Analysis of a tool cache recovered at the site provides information about the use of such stores and their integration into the technological system. The nature of the technological system, inferred from the tool cache analysis can contribute to the Middle Plains Archaic settlement and subsistence debate.

We first review the nature of caching behavior, concluding that tool storage is a response to a set of conditions different from those conditions resulting in other types of caching. Turning our attention to caches recovered on the Northwestern High Plains, we review their context and content. The McKean site tool cache is found to have several unique characteristics compared to most other known Plains caches. Third, we describe the general characteristics, geomorphic, and archaeological context of the McKean site cache and present the technological analysis of the stored items. In the last section, we contrast Northwestern High Plains caching behavior to nearby regions and make inferences about hunter-gatherer adaptations during the Mckean Period.

GENERAL ASPECTS OF CACHING

Caches are common features of archaeological sites, but many different kinds of facilities and, by inference, behaviors have been subsumed under this designation. The dictionary defines cache as "a place in which stores of food, supplies, etc., are hidden" and "anything stored or hidden." The implication of this definition is that the hidden items will be recovered for later use. This eliminates the so called "burial caches" from discussion of caching behavior. Burial "caches" are misnomers; the artifacts contained in

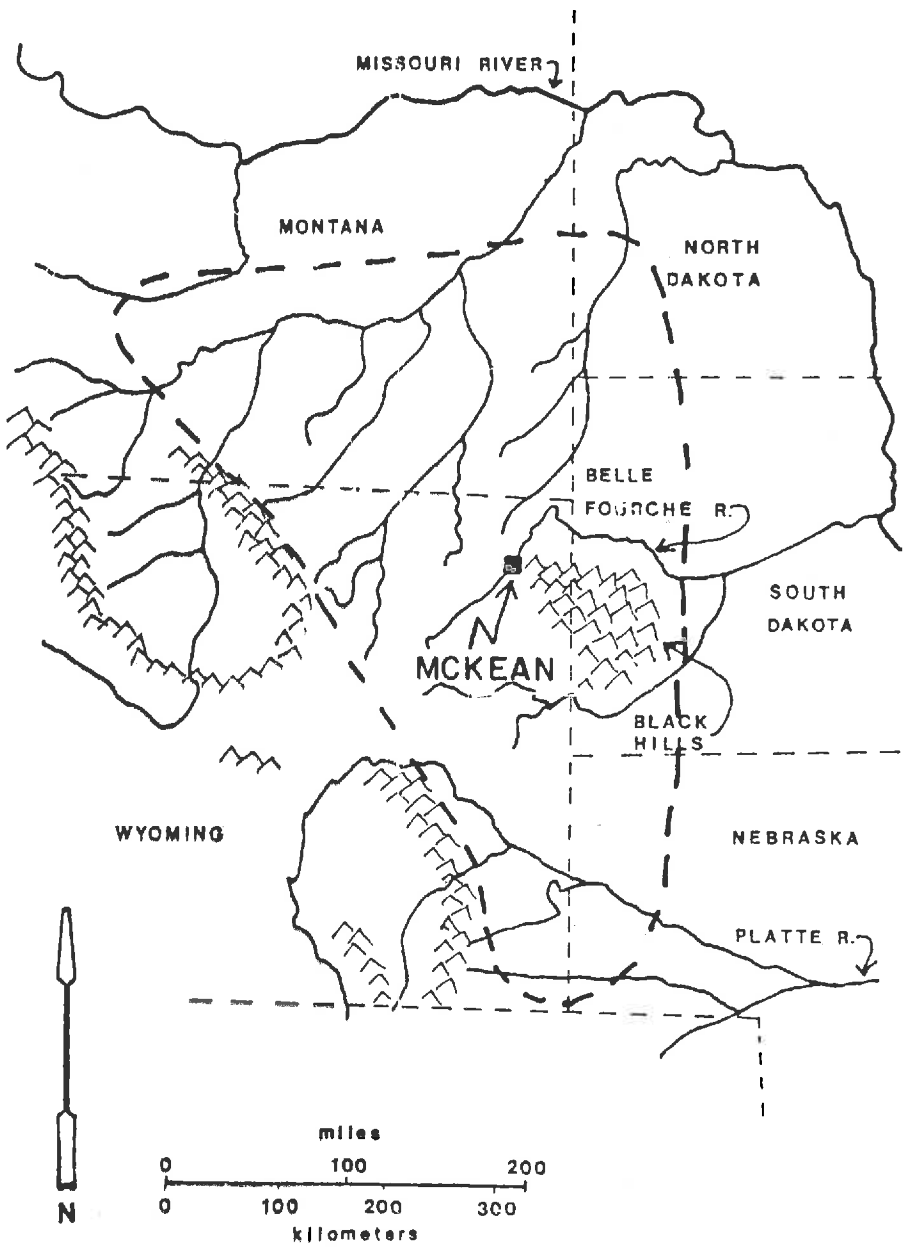

Figure 1. Location of McKean site and Northwestern High Plains.

these features are burial goods, which were meant to stay with the interment. As burial goods, they represent a special kind of fallout from the cultural system and should be compared to other caches with this in mind. Burial "caches" have been compared to and discussed with implement caches (see below) partially because of the similarity of their contents. It is likely that such similarity is a function of hunter-gatherer sociocultural integration, resulting in both burial goods and stored implements consisting of items of personal gear (Binford 1979). Even if one argued that burials are a way of storing bodies and associated items for later social or ideological purposes (ceremonies), this type of "caching" is organizationally different. That is, it is conditioned by different cultural contexts and constraints. Like burials, medicine bundles are also ideotechnic objects that are often cached. However, medicine bundles are meant to be recovered for use in ceremonies, while burials and their contents are generally meant to remain undisturbed.

The other types of caches are considered to be a part of cultural infrastructure (Harris 1979:53). Their purpose is to temporarily store resources. These caches can initially be separated into subsistence and implement stores. Subsistence stores consisting of food and grainery features are known from a variety of archaeological contexts and are not further considered here. Implement stores are also widely reported, and the items included can be divided into several classes, such as bifaces, flakes, blades, other flake tools, ground stone, and bone tools. Each class has specific implications for technological organization. Apart from showing biface flaking as a part of the technological strategy, storing bifaces suggests other characteristics of the technological system, such as staging in the manufacturing process. Other attributes of the cached items, such as usage and the type and extent of remanufacturing also have implications for the technological strategies employed. We explore these implications with the analysis of the McKean site tool cache.

Behaviorally, caching is a response to anticipating future needs in the face of spatially or temporally restricted resource distributions (Binford 1979:258; Kelly 1985). Although both food and implement stores are keyed to resource distribution and anticipation of future needs, we think it important to distinguish between the two. Food storage is a strategy for providing resources during periods when no resources are available. Implement storage is a means of fostering mobility. That is, it is a way to make broader areas of the landscape useful by providing resources where, rather than when, no resources are available. Food and implement stores are thus designed to solve different problems and are considered to be organizationally distinct phenomena.

Caching must also be viewed as conditioning access to resources. Food and implement stores can be manipulated to result in equal or unequal access to resources. Under certain condition, food stores have been argued to function in the creation of social inequalities (DeBoer 1988). Among hunter-gatherers, implement caches may serve the opposite function. Providing equal access to resources, and thereby maintaining egalitarian relations, is a fundamental characteristic of such sociocultural systems (Fried 1967; Woodburn 1982). Hunter-gatherers may store implements as a means of ensuring their independence instead of incurring potential debts through borrowing or relying on others. From this perspective, food and implement caches are also organizationally different.

Unfortunately, the social implications of implement caching and the ecological conditions creating the need for such storage are not independent phenomena. Although this study is largely about technology and mobility, the realization of the social implications of implement storage is necessary for making meaningful interpretations from the McKean site cache.

NORTHWEST PLAINS CACHES: A SUMMARY

The purpose here is to introduce the general characteristics of Northwestern High Plains implement caches, specifically the incidence (rate), context and content of storing behavior. Caches are known from much of the Plains, but on the whole their incidence is low (e.g., Archaeology in Montana 1985). This is expected as a cache should be recovered and used except in rare circumstances such as death of the cacher or loss of cache location (e.g., Reher 1984:5; Tunnell 1978:1). We can expect such death or loss variation to be random and therefore known caches should represent an unbiased sample of this type of past behavior (older people being more likely to die than young notwithstanding).

Perhaps a dozen implement caches are known from the McKean site area of northeastern Wyoming and vicinity, a region of about 200,000 km^2 (e.g., Beckes 1985; A.D. Darlington, personal communication; Davis 1976; Clark and Fraley 1985; Grange 1964; Lippincott 1985; Reher 1984). None of these are from the Paleoindian or Early Plains Archaic periods, so the known examples span about 5000 years of prehistory. At the McKean site (Figure 2), the cache described here was the only one found during excavation[1], although a substantial portion of this large site has been excavated (Kornfeld and Frison 1985, 1988; Mulloy 1954). Given that only "lost" caches are archaeologically recoverable, even a dozen such features from this region suggests that storage was an alternative chosen as a part of the technological strategy.

The contexts of Northwestern High Plains implement caches vary a great deal. A large portion of the caches can be considered as isolated facilities, occurring either away from other cultural debris or at locations with only low-density chipped stone scatters. For example, both of the Mehling caches in southeastern Montana are near low-density lithic scatters (Clark and Fraley 1985:8,9). On the other hand, caches occur at large sites. The Lower 30 cache in southern Montana was one of several features at a large, open habitation site (Beckes 1985:62). Beckes suggests that the site represents a large, single component, transitory camp (over 1000 items, including Pelican Lake projectile points were seen on a slightly deflated surface; Beckes 1985:62). The Wagensen cache, in northern Wyoming, is in an analogous context at an extensive tipi village, where a variety of camping activities has been documented (Latady 1982; Reher 1982, 1984). Other caches in northeastern Wyoming occur at extensive multicomponent sites (Darlington and Francis 1987).

The Northwestern High Plains caches vary in content from a few to over 100 items, with several dozen as the usual number (Archaeology in Montana 1985; Darlington and Francis 1987; Reher 1984). These facilities commonly consist of bifaces or else bifaces and flakes, and occasionally include other types of tools. The biface caches include items from roughouts to finished projectile points. The other tools found in these facilities are usually some sort of scrapers.

McKEAN SITE TOOL CACHE

The cache described here differs from the one other reported McKean Period cache (Davis 1976) and other Northwestern High Plains mostly biface caches, in that it is a tool cache. It also differs from the others in that it is a small cache, containing only seven items. The McKean site cache occurs at an extensive, multicomponent site. The site represents a short term camp or processing location occupied repeatedly and redundantly from about 6000 years ago to the present (Haspel and Wedel 1985; Ingbar 1985b; Kornfeld and Frison 1988; Kornfeld and Larson 1986). Direct behavioral association of the cache with other facilities and artifacts cannot be shown. The site also includes hearths, two burials, and several possible structures including a pit house (Haspel and Wedel 1985; Kornfeld and Frison 1988; Mulloy 1954; Stewart 1954). The artifact assemblage consists largely of chipped stone debitage and tools, but also includes ochre, charcoal, bone, bone tools, bone beads, seeds, and ground stone.

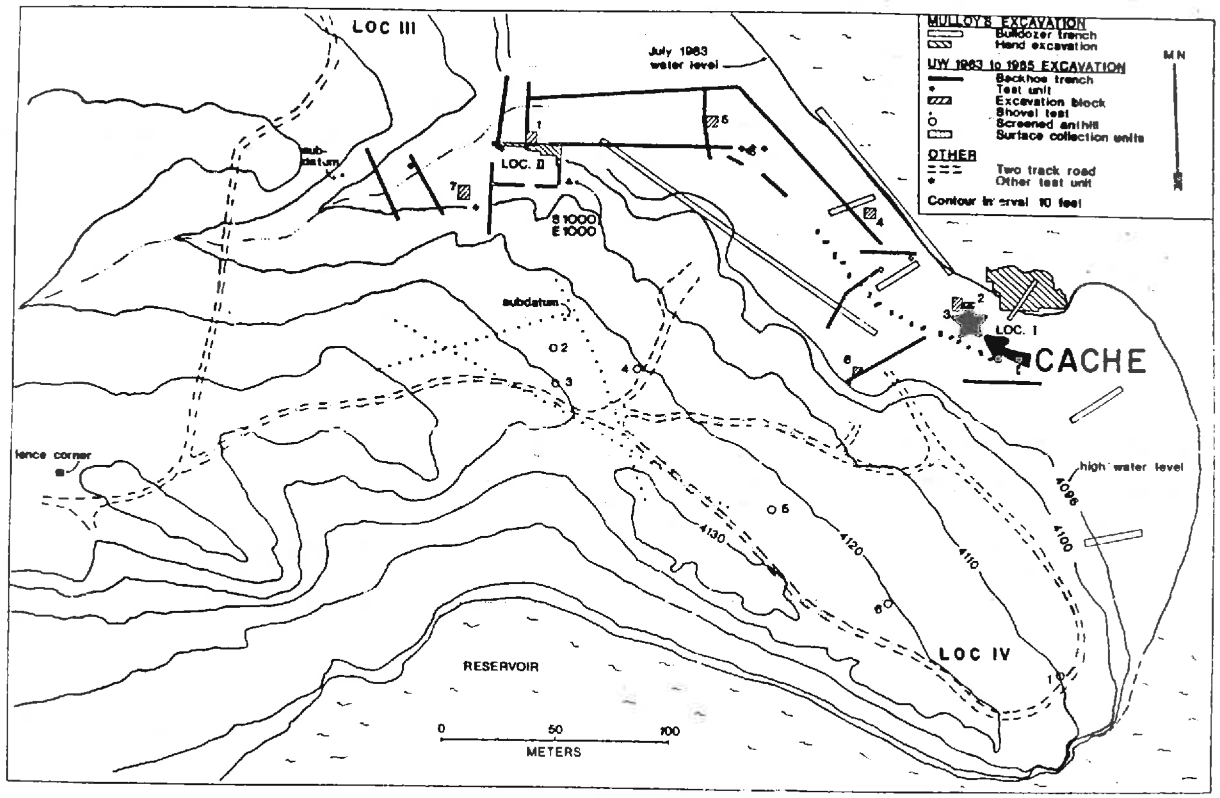

Figure 2. Location of tool cache at McKean site. Also shown is history of excavation.

We think it is relevant that the cache occurs on the same portion of the landscape as this extensive occupation. That is, the McKean cache is a part of the technological organization that resulted in repeated and redundant use of this location over a 6000 year period. This does not imply a lack of cultural change or evolution on the Northwestern High Plains. It only implies use of the McKean site landscape remained static over this period, even if other systemic change occurred. Such systemic change may be precisely the reason the McKean site tool cache was not recovered by the cachers. That is, systemic change may have resulted in proper tools being brought to the site as a part of the regular settlement round, during which the storage facility fell into disuse (other scenarios are possible as well).

The tool cache consists of a cluster of six scrapers and one flake (Figure 3). Although non-cultural factors can result in such spatial configurations, this is very unlikely given the geomorphic context of this cache (Figure 4). The stored items are in a shallow depression on slightly sloping bedrock facing southward and covered by colluvial deposits (Albanese

Figure 3. McKean site tool cache in situ.

1985). Concentrations of large artifacts can be created in such depressions by alluvial processes (e.g., Isaac 1967). However, colluvial action in this area of the site would not have had the energy necessary for such sorting. The cache was in a dark brown, strongly developed A soil horizon, dating to about 5000 B.P. (Kornfeld and Frison 1985:37; Reider 1985). Mulloy (1954) associated this stratum with the McKean complex.

Six of the items are made of Morrison silicified siltstone, while the seventh piece was manufactured on Cloverly Formation quartzite (Table 1). From the perspective of chipping potential, the raw material of five of the specimens is some of the finest-grade Morrison siltstone encountered in this region. The same is true for the one Cloverly piece. Morphologically, the scrapers are all large end-scrapers, but they also exhibit other employable units (EU, Knudson 1983) and can be considered multi-edged tools. The morphology and length of their working edges, and their general morphology, varies a great deal (Table 1).

<u>Analytical Methods</u>

The seven cached items were analyzed for evidence of use and production processes. These processes can be inferred from microwear traces, raw-material source locations, and manufacturing techniques employed.

There are several different categories of microwear traces which provide different types of information about tools. These include microflaking (or "edge damage"), microwear polish, striae, and edge rounding. Microflaking analysis was not used because scraper edges were by definition secondarily retouched and there is no reliable criteria to differentiate between secondary retouch and microflaking from use. As a result, this analysis relies on inferences from polish, striae and the rounding of tool edges.

The microwear analysis is based on large scale, replicative experiments con-

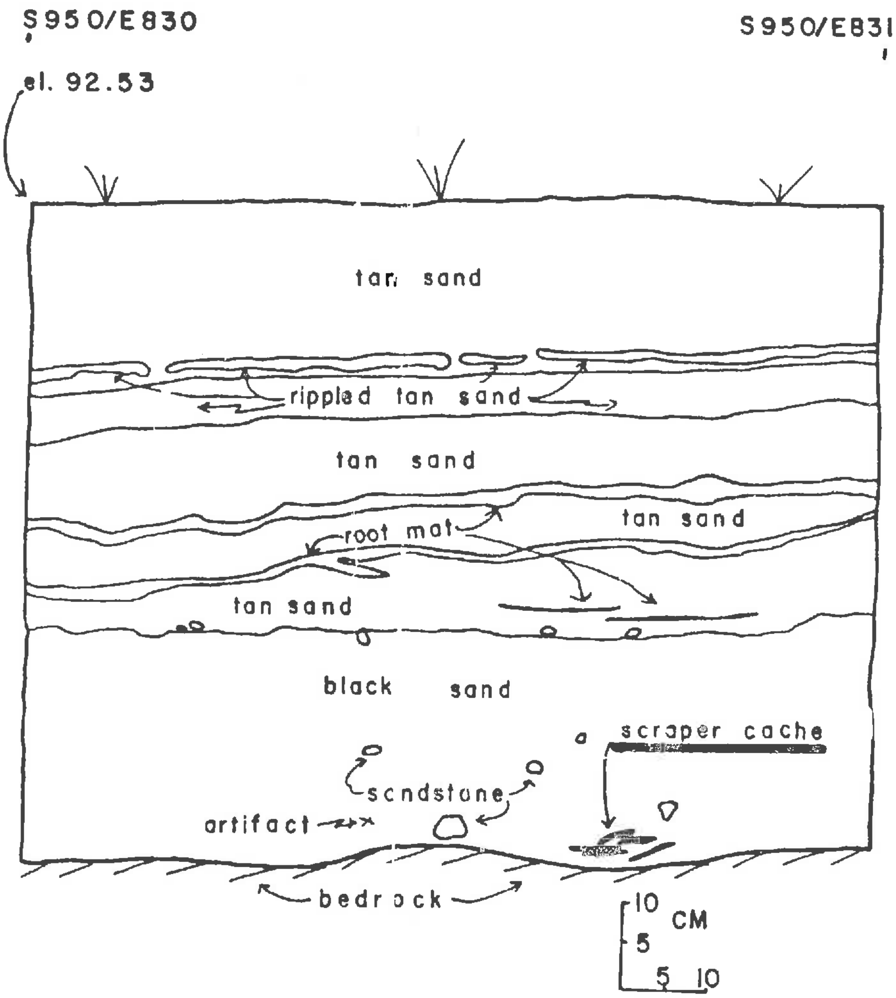

Figure 4. Stratigraphic location of McKean site tool cache.

ducted at Tohoku University in Sendai, Japan. That experimental program was originally designed for Japanese Palaeolithic and Jomon artifacts using raw materials such as shale and chert. Both of these materials are crypto-crystalline silicates (CCS). The widely recognized observation that most CCS produce similar types of microwear polish lends credence to the application of the interpretative framework developed in Japan to the chipped stone materials from the Northwestern High Plains.

Analytical methods and results of experimental microwear studies have been published elsewhere (e.g., Akoshima 1987, 1989; Kajiwara and Akoshima 1981; Serizawa et al. 1982), but a summary is presented here. A metallurgical microscope with incident light attachment (Olympus BHM-J) is used to observe the specimens under magnifications of 200X and 500X. To make observations, this microscope does not require surface coating of CCS, and the pre-treatment that is necessary in the use of scanning electron microscope can be bypassed. Thus, observation can be done as quickly as with a low-power stereoscopic microscope. Although the "Keeley method"

Item No.	Catalog Number	M.L.	M.W.	M.T.	END SCRAPER EMPLOYABLE UNIT* Length	angle	Other edge angle	Mat. Type
1	48CK7-644	69.9	71.2	14.4	70.1	63	45	MS
2	48CK7-645	55.3	40.7	10.3				MS
3	48CK7-646	84.2	71.0	20.1	67.3	66	52	MS
4	48CK7-647	76.2	49.3	10.8	37.8	64	50	MS
5	48CK7-648	81.5	58.9	9.1	21.7	65	47	MS
6	48CK7-649	81.2	57.9	13.7	35.7	62	35	CQ
7	48CK7-650	92.5	71.1	12.3	48.5	70	59	MS

M.L. = Maximum length. Greatest dimension often, bulb of percussion to working edge.
M.W. = Maximum width. Greatest measurement, generally perpendicular to length.
M.T. = Maximum thickness. Greatest measurement, generally perpendicular to maximum length and width. Usually at the bulb of percussion.
MS = Morrison Silicified Siltstone
CQ = Cloverly Formation Quartzite
*Employable Unit from Knudson 1983.

Table 1: Measurements of cached items. (Lengths in mm; angles in degrees, measured with a goniometer).

has been criticized, it is the most reliable method available for determining the function of lithic artifacts (e.g., Keeley 1980; Newcomer et al. 1986; Odell and Odell-Vereecken 1980; Vaughan 1985).

The polish classification used for this analysis is presented by Akoshima (1989) and Kajiwara and Akoshima (1981). The classification shows the correlation between polish type and worked material is not necessarily exclusive (Table 2). Thus, calling polish by reference to worked material (for example "antler polish") is misleading (Grace et al. 1985; Serizawa et al. 1982; Vaughan 1985:46). Thus, we refer only to the experimentally produced "polish type" and infer the worked material from this as the best probabilistic estimate.

Inferences about procurement, manufacturing, and recycling of raw material are based on locations of raw material sources and artifact morphology. Raw material source locations near the McKean site are well known (Craig 1983; Fredlund 1976; Reher 1985). Morrison formation source locations are ubiquitous in this region, although the high quality material, such as most of the cached items, occurs consistently only in restricted locations. One such location is within 2 km of the McKean site (Reher 1985:98). Cloverly sources are more restricted, but a location is known within 30 km of the site (Love and Christiansen 1985; Reher 1985:99). Source locations

Polish type	Contrast and texture	Extension	Other Characteristics	Worked materials, ( ) = less common materials
A	Very bright and smooth	Covers wide area rather evenly	"Filled-in" striae, "Comet-shaped" pits; When underdeveloped resembles type B	Non-woody plants, (bamboo)
B	Bright and smooth, round and "domed" appearance	Well-defined patches develop on high points	Clear striae	Wood, bamboo, (bone, non-woody plants)
C	Relatively bright but rough	Covers wide area rather evenly with flat patches; Patches are ill-defined	With numerous pits of various size/ shape, depressions, striation; Often surrounds types D1 and D2	Sawing soaked antler (and bone)
D1	Bright and smooth; Very flat and lacks "round-ness;" Includes "melted snow" type	Flat polish patches are well-defined	Directional undulations often constitute wide striated features	Bone, antler, (wood)
D2	Bright but less smooth than D1	Polish patches are well-defined	Patch surface undulates with numerous parallel, sharp striae	Bone, antler, wood, (bamboo)
E1	Dull and relatively rough	Polish patches are small and confined	Numerous tiny pits and very minutely rugged (="rugose"); Usually accompanies types E2, F1, F2	Hide, meat, (wood)
E2	Dull and relatively rough, "Mat" texture	Patches are less confined and some-times flat; When developed patches grow and "round-ness" increases	Numerous tiny pits and very minutely rugged (="rugose"), Usually accompanies types E1, F1, F2	Hide, meat
F1	Dull and rough, sometimes "greasy luster"	Patches are not well-defined; Polish follows micro-topography (both on elevations and depressions)	Coarse "rugged" appearance; Type F1 often develops into type D1 on antler/bone	Dry antler, bone, hide, meat, wood
F2	Very dull, weak	Polish follows micro-topography	Often accompanies other types	Generic polish, hide, meat, (wood, bone)
X	Dull, "Battered" appearance	Extend widely	Very "rugged;" Full of pits, depressions; Striae everywhere	When soil is involved
Y	Relatively bright but no contrast (even brightness), variable texture	All surface is covered	Random striae; Various pits	"Patination" polish, polish on naturally warn surface

Table 2: Polish types on siliceous hard shale; Akoshima 1989; Kajiwara and Akoshima 1981).

alone do not suggest a procurement strategy, but characteristics of procurement can be inferred by combining information on source locations with the production system. If the piece has not been facially modified, flake blank morphology, including platform characteristics and the nature of the dorsal surface, are reflective of core types. These variables suggest the knapping process, which is related to procurement and manufacturing strategies. The degree of facial modification suggests the intensity of the production effort, another aspect of manufacturing. Evidence of resharpening is observed along tool edges. A break in wear pattern at a location of a negative flake bulb is an indication that a tool has been resharpened. Remnants of different use-wear patterns on a tool suggests lateral cycling, that is, a change in tool function through its use trajectory.

Raw material procurement, manufacturing, and recycling strategies associated with this tool cache are inferred from these analyses.

Utilization and Production Analysis Results

Results of the analysis are summarized in Tables 1 and 3. The cached items were manufactured either on large, flat flakes or on tabular pieces of raw material (Figure 5). The raw material varies in source type, color, and type and shape of inclusions, suggesting at least five different nodules were used to manufacture the seven items. The raw material of items 1, 3, and 4 could have been from one nodule. The raw material source of one of the pieces (6) is at least 30 km from the site. The raw material source for two other items (5 and 7) may be as close as 2 km from the site. The raw material for the rest of the items suggests at least two different locations in northeastern Wyoming. Thus, at least four source locations are suggested by the raw material. Three of the items (1, 2, and 6) suggest that a multidirectional core was a part of the tool production trajectory and this includes one Cloverly quartzite piece and two Morrison items. Two (5 and 7) or possibly three items (including Item 3) were produced from tabular pieces or raw material well suited for manufacturing the type of tools cached. That is, the tabular pieces needed little modification to become functional tools of the type cached. In one case the modification is extensive and core characteristics are obliterated by unifacial retouching (Item 4; Figure 5D). This tool suggests a more elaborate production process than the other items.

Marginal retouching to produce EUs varies from light (Items 4 and 5) to heavy or highly invasive (Item 3). Retouching on the one ventrally modified piece (Item 1; Figure 5A) is not substantially different. Ventral marginal retouching created the desired edge angle and shape with the least effort on this blank. The massive marginal retouching of item 3 may be because of its large size, especially thickness (Figure 5C). This tool is also the only one on which extensive bulb removal was attempted. It may be more than a coincidence that it is still the thickest item in the cache.

Except for one item (2), all others contain several differently shaped working edges with up to five separate EUs (Item 6). Significantly, item 6 was manufactured on raw material whose source is the farthest from the cache. End scraper-like unilateral retouched edges (usually distal edges), with edge angles from 62 to 70 degrees, are the most common, occurring on six of the items. These edges vary substantially in the degree of convexity and length, the length ranging from 21.7 mm to 70.1 mm (Table 1). The other EUs on these tools are straight, concave, convex, or sinuous and unilaterally or bilaterally marginally retouched. The angles of these edges (Table 1), in comparison with the end scraper (distal) EUs, are all more acute (35-59 degrees).

In summary, the manufacturing process, from the original blank to the finished tool, was the same in all but one instance (Item 4). Manufacture involved the modification of edges by unilateral marginal retouch to produce the convex end scraper working edge. In addition, the rest of the edges were either unilaterally or bilaterally marginal-is on the dorsal surface. The ventral face of the right lateral edge of item 3 (the sinuous edge) exhibits a worn surface, which appears shiny even to the unaided eye. Polish of type "B" is extensive on this surface. The polish patch is bright and smooth, and the contrast is strong. Patches of type "B" polish are partially surrounded by type "F1" (Table 3). The material worked with this edge was probably wood. Item 6 exhibits two

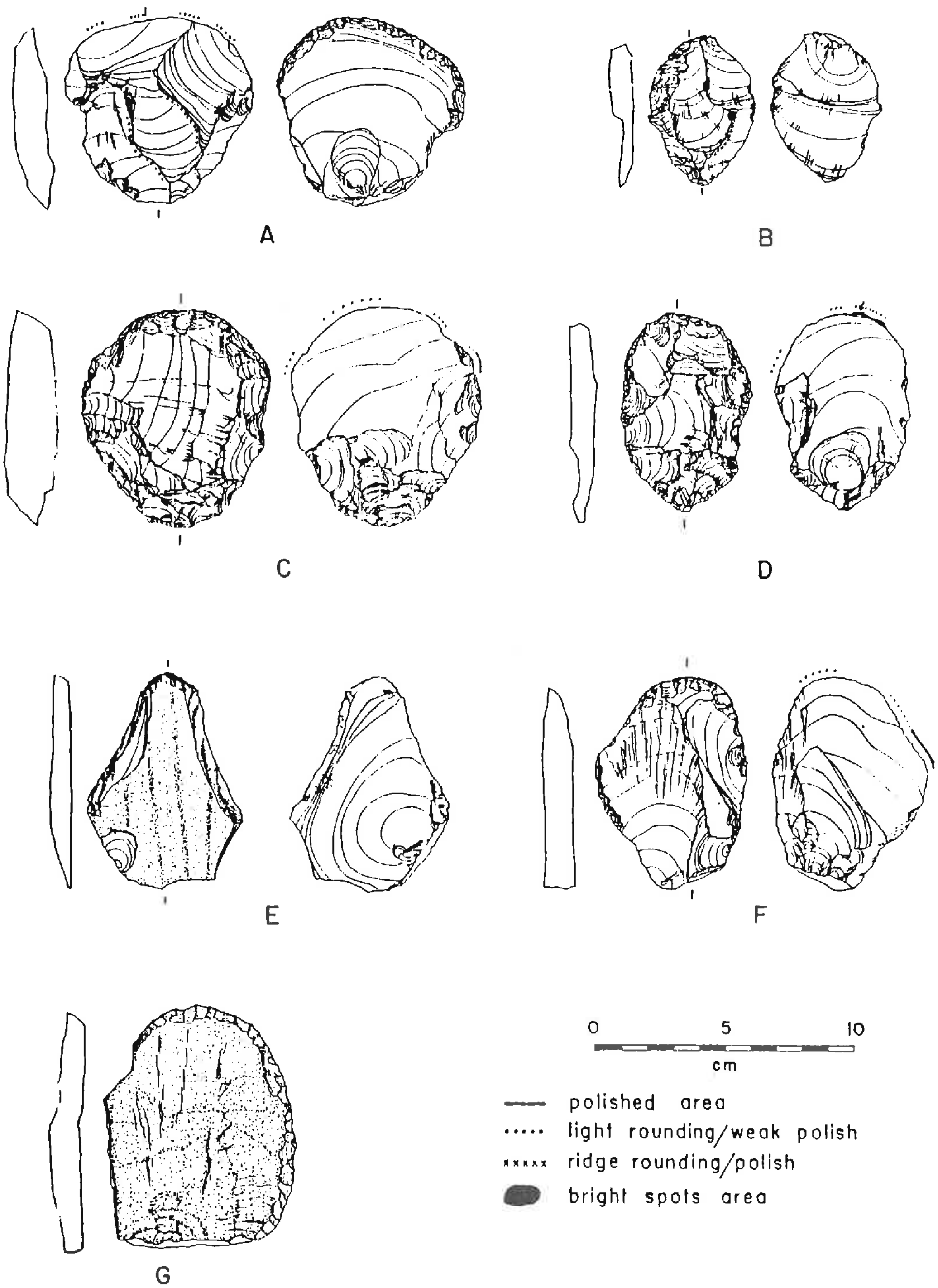

Figure 5. Cached artifacts showing production morphology and location of polish types: A) Item 1, B) Item 2, C) Item 3, D) Item 4, E) Item 5, F) Item 6, G) Item 7. (Drawings are in Japanese technical style).

Item No.	Previous flakes removed	Direction of previous flakes	Termination of previous flakes	Eraillure	Flake blank termination
	Dorsal surface			Ventral surface	
1	4-5	M	R/H	Y	H
2	5	M	F/H	N	R/F
3	0-1	-	--	Y	--
4	--	-	--	-	--
5	N-CT	-	--	-	FR
6	4	M	F	Y	--
7	--	-	--	-	--

Table 3a: Morphology of flake blanks used for cached tools.

Item No.	Facial retouch	Marginal retouch	Distal EU	Other EU	Resharpening
1	N	V-D+LT	S-CV	CV+C	Y
2	N	N	N	N	N
3	DR-2fl	DR-EE/ HV+V-BL	CV	CV+C+ SI	Y
4	DR-HV	DR-EE+P -BI	CV	CV+C	Y
5	N	DR-D+LT	C	CV	?
6	N	DR-EE	CV	CV+C+ 2S	Y
7	N	DR-D+LT +P	CV	CV+S	?

Table 3b: Manufacturing variation of the cached tools.

Item No.	Surface condition	Rounding	Striae	Primary polish	Secondary polish
1	G	D+DR	D	D-W/I	
2	G	DR	N	DR-BR	DR-"B"
3	G	D+DR+LT +P	D+LT	D-I	D/LT-"B"+ "F1"
4	G	A+DR	D	D-I	
5	G	N	N	N	
6	G	A+D+LT- HV	LT	LT-"E2"	D-"E2"

Table 3c: Wear characteristics of the cached tools.

Codes for Table 3: A=all; B="B" polish; BI=bidirectional; BL=bulb; BR=bright spot "polish"; C=concave; CV=convex; CT=cortex; D=distal; DR=dorsal ridge; EE=entire edge; E2="E2" polish; F=feather; fl=flakes (scars); FR=fracture plane; F1="F1" polish; G=good; H=hinge; HV=heavy; I=indeterminate polish; LT=lateral; M=multiple; N=no/none; P=proximal; R=ripple; SI=sinuous; S=straight; V=ventral; W=weak polish; Y=yes.

edges with recognizable polish. A strong polished area is between the one concave (distal) and the lateral straight EU. The polish is very evident on the ventral aspect of the flake. In this location, distinctive "E2" type polish (Table 3) is distributed extensively and is partially accompanied with striae, which are oriented perpendicular to the edge. Heavy edge rounding is also observed here, which is detectable even with the unaided eye. The "E2" type polish is mat texture, of low contrast (dull), suggesting use on hide. Crystals in the matrix, which had been flat and shiny were crushed and turned to mat texture where they were affected by the polish along the edge. Where the polish developed further, it appears similar to "bright spots." However, the ill-defined nature of "bright spots" gradually turning to typical mat type "E2" (hide) polish, suggests that this polish is a part of the developmental trajectory. In our experiments, hardened dry hide sometimes produced very bright smooth polish. Because of the difference in the raw material (coarseness), this is only a suggestion. The most common polish was indeterminate, weak type polish on distal EUs. A small area of item 4 (arrow in Figure 5D) exhibits this polish type, which is rather bright and flat. The material worked with this piece is unknown.

Microwear analysis suggests these ly retouched, producing a variety of edge shapes and angles. Only one item was unifacially modified (Item 4). The manufacturing process in all but two instances (Items 3 and 4, in the former the bulb of percussion was removed by extensive retouching) suggests a rather limited modification, perhaps "expedient" production (i.e., production at the time the need arises or situationally) of the original flake.

The surface condition of all cached items is good, rendering them useful for microwear analysis (Table 3). Only items 1 to 6 are considered in this analysis because the coarse nature of item 7 prevents reliable microwear observation. Rounding was observed on all items except 5. Location of rounding was most common on dorsal ridges. "Bright spots" and type "B" polish (Table 3) accompanied dorsal ridge rounding on at least one item (2). Patches of very bright and extremely flat polish appear along dorsal ridges. This type of polish is called "bright spots" (e.g., Moss 1983:81-83). One spot (arrow in Figure 5B) is worn so heavily that it constitutes a small facet which can be seen with the unaided eye. The agent(s) which produces "bright spots" is unknown, but such wear was experimentally produced by rubbing flint with flint when water is involved (Levi Sala 1986; Vaughan 1985:185-187). There are also polish patches of type "B" on a ridge and near the distal end. The polish is bright and smooth, suggesting probable contact with wood/plant material. Rounding was also present on all other edges and on two items (4 and 6) it was present around the entire perimeter of the tool. Striae were present on all but two items (2 and 5), being most common on the distal tool edges.

All but two items exhibited microwear polish. On item 2, type "B" polish (Table 3), suggesting contact with wood, items were cached when their scraping or cutting edges were still in good, fresh condition. Two pieces, however retained heavily utilized edge surfaces, which were incompletely resharpened before caching (see Kornfeld et al. 1990, Figure 3). The few items with signs of dorsal ridge rounding suggest either contact with a container or prolonged prehension (Items 1 and 2). The materials worked with these items includes at least wood and hide. The various stages of microwear traces suggest these items were not expedient tools, in that they were not produced, used, and then discarded on the spot, i.e., at the McKean site. Rather it is probably that these pieces had been in the system (i.e., curated) for a substantial period of time before they were cached.

IMPLICATIONS OF THE McKEAN TOOL CACHE

The raw material indicating at least four different source locations also suggests several procurement episodes and hence collection of material during various subsistence tasks. Binford has argued that raw material procurement among hunter-gatherers is embedded in other subsistence activities (Binford 1979; Binford and O'Connell 1984; cf. Gould 1980; Reher n.d.). If procurement had not been embedded, fewer raw material sources would be expected. This has been argued to be the case with "geared up" tool kits at several bison kill sites (e.g., Reher and Frison 1980:122). Concerning flake morphology, all items were manufactured on large flake blanks or tabular pieces of raw material. These types of materials are found in restricted locations in northeastern Wyoming. Since several locations were visited, rather then just one, an embedded strategy is again the most likely method of procurement.

Early stages of reduction, indicated by bi-directional cores from several raw material sources, suggest that the manufacturing strategies for these materials were the same. Binford and O'Connell (1984:429) argue that hunter-gatherer procurement and manufacturing strategies are tool specific. The similarity in the early stages of manufacturing of this cache implies such a strategy for the Northwestern High Plains hunter-gatherers. In other words, the large, flat flakes were obtained either by removal from large cores or by locating flat tabular pieces, specifically to manufacture and maintain this tool kit. This is not to say that other tool production cannot follow the same trajectory.

The production strategy, which created items with a variety of working edges, resulted in items with multiple potential uses. Only minor modification of the flake blank was necessary to produce a usable tool. With the one unmodified item, this indicates a staging strategy, as suggested for flake and biface caches (Reher 1984), may also have been involved with the manufacturing process of this cache. Large flakes may have been carried around or cached, and modified when needed for a particular task. This again points to the embedded nature of raw material procurement. That is, the one unmodified flake suggests that raw material was obtained when opportunity arose, carried to the cache, stored with items of associated utility and modified into finished tools only when necessary. The several stages of modification and intensity of use support this proposition, as does the one, most modified tool being manufactured from the most distant raw material.

The McKean site tool cache seems to represent an event analogous to the expedient use of personal or passive gear (Binford 1979:256, 266). The cache is argued to have been personal gear because of the evidence for extensive transport (i.e., the wear on dorsal ridges) before caching. The expedient use is inferred from observation of several stages of modification (i.e., flake to unifacially modified items), and variety of edges (concave, convex, sinuous, acute and so on). The generalized nature of the procurement, manufacturing, and utilization processes of this passive gear suggests its versatility. Any of the cached tools could have been useful for a variety of tasks. Binford has argued that expedient use of personal or passive gear occurs in task specific locations, where the participants are involved in extracting resources (Binford 1979:266). From this we could deduce the McKean site is a task specific location. Extraction loci are organizationally similar to foraging locations, however and thus exhibit some similarities in assemblage characteristics. Thus, expedient use of caches may be a necessary organizational response if foraging strategies are to be successful on the Northwestern High Plains.

Resharpening, resulting in the intermittent nature of fresh and used edges, is evidence of recycling processes, that is, the rejuvenation of "worn" tools for the same or different functions. The tool edges of the cached items exhibit a variety of angles and retouch characteristics (unilateral and bilateral), suggesting that each item was used for several tasks sequentially and possibly cyclically. It appears that any of the tasks previously performed with the tools could be done again. With slight modification, other tasks could also be performed. Another aspect of recycling is the preparation of edges before storage, leaving the gear in working order. By doing this, the cachers remained aware of the state of the tools and could make decisions on whether to obtain additional raw material before returning to the site. Planning is often associated with logistical settlement strategies, where specific tasks are meticulously planned and special gear is prepared for them (e.g., Binford 1978; Reher and Frison 1980). Foraging tasks are also planned, however; the !Kung must have karosses for carrying various resources and cached nutting stones for their foraging system to be successful (Lee 1979:153). For the McKean site tool cache, planning is argued to be a part of a foraging strategy, where tools were stored for opportunistic resource procurement. The multifunctional nature of the tools, shown by variation in edges and wear patterns, renders them useful for a variety of tasks. This complex mixture of foraging and collecting strategies of the Northwestern High Plains hunter-gatherers has recently been addressed (Francis and Larson 1988). The inferences from the present analysis support the need for re-assessing the nature of these strategies in temperate environmental zones.

The McKean site tool cache likely represents a tool kit, similar to many such features in the Great Basin (e.g., Ingbar 1985a; Lindsay et al. 1968). The Great Basin caches are suggested to represent "scuttling" of personal gear, often near bedding areas (Binford 1983: 184; Ingbar 1985a). While such caches are common in the Great Basin, they are rare on the Northwestern High Plains (Ingbar 1985a). Several reasons can be suggested for this difference: 1) Great Basin hunter-gatherers used a similar tool distribution option as a part of their mobility strategy, but relied on it more often than did the Northwestern High Plains populations; 2) the observed variation in caching behavior intensity in the two regions may be the result of different characteristics of raw material distributions; or 3) the difference in the caching behavior suggests a profound difference in settlement/subsistence strategies of the two regions.

We suggested above that the McKean cache may have remained unutilized because systemic change (change in the settlement system) eliminated the need for it. A variety of environmental factors can cause changes in the settlement system. Caching may be a response to a certain frequency and amplitude of environmental variation. Beyond a given frequency or amplitude of change however, caching may no longer be a useful strategy. In such cases, caches would fall into disuse. Thus, the Great Basin caches may be more frequent archaeological features not because they were a more important part of the settlement system, but because of more frequent changes in the settlement system, which caused caches to be frequently abandoned. Conversely, the fewer caches found on the Northwestern High Plains may indicate their continual importance in the technological strategies. That is, if the caches continued to be important adaptive facilities, they would not fall into disuse and would be exhausted rather than be left for archaeologists to recover.

Raw material distributions condition some aspects of technological organization. However, spatially abundant raw material sources do not necessarily result in expedient technologies. Conversely, restricted and scattered sources do not automatically create the need for curation, including some sort of caching (e.g., Ebert 1986:36; cf. Bamforth 1986). Caching, we argue, is a response to time stress caused by spatially restricted and scattered resources. This means it is the time stress to be solved by modifying the resource distribution (Ebert 1986:227; Torrence 1986). Thus, the McKean site tool cache is informative about time stress and its resolution on the Northwestern High Plains. The immediate vicinity of the McKean site offers raw material in erosional scarps. However, these are very poor quality and may not be efficient for the same tasks as the cached items. The cache can then be argued to have served as a solution to the where problem in the spatial incongruity of raw material. Furthermore, the McKean cache was transported for some time (judging by the dorsal ridge wear) before being cached at the locality that seems to have a pivotal value in the settlement system. Such caching at non-habitation sites is suggested to show stability in recurrent resource locations over time (Ebert 1986:228). This resource condition would favor a foraging exploitation strategy of the McKean site area. The cached tool kit characteristics fit the redundant and repeated use of the site evident from other analyses, and the foraging strategy argued to be the dominant settlement mode in the western Black Hills region during Archaic times (Haspel and Wedel 1985; Ingbar 1985b; Kornfeld 1988; Kornfeld and Larson 1986). A multipurpose (generalized) cache alleviates the time stress caused by spatially dispersed resources, making it possible to exploit the Northwestern High Plains with foraging settlement strategies. Caches make the success of many different kinds of resource exploitation opportunities more likely, thus conferring an adaptive advantage to those aware of the cache.

On the other hand, the more common tool caching in the Great Basin may be a function of the need for equal access to resources. If such access served to maintain egalitarian relationships, it can be inferred that such relationships were more important adaptive features in the Great Basin than on the Northwestern High Plains. This is the case in the Historic Period, but perhaps extends into antiquity as well (Grinnell 1972; Steward 1938).

CONCLUSION

The cached McKean tool kit has yielded evidence about its production, manufacture and use. All these suggest a flexible technological organization adaptable to a variety of situational conditions. Foraging strategies on the Northwestern High Plains may require such extreme technological flexibility. This paper has explored the nature of Northwestern High Plains settlement and subsistence strategies inferable from our analysis. With these results, and other studies (Francis and Larson 1988) the role of big game procurement and logistical settlement strategies in this region should be reconsidered.

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Notes:

1. An avocational archaeologist has reported a biface cache from the site since our field investigation. This cache has not yet been analyzed.

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GROUND-PENETRATING RADAR AS A SURVEY TOOL IN ARCHAEOLOGICAL INVESTIGATIONS: AN EXAMPLE FROM FORT LARAMIE NATIONAL HISTORIC SITE

by

Steven LeRoy De Vore

ABSTRACT

A voluntary reconnaissance survey was conducted at Fort Laramie National Historic Site, Wyoming, to provide an application of non-destructive geophysical techniques available for cultural resource management. Ground-penetrating radar was used to delineate possible locations of numerous structural features at the Fort Laramie military site (1841-1890). The investigations also attempted to locate the original fur trade post, Fort William (1834-1841), located a couple of miles from the present military fort site. Ground-penetrating radar, like magnetometers, provides the archaeologist with invaluable information concerning sub-surface disturbances which can then be incorporated into cultural resource management programs. Use of such data can provide the archaeologist with spatial information concerning areal extent and depth of those disturbances prior to exploratory archaeological testing. This is especially true for multi-use sites, such as Fort Laramie, where numerous alterations and building episodes have occurred.

INTRODUCTION

In September 1988, a voluntary reconnaissance survey of ground-penetrating radar (GPR) was conducted at the Fort Laramie National Historic Site, Wyoming (Figure 1). An agreement between Clark Davenport of Envirosphere, Denver, Colorado, and the park staff during a visit to the park resulted in the voluntary GPR survey. The survey personnel consisted of a voluntary geophysics team and National Park Service personnel. The geophysics team from Denver, Colorado, consisted of Clark Davenport, Senior Geophysicist, Envirosphere; Don Heimmer, President/Geophysicist, Geo-Recovery Systems; John Gilmore, Chief Geologist, Colorado Division of Highways; and John Lindermann, Consulting Geologist. In addition, the author, at the time a National Park Service (NPS) archaeologist from the Midwest Archeological Center, provided archaeological expertise to the geophysics team. The Fort Laramie NPS staff provided historical documentation, proposed survey locations, and additional support and enthusiasm. The geophysics team conducted the survey during two days of personal time and at their own expense. The results of the survey and its interpretation was completed by the geophysics team (Heimmer et al. 1988).

The NPS has used various forms of remote sensing, including GPR, for non-destructive archaeological investigations for over one and half decades (Avery and Lyons 1978; Lyons 1976; Lyons and Avery 1977; Lyons and Hitchcock 1977; Lyons and Scovill 1978;

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Morain and Budge 1978). Remote sensing in the NPS is centered around three goals: 1) research and development of remote sensing methods for archaeological projects which may be employed by archaeologists and cultural resource managers, 2) application of specific methods to different environmental and spatial conditions, and 3) dissemination of the results of these applications (Lyons and Mathien 1980:1). Remote sensing involves detection, recognition, and evaluation of objects from distant sensors. The most common remote sensing instruments are those associated with aerial and terrestrial photography (Lyons and Avery 1977:1). This imagery can provide vital information to archaeologists concerning "the discovery, evaluation, and preservation of historic or prehistoric cultures" (Lyons and Avery 1977:1).

Imaging sensors are limited by visual and mental capacities of the human body to detect and interpret the electro-magnetic spectrum within the visible and near visible ranges. Non-photographic sensors are able to record cultural and natural phenomena which are not recognizable within these ranges (Lyons and Avery 1977:40). Non-imaging sensors record energies emitted or reflected from the earth's surface. GPR represents one form of non-imaging sensing instruments employed to penetrate soils and rock in search for cultural manifestations (Lyons and Avery 1977:40). Other types of non-imaging instruments used in archaeology include electrical resistivity devices and magnetometers (Weymouth 1986:539; Wynn 1986:534-536).

The use of GPR as a technological innovation in archaeology has occurred over the past fifteen years (Wynn 1986:535). In the early 1970s, GPR was introduced in the United States as an engineering geological tool (Cook 1974; Moffat 1974; Morey 1974). Since its introduction, NPS archaeologists and others have become increasingly aware of its potential for intrasite mapping (Bevan and Kenyon 1975; Bevan et al. 1984; Kenyon and Bevan 1977; Vickers and Dolphin 1975).

HISTORICAL BACKGROUND

The Fort Laramie National Historic Site commemorates the epic expansion of the American frontier during the nineteenth century. Located at the junction of the Laramie and North Platte Rivers in eastern Wyoming, the National Historic Site represents a vivid reminder of a heroic past (Mattes 1980:1). Fort Laramie has served as a fur trading establishment and an evolving military post. Its strategic location along the central continental migration corridor, from the Mississippi, Missouri, Platte and North Platte Rivers to the South Pass, provided explorers, trappers, traders, emigrants, freighters, missionaries, cowboys, homesteaders, Pony Express riders, stage coach drivers, soldiers, and Native Americans with a temporary home to camp, rest, trade, and re-provision within a protective fortification. An excellent history of the fur trading period, military era, country village period, and State and Federal park era is provided by Mattes (1980).

The first Euroamericans to explore the headwaters of the North Platte River were the French-Canadian and American fur traders and trappers. The first documented visit to the Laramie Fork occurred in 1812. A group of American Fur Company employees, under the leadership of Robert Stuart, passed by this location while carrying dispatches from St. Louis to Astoria. Over the next two decades, numerous American explorers, traders and trappers, passed by the Laramie Fork (Mattes 1980:2-4).

In 1834, William Sublette and Robert Campbell built the first establishment at the juncture of the Laramie and North Platte Rivers. Fort William, a log stockade, served as the only trading post in

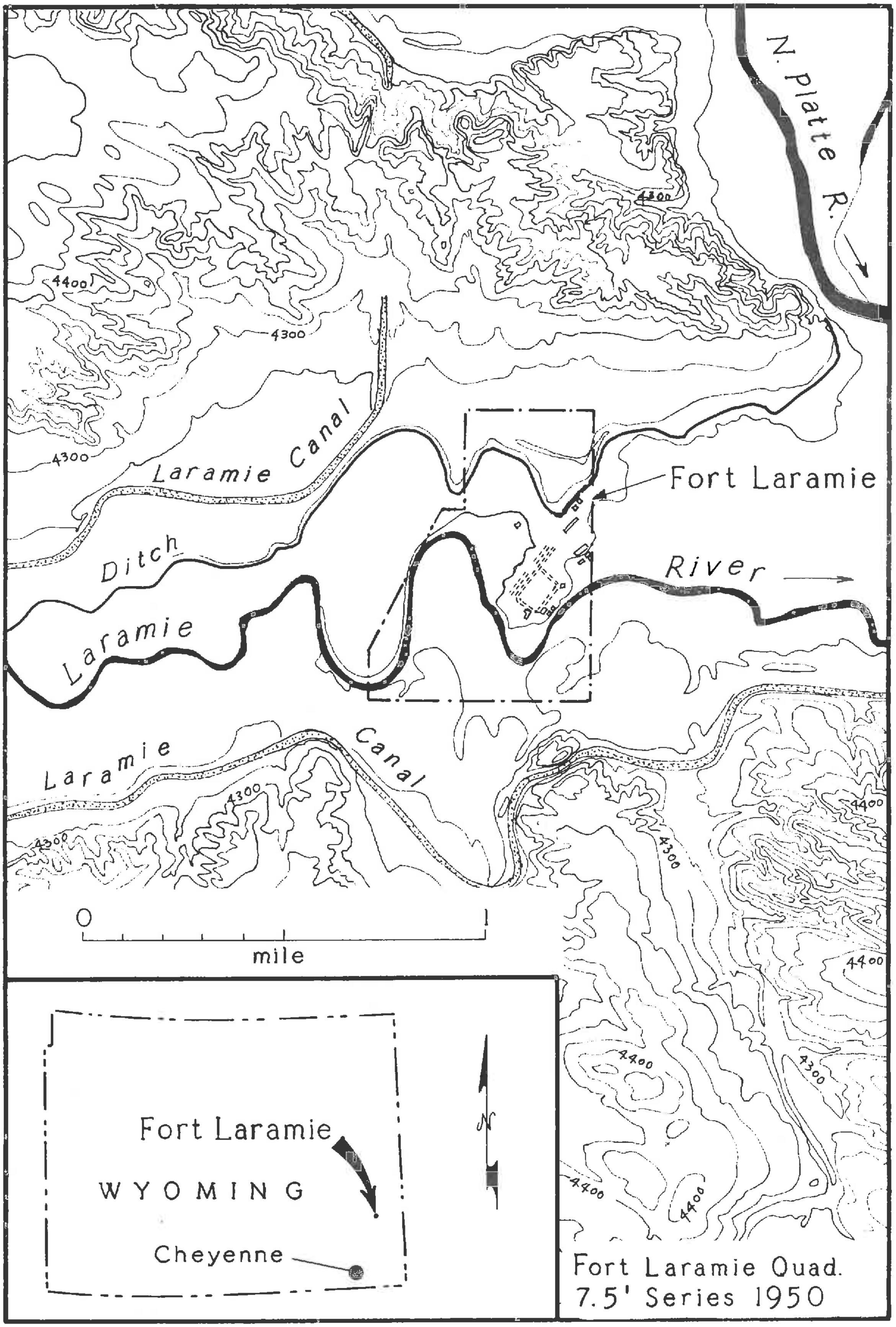

Figure 1. Geographic location of Fort Laramie National Historic Site, Wyoming.

the North Platte region until 1841 when Lancaster Lupton built Fort Platte. This second fur trading post was located along the North Platte about a mile from Fort William (Mattes 1980:7). The American Fur Company which now owned Fort William decided to build a new establishment nearby. The new trading post, Fort John, was a massive structure constructed out of adobe brick. Rivalry between Fort Platte and Fort John continued for the next few years. Eventually, the American Fur Company dominated.

In 1842, a journalist on the White-Hastings expedition to Oregon was to provide the trading post and succeeding military fort with the name of "Fort Laramy" (Laramie). During the years to follow, the great migration to the Oregon territory occurred (Mattes 1980:9-11). American activity along the Oregon trail was an unwelcome intrusion to the Amerindians, especially the Sioux and Cheyenne (Nadeau 1967). In 1846, Congress passed an act to construct military posts along Oregon Trail. In 1849, the military purchased the American Fur Company holdings and established a military presence on the Plains which was to last until 1890 (Lavender 1983; Mattes 1980).

As a military post, Fort Laramie played a vital role in the Plains Indian wars and treaties of the mid and late nineteenth century. In addition, thousands of emigrants sought protection, rest, and provisions at the post on their way to Oregon, California, and other western territories. During this period, Fort Laramie evolved from the small confines of the old Fort John trading post into a large open military post containing officers quarters, cavalry and infantry barracks, stables, commissary, hospital, and numerous other buildings. Between 1849 and 1885, over 180 buildings were constructed at the military fort site. Approximately 65 Army and civilian buildings and structures were recorded in the last official inventory of 1888 (Mattes 1980:42).

As a result of the role Fort Laramie played in the opening of the western Unites States, the State of Wyoming designated the site as a State Landmark in 1937 (Mattes 1980:124). In 1938, the national role of Fort Laramie was officially recognized by President Franklin D. Roosevelt when it was proclaimed a National Monument (Mattes 1980:132). In 1960, the park was enlarged and transformed into a National Historic Site (Mattes 1980:263-264). During the fifty or so years of federal ownership, Fort Laramie underwent numerous changes. Archaeological investigations and reconstruction of several buildings have provided the public with insight to the lives of the frontier solider, trader, and settler (Lavender 1983; Mattes 1980:54-358). The park staff has also continued to develop historic aspects of the fur trading and military establishments at Fort Laramie. An important addition to the park records was the drafting of the "Historic Base Map of Fort Laramie, Wyoming, 1841-1890" which appeared in the 1965 <u>Master Plan for Preservation and Use, Fort Laramie National Historic Site, Goshen County, Wyoming</u> (National Park Service 1965).

PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

Excavations at Fort Laramie fall into the field of historical archaeology (Noel Hume 1975). While prehistoric archaeologists are essentially left with material residue of any particular culture, the historical archaeologist is able to incorporate historical documentation (i.e., diaries, official reports, photographs, maps, ledgers, letters, and other archival records) and oral histories with the material residue. As a result, the historical archaeologist is able to cross-check interpretations based on the archaeological evidence with historical data and can "fill in the gaps that exist in the available archival and oral historical sources" (Gradwohl and Osborn 1984:165). The vast majority of historical sites have received archaeological excavations as a prelude for reconstruction or restoration rather than investigation of past lifeways (Noel Hume 1975:11). Fort Laramie is a prime example of this type of archaeological activity.

Numerous archaeological investigations have focused on the Fort Laramie military post. Interest in the fort resulted in the reconstruction of several buildings. Several archaeological investigations were concerned with proposed reconstruction or renovation projects at the old fort site, including the Old Bakery (Beaubien 1941), Old Bedlam (McNutt 1958), and the 1985 excavations in the 1874 Cavalry Barracks (D. D. Scott, personal communications, 1988).

One of the earliest archaeological activities at Fort Laramie involved the excavations of Officers' Quarters D and the Sutler's Store (Hendron 1941). Officers' Quarters D represented one of the last buildings in the series to be erected and was also one of several structures to evolve through accretion. Archaeological and historical data indicated the building developed from a two room adobe in 1855 to a multiple room, lime concrete structure in the 1880s. The Sulter's Store was constructed from adobe bricks removed from Fort John shortly after the Army purchased the property. Artifacts from the Sulter's Store reflect the operation of a private enterprise rather than military occupation. The Sulter's Store remained in operation after the Army abandoned the fort in 1890.

The 1951 archaeological investigations focused on the continued excavations of the Sulter's Store and excavations at the site of Fort John and the Old Cemetery (Beaubien 1951). During 1963, the National Park Service and the Missouri Basin Project of the Smithsonian Institution conducted excavations at the location of a proposed visitor center and parking lot (Husted 1964). These facilities were constructed in areas known to contain historic buildings relating to the military period at Fort Laramie. Archaeological excavations were conducted to insure the salvage of the archaeological evidence prior to the initiation of construction. Excavations in 1969 (Husted and Moore 1970) focused on utility lines, roads, and residences. Test excavations were also conducted in 1973 in the proposed park entrance right-of-way since prior testing indicated the presence of historic structures as well as a prehistoric occupation (Husted 1963; Husted and Moore 1970). Aboriginal and historic debris were noted in the project area. In 1984, investigations were conducted along the bank of the Laramie River (Scott and Connors 1984). Unusually severe spring flooding resulted in the erosion of archaeological material from the river banks. A number of trash deposits contained archaeological materials from the military occupation of the fort site.

PRESENT INVESTIGATIONS

The 1988 investigations involved the delineation of possible locations of numerous unidentified structures at the fort site. There was also an attempt to locate the original fur trade post, Fort William, at the park. The investigations were designed to provide the Fort Laramie National Historic Site park staff with an application of nondestructive geophysical techniques available for cultural resource management (CRM). These investigations involved the utilization of the Subsurface Interface Radar 8 System with 80 MHz and 300 MHz Antennas, magnetic tape recording, and computer processing capabilities.

Non-destructive survey techniques, such as ground-penetrating radar, provide archaeologists with a means of determining potential areas of cultural/historic significance (Vaughan 1986:595). An entire site can be profiled with the data analyzed in a short time with the use of GPR. Although it is not meant for a replacement of exploratory archaeological investigations, data collected from GPR surveys can provide the archaeologist with specific areas that need further investigation. Narrowing the area in need of testing saves both money and energy involved in the labor-intensive process of archaeological testing.

Results from GPR surveys can be instantly generated with a portable printer or saved for further analysis with a recorder and computer processing capabilities. The results can provide archaeologists with the location of cultural anomalies (i.e., structures, features, and artifacts) that require additional archaeological testing. They can also provide the archaeologist with more accurate proveniences for exploratory excavations.

Since GPR responds to variations in the dielectric properties of the subsurface matrix, it is sensitive to both metallic and non-metallic materials, unlike magnetometers and metal detectors (Vaughan 1986:595). Radar works extremely well where sharp dielectric discontinuities (i.e., buried wall, foundations, floors, and wells) produce strong echoes (Weymouth 1986:539). A major advantage of GPR is its ability to produce fairly accurate depth information. The GPR survey also supplies continuous data along the transect which is easily interpreted in the field (Wynn 1986:535). Yet another advantage of the high-resolution radar method is that it is usable on frozen or snow covered terrain (Annan and Davis 1979; Morey 1974). The ability to collect data in conditions which would limit normal archaeological excavations also provides the archaeologist with a means to assimilate pertinent data for future investigations. A major disadvantage of GPR is its inability to cope with high clay content soils (Wynn 1986:535). The clay matrix blocks the return of the radar pulse to the antenna resulting in a false reading. Until recently, costs of a GPR system have also limited its archaeological applications.

Radar profiles provide several types of information which are relevant to subsurface archaeological investigations. Two major types are the range and pattern of the echo (Kenyon and Bevan (1977:51). Additional information concerning the description of echo interpretation is provided by Bevan and Kenyon (1975).

SURVEY METHODOLOGY

The GPR survey was conducted on a "paced-grid" established with a distance measuring wheel and compass or by an individual pacing off the distance. Any future survey at Ft. Laramie would be done more formally and would be based on a mapped grid. Once the grid was established, the antenna was pulled over the transect. The antenna was connected to the Subsurface Interface Radar 8 System by means of a 50 foot cable. The System's equipment was located in the back of a pick-up truck. This allowed the geophysicists to move the antenna by itself or move the System and antenna together producing a continuous flowing printout of the data collected as they passed over the transect.

Utilization of the Subsurface Interface Radar 8 System provided instant feedback on a printer readout. Identification of anomalies on the printout allowed the team to run additional parallel and perpendicular transects in the vicinity of anomalous reading. In addition, use of a magnetic tape allowed the team to store the data for subsequent computer analysis at GeoRecovery Systems. Investigations were conducted at the Fort Laramie site and at the potential site of

Fort William.

Fort Laramie Site

The GPR survey at Fort Laramie was conducted in an attempt to locate the defensive trench system. Three transects were conducted in an area northeast of the Non-Commissioned Officers (NCO) Staff Quarters (Historical Building [HB] 146). An anomalous area occurred in the area illustrated on the Fort Laramie Historic Base Map, 1841-1890 (Figure 2); however, subsequent transects in this vicinity failed to reveal a continuous trench (Heimmer et al. 1988:3). At the north end of the transects, an anomalous area corresponded to the "Death House" (HB 183) while other disturbances correspond to the location of two cavalry stables (HB 145 and 162).

GPR transects on the west side of the New Hospital (HB 139) indicated the location of two graves originally found during structural repairs to the west wall of the hospital. A third anomalous area was located near the south corner of the Hospital. This area was detected by magnetic surveys and a two-box electromagnetic system. On the north side of the hospital and along the back of the NCO Staff Quarters (HB 146), the defensive trench system was apparently located with the GPR profiles being consistent with those expected for a large trench (Heimmer et al. 1988:4).

Fort William

Fort William was a fur trading post built in 1834 by the trading partnership of William Sublette and Robert Campbell. It existed until 1841. The fort was a quadrangle with blockhouses at diagonal corners and a large blockhouse over the main gate. The interior was about 150 feet square (Mattes 1980:6). The location of the fort is believed to be east of the military post of Fort Laramie near the confluence of the Laramie and North Platte Rivers. Available aerial photographs indicate no observable surface indications (Heimmer et al. 1988:2). Land leveling of the area during past farming utilization of the land may account for this fact.

The GPR team set up an initial "paced grid" in line with the old Army bridge across the North Platte River and oriented in the direction of the proposed location of Fort William (Figure 3). Five transects (Lines 1-5) were made over the proposed area. Figure 4 illustrates the undisturbed GPR profile along Line 3. GPR Lines 2B and 5 provided graphic representation of subsurface anomalies interpreted as the location of Fort William.

The evenly spaced, horizontal lines along the edge of the GPR profiles represent depth intervals of 1.5 feet (Figures 5-6). The units are actually units of time converted to a distance factor by calculating the speed of the wave-length generated by the antenna and its travel time between the antenna and a reflector (object/feature) in the soil (Kenyon and Bevan 1977: 51). The transmitted pulse is represented by smooth horizontal black and white lines at the top of the GPR profile. Reflected pulses are represented by more jagged black and white lines below the 1.5 foot mark. Typically, the large white band represents the ground surface. Weak reflectors, such as living surfaces, may be represented by two or three bands while strong reflectors, such as wall or foundations, may be represented by a series of five bands. The corresponding depth below the surface is generally represented by the top white band. The pattern or two dimensional shape of the reflector on the recorder profile reflects the shape and size of the individual reflector. The strength of the reflection for any given manifestation is proportional to the dimensions of the object or feature. A hyperbolic pattern characterizes any discrete reflector. Interpretation of the

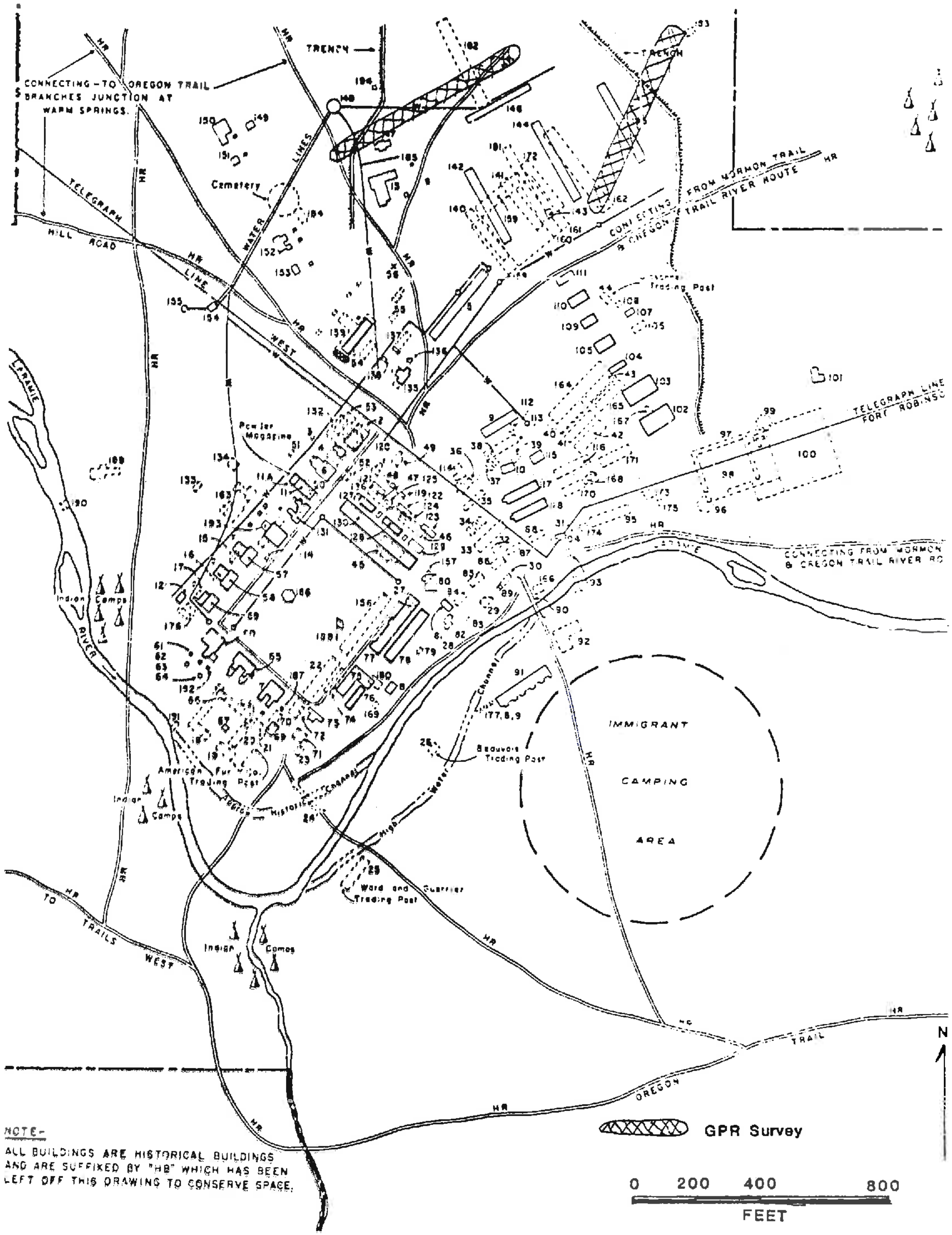

Figure 2. Historic Base Map of Fort Laramie, Wyoming (1841-1890).

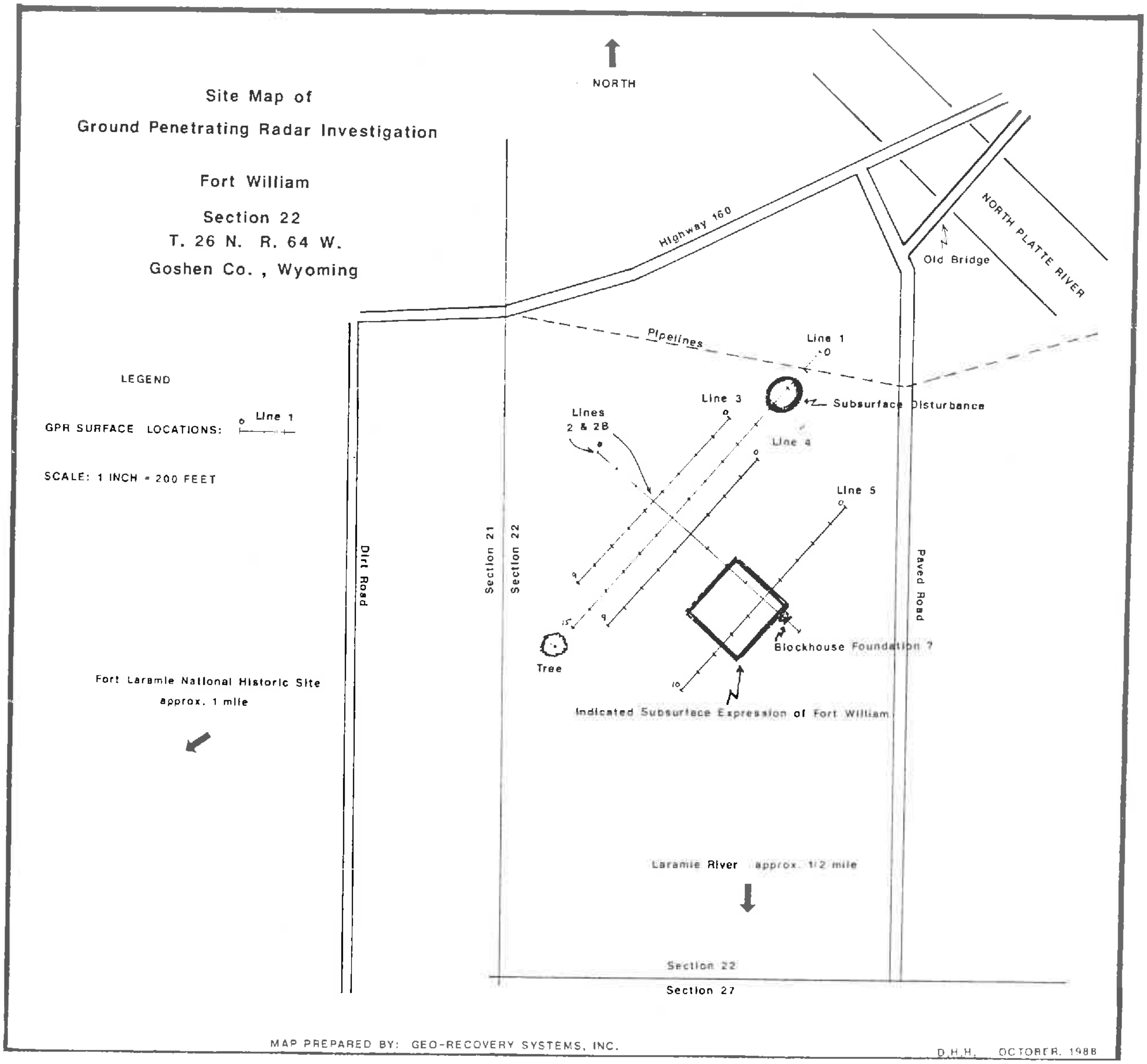

Figure 3. GPR survey at possible location of Fort William.

hyperbolic shape indicates the type of object or feature (Kenyon and Bevan 1977:52-53). In addition to these interpretative factors, "the amplitude and phase of the echo, the specular reflection of the object, the characteristic frequency of the returned pulse, and the attenuation through the medium" (Kenyon and Bevan 1977:53) must also be considered.

The profile of Line 2B indicates a disturbed area approximately 150 feet in length (Figure 5). The disturbance occurs from a depth of 1.50 to 4.50 feet. The distinct planar echo suggests a buried surface. A deeper, second disturbance occurs at the eastern end of the disturbed area. It extends from a depth of 6.00 to 9.00 feet. The radar echo is represented by a series of arcs which are interpreted as a wall trench or foundation. The interpretations of the profiles suggest the location for Fort William (Heimmer et al. 1988). In addition, surface inspection of the area indicated the presence of historic materials (i.e., bottle glass and metal Infantry button).

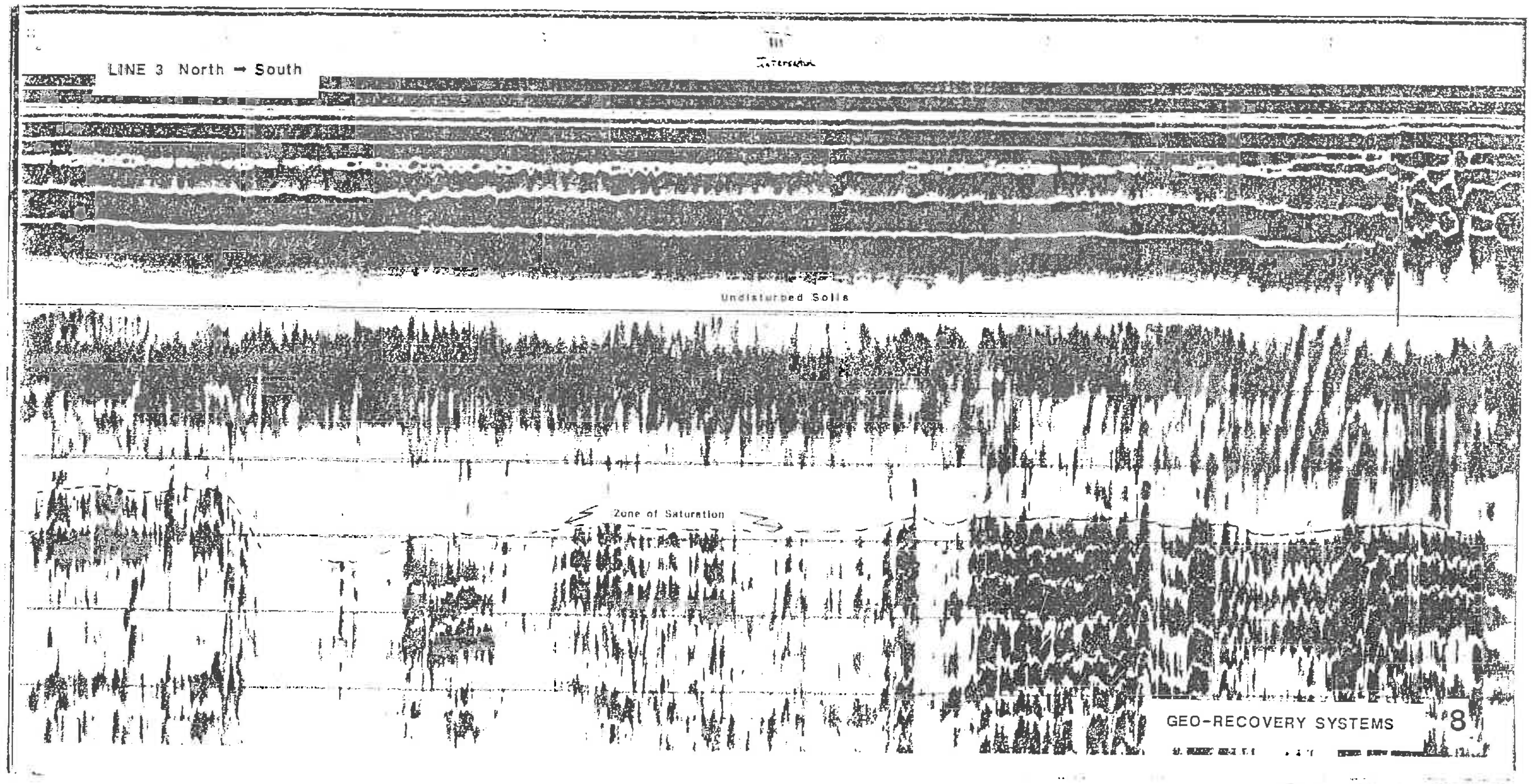

Figure 6. Anomalous GPR profile along Line 5 showing possible historic surface, Fort William.

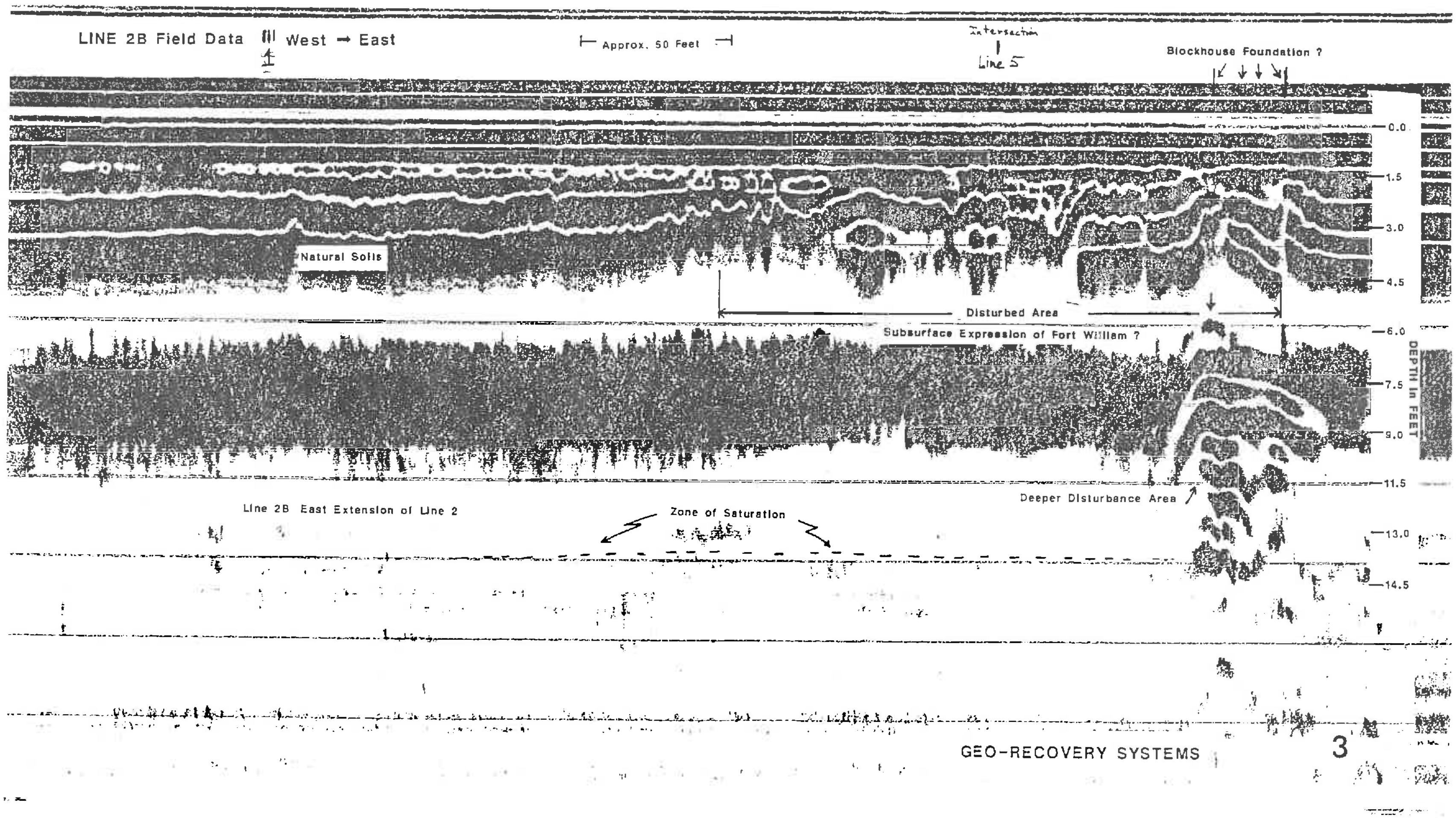

Figure 4. GPR profile of undisturbed area along Line 3, Fort William.

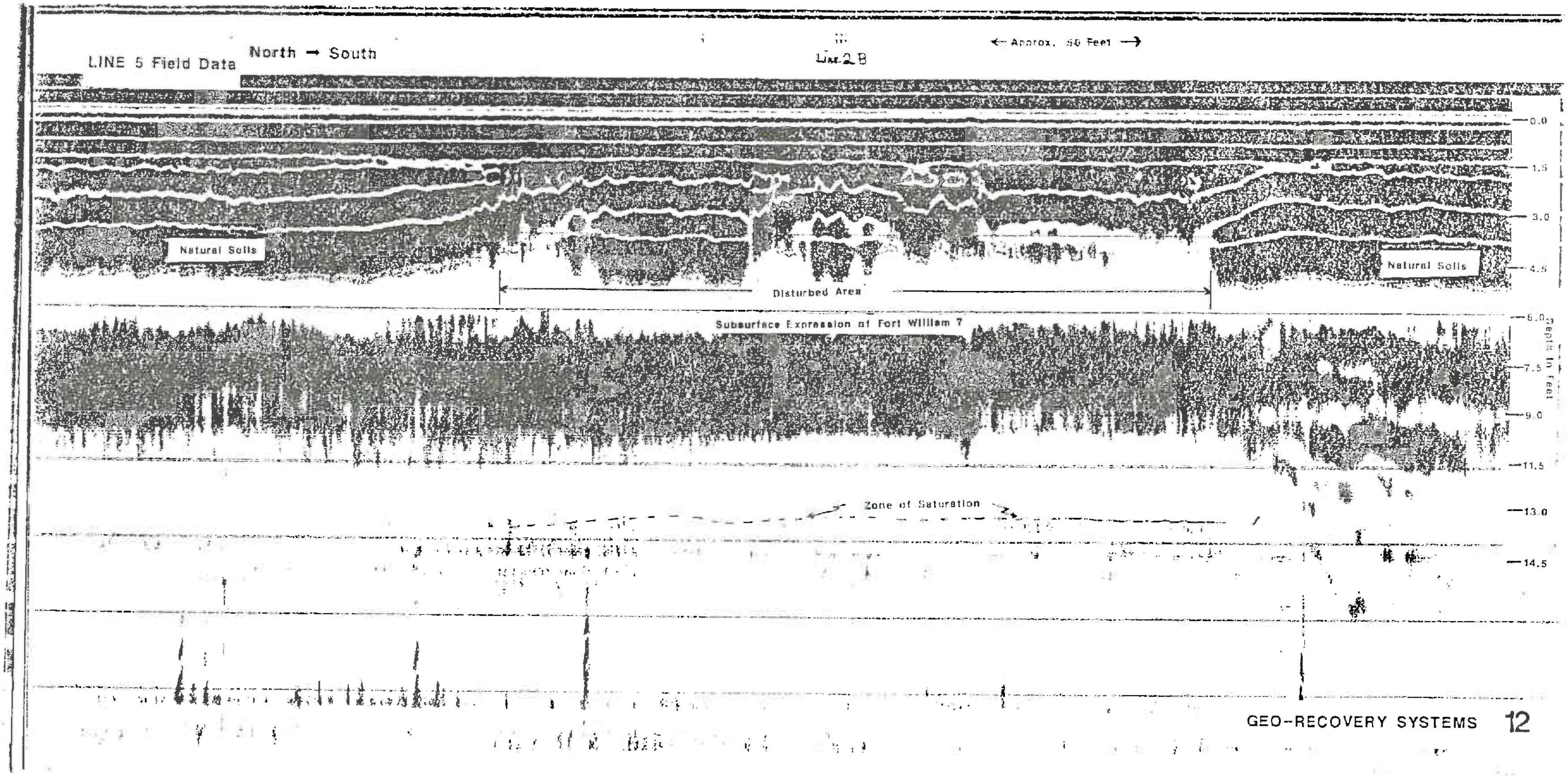

Figure 5. Anomalous GPR profile along Line 2B showing possible historic surface and blockhouse trench/foundation, Fort William.

Line 5 represents a north-south transect across the anomalous area identified in Line 2B (Figure 6). The disturbed area in Line 5 occurs at 1.50 feet to 4.50 feet beneath the surface corresponding with that identified in Line 2B. The disturbance continues for a distance of approximately 200 feet.

Interpretation of the anomalies by the geophysicists indicate that the anomalies represent cultural influences (Heimmer et al. 1988). The location and dimensions of the disturbed area in Lines 2B and 5 are consistent with those reported for Fort William. In addition, ancillary structures are indicated by other subsurface anomalies in the vicinity (Heimmer et al. 1988: 3).

The next step in the investigation of the location of Fort William would be additional GPR transects along an established grid at regular intervals. Following the non-destructive survey, there is a need to conduct limited archaeological testing of the anomalous areas in order to establish the exact nature of these areas. While the GPR profiles provide a clue as to the location of Fort William, it can not be verified without visual and artifactual documentation.

CONCLUSIONS

The amount of time spent conducting the GPR transects is far less than would be needed for an archaeological survey assisted by shovel testing. The depth of the possible cultural manifestation of Fort William is below the typical shovel test depth although the use of auger holes would penetrate to the cultural level. It is also highly possible that a archaeological survey of the area would have a negative result. Incorporation of GPR surveys and other types of non-destructive geophysical techniques with archaeological methodology can provide the CRM personnel with a means of locating and identifying buried cultural phenomena. This especially true for multi-use sites, such as Fort Laramie, where numerous alterations and building episodes have occurred.

Advantages of the ground penetrating radar include continuous and rapid accumulation of data, immediate feedback, non-destructive nature, ability to penetrate a variety of mediums (e.g., soil, wooden floors, pavement, etc.), and operation in wide range of climatic conditions (Vaughan 1986:595). A major disadvantage is the inability of the radar system to operate in soils high in clays. Cost factors in a radar survey do not substantially differ from other forms of geophysical surveys (i.e., magnetometer).

Ground-penetrating radar displays a potential for CRM planners. The ability of the radar system to work in numerous types of material and under a variety of conditions lends itself to non-destructive archaeological survey. Applications useful to CRM planners and archaeologists include: 1) mapping of buried structures, 2) locating buried artifacts, and 3) identifying anomalous areas quickly. Although the use of ground-penetrating radar is not a panacea for archaeological investigations, it can provide initial data concerning the location of cultural deposits.

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THE OBSERVATIONS OF AN AMATEUR ARCHAEOLOGIST

by

Joe Bozovich

Being an amateur interested in archaeology, I have taken several courses in field methods, excavation, testing, and archaeological lab methods. Because of this background, I felt that I had a good idea of the problems that would come up in doing an archaeological survey. Several years after taking these courses, I did a little survey of my own, using the latest U.S.G.S. topographic quad maps to plot the different features located on a survey area. This was not a scientific survey, only what an interested amateur could do.

The area surveyed is located on the southeastern flank of the Rock Springs Uplift, and along the east flank of Cooper Ridge (Figure 1). The Erickson Sandstone Formation forms Cooper Ridge which rises to a height of about 700 feet (213 m). With the prevailing winds from the west, this gray and brown sandstone is a probable source of supply for the dunes located about two to three miles (3.2-4.8 km) to the east. On the western side of the dunes there are some small gray sandstone outcrops about 20 ft. (6 m high), that could also help to re-supply the dunes to the east. This line of dunes is about 3-4000 ft (914-1524 m) wide. Its approximate bearing is N25E, the dip or pitch at the nearest outcrop is eight degrees, and the bearing of the dip is S48E. The area surveyed is about nine miles (14.4 km) long, with a good supply of water from a series of springs at the south end of the survey. Also, there is a strong possibility of some springs in the center of this survey, which I will explain later.

The sand in this area is the color of the sandstone outcrops, medium gray to medium tan or buff, with the texture being medium course to medium fine. Some of the sites have a buff colored soil that is natural in the area, especially where the wind has eroded the sand away. The sand is of aeolian deposition, with some alluvial deposition near the valley floor.

OBSERVATIONS

Starting at the south end of East Saltwells Creek and working to the north to Black Butte Creek, it was no problem to locate the open campsites. Some were located in the dune pockets and sand shadows, or both leeward side and windward side. Since the prevailing winds are generally from the west, this type of terrain was a natural for open campsites.

I feel it appears the most important aspects the Indians had in selecting a campsite were the following:

(1) Wind protection. Since the wind is fairly constant from the west, both winter and summer, they needed some protection. During the summer, it is possible that they had some type of brush shelter, especially if they were to stay in the same area for a long time. During the winter, it is possible that they had some type of brush shelters or a combination of pit house and brush shelter. This can only be proven by excavation of the open campsites.

(2) South or southeast exposure. This exposure was a little warmer in the winter in the

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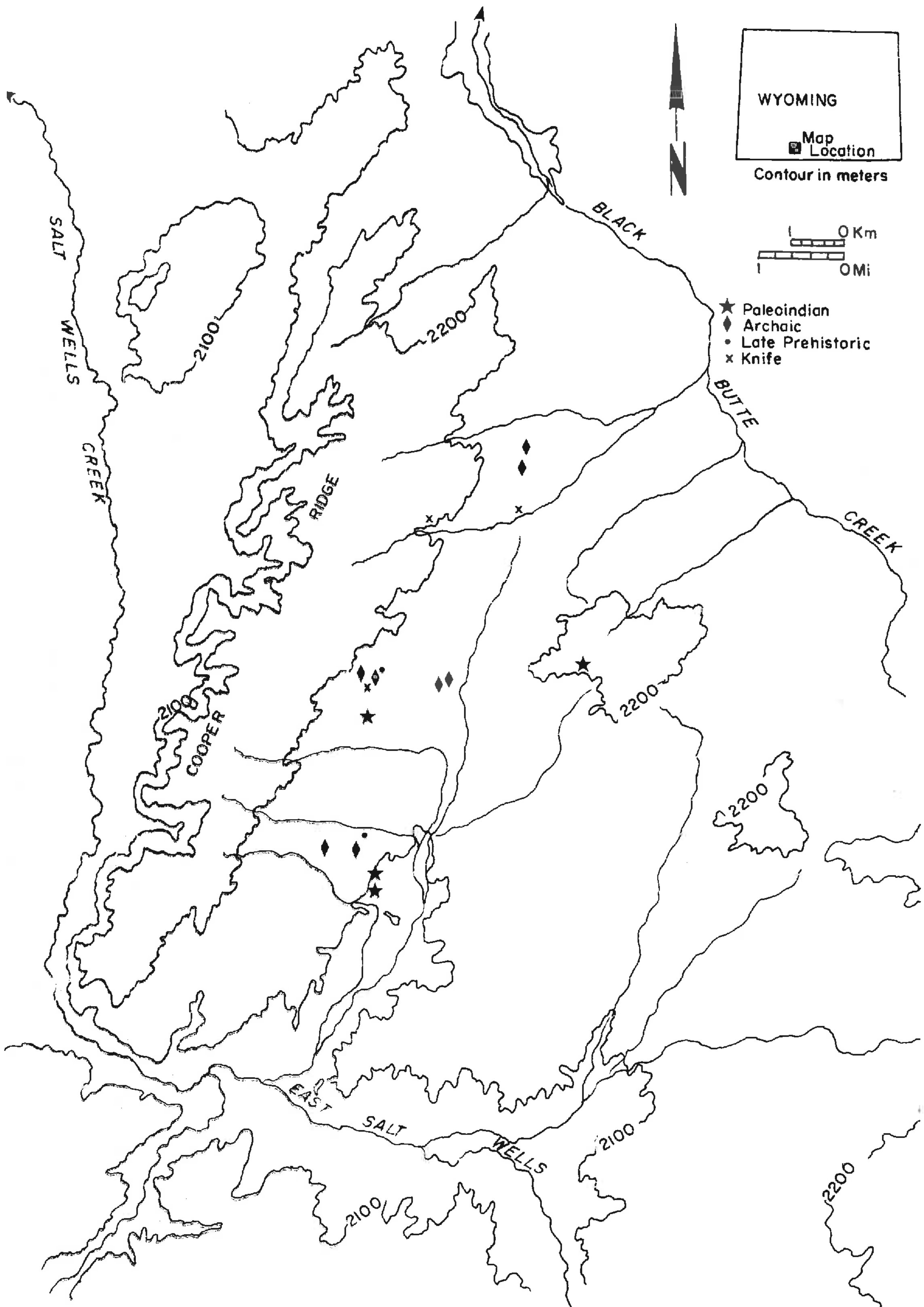

Figure 1: Map of survey project area showing distribution of diagnostic artifacts found.

early mornings, and a little cooler in the summer evenings.

(3) Sandy soil campsite. They probably preferred sandy soil because it was more comfortable to live on and would be easier to clean if they were there for a long time.

(4) Visibility. They also preferred, if possible, a campsite with a good overview of at least 180 degrees in visibility.

(5) Good food supply. This was a very important factor because the better the food supply, the longer they probably stayed in the same campsite.

The area that I surveyed had a good supply of deer, pronghorns, coyotes, rabbits, sage chicken, badgers, prairie dogs, gophers, muskrats, beavers, foxes, bobcats, mice, rats, ducks and some geese. It is more than likely that there were some bison around, as well.

The Indians also needed a good supply of the different kinds of grasses that they could harvest for seeds at the proper time when they were ripe. The flora for this area consists of Indian rice grass, buckwheat grass, wild onions, foxtail barley, great basin wild rye, primrose, Indian paintbrush, dandelion, sage brush, salt sage, willow, greasewood, juniper, aspen, prickly pear cactus and rabbit brush. This flora could be harvested during the spring or summer, whenever ripe.

Most of the campsites were small and marked mostly by fire cracked rocks. I looked first for small pieces of fire cracked rocks that were colored. Red, black or gray sandstone was the only type of material available in this area. The fire cracked rocks ranged in size from one to five inches (2.5-12.7 cm). Occasionally I found a small piece of quartz. The quartz had to have been carried in, because it does not occur naturally in this area.

Most of the small campsites had very few flakes. Any debitage that was there consisted of Black Buttes speckled gray quartz, or light tan chert. This material is available on Black Butte Mountain, or the Delaney Rim area. I also noted some dark brown chert which can be found of many different colors in the Cedar Mountain area. Very little obsidian was found on this survey.

I always check ant piles, and it seems that ants like to build their home on top of old fire hearths if there are any around. I have often wondered why. Is it because there is still a small amount of grease or smell in the sand from the Indians' cooking fires? In checking some of the ant piles, I noticed that the ants had moved some small pieces of retouch or pressure flakes onto the sides and tops of the piles.

As I continued my survey, I also noticed that around some of the campsites there were some small slabs of light brown sandstone. These measured about eight to ten cm long and one cm thick. Having seen this same feature many times, I can only speculate that they were used as plates while eating around the campfire. The slabs were usually on the windward side of the fire hearth. They were never discolored, always light brown. Sometimes there were slab-lined fire hearths on the site and sometimes not. It is possible that the slabs could be used for holding down animal hides. Also, the slabs were not the proper material for making metates. If these slabs were to be used as plates when eating, I think it would be easy to count how many people sat and ate around these campfires. It would be necessary to do some scientific research to confirm this speculation. There could also be other possibilities for use of the slabs. Later in my survey, I noticed several pieces of pottery and some red fire cracked rocks, but no artifacts. I did finally find a graver, but no other artifacts. Several days later, I went back and surveyed farther north and located a small mano and a small end scraper, but no metates. It is my opinion these people were hunters and gatherers. With the evidence they left on the surface, it can be a very interesting puzzle.

I never did find any metates on this survey, although I am sure that the Indians used them. Most metates that I have seen weighed from 15 to 30 lbs (7 to 15 kgs). I think it would be quite a burden to carry one unless they stayed in a campsite for quite a long time. Also, the material they used at other localities to make metates is quite scarce in this area.

I believe that they used snares to catch rabbits, prairie dogs and gophers. The various grasses and roots were eaten whenever they were ripe. In surveying farther north, I did locate a medium sized campsite that had several fire hearths and a fair amount of debitage. On the outer edge of the site, I found an end scraper made of orange chert that was slightly worn, and a Black Buttes speckled chert biface. I was hoping to find other artifacts so that it would give me an idea of the age of this site, but no luck.

At several of the smaller sites I noticed quite a few cracked bones, such as would come from rabbits, gophers or sage chicken. There were also some bone fragments that were larger, such as would come from deer or antelope. They were probably crushed to get to the bone marrow, for grease and for making soup. In a small gully near this medium-sized site, I noticed some tall wheatgrass, Great Basin wild rye grass and some others that I did not recognize.

I believe that winter snowdrifts would accumulate here and melt very slowly into a sandstone formation that would release the water slowly. This could supply water for several months depending on how large the snow drifts were. With the rainfall being only an average of seven to nine inches (17.8 to 22.8 cm) for the year, every little bit of water would help. However, there was a good supply of water about three miles (4.8 km) to the south.

After surveying farther north, I finally located a large base camp on the south slope of a rolling hillside. Fire-cracked sandstone rock was scattered about. There was also large amounts of debitage such as gray chert, tan chert, and speckled gray Black Buttes quartz. I also found both rocklined and unlined fire hearths. On some parts of the site, you could see some of the occupation floor as they had left it, except where there was erosion.

I finally did find some projectile points (Figure 2) made of gray chert. There were several corner-notch points, several Elko corner-notch artifacts, several end scrapers and one Mallory artifact. In checking out the north slope from the hilltop down to the bottom of a large gully, there was still some debitage scattered. Down in the gully bottom I noticed some tall grasses, like Great Basin wild rye and wheat grass, plus some short grasses and others that I did not recognize.

I think that there is a very good possibility that there was a spring here in the past. This could be a very good reason for the large base or residential campsite to the south and north. Was this a permanent campsite during the winter and summer, or only seasonal? Excavation by professional archaeologists could give us the answer.

In surveying still farther north, I found a broken corner tang knife that was converted into an end scraper (Figure 3). This tool was made of orange jasper or chert. Some Elko corner notch artifacts were also found. About four miles (6.4 km) north of the large base campsite, I located another possibility of a spring. There were some campsites in the area nearby, but not as large as the one to the south. Of course, there were other small sites between the two springs.

One site near the spring had several Rose Springs points and a large knife

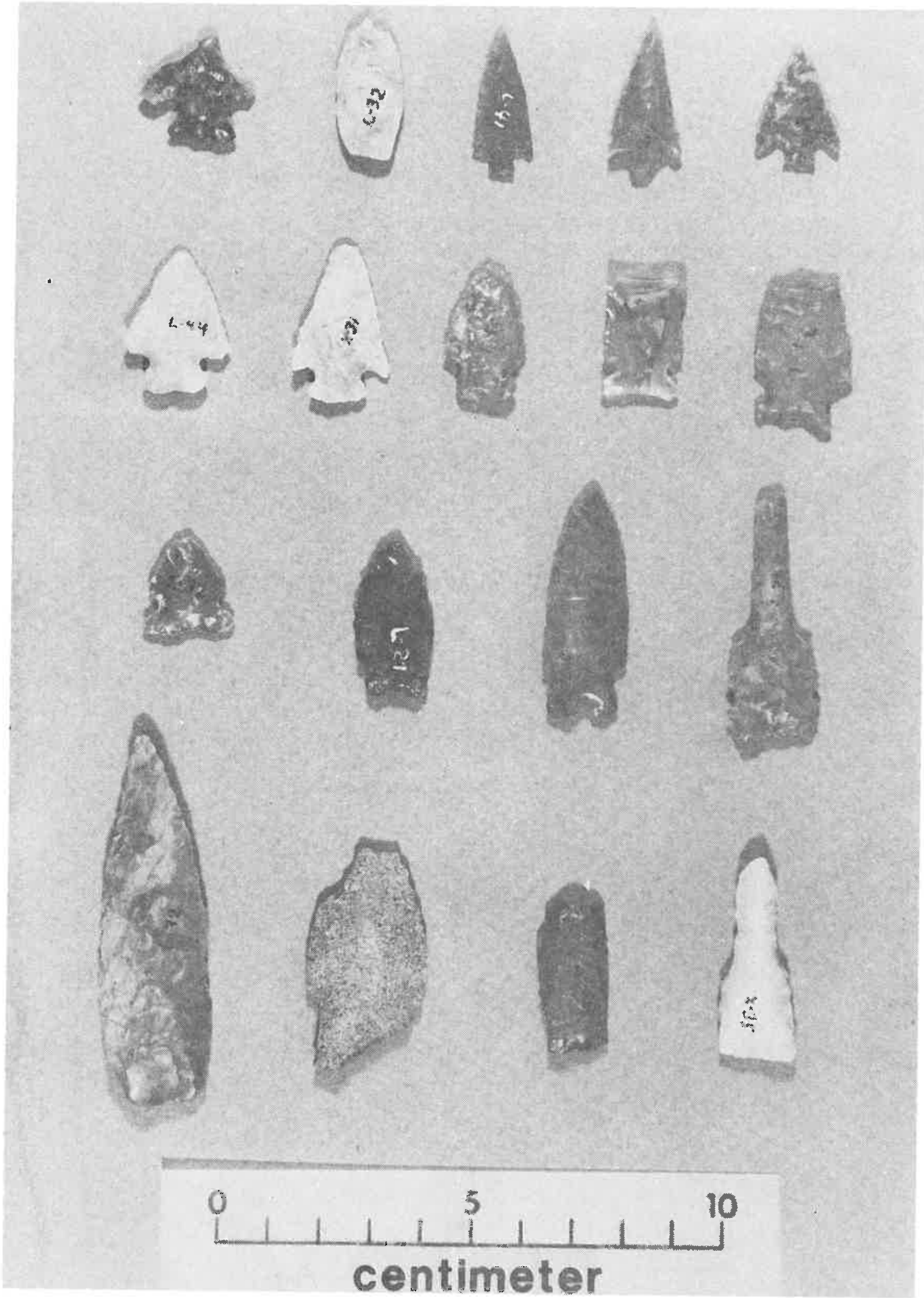

Figure 2: Photograph of representative projectile points and drills. Projectile points represent Paleo Indian (bottom row), Archiac (second from bottom row) and Late Prehistoric occupations (top two rows).

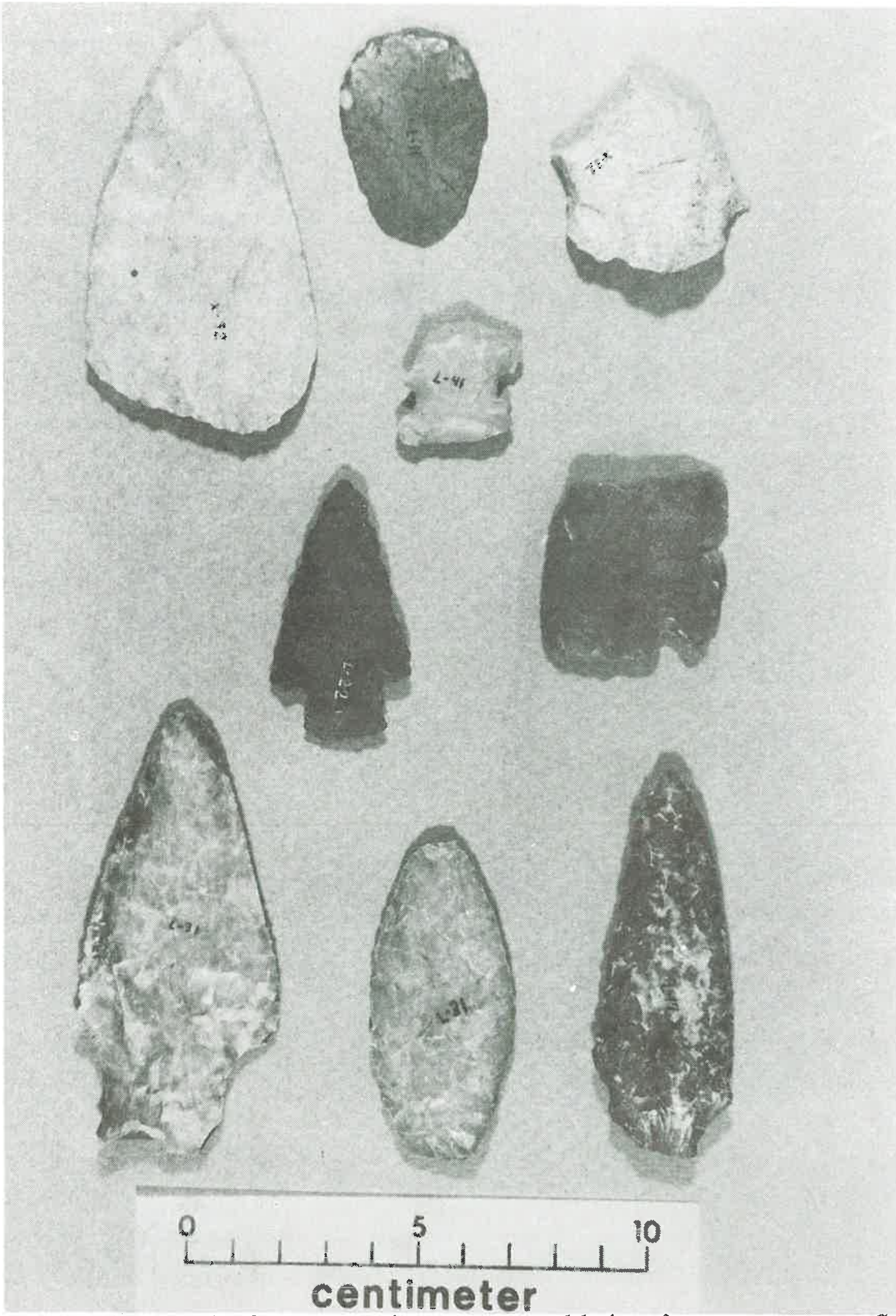

Figure 3: Photograph of representative scrapers and knives from survey area. Specimen X-32 (upper left) is a three pronged spurred scraper. Specimen L-41 (second row, middle) is a hafted end scraper. Specimen L-11 (third row, right) is a tang knife.

that had been re-sharpened. In surveying still farther, I found a site with a little pottery, but not nearly enough to reconstruct a complete vessel. Also farther north, I found a side notch hafted drill and later a Mallory artifact and an end scraper. In surveying even farther, several small sites were located that had some Elko side notch artifacts and scrapers. Later I found a site with a biface and some broken parts of artifacts. My survey ended near a well-traveled road.

This particular area did not have any caves, although there are cliffs in the area. The cliffs faced to the west, which meant that there was no wind protection. Also, the cliffs facing the west did not have any petroglyphs. I think the reason for this is also the lack of wind protection. At the south end of this survey there were several panels of petroglyphs, but they face south, with some wind protection. I also located one stone circle on the top of a sand dune, which is a very unusual place for a stone circle.

SUMMARY

In summary, I believe that these Indian campsites are typical of the hundreds of campsites in southwestern Wyoming. The Indians preferred to locate their campsites in and around sand dunes. There are a few that are not, but very few. Most of the sites were small. If the food supply was short, they moved to a better supply. The better the food supply, the longer they stayed. A hunting and camping pattern can be developed where there is an abundant supply of large and small animals and grasses. If they found a good food supply in the fall, they could store for the coming winter. I can only speculate that most of these campsites were used by small family groups and that some campsites were used several times over. I believe that these sites were used between the Archaic period and the Late Prehistoric period, about when the bow and arrow was introduced on the plains of Wyoming. All the artifacts found in this survey were cataloged, and the sites plotted on U.S.G.S. topographic maps. The IMACS site form was filed. All data was entered and filed on my computer using the D-BASE 3 PLUS program. This very interesting survey took me several summers to complete and I enjoyed doing it very much.

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BOOK REVIEWS

Ecology and Human Organization on the Great Plains. DOUGLAS B. BAMFORTH. Plenum Press, New York, 1988. figures, tables, references cited, index. $29.50 (cloth).

The title of this book may seem daunting. In fact, the volume is eminently readable. Bamforth presents a series of complex arguments in clear, well-written prose that will give no problems to the interested non-professional archaeologist and reader.

Bamforth is investigating a topic of great interest in Plains anthropology: Is there a relationship between how human groups are organized and the environment in which they live? The question itself is not new, but Bamforth's perspective on it differs from many others.

In essence, Bamforth argues that there should be a link between the predictability and abundance of subsistence resources and the number of social roles within a society. Most of the rest of the study is devoted to an examination of this proposition, using information from the central Great Plains.

Bamforth first examines the general climatic and forage conditions that determine the predictability and abundance of modern bison herds. Against this information, the behavioral ecology of ungulates is examined. The study then turns to a specific consideration of the modern forage production characteristics of the Great Plains. The historical record of bison aggregation and predictability is then examined. This is a thorny topic for which many different interpretations of historical climatic data have been made.

Bamforth takes the position that historical forage patterns were similar to modern patterns and, perhaps more important, the qualitative differences between different subregions of the Plains are fixed by physiography and climate, although the absolute amounts of forage produced may change through time.

After this foray into historical records, Bamforth then considers the movement of "tribal" populations on the Plains from the mid-seventeenth century to the mid-nineteenth century. Measures of resource availability within tribal territories (ca., 1850 A.D.) and measures of social complexity are then derived and compared to the model's predictions. Bamforth's analysis finds that the general model does work, and, interestingly, component factors (such as precipitation) are not correlated with social complexity.

The final sections of the study attempt to examine changes in organizational complexity of Paleoindian groups on the southern High Plains (the Llano Estacado and Middle Pecos valley). This is perhaps the least convincing part of the study, since only indirect measures of social complexity can be used. Bamforth admits that this is problematic. As a proxy measure, site locations and types are used to argue that there was organizational change and (perhaps of greater importance) that the change is detectable archaeologically.

This brief summary does not do justice to a study that weaves together many current threads in American anthropology and also presents a large amount of information. I suspect that there will be many questions and opinions raised by some of the ideas in this book. For example, the section on historical movements, from the perspective of the relationship between ecology and human organization, will undoubtedly draw detractors. This will happen, inevitably, because of the rather poor historic and protohistoric records of tribal movements. A similar problem is present in the discussion of Paleoindian group organization. Changes in site locations and types through time are a thorny problem in archaeology, even without considering how one defines "site types" operationally. Patterns in site location may be more suggestive of erosion that exposes sediments of appropriate age. So too, the definition of site types, based on tool assemblage size and composition, may be more a typology of site re-use than a measure of how a place was used during a single occupation.

Nonetheless, the degree of controversy generated by a book is often its best measure. Ideas that are current and plausible should always draw some degree of argument. The other alternative for a study is quiet death. I do not think this book will achieve this latter destiny. Its accessibility to readers, regardless of their backgrounds, and its interesting combination of arguments and data make this an important work for both the professional and avocational archaeologist.

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Time, Energy and Stone Tools. Edited by ROBIN TORRENCE, Cambridge University Press, 1989. 130 pp., tables, line diagrams, $44.50 (cloth).

The study of human technological organization involves more than just the analysis of the artifact itself. The analysis considers tool location on the landscape, the relationship of tools with other artifactual and ecological remains in the archaeological record, and the social context of tool use. The development of a theory about the relationship between human technological behavior and the tools produced is an explicit goal of such studies. As is often the case, borrowing from other disciplines marks the initial stages of theory development. Time, energy and stone tools, edited by Robin Torrence, is no exception, as it addresses theoretical issues in lithics research from the perspective of evolutionary ecology. This volume contains ten articles and an introduction by Robin Torrence.

Tools are one way that humans have available to them to solve problems. All articles in this volume view technology as an efficient part of a larger cultural system and except for Joan Gero's article, as the by-product of subsistence pursuits. Most articles in this volume identify one primary factor that determines technological efficiency. It is assumed that humans attempt to optimize the selected factor (e.g., energy, time, information, or the avoidance of risk to make more efficient use of time). Tools are a direct reflection of that optimization. The predominant tools studied in this volume are chipped stone, but ground stone is also considered in one article (Roger Boydston's).

In the introduction, Torrence divides the articles into two parts. The first part contains articles that focus on how tools vary with fluctuation in external con straints, such as raw material availability, energy, and time. Brian Hayden sees the evolution of different tool resharpening techniques throughout human prehistory (from hard hammer to soft hammer, flake and blade production techniques to pressure flaking) as the result of energy conservation tied to the availability of raw materials and cutting requirements. Articles by Carol Morrow and Richard Jeffries, Robert Jeske, Rochelle Lurie and Roger Boydston analyze material from the American Midwest. These authors attribute technological change to shifts in human mobility that led to differential access to stone tool raw material sources. Boydston argues convincingly that different mobility patterns and the amount of time invested in procurement, production and maintenance may be used to explain the co-existence of ground and chipped stone axes and adzes in the Archaic of the American Midwest.

Torrence's second category of articles discuss how tools vary in a problem-solving context and then predict optimal solutions from that discussion. Andrew Myers and Robin Torrence argue in separate articles that tools vary to avoid risk in the efficient budgeting of time. Torrence develops a theory of what types of tools should be expected given differences in risk and mobility. One failure with this article is the absence of links between the proposed theory and its application to the archaeological record. Myers, on the other hand, applies a theory of risk avoidance to archaeological remains from the British Mesolithic. Myers further argues that changes in tool forms are related to changes in the resource base through time.

In a unique approach for this volume, Joan Gero argues that technology is manipulated consciously to gain power and reinforce social status through the inclusion of information in tools. For example, "rare materials in the archaeological record can encode information about the social relationships that operated in a society" (p. 93) in that rare materials are more prestigious because they are more costly (energetically). This and other expectations about differences in tool longevity, size, production stages, and restrictiveness of production are tested with archaeological examples from Peruvian early ceramic periods. Gero fails to tell us anything new (projectile points and bifaces are argued to be better transmitters of information because of their longer lives and greater time investment). However, the article is thought provoking and a refreshing approach to the meaning of stone tool variability.

The article by Eileen Camilli, belonging in a category by itself, develops innovative methods to link a theory of artifact use and expected artifact densities with the archaeological record of Cedar Mesa, Utah. Camilli's recognition that the archaeological record is different from prehistoric human behavior and development of methods with which to link the two are unique to this volume. While all other authors in this volume assume the archaeological record reflects human behavior directly, Camilli emphasizes that understanding the archaeological record structure must precede any behavioral inferences.

In the concluding chapter, Michael Jochim provides an interesting critique of the application of evolutionary ecology to the study of human technological organization. Jochim recognizes that technology is embedded within the larger environmental system (here I include both the natural and the social environment). This technology tends to vary according to internal or external constraints. However, the preliminary nature of the theory of technological organization is also emphasized. Because of this, there are several problems that result from oversimplifying cultural behavior and the reduction of all technological variation to only a few determinants.

This volume, dedicated to Lewis Binford, suffers at times from an unquestioning application of Binford's collector/forager jargon. There are also occasional typographic errors and some of the articles are difficult to understand. However, it does illustrate some new approaches to the study of lithic technology and technological organization. This book is aimed primarily at a professional audience. However, be Time, energy and stone tools would useful for anyone interested in the newer, theoretical approaches to stone tool analysis. Like many Cambridge University Press books in the New Directions in Archaeology series, this book is not available in paperback and is quite expensive.

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