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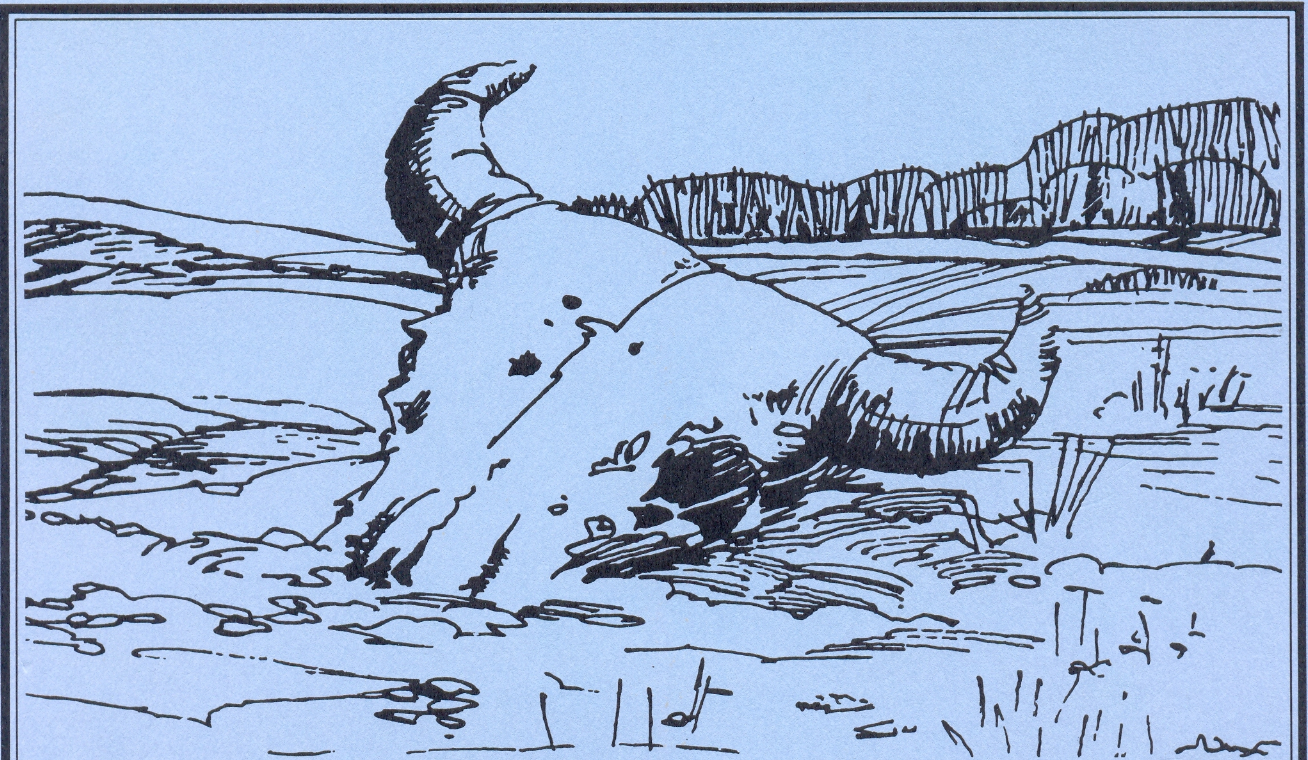

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ARCHAEOLOGY IN ALBERTA, 1986

Compiled by

Martin Magne

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ARCHAEOLOGY IN ALBERTA, 1986

By
John W. Ives
Archaeological Survey of Alberta

During 1986, the Archaeological Survey of Alberta continued to undergo as much or more change as has occurred at any time since the founding of the organization. Much of this change has come simply through shifts in personnel. In recent years, Paul Donahue (formerly Director), David Burley (formerly Head of Research), Ray Le Blanc (formerly Northwestern Archaeologist), and Bob Vance (formerly Palaeoenvironmental Research Officer) have left the Survey. In March of 1986, I became Director. After a brief sojourn as Northwestern Archaeologist, Martin Magne became Head of Research in June, 1986. Later that summer, Milt Wright became Boreal Archaeologist. In February of 1986, Alwynne Beaudoin became Palaeoenvironmental Research Officer.

Other changes in 1986 followed upon the difficult budgetary situation which has prevailed in Alberta. Because of fiscal cutbacks first felt at the end of 1986, the resources with which the Archaeological Survey of Alberta once operated were sharply limited. This has been felt particularly in the loss of two positions. The coordinator's position for subdivisions and integrated resource planning, occupied by Barry Newton, was abolished. The capacity to take part in the government's integrated resource planning process is so critical, however, that we have devoted a vacant position (formerly for the Northwestern Archaeologist) to this function. The position, now called the Resource Planning Archaeologist, has been filled by Barry Newton, who will carry out field and administrative duties.

A position in the Research Section, occupied by Heinz Pyszczyk, was also abolished in the same series of cutbacks. However, we had access to another vacancy in consequence of a long-term disability. Given the scale of historic archaeology needs now evident, particularly in support of interpretive developments conducted by the Historic Sites Service, the function Heinz fulfilled had to be maintained. The available position was committed, therefore, to continued work in historic archaeology.

The year 1986 for the Archaeological Survey of Alberta can best be characterized as one of bringing outstanding projects to fruition. Staff archaeologists were asked to make every effort to clear up reports and publications ensuing from work already initiated. This was not simply to clear the slate, but so that we could gather ourselves for some joint efforts at research projects of great significance.

Most important in this respect was planning for a "First Albertans Research Project," designed to explore how Native peoples first came to Alberta. There is a consensus amongst staff that, in all probability, the ice-free corridor played a pivotal role in this. A key component of the planning which went on in 1986 was to identify productive ways of searching systematically inside Alberta's portion of the corridor. Early thinking in this vein has stressed topographic predictions of site location based on sites like Vermilion Lakes and Sibbald, which are known to be relatively early. We also solicited from field personnel in a variety of agencies information on rock shelters and caves, mindful of the example of Bluefish Caves in the Yukon. With the resources currently available to us, it is not possible to search extensively in so large a region as the approximately 40,000 square kilometres of the corridor. Nevertheless, it is possible to search systematically and intensively at the best locations, and this premise will guide future work.

The configuration of Late Wisconsinan ice sheets in the eastern slopes region and the biophysical conditions within the prospective corridor are still not well understood. Another key objective of the project will be to enhance our knowledge of these issues. Alwynne Beaudoin will work closely with archaeological researchers involved in the project (including myself, Martin Magne, Milt Wright, Brian Ronaghan and Rod Vickers) to synthesize palaeoenvironmental information for the corridor region and to undertake original research on selected problems concerning palaeoenvironmental conditions inside the corridor.

"First" Albertans research has been defined in a liberal way, and our interest in this time period does extend to later Palaeo-Indian sites, which may represent the first concerted occupation of the province. Rod Vickers began planning long-term strategies for deriving more information about the Fletcher site in southern Alberta, an Alberta-Scottsbluff bison kill, in this connection.

In concluding this initial brief description of the First Albertans Research Project, I should add that the focus is upon a team approach, with interdisciplinary objectives. The Archaeological Survey of Alberta would welcome overtures from other researchers prepared to commit time and resources to the topic under consideration. Over the next several years, I expect the Occasional Paper series will provide information on our progress on this research topic, which I think can be said to be of international significance.

There is a conceptual connection between this research project and another which was planned in 1986. Through the Department of Anthropology, University of Alberta, I was so fortunate as to meet delegates from the Heilongjiang Provincial Relics Committee. Heilongjiang, China's northernmost province, is one of Alberta's sister provinces. The Heilongjiang officials expressed an interest in seeing Canadian archaeologists visit their province in order to exchange ideas about methods and procedures in archaeology and matters such as cultural resource management.

Most intriguing of all was the prospect of visiting sites and examining collections which document a human presence in northern China in excess of 20,000 years ago. Much as Alberta might be viewed as the first destination south of the Late Wisconsinan ice sheets for the ancestors of today's Indian populations, northern China is clearly one of the regions of northeastern Asia which could be implicated as the ultimate source for such populations. The initial contacts with Heilongjiang officials in 1986 led to a scientific exchange concerning this subject, the results of which will be reported in succeeding Occasional Papers.

On a smaller scale, 1986 also saw limited planning for a "Lithic Source Study." Through a variety of efforts, the Archaeological Survey of Alberta already has been engaged in the recovery and characterization of raw stone materials with sources in Alberta and elsewhere in western North America. Since the Archaeological Survey of Alberta could readily play the role of "clearing house" for information of this sort, we will begin systematic efforts to establish comparative collections of both common and exotic raw stone materials employed in tool making in this province. Once again, researchers with a special interest in this topic should feel free to contact the Archaeological Survey of Alberta, and in particular, Dr. Martin Magne, Assistant Director for Research.

As was reported in the last Occasional Paper, the Archaeological Survey of Alberta had underway by early 1986 two projects expressly designed to further public appreciation of archaeology in Alberta. One of these projects, the "Traces, Stories and Choices" series of posters, was completed in the fall of 1986. The images involved, rendered by Marna Bunnell and Brian Noble, have been the subject of many positive comments in Alberta, across North America, and from various points elsewhere in the world. The second project, involving work on a trade publication for lay audiences, continued throughout 1986. That volume, entitled The First Albertans, An Archaeological Search, was released in June of 1987. It was the product of a highly successful collaboration between Archaeological Survey of Alberta staff, other professional scientists throughout Alberta, and Lone Pine Publishing. Grant Kennedy of Lone Pine brought his considerable enthusiasm and acumen to the project, along with the talents of writers Gail Helgason and Bill Williams and illustrator Don Inman.

Of course, 1986 saw increasingly intense levels of activity concerning Head-Smashed-In for many of us at the Archaeological Survey of Alberta, and most especially Jack Brink, Milt Wright and Bob Dawe. These staff members worked closely with Historic Sites Service personnel on the planning team for the Head-Smashed-In Buffalo Jump Interpretive Centre, in preparation for the July 1987 opening by the Duke and Duchess of York.

Throughout all of these activities, the Archaeological Survey of Alberta maintained its functions in other key areas of resource management and research. In describing this work, I will rely heavily upon Bruce Ball's account of archaeological activities in Alberta as it appeared in the Canadian Archaeological Association Bulletin.

Eighty-nine permits were issued in Alberta in 1986: seven of these were eventually cancelled. Of the 82 remaining permits, 57 were for historical resources impact assessments; two were for impact assessments and mitigations; eight were for mitigation; and 14 were for research purposes. Archaeological work was also carried out in national parks areas of Alberta by staff of Environment Canada, Parks. A total of 742 new sites were located from work throughout Alberta: 494 of these through the permit process and 248 outside the permit process (principally through Environment Canada, Parks work). Another 239 sites were re-visited. Joan Damkjar, Site Data Compiler, supervised the entry of 966 sites to the CHIN (Canadian Heritage Information Network) system.

The majority of the above work was undertaken by the consulting community. Individuals associated with firms taking out permits included: Rebecca Balcom, Richard Callaghan and Jim Light for ARESCO Limited; Tom Head and Stan Van Dyke for Bison Historical Services Limited; Rebecca Balcom for Environmental Management Associates Limited; Jim Light and Glenn Stuart for Ethos Consultants; Gloria Fedirchuk and Ed McCullough for Fedirchuk McCullough and Associates Limited; Jim Calder, Bea Loveseth and Brian Reeves for Lifeways of Canada Limited; and John Pollock for Settlement Surveys Limited. The independent consultants included Peter Bobrowsky, Terry Gibson and Eugene Gryba. Research permits were issued to Alan Bryan and Theresa Ferguson of the University of Alberta; Brian Kooyman and Margaret Kennedy of the University of Calgary; Laurie Milne of Medicine Hat College; and Susan Marshall of Trent University. From the Archaeological Survey of Alberta, permits were issued to Bruce Ball, Jack Brink, Michael Forsman, Brian Ronaghan and Rod Vickers.

Several students in the Department of Anthropology at the University of Alberta undertook research projects in Alberta. Theresa Ferguson implemented research on hunter-gatherer models of resource exploitation with a survey of the Salt River in the extreme northeast corner of the province. Maureen Rollans entered the final stages of her Master's thesis research (sponsored by the Archaeological Survey of Alberta) on drive lane systems at Head-Smashed-In Buffalo Jump. Kathy Connor-Learn completed her thesis on pottery and prehistory of the Black Fox Island area. Carole Mandryk continued her work on palaeoecological models of the ice-free corridor. Catherine Sandham continued her research on the impact of climatic change in the northern parkland-marginal farming areas of central Alberta.

In Banff National Park, Daryl Fedje and Alison Landals undertook test excavations at two house pit sites in the upper Red Deer River valley and another house pit site in the Bow River valley. They also excavated two multicomponent, Early Prehistoric sites which they expect will have ages up to 8,000-9,000 years B.P.; in both cases cultural material was recovered from below layers of Mazama ash.

The largest assessment project in the province involved work associated with the construction of the Oldman River Dam situated just north of Pincher Creek. Brian Reeves continued his inventory and site assessment throughout the reservoir area. More than 300 prehistoric sites have been identified to date in the greater project area. John Brumley and Glenn Stuart, also working on the Oldman River Dam project, undertook impact assessments and mitigation of specific sites in the valley.

Gloria Fedirchuk conducted excavations at a high terrace campsite (EdPq-16) on Gorge Creek in the heavily forested foothills west of Turner Valley. Occupations ranging from Lusk through Late Plains have been identified in this shallow site.

Ed McCullough conducted a public archaeology project at the Duckett site located near Cold Lake in east central Alberta. The project was funded by Esso Resources and was aimed at the recovery of additional cultural and environmental data from this Early Middle Prehistoric site. For the first time, pottery was recovered from the site, and clearly undisturbed deposits were identified. The project was particularly successful in providing the opportunity for people of the area to view the excavation activities or participate as volunteers. The public archaeology programme was well received with over 400 people visiting the site and over 30 volunteers taking part in the excavation programme. Ed, Gloria and Esso Resources are much to be commended for this effort.

Barry Dau and John Brumley completed fieldwork at Forty Mile Coulee Reservoir. This project lies within a large glacial spillway valley situated in prairie lands between the Milk and South Saskatchewan river basins. Most of the 108 sites examined consisted of surface stone features (tipi rings and cairns). To date, about 30,000 items have been recovered from the sites that were selected for assessment and mitigation. Although about half of this total is composed of faunal remains, the large numbers of both faunal and lithic items recovered is unusual for stone feature sites. Diagnostic artifacts indicate most sites are Late Prehistoric in age.

Rebecca Balcom, working for ARESCO Limited, undertook mitigative excavations at the Cranford gravel pit in southern Alberta. The Cranford site is a stone feature site consisting of about 85 tipi rings and is located on an upper terrace of the Oldman River. Sediment traps within the site area contained deposits of up to one metre in depth. The site assemblage included diagnostics of Late and Middle Prehistoric age. Late Period Side-notched, Avonlea, Besant, Pelican Lake, Hanna, McKean and Boss Hill points were recovered, as were ceramics, bone and features.

John Pollock recorded a new medicine wheel site during the course of a gravel pit impact assessment in the Oyen area in southeastern Alberta. The feature had been reported previously by amateurs but had not been recorded by a professional. Eugene Gryba subsequently mapped the feature. Interestingly, in the same general area, another medicine wheel site has since been reported and mapped by members of the Calgary chapter of the Archaeological Society of Alberta.

Stan Van Dyke and Thomas Head conducted an inventory and assessment of a possible dam and reservoir area near the junction of the Milk and North Milk rivers. The project is the first intensive work to be undertaken on the Missouri drainage basin in Alberta, with the exception of the rock art sites recorded at Writing-On-Stone. Some 213 sites were recorded including buried sites with stratified components, bison kills, stone feature sites, and a medicine wheel. Five of the sites have yielded ceramics.

A number of students in the Department of Archaeology at the University of Calgary continued their research interests in Alberta. Margaret Kennedy completed extensive faunal and artifactual analysis of the assemblage excavated from the Morleyville Mission site located west of Calgary. The site dates to the period 1875-1922 and has the oldest church building in southern Alberta on its original foundations. Margaret also began her doctoral research on southern Alberta trade in the late nineteenth century with the excavation of an independent whiskey trader's cabin (EdPl-12) situated in the Highwood-Sheep River region of southern Alberta. Neil McKinnon completed his Master's thesis research on palaeoenvironmental reconstruction using carbon isotope ratios on Bison remains recovered from the Head-Smashed-In Buffalo Jump site. Lynn Tuk progressed with her Master's thesis research on the competition between the Hudson's Bay Company and the North West Company as seen at Acton House (Rocky Mountain House) between 1799 and 1821.

The Department of Archaeology at the University of Calgary began their second, five-year research and education programme at the Strathcona Archaeological Centre in 1986. Dr. Brian Kooyman directed the project. In addition to his research, administration and teaching responsibilities associated with Strathcona, Brian began teaching courses in the Department of Archaeology at the University of Calgary.

Two very large, chert pebble quarry sites were recorded, the first by Bruce Ball, the second by Ed McCullough. Both sites are large in area and contain mass quantities of chert pebbles, as well as the unmistakable remnants of pebble tool manufacture. This area of the Neutral Hills had previously been noted for its high incidence of pebble tools, chert pebble cores and pebble tool detritus in sites recorded and excavated by Mike Quigg in 1976.

The Archaeological Survey of Alberta supported research in a number of areas during the past year. Jack Brink directed the fourth season of field studies at Head-Smashed-In Buffalo Jump in the Porcupine Hills of southwestern Alberta. Other key personnel on this project included Milt Wright and Bob Dawe. Research continued to focus on the compressed archaeological deposits of bone and fire-broken rock in the camp and processing area of the site. The excavation revealed the first indications of stratified deposits in this part of the site. It is hoped that these data will assist in the correlation of specific episodes of site use. Because of the proximity of the 1985 and 1986 excavation areas, research results of both seasons of fieldwork will be combined in a single report. Analysis will focus on problems identified in previous research; these include the structure of the faunal assemblage of a bison processing site and the nature of the lithic tool kit associated with the pre-planned hunting events of the great communal kills.

In addition to this work, a more extensive excavation was completed at the Calderwood Buffalo Jump located approximately 1 km north of Head-Smashed-In. This excavation was directed by Susan Marshall of Trent University who will use the site data as a basis for her Master's thesis. The project was partially funded and supported by the Archaeological Survey of Alberta. Twenty-one 1-square-metre units were excavated. The kill site was originally thought to contain three discrete bone lenses but it now appears that at least four separate bone lenses are present. The upper layers are relatively well preserved. Lower layers, however, were uniformly burned and calcined and consequently element identification from these levels is poor. Most of the points recovered from the lower levels are Pelican Lake specimens. Point styles from the upper layers are most similar to Old Women's Phase materials. Radiocarbon dates from the site range from 2,800 to 210 years B.P. and are consistent with the ages expected for these point types. Susan's research will compare the variety of bone elements and portions present within the components with that expected as suggested by recent models of utility and selection at bison kill sites.

Bruce Ball undertook an assessment of the Pincher Creek Buffalo Jump. Assisted by Brian Ronaghan and his crew, Ball mapped the extent of cultural material at the site and tested the kill site and campsite areas. Results of the work indicate that the site dates to the Middle and Late Prehistoric periods. Three separate bone beds were identified in the kill site, two of which produced Prairie and Plains Side-notched projectile points.

Brian Ronaghan initiated survey in the Porcupine Hills of the southern Eastern Slopes. While the number of sites recorded was small, owing to a restricted time schedule, the results were nevertheless promising, with the recovery of an Eden style point from one of the assemblages.

Brian Ronaghan and Barry Newton undertook an assessment of an integrated management area located in the Jean D'or Prairie region in northern Alberta. During their survey, they were able to relocate the North West Company's provisioning and fur trading post, Aspin House. Although there are forts known to have been built earlier, Aspin House is the earliest presently recorded in the province.

J. Rod Vickers of the Archaeological Survey of Alberta conducted a brief inventory of sites in the vicinity of Majorville Cairn in southern Alberta. Within a surrounding area of 3.5 square km, 33 new sites were recorded. Composed of 143 stone circles and 22 cairns, the larger sites included features of up to 24 tipi rings and were found to be situated near the Bow River Valley escarpment; inland sites were much smaller and displayed fewer features (ranging from 1-3 rings). The site density (about 10 sites per square km) is similar to that noted previously on the lower Red Deer and the South Saskatchewan rivers.

Michael Forsman carried out a brief survey for early fur trade sites along the Athabasca River between Fort McMurray and Fort Chipewyan. The post of Pierre au Calumet, established some time before 1819, was relocated, mapped and photographed. An assessment of the continuing impacts of river erosion was also undertaken at the southern Alberta sites of Fort Whoop-up and the original Fort Macleod. No excavations were carried out.

In addition to work on his doctoral dissertation on the role of material goods in social structure in the fur trade of western Canada, Heinz Pyszczyk carried out photo documentation of an early 20th century blacksmith shop in Sexsmith, Alberta. This documentation is part of a long-term historic restoration project.

Aspects of a number of these projects are reported in the articles in the present volume, which I am pleased to say features a significant variety of subjects. On behalf of the staff members of the Archaeological Survey of Alberta, I wish to express sincere thanks to the many individuals, institutions and companies who have assisted us in our work in 1986. We look forward to 1987 with great anticipation.

RESEARCH EXCAVATIONS AT EdPl-12:
A WHISKEY TRADE ERA STRUCTURE IN HIGH RIVER

By
Margaret Kennedy
University of Calgary

INTRODUCTION

Archaeological investigations into southern Alberta's whiskey trade of the early 1870s have been limited; however, existing studies, in tandem with detailed historical analyses, illustrate that the phenomenon was of much greater importance than often thought previously. Research excavations at a former cabin site historically linked to the 1870s whiskey trade era have contributed to an increased understanding of several aspects of the trade, including the range in variation of establishments from which the trade was conducted, cultural material profiles of whiskey trading sites, and a "fleshing out" of the space economy or locational and exchange networks in which the trading posts participated.

The site (EdPl-12) was investigated by the author, supported by funding from the Alberta Historical Resources Foundation and the Archaeological Survey of Alberta, in fall of 1985 and summer of 1986. It is a single cabin foundation located on private land, 3.5 km west of the town of High River. EdPl-12 was first brought to the attention of Mr. Don King, Curator of the Highwood Museum, 32 years ago by Mr. Charles Short, a long time resident of High River. Aged 84 years when interviewed by Don King, Mr. Short recalled that as a child he played amongst the log remains of an old cabin associated with the 1870s whiskey trade (Don King, personal communication 1985). Due to Mr. King's care over subsequent years, the site escaped any disturbance associated with the construction of a new house and driveway in the immediate vicinity in the 1960s and the laying of a second driveway on the adjacent north edge in 1986.

Mr. King briefly shovel tested the site in the 1950s and conducted a metal detector survey of the foundation remains in the early 1980s. No formal en bloc excavations of the site took place until the fall of 1985, when the author initiated a small-scale research project (A.S.A. permit 85-80). When adverse weather conditions forced a premature halt to the excavation, the project was postponed until the summer of 1986 when the entire foundation was exposed (A.S.A. permit 86-27).

RESULTS

The cabin foundations uncovered in 1986 measured 10.5 x 5 m (approximately 35 x 16.5 feet) with the long axis oriented east-west (Figure 1). The scattered remains of a cobble fireplace were exposed in midsection of the north wall. A gap in the traces of wood which represent the south wall is interpreted as being a doorway (a logical orientation for a whiskey trade era structure inhabited in winter). The presence of windows is deduced from the large quantities of broken flat glass found in and around the foundation. Much of this glass was encountered along the east wall and the easterly portion of the south wall. A possible sill for a central roof support was represented by wood remains lying in a shallow, 2 m long trench in the east half of the cabin exactly half way between the north and south walls. No other such features were observed.

Large concentrated sheet scatters of ash and artifactual and faunal refuse were encountered just inside the presumed cabin doorway and immediately outside along the southeast corner. A preliminary interpretation of this feature is that garbage disposal consisted of heaving undesired materials out the door and possibly out a window which may have been located east of the door. The interior refuse was overlain by what appears to have been the door frame (Figure 2). This sequence of refuse deposition and structural decay, while not absolutely linking the refuse with occupation of the cabin, at least limits the time period in which this material entered the archaeological record.

The artifactual assemblage is fairly basic in composition, consisting of architectural materials (cut nails, spikes, screws, flat glass, etc.), trade/personal items (metal, glass and mother-of-pearl buttons, glass seed beads, brass beads, comb fragments, etc.), ammunition representing at least four different types of arms (cartridge cases and

Figure 1. Excavations at EdPl-12, High River. View is east across cabin foundation. Arrows mark the remains of south wall (July 1986).

Figure 2. Sheet refuse scatter inside the cabin doorway. Wood remains of a possible door frame lie immediately over the ash, bone and artifact concentrations (July 1986).

bullets, percussion caps and various sizes of musket balls), and smoking items (fragments of at least three different clay pipe bowls). Bottle glass fragments were fairly numerous, but tin cans were poorly represented. This is surprising since it was presumed a large part of the subsistence fare would have been derived from canned goods shipped out from Fort Benton. (An exterior dump was searched by Don King in 1955 and the author in 1986, but neither bottles nor cans were found.) It appears from the variety of species and butchering cuts present at the site that the trader(s) may have depended heavily on meat. Bison remains dominated the faunal assemblage in the form of butchered ribs and thoracic vertebrae. No bison long bones were found. The predominance of the rib and hump meat cuts suggests that very discrete packages of meat, likely obtained through trade, were entering the cabin site. Numerous foetal bison bones have been identified, lending support to the interpretation of winter occupation of the site. Canid faunal remains, including at least two adult wolves, as well as rabbit, Sharp-tailed grouse, ground squirrel, mouse and prairie vole, completed the faunal assemblage. (The last three species lacked any butchering evidence and were likely natural to the site area.) Some faunal elements were highly comminuted and associated with both the ash scatters near the cabin wall and fire-broken rock scatters to the east of the foundation. The occasional presence of hammerstone-size rocks alongside the bone fragments and fire-broken rock in the predominantly flood silt matrix outside the cabin may be evidence of short-term native occupation of the site area. Presently ongoing analyses of both excavated materials and contextual information hopefully will clarify this situation.

THE PLACE OF EdPl-12 IN THE SOUTHERN ALBERTA WHISKEY TRADE

Historical documentation for the whiskey trade is frustratingly incomplete in many areas. A recent inventory of the extant archaeological and historical records for the trade (Kennedy and Reeves 1984) identified over 40 posts (over twice as many as traditionally enumerated) but also disclosed the inconsistency of associated archival information, particularly with regard to merchant affiliation and date of occupation. Using available information, a preliminary model of locational organization of whiskey posts along the Oldman River was formulated (Kennedy 1985). This model accommodated existing archaeological information concerning inter-post proximity and archival data regarding size, date and affiliation of each post (when known) and sought to account for their spatial distribution by reference to basic concepts of threshold and range.

There is evidence that the major post, Fort Whoop-Up, caused the smaller posts to be aligned in a very fluid pattern along the Oldman River, each presumably competing to partake of the intervening opportunities caused by Fort Whoop-Up's drawing power. A similar analysis might be made of the northerly Sheep/Highwood district, although documentation is particularly sketchy for many of these posts. Existing data indicate that posts were fewer in number there and were concentrated in tight groups along the Highwood, Sheep and Elbow rivers and that Fort Spitzee was a large and important centre. Fort Spitzee, established in 1869-1870, is located 3.2 km southwest of EdPl-12, further up the Highwood River. It appears to have been almost as large as Fort Whoop-Up and may have played a similar role in the northern half of the trading area. The reasons for this more attenuated trading network along the waterways between the Highwood and the Bow are unknown, although several factors may have been influential (for example, the increased distance from Fort Benton, the distribution center; the increased incidence of violent attacks by Indians in this area; and the fact that the area may have just been in the process of full-scale development when the trade was abruptly stopped by arrival of the North West Mounted Police). However, if small post size can be equated with a more restricted trading threshold, establishments such as EdPl-12 may represent an attempt to maximize decreased intervening opportunities in this area without a large outlay for post construction or trading inventory.

SUMMARY

In conclusion, research excavations have disclosed an unstockaded cabin site, apparently occupied only briefly and almost certainly over the winter months. The existence of this particular type of trading establishment in the Highwood locale is a valuable indication of the nature of the trade in the region south of the Bow River. It would appear, on the basis of extant archival documentation and archaeological evidence, that the whiskey trade in the Highwood-Sheep region was of sufficient complexity to prompt the development of a hierarchical range of trading establishments. On the Highwood proper, in the vicinity of EdPl-12, there was the Fort Spitzee organization (one to two posts in the immediate area) and EdPl-12. (No other sites are currently recognized.) This suggests that Spitzee may have dominated trade on the Highwood and that only low-order posts such as EdPl-12 could effectively deal with the higher trading threshold that such competition would enforce. However, while it is never very satisfying to read that "more work will be needed," such is certainly the case in order to fully comprehend the obviously complex southern Alberta whiskey trade era.

MORE ON IMAGE AND MATERIAL CULTURE IN THE FUR TRADE

By
Heinz W. Pyszczyk
Archaeological Survey of Alberta

INTRODUCTION

In last year's annual review, I examined how occupational and settlement rank in the fur trade affected variability in some architectural attributes and remains (Pyszczyk 1986). The results of that study corresponded to those of other studies which indicate that, in many societies, material culture is often used in social and reciprocal strategies between individuals or groups. In other words, some attributes of material culture take on symbolic significance as another form of communication in the social and economic interactions between humans. In the fur trade, it is evident that fort rank was positively related to the size and quality of the forts and their buildings. It was suggested that such differences were more prominent in the officers' quarters than in those of the labourers at the inland fur trade forts. Additional research has supported this interpretation, indicating that architectural attributes reinforced the positive images of particular forts within the regional system and of the officers who operated them (Pyszczyk 1987).

While collecting data for the above research, I ran across references in the historic journals which suggested that material culture was important in portraying a positive image to another target group, namely the Indians who traded at the many inland fur trade forts. Here again material culture functioned symbolically in social and economic interactions between two different groups. The purpose of this paper is to investigate further how fort size and rank affect architectural remains and how the Indians influenced architectural attributes in the fur trade. It must be stated at the outset, however, that it is one thing to explain these relationships with documentary references but entirely another matter to support them with sound archaeological and architectural data from the various fur trade records. This paper is a preliminary attempt to investigate the subject, one which I hope will stimulate others to re-examine their documentary and archaeological data to either support, refine or reject some of the interpretations made here.

EUROPEAN AND INDIAN TRADE RELATIONS

In the fur trade, it was very important for the Europeans to have good trade relations with the Indian population. This was especially true during that period from the late 1780s to 1821 in the Athabasca and Saskatchewan fur trade districts when the competition for furs between the Hudson's Bay Company and its chief rival, the North West Company, was extremely fierce. Before I examine how variability in trade relations and competition might have affected the use of material culture, I will review briefly how important a positive image and trade relations with the Indians were for the survival of many of the inland posts.

Trade relations with the Indians during the late eighteenth and early nineteenth centuries were very liberal in both companies, although always slightly more so in the North West Company. In some instances, the North West Company went so far as to marry company officers to Native women who were related to prominent leaders (Brown 1980). In addition, Indian groups were given presents and honours to induce them to trade at the posts. According to most sources, the Montreal pedlars always had more lavish trade goods than the Hudson's Bay Company (Davidson 1918; Masson 1890). For example, Duncan M'Gillivray describes trading ceremonies with the Indians at the North West Company Fort George in 1794-1795. To convince the Indians to trade, they were given tobacco and rum, and some were given "Chief's clothing" which marked them as superior traders among their people (Morton 1929:31, 50, 55, 74).

Although the Hudson's Bay Company traders also gave the Indians gifts to encourage trade, the insufficient supplies provided by the tight-fisted London committee did not allow them to compete with the lavishness of the North West Company. M'Gillivray's comments regarding the trading methods at the Hudson's Bay Company's Buckingham House in 1794 (as opposed to those of the rival Fort George) provide a good example of the trading differences between the two companies and the importance of having sound relations with the Indian groups.

Our neighbours are scarce of Goods this Spring, a circumstance which they have hitherto carefully concealed from the natives, but the demands made upon them at this time are so great that they could not supply them or satisfy the Indians in the usual manner. To increase this dissatisfaction and to make the contract more glaring, we have been rather more lavish than usual . . . (Morton 1929:75).

There are additional references in the literature which indicate that the image of fur trading posts as portrayed through trade goods and fort appearance was a very important factor in convincing the Indians to trade at the forts. For example, George Simpson, while observing the conduct of the trade in the Athabasca district just prior to amalgamation of the two companies in 1821, remarked that the Indians liked to trade at posts that displayed wealth in the outward appearance of the establishment and a large store of trade goods inside the establishment.

. . . we fell off however considerably in the estimation of the Indians, with whom well stocked stores is the only criterion of respectability and consequence . . . (Rich 1938:378).

The extravagance of trade relations which the Indians had become accustomed to changed dramatically after 1821 when the new Hudson's Bay Company monopolized the trade in the interior of western Canada. Fewer gratuities were given to the Indians, and the use of alcohol in trade was forbidden. In 1829, while travelling through the Athabasca district, George Simpson noted with some satisfaction:

. . . [I] saw a large band of Indians at Portage la Loche, some of whom claimed special notice from their acquaintance with me in the "Days of the Wars" at Fort Wedderburn: they all acknowledged, that the change from hot opposition with boundless extravagance, to peaceful and well regulated Trade with all its wholesome restrictions, had been of immediate benefit to themselves and Families . . . (Rich 1947:6).

However, there are some telling references which indicate that even after amalgamation the image of the European establishments was still very important for trade. Considerable amounts of money were still invested in the appearance of the fur trade posts. Macoun's (1877:166) description of the newly rebuilt Fort Chipewyan in 1872 provides a good example of this.

Fort Chipewyan is situated on a peninsula at the west end of Lake Athabasca. Under the fostering care of Mr. McFarlane, it

> has attained the pre-eminence of being the capital of the North. All the buildings are of the most substantial character, are all shingled and white-washed, and present from the lake quite an imposing and beautiful appearance. Two large stores with glass windows, each sixty-three by thirty-one feet and seventeen feet high, stand next to the landing.

The question arises of what target group the company officers were trying to impress with the extravagance of the company forts. I have suggested elsewhere that there was considerable competition between officers of various forts and districts for furs (Pyszczyk 1986). Chief traders were jockeying for more power and profits in their respective regions. The forts they controlled were visible extensions of that power and of the rank they held, to both their European counterparts and the Indians. This fact is all too clear from Simpson's description of Fort Edmonton in 1841; the characteristics of the fort seemed to impress both Simpson and the Native people.

> Edmonton is a well-built place . . . surrounded by high pickets and bastions, which, with the battlemented gateways, the flagstaffs, etc., give it a good deal of a martial appearance. . . . This fort, both inside and outside, is decorated with paintings and devices to suit the taste of the savages that frequent it. Over the gateway are a most fanciful variety of vanes; but the hall, of which both the ceiling and the walls present the grandest colors and most fantastic sculpture, absolutely rivets the astonished natives to the spot with wonder and admiration (Simpson 1847:101).

From these few references, it is apparent that fort size, building size and building lavishness all played important roles in impressing and maintaining good trade relations with the Indian groups. But while many architectural features may have been important in impressing the Indians who traded at the posts, the overall size of the fort, the trading store and Indian hall may have been especially important. Of these, the Indian hall was likely the most important, since it was there that the Indians were received, entertained and encouraged to trade their furs. It would be profitable to examine the archaeological and documentary record of the trading stores and Indian halls, both between companies and through time, to determine if these architectural features were being purposefully embellished to impress the Native population.

METHODS OF INVESTIGATING ARCHITECTURAL VARIABILITY

TRENDS AND COMPARISONS

Based upon the historic evidence, it is apparent that the need to maintain sound social relations with the Indian population was important for both fur trade companies throughout the entire fur trade period in western Canada. The difficulty is how to measure what relative percentage of any architectural feature was attributable to maintaining these relations, as opposed to the many other possible factors that could also account for architectural variability. It is evident that there are few architectural attributes that are influenced solely by social factors. The key to measuring the effect of social variables on material culture remains is to compare historic situations where the relative importance of the variable has changed through time or space. Fortunately, in historical archaeology, the documentary record often is complete, and the accurate control of many of the factors that affect architectural variability allow such comparisons to be carried out.

Keeping the methodological limitations of the data in mind, instances must be found in the fur trade data where definite changes in possible emphasis of social relations between the European traders and the Indians occurred. The data can then be grouped accordingly to see if there is a positive relationship between the cultural variable and the material culture variable.

It is evident from the historical fur trade records that social relations were more important during the period of intense rivalry and competition between the North West Company and the Hudson's Bay Company than any time before or after. Therefore, if certain architectural attributes were important to impress the Indians in order to gain an advantage in the trade, those attributes should be relatively more prominent in the early period of competition than any period thereafter (after 1821). There is also some indication that the North West Company invested considerably more time and resources to gain a monopoly in the trade than the Hudson's Bay Company. Therefore, architectural attributes intended to gain an advantage in the fur trade should be relatively more prominent at North West Company forts than at Hudson's Bay Company forts.

Another possible way of dividing and comparing the architectural data is between the two fur trade districts. It seems that although competition for furs was fierce in both fur trade districts, it was much more intense in the Saskatchewan district. (The North West Company totally monopolized the trade in the Athabasca district.) There is some reason to believe, therefore, that architectural attributes designed to impress the Indians should be more apparent at the Saskatchewan district posts than in the Athabasca district.

DATA AND METHODS OF MEASUREMENT

The data that exist to determine if some architectural attributes of buildings or forts were more extravagant than was functionally required, or relatively more extravagant than necessity dictated, consist of archaeological and documentary architectural information collected from a number of fur trade forts in western Canada. Although these data by no means include all the possible architectural information for the fur trade, they do represent both the Hudson's Bay Company and the North West Company forts and come from both the Saskatchewan and Athabasca fur trade districts. It should be emphasized that due to the poor clarity and/or small size of the historic maps and the nature of the archaeological remains, the accuracy of the measurements of attributes is somewhat decreased; however, the degree of error is likely too minimal to make any difference in the interpretation of the results.

A number of problems had to be addressed before the major research question could be adequately investigated. The first problem that had to be dealt with was to determine how fort size is related to environmental/economic factors, primarily the fur resources that the traders were there to exploit. Although there is no direct evidence that fort size and population were related to the number of Indians exploiting furs in a particular region, it seems likely that fort size was largely determined by the fur resources available and the amount of those resources traded to the forts. Indirect evidence to support the relationship comes from examining the Indian population data in the Athabasca region between 1805 and 1830 and comparing it to overall fort population (Figure 3). The relationship is relatively good, suggesting that fort population/size was

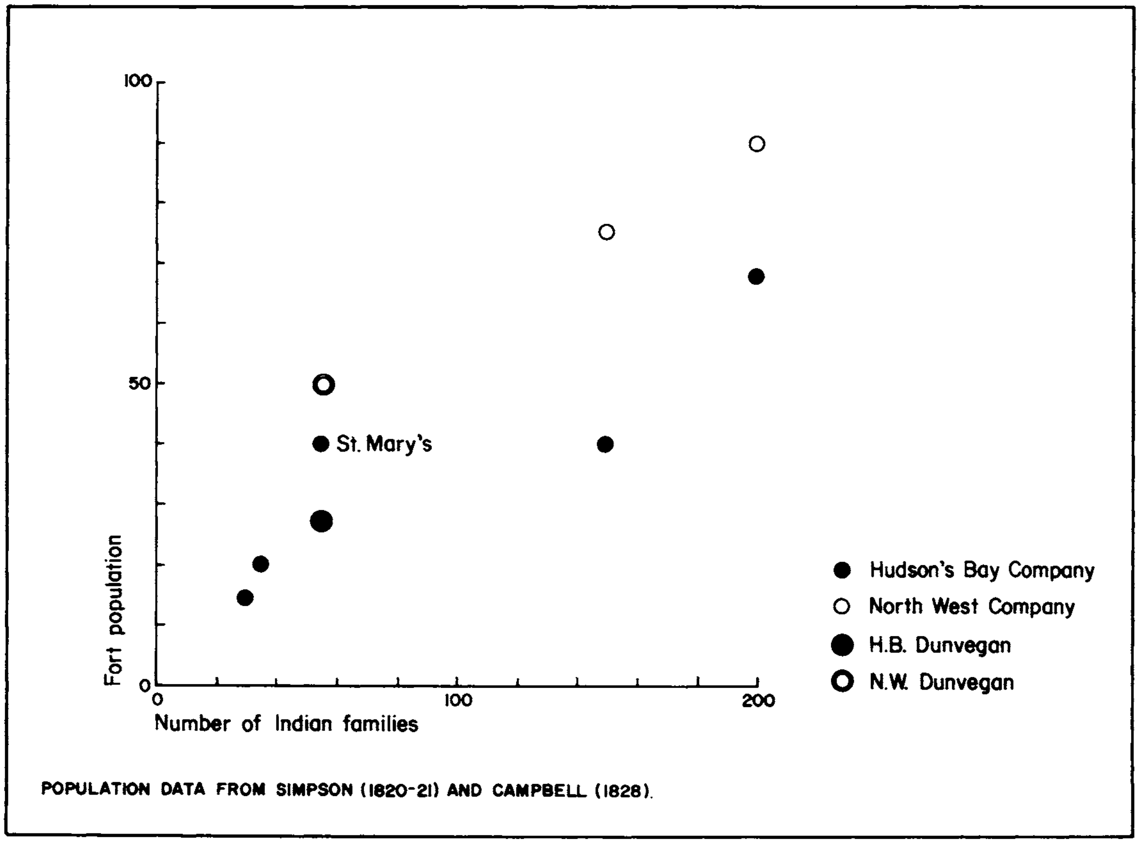

Figure 3. Estimated populations of Indians and traders in the Athabasca region between 1805 and 1830 (for Simpson [1820-21] see Rich 1938).

related to the number of Indians trading and the degree of resource exploitation of the area. These results imply that, since regional resource richness affected fort population and possibly size, this variable must first be taken into consideration before the effect that social variables have on fort size can be adequately measured.

Next, it was important to assess what proportion of the difference in building size (e.g., trading store or Indian hall) was due to the overall size and to the rank of the fort. In order to examine this question, fort size was compared to total building area, to a number of specific building types, and to the size of the trading store. The results of a comparison of fort size to total fort building area (square feet) show a remarkably high correlation (Table 1; Figure 4). In other words, overall fort size can predict very well total fort building area, a fact which, although slightly peripheral to this study, is important

Table 1. Summary statistics of single regression: fort size - building area.

Simple: X - Fort Size Y - Total Building Area

DF:	R-squared:	Std. Err.:	Coef. Var.:
16	.925	2495.1	31.204

for general investigative procedures used at other fur trade sites. For the purposes of this study, however, we must determine how well total fort size can predict the total area of some specific buildings located within the fort. In order to examine this question further, total fort size was compared to total storage area. The results of the single regression indicate that there is a strong relationship between fort size and total building storage area at the fur trade forts (Table 2; Figure 5). These results are not too startling, since it is expected that fur trade forts were built only large enough as was necessary to carry out the fur trade in an area, and their respective storage areas would also

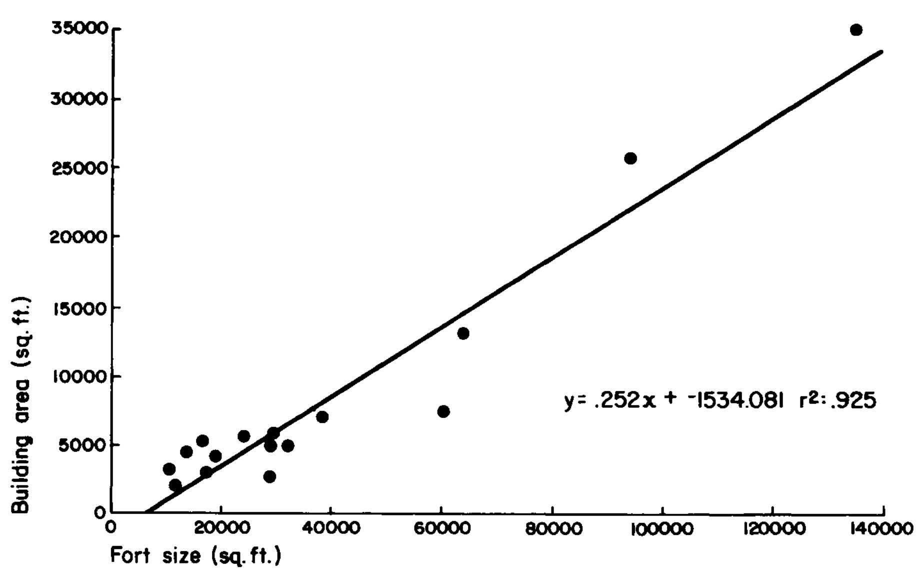

Figure 4. Relationship between total fort size (square feet) and total building area (square feet).

Table 2. Summary statistics of single regression: fort size - storage area.

Simple: X - Fort Size Y - Storage Area

DF:	R-squared:	Std. Err.:	Coef. Var.:
9	.947	419.074	23.947

conform to these needs. However, the predictive power of the regression equation might have some very important uses in archaeological situations where only general fort dimensions are known. For the specific problem outlined in this paper, it appears that the sizes of specific building types at forts were highly related to overall fort size and that size was closely related to the economic factors in the fur trade.

In the last comparison, fort size was compared to trading shop size (square feet). The results of the single regression reveal a relationship between the size of the fort and fort trading shop, but the relationship is not as good as in other comparisons (Table 3; Figure 6).

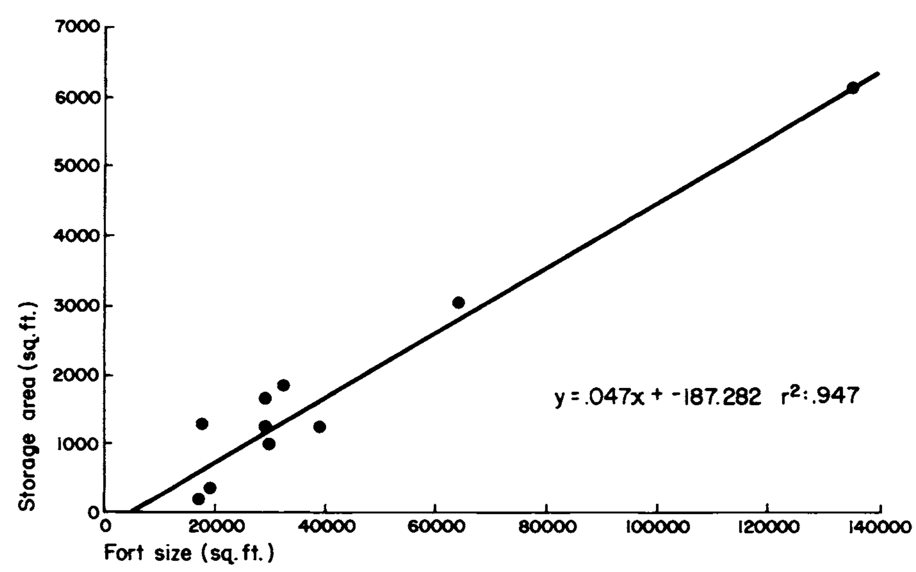

Figure 5. Relationship between fort size (square feet) and total storage area (square feet).

Table 3. Summary statistics of single regression: fort size - trading shop size.

Simple: X - Fort Size Y - Trading Shop Size

DF:	R-squared:	Std. Err.:	Coef. Var.:
8	.87	335.001	33.385

In other words, it is tempting to say that these results show that fort size accounts for most of the variability of building sizes, although less so for the trading store. However, other types of comparisons are needed to further examine this possible relationship.

COMPARISONS

Since it was evident that the size of the trading shop was related primarily to the overall size the fur trade forts, any subsequent comparisons of the data to establish how social factors affected the size

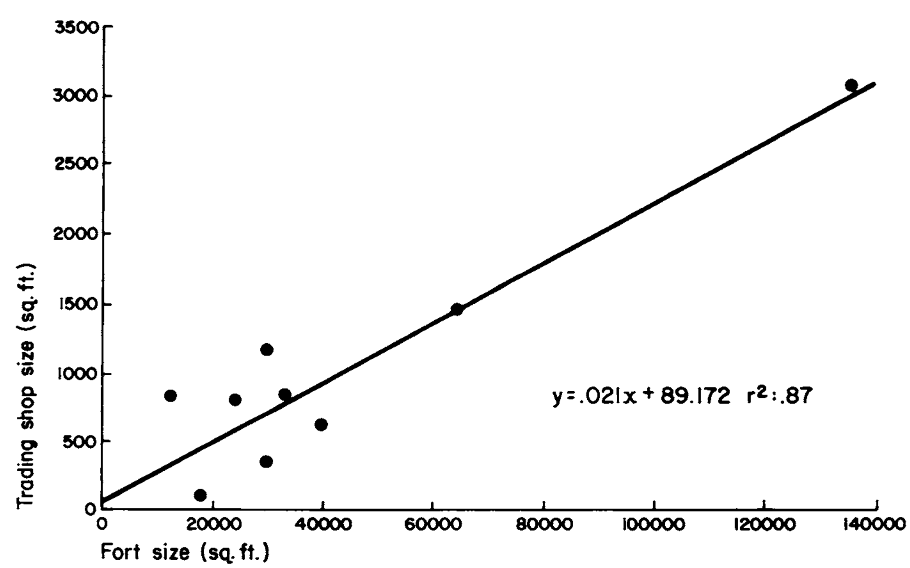

Figure 6. The relationship between fort size (square feet) and trading shop size (square feet).

of the trading shop had to first take fort size into account. Therefore, the size of the trading store/Indian hall was divided by the total size of the fort in order to investigate shop size variability through time, between fur trade companies, and between regions.

In order to determine if a greater investment of labour and money went into this building relative to the entire fort during the early versus the later period, the ratio of trading store/Indian hall to total fort size was computed for three general time periods in the fur trade: the early period before 1821, the middle period from 1821-1860, and the late or post-1860 period. The results of the comparison of Indian hall/trading shop dimensions in these three periods to total fort (Table 4) indicate that there is a general decline in the ratio of the Indian hall/trading shop size to total fort size from the early to the later fur trade period. Although the mean area of the Indian hall/trading shops continually increased throughout the fur trade, this increase was considerably less than the growth in the overall size of the forts. The above results suggest that relatively less emphasis was placed on the Indian hall/trading shop as these forts grew in size and that the fur trade companies invested labour and money elsewhere during times of monopoly.

In a second comparison, the mean ratio of Indian hall/trading shop to total fort size was compared between the Hudson's Bay Company and the North West Company during the early period. The results indicate that the size percentage of the Indian hall/trading shop to total fort size was 3 percent for both companies. Comparison of the same ratio for Fort Augustus 2, where both companies were located side-by-side, indicates that the North West Company Indian hall/trading shop was slightly larger relative to overall fort size. Unfortunately, no other sets of data currently exist which would permit a similar comparison.

In a third comparison, where the ratio of the size of the Indian hall/trading shop was compared between the two major fur trade districts, the sample is currently so small that the results of the comparisons must remain very tentative. However, these data do suggest that the size ratio of the Indian hall/trading shop to the size of the fort was generally larger in the Saskatchewan district than in the Athabasca district.

Table 4. Comparison of Indian hall/trading shop to total fort size.

Fort	A. Indian Hall/ Trading Shop (sq. ft.)	B. Fort Size (sq. ft.)	A÷B (%)
Early Period			
Augustus 2 H.B.Co.	756	24300	3.1
Augustus 2 N.W.Co.	1149	29700	3.9
Dunvegan 1 N.W.Co./H.B.Co.	598	38809	1.5
Buckingham House H.B.Co.	87	17835	0.49
Hudson's House H.B.Co.	784	12100	6.5
Red Deer's Post	400	-	-
MEAN	629	24548.8	3.1
Middle Period			
Pelly H.B.Co.	800	32554	2.5
Carlton	1449	64349	2.3
Fort Chipewyan	750	-	-
MEAN	1000	48451.5	2.4
Late Period			
St. James	720	-	-
Dunvegan	469	-	-
Chipewyan	750	-	-
Lac La Biche	880	-	-
Lac La Biche	822	-	-
Victoria	348	29480	1.2
Augustus 4	3060	135750	2.3
MEAN	1007	82615	1.8

Note: The above data were taken from Babcock 1984; Clark 1969; Forsman 1985; Harris 1974; Klimko 1983; MacDonald 1959; MacGregor 1967; G. Nicks 1969; J. Nicks 1977; Pyszczyk 1983.

CONCLUDING REMARKS

It is obvious from the above results that there are very few (if any) attributes of material culture that are sensitive only to single cultural variables. It is equally apparent that many attributes of material culture, especially the size of architectural remains, environmental and economic factors (e.g., total resources, population, etc.), likely always will account for the greatest amount of variability found in those remains. This is obvious when archaeological variables are compared to one another for the fur trade data. For example, the overall size and population of the many inland fur trade forts were related to the Indian population trading furs and the total resources that could be exploited in a region. In turn, many of the changes in buildings were related to major changes in the degree of resource exploitation.

It is also apparent that social factors, although they may be economically influenced (e.g., architectural lavishness to induce the Indians to trade), play a lesser role in cultural systems. These secondary factors are often very difficult to isolate from the more prevalent economic variables. Nevertheless, they are important since fort size alone cannot account for all the variability in the size of the Indian hall/trading shop.

In the three final comparisons, there was some indication that the importance of the Indian hall/trading shop decreased relative to the size of the fort and to other buildings through time. The results of comparisons between the two fur trade companies or between the fur trade areas are inconclusive. Because the database is so small, I would caution readers about the reliability of these results at the present time.

The current results of using architectural remains to determine whether certain material culture attributes played a social role in the fur trade must be re-examined with more documentary and archaeological data from fur trade forts. It is clear in this study, as well as in other studies that undertake temporal or regional comparisons of fur trade data, that the database with which archaeologists must deal is relatively small compared to the total population of fur trade sites in western Canada. Perhaps other attributes should be used to examine the study problem, but there are relatively few other types of material culture or architectural attributes that are readily available or easy to measure quantitatively.

To conclude, even though the initial investigation of material culture in a social context in the fur trade was somewhat inconclusive, there are indications of relationships between fort and building attributes that may have more practical applications and should be pursued in future studies. For example, the ability of total fort size to predict total building area, total storage area, and perhaps other building characteristics is a very promising avenue of research in the fur trade. If regression equations could be computed which would allow archaeologists to accurately predict unknown architectural characteristics of the fur trade forts they investigate from only a few types of data, the time and money saved in more thorough investigations would be tremendous.

THE PINCHER CREEK BUFFALO JUMP:
A LATE PREHISTORIC BISON KILL SITE

By
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INTRODUCTION

The Pincher Creek Buffalo Jump (DjPl-1) is located approximately 4 km north of the town of Pincher Creek and 1.5 km south of the Oldman River in the foothills of southwestern Alberta (Figure 7). The site is well known to local amateur archaeologists and has been focus of collectors for over fifty years. But despite its long-lasting eclat, the site had somehow eluded the attention of professional archaeologists. This report describes the results of a formal investigation of the Pincher Creek Jump site.

The site is situated on the southern face of the eastern extremity of a large sandstone feature, geologically described as a remnant of a tertiary peneplain and now part of the Porcupine Hills formation. The northern margins of the feature parallel the Oldman River and display relatively steep sides. The feature gradually rises above the surrounding landscape from the west and is easily accessed from the southern and southwestern flanks. Presumably, it would be from this southwestern quarter that the bison would have been herded into position for the jump.

PURPOSE AND OBJECTIVES

Stimulus for this investigation originated in the Oldman River Dam project. The realization that the Pincher Creek Buffalo Jump site was an archaeological unknown resulted from a proposal by Alberta Environment to use the jump area as a quarry for construction materials. With this proposal it was educed that, while some site characteristics were known, no formal investigation had ever been undertaken, and the site's spatial and temporal dimensions were essentially unknown.

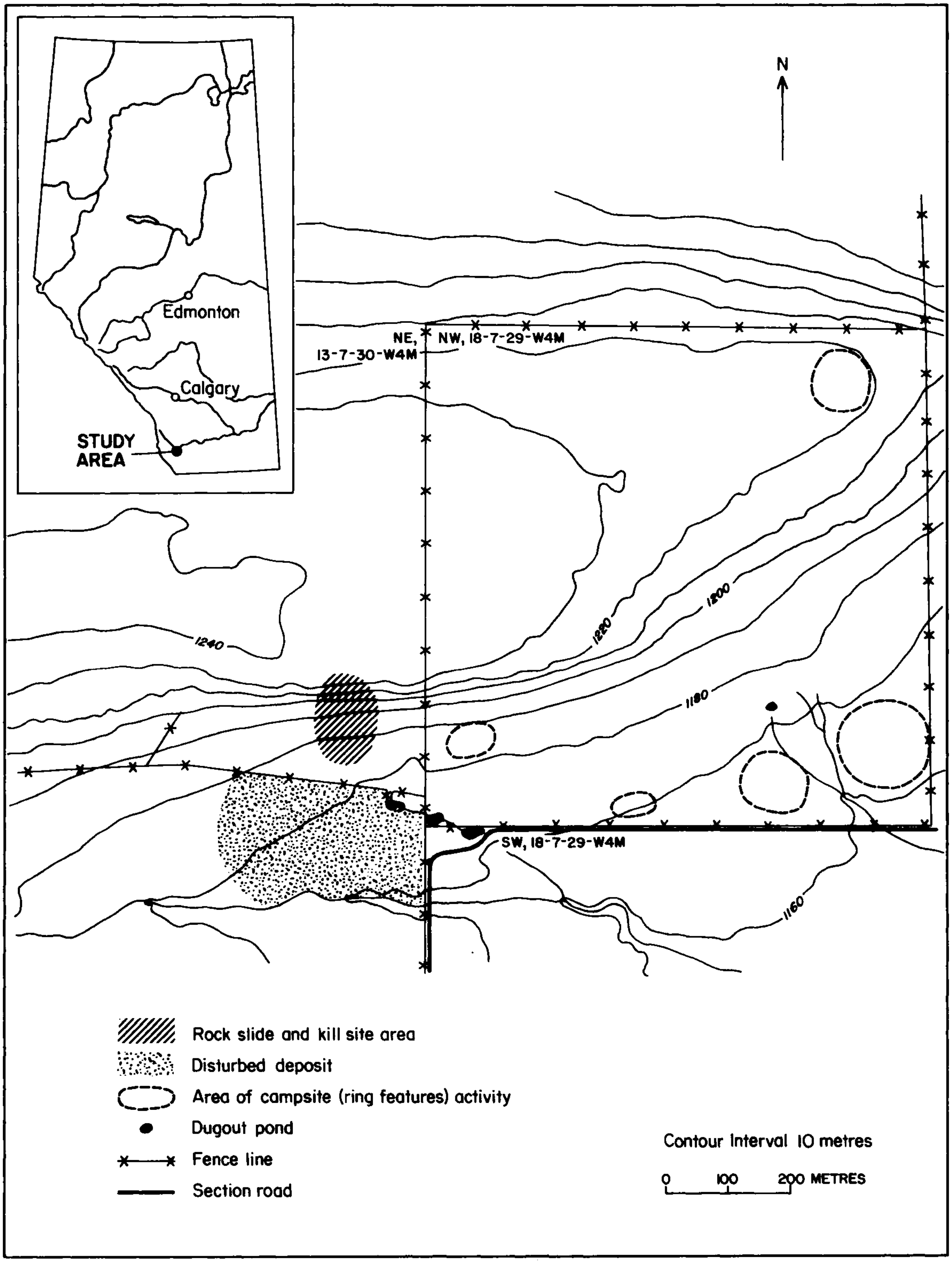

Figure 7. The Pincher Creek jump site showing the five areas of ring features to the east of the kill site and the distribution of disturbed deposits found below the kill site.

General information about the site from local sources suggested that the site deposits were extensive, the cultural historical material was regionally unique, and, temporally, the site spanned the Middle and Late Prehistoric time periods. A review of local collections of projectile points gathered from the site later revealed that the styles were restricted to the Late Prehistoric Period. Nevertheless, the general feeling of the local collectors and amateurs was that the site was significant. The formal investigation was to provide descriptive information which would allow for an initial evaluation of the site's significance and thereby establish the legitimacy of the reported claims of its importance. Assuming the legitimacy of the reports was upheld, data resulting from this formal evaluation would provide the basis for a provincial site designation status proposal.

The assessment of site significance was proposed through the identification of the extent of disturbance, the horizontal and vertical extent of cultural deposits (size of site), the cultural historical contents of the site, the temporal dimensions of the deposits, the existence of stratified deposits, and the cultural historical affinities of site components with other known similar type sites of the northern Plains region.

METHODOLOGY

The first problem was to determine the exact location of the jump. Through conversations with local individuals who were familiar with the site, it was learned that the main bone deposits were to be found below a large rock slide which, according to the landowner, occurred in 1926 (Figure 7). The size of the material in the rock slide precluded testing the area. Instead, we began an augering program around the bottom and sides of the slide to identify the existence of bone deposits in these areas. To further define the limits of the kill site area and to determine the extent of disturbance in the areas below the kill, a shovel test program was undertaken (Figure 8).

Using the results of the augering and shovel testing, two 2 x 2 m test excavation unit locations were selected at the bottom of the slide area (Figure 8). To identify associated activity areas, a systematic

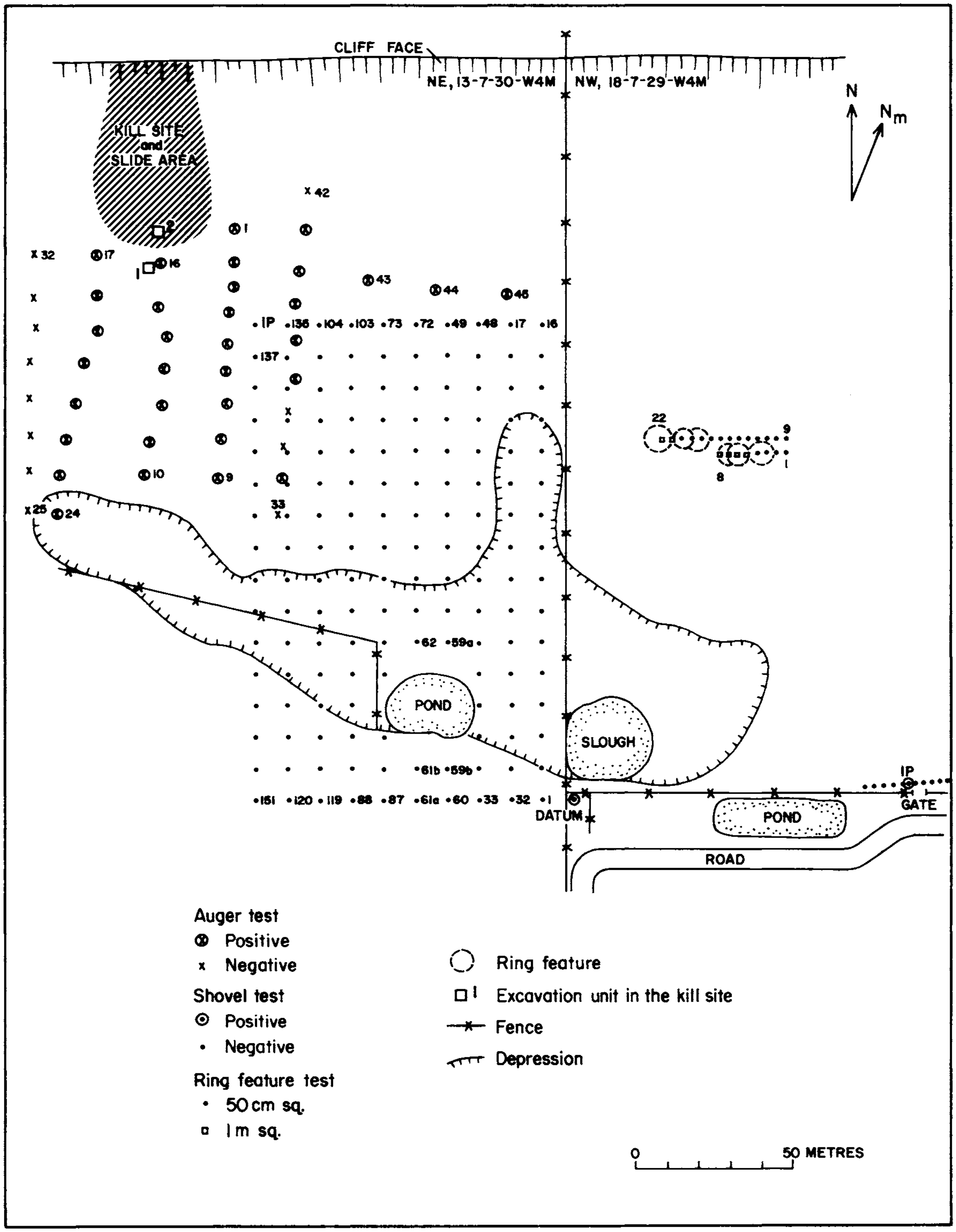

Figure 8. Location of the various testing programs (augering, shovel tests and systematic excavation units) within the immediate vicinity of the Pincher Creek Jump kill site.

surface survey was carried out in the lands adjacent to the kill area. Two clusters of tipi rings located relatively close to the jump were tested using 50 x 50 cm and 1 x 1 m test units (Figure 8).

RESULTS

Through discussions with the landowner, it was learned that bone had been mined (or at least collected from extensive surface deposits) from the site during the early 1900s. He described a situation wherein, prior to the bone mining, the surface of the kill site area had been "white" with bone remains. A rock slide, which occurred around 1926, covered the main kill deposits and thus checked further disturbance to this part of the site. Surface collection of the ploughed field below the jump continued, however, as did one attempt to excavate in the kill deposits. Evidence of the latter was still present at the time of our investigations; in fact, our Unit 2 test in the kill was placed beside the pot hunter's hole.

Results from the two excavation units placed at the bottom of the slide showed the presence of a substantial overburden of disturbed deposits. Figures 9 and 10 show the locations of disturbed and undisturbed bone deposits, along with the locations of lithic remains and the relative amounts of lithic artifacts recovered given as percentages by level. Three layers of undisturbed bone were recorded in excavation Unit 2. The upper most layer contained fragments of burnt bone, bone and charcoal. The middle layer contained more and larger fragments and whole elements, some in articulated positions. The lower layer was identified with the aid of an auger, and, as a result, the condition of the material is not known. Both excavation units contained disturbed deposits in the upper levels. In excavation Unit 1, disturbed deposits were encountered down to 75 cm below surface. Only one undisturbed bone layer was encountered in Unit 1, at 125 to 135 cm below surface.

None of the layers contained large numbers of bones, and it appears that the major portion of the kill site deposits are to be found beneath the rock slide. Testing of the ring features showed the cultural deposits to be restricted to the top 25 cm of deposit.

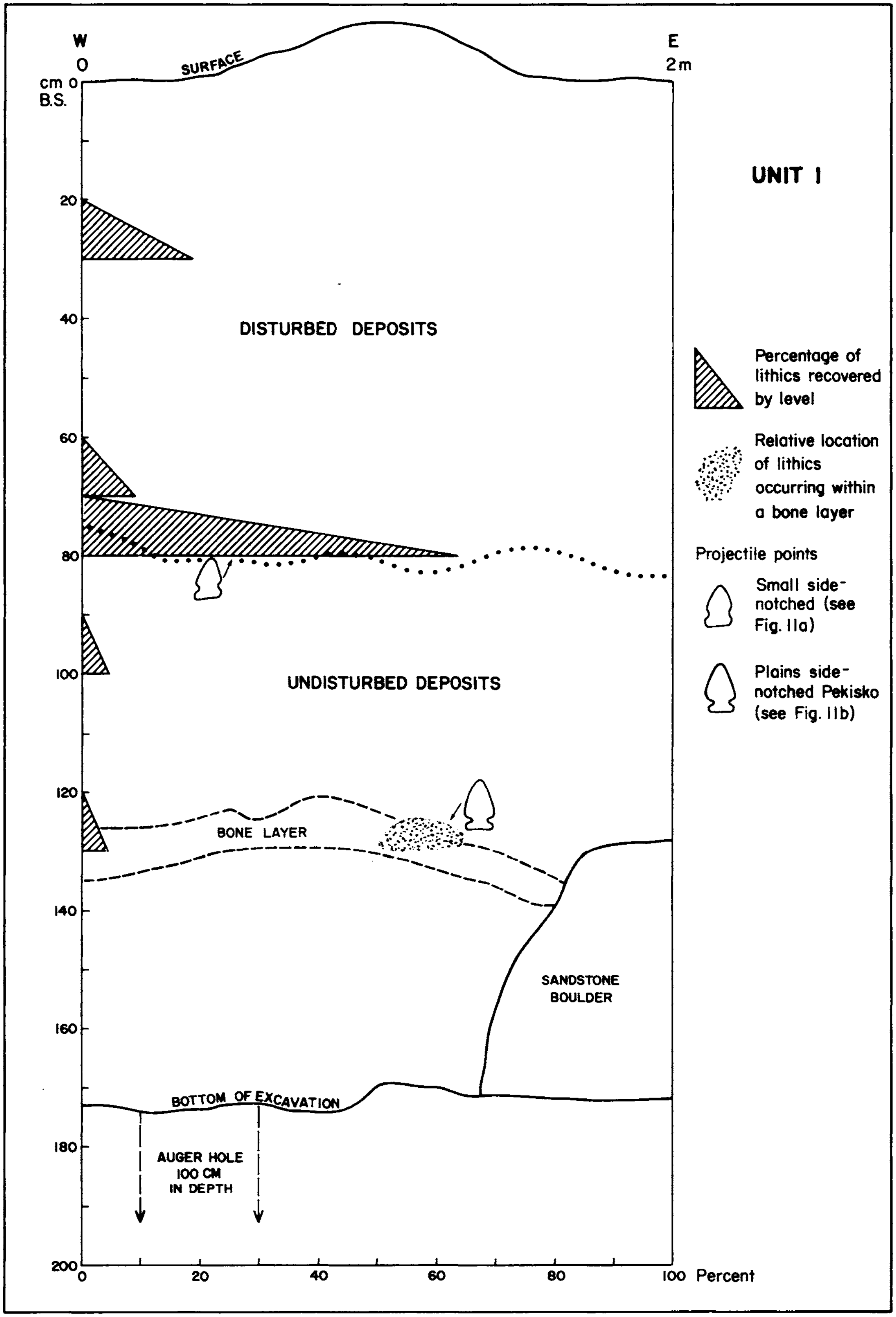

Figure 9. Profile of the north wall of Unit 1.

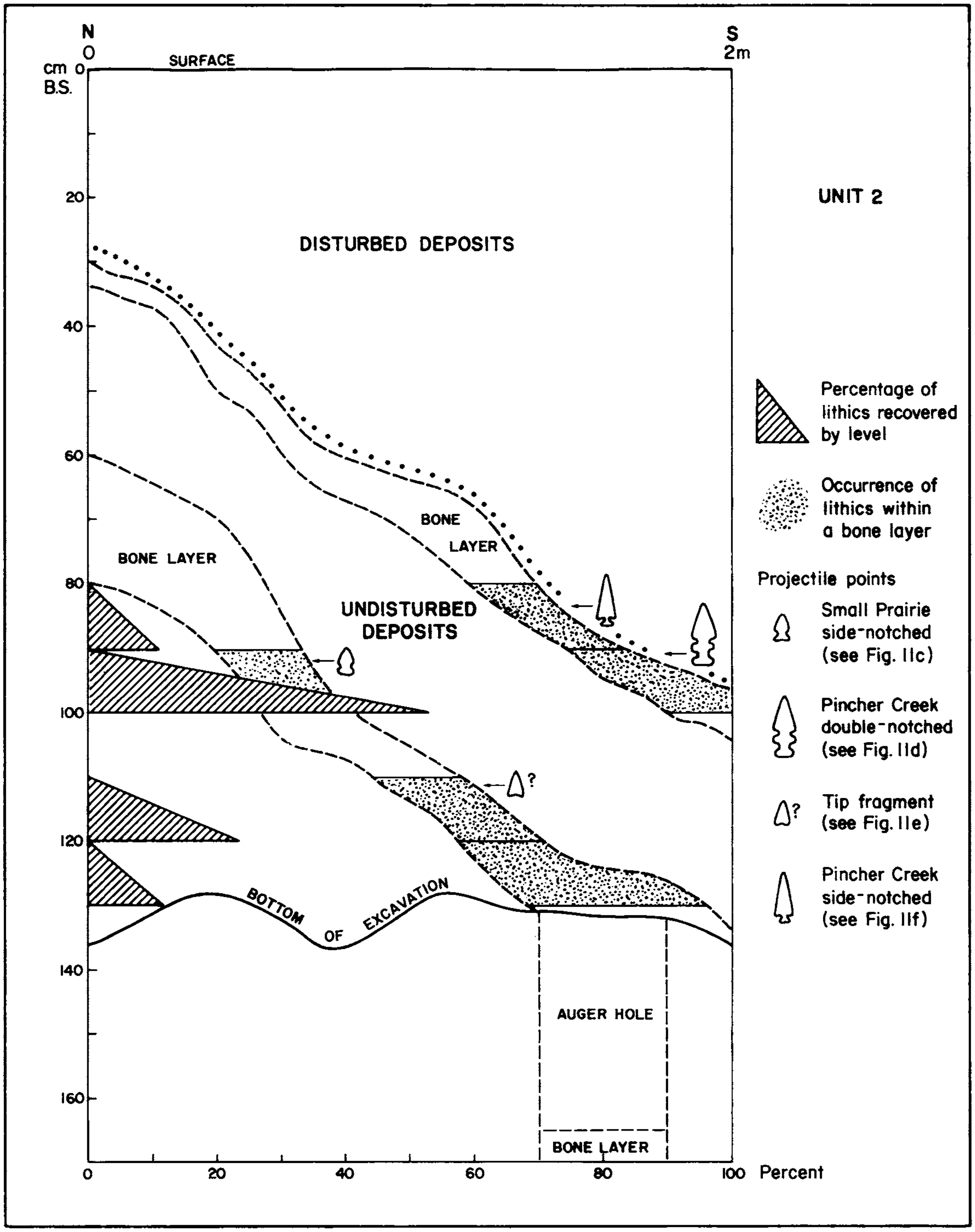

Figure 10. Profile of east wall of Unit 2.

The number of items and the number of types collected from the excavation units in the kill site were small. Of a total of 578 lithic items recovered, 6.75 percent came from the two excavation units in the kill site area; 1.21 percent resulted from the shovel testing below and east of the jump; 3.6 percent were from surface collections; and 88.4 percent came from the testing of the rings. Seven projectile and projectile point fragments were recovered; five of these display recognizable morphological characteristics. In Unit 1, two points were found: a small, side-notched type (Figure 11a) from level 8 and a larger, side-notched form (Figure 11b) from level 13. The former lacks any particular distinguishing characteristics and was found in a disturbed context. The latter may be described as a Plains Side-notched Pekisko point type.

Five specimens were recovered from Unit 2; two of these are point tip fragments (one is shown in Figure 11e). A small Prairie Side-notched type was found in level 10, bone layer 2 (Figure 11c). A small, well-made point type (Figure 11f), which shows some similarity to Head-Smashed-In Corner-notched type (Reeves 1983a), was recovered from level 9 in bone layer 1. However, with its stratigraphic positioning above the Prairie Side-notched type (found in bone layer 2 below layer 1), one expects that it would date more recent than Reeves' classification would peg it. Using Vickers' (1986:98) techniques adapted from Forbis' (1962) typology, the point would be classified as an Irvine or High River Prairie Side-notched type. Vickers (1986:99) places Irvine within the A.D. 600 to A.D. 1700 period. The overall distinctive morphology and workmanship of this specimen (Figure 11f) is unlike other known types of the area. It is herein called a Pincher Creek Side-notched type. Finally, a double side-notched point type (Figure 11d) was recovered from level 10 in bone layer 1.

The double-notched type is a unique point type that has not been described in Alberta archaeology previously. While several of my colleagues swear on their Clovis Point collections that they have seen the double-notched variety type before, I can find no references or examples of this type in any of the collections or reports of sites in Alberta. This type is herein referred to as Pincher Creek Double-notched.

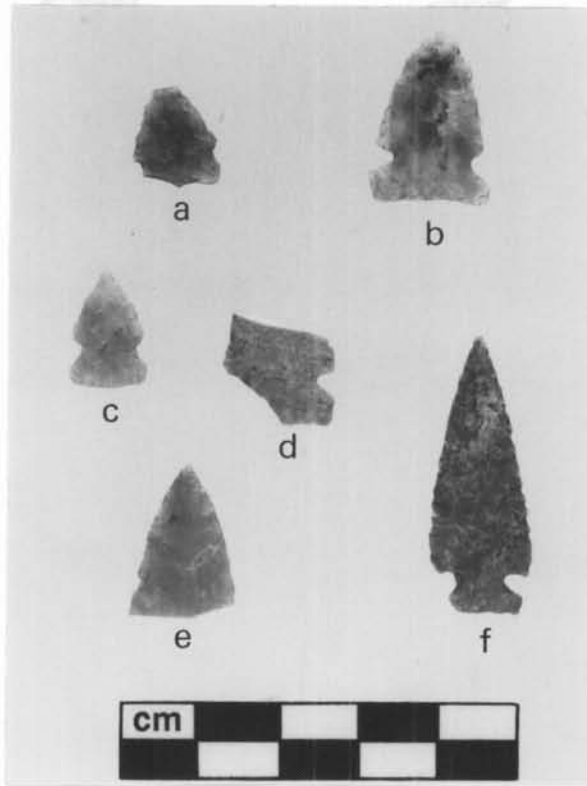

Figure 11. Projectile points recovered from units 1 and 2 in the kill site deposits.

Forty-one percent of the material from the kill site excavation is chert; 43.6 percent is quartzite and siltstone; and mudstone and petrified wood makeup the remainder. The lithic material recovered from the shovel tests is composed totally of flake fragments and one modified chert pebble flake. The raw material assemblage comprises almost equal proportions of quartzite and chert. The majority of the lithics recovered during the project was from the test excavations of the ring features.

Approximately 95 percent of the recovered assemblage from the ring feature tests is made up of debitage. The remainder is composed of biface fragments, projectile points and point fragments, pottery fragments and one very small end scraper (Figure 12). The latter measures 15.4 mm in length, 7.02 mm in width and 2.67 mm in thickness, and its edge angle is approximately 37 degrees. This artifact type is not unique to this area, having been described both at Head-Smashed-In Buffalo Jump (Brink et al. 1986) and the Bootlegger Trail site (Roll and

Figure 12. Small endscraper recovered from the testing of the ring features.

Deaver 1978). The morphology is almost identical to that of the "typical" endscraper, that is, teardrop-shaped or triangular with a plano-convex cross section and showing use wear on the bit. On our example, wear or retouch flaking is present on the ventral face of the small end opposite the bit, and wear is apparent on the lateral margins. The main difference between this type and the ones typically found in Plains assemblages is its diminutiveness.

Five recognizable point types were recovered from the ring features: a Prairie Side-notched type (Figure 13a) which bears greatest resemblance to Kehoe's (1973) Tompkins Side/Corner-notched variety; an unnotched, triangular type (Figure 13c, a variant of the Plains Side-notched group); a Plains Side-notched Pekisko type (Figure 13b); a Prairie Side-notched variety (Figure 14b); and a double-notched specimen (Figure 14a). As mentioned above, there are no published or unpublished reports of similar double-notched types being found in southern Alberta. The base is unlike the double-notched fragment recovered from Unit 2 in the kill site area (Figure 11d). The specimen from the kill displays the square-shoulder base, whereas the specimen from the area of the ring features has the sloping-shoulder base more typical of Prairie Side-notched forms.

Four other projectile point fragments were recovered from the excavation of the rings. Unfortunately, all four lack distinguishing characteristics. The only other formed artifacts from the tests were a

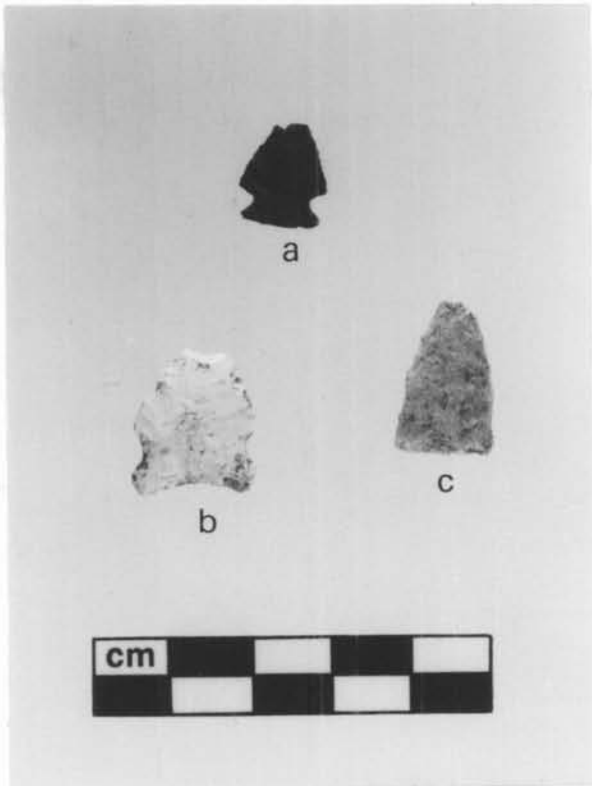

Figure 13. Projectile points recovered from the ring features located just east of the kill site.

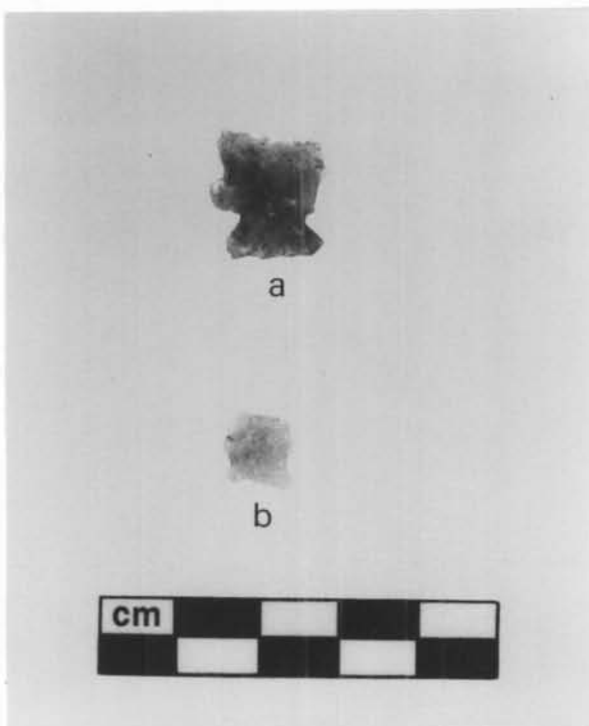

Figure 14. Projectile points recovered from the ring features located just east of the kill site.

biface fragment and a historic copper "tinkle cone." The raw material recovered from the rings consists of 38 percent chert, 13 percent siltstone, 3 percent mudstone, and small quantities of petrified wood, obsidian, limestone and ceramics. The largest of the pottery specimens is a cord-marked neck sherd which may be affiliated with the Late Variant of the Saskatchewan Basin Complex ceramics (Byrne 1973).

Artifacts collected from the ploughed field south of the kill site included projectile points and point fragments (Figure 15), a pièce esquillée, three scraper fragments and four biface fragments. The point styles are not inconsistent with those recovered from the undisturbed deposits consisting of both Plains and Prairie styles. Results from the analysis of the faunal remains are not yet available.

CONCLUSIONS

A rock slide which occurred around 1926 covered the main kill deposits of the Pincher Creek Jump site and effectively conserved this portion of the site. Prior to the slide, bone remains were removed from the kill to supply the "buffalo bone trade." It is impossible to determine the extent of disturbance that the bone mining caused, since we have no idea what was there before the removal of the bone.

While the rock slide protected the bone deposits in the kill, it also prevented us from mapping the full vertical and horizontal extent of the remaining deposits. From our two tests at the bottom of the slide, we were able to identify three undisturbed layers of bone. The upper two of these can be dated to the Late Prehistoric Period, as indicated by the recovery of known projectile point styles from these layers. A third bone lens was identified in Unit 2 at 1.65 m below surface. No samples were recovered from this third layer since it was discovered in an auger test. As a result, we are unable to provide information regarding the nature of these deposits outside of the obvious conclusion that they date to before the remains of bone layer 2.

In addition to the recognizable point forms, two new forms were recovered; one is called a Pincher Creek Side-notched point and the other a Pincher Creek Double-notched point. Both appear to show temporal affinities with Plains Side-notched point types. Other archaeological

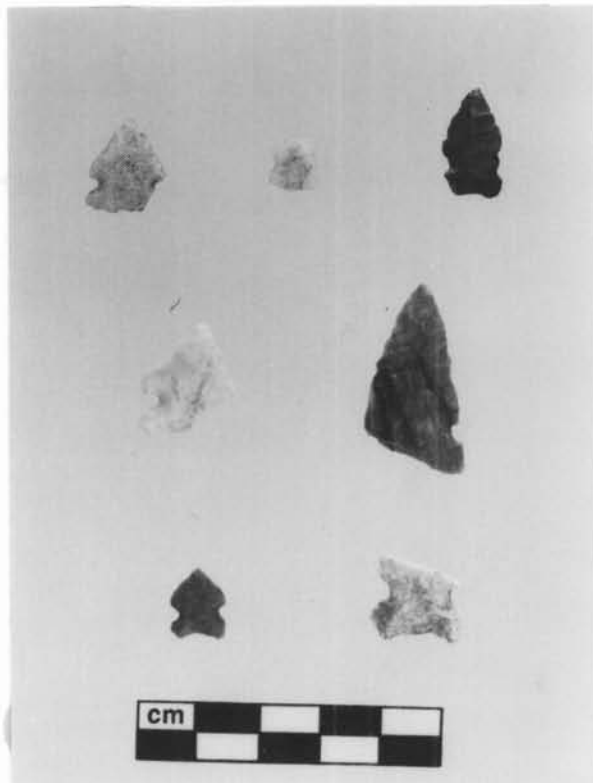

Figure 15. Projectile points and point fragments surface collected from the ploughed field below the kill site.

evidence of cultural activity at the site is found to the south and east of the kill deposits and is composed of bone and lithic scatters in a ploughed field, isolated finds and ring features. Excavation of a series of rings located just east of the kill resulted in the recovery of both bone and lithics. The projectile points from the rings indicate that these features date to the same time as the kill. Point styles from the collections in the ploughed fields are of similar apparent age. Radiocarbon age estimates will be made on bone samples from the kill and ring features, and these results should provide support for the comparative age estimates suggested by the projectile points.

PRELIMINARY REPORT ON THE 1986 FIELD SEASON AT HEAD-SMASHED-IN AND CALDERWOOD BUFFALO JUMPS

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INTRODUCTION

The 1986 field season at Head-Smashed-In Buffalo Jump (HSI) in southwestern Alberta was the final year of field studies sponsored by Alberta Culture prior to the opening of the on-site interpretive centre. During the three previous seasons, many of the objectives of the annual research designs had been attained. In brief, these consisted of mitigating potential impacts to archaeological resources as might be occasioned by the interpretive developments; documenting the archaeological record of the previously poorly known processing site below the kill; experimental studies of hearths, bone boiling and bison taphonomy; baseline studies of associated site features, including petroglyphs, a vision quest site and the drive lane complex; and the investigation of other potential kill sites in the immediate vicinity of HSI (see Brink et al. 1985, 1986; Marshall and Brink 1986; Reeves 1985; Rollans 1986; Wright and Brink 1986).

At the onset of the 1986 field season in June, all major development-related activities that posed a threat to in situ archaeological materials had either been completed or were well underway. Hence, no further mitigative studies were required. With many of the research objectives attained or in progress, the 1986 season was accordingly reduced considerably in scale relative to previous seasons. At Head-Smashed-In Buffalo Jump, field work consisted of the excavation of two contiguous 2 x 2 m units on the prairie level adjacent to the units excavated in 1985 and screening of a sample of the dirt which forms a small dam at the head of a spring channel below the kill. Also in 1986, excavations at the Calderwood Buffalo Jump, situated about 1 km north of HSI, were conducted under permit issued to Marshall. Because of the closely related nature of these two projects, they are discussed here in a single report.

1986 AT HEAD-SMASHED-IN

Head-Smashed-In Buffalo Jump is located in southwestern Alberta at the southern end of the Porcupine Hills (Figure 16). Bison were rounded up in the confines of a large natural basin located to the west of the jump and herded through a complex series of drive lanes to the edge of a 10 m high sandstone cliff. Topple and slump from the cliff face have formed a bench at the base of the cliff, and it is this bench which contains the stratified layers of bison bones and stone tools extending to a depth of 10 m below surface. Archaeological study of the bone bed at the kill site has been conducted by Wettlaufer (1949) and Reeves (1978, 1983b). To the east of the kill, the bench drops off steeply to the prairie level where a shallowly buried blanket of cultural material covers and estimated area of 500,000 square metres. This has been referred to as the processing/campsite portion of the site and has been the primary focus of recent site studies sponsored by Alberta Culture.

The rationale for the selection of this component of the site for detailed investigation lies, in general, in the paucity of archaeological examination of butchering/processing sites associated with communal bison kills on the Plains and, more specifically, in the fact that little was known about this component at HSI. With the decision by the Alberta government to construct a major, on-site interpretive facility, it became apparent that adequate development of the interpretive storyline and displays required a substantial amount of new research into poorly understood aspects of HSI. The 1986 field season saw a continuation of research at the processing/campsite portion of the site.

During the first season at HSI (1983), a number of exploratory excavations were placed over a large area of the processing site (Brink et al. 1985). This provided a preliminary indication of the nature and extent of cultural materials in different portions of the site. The

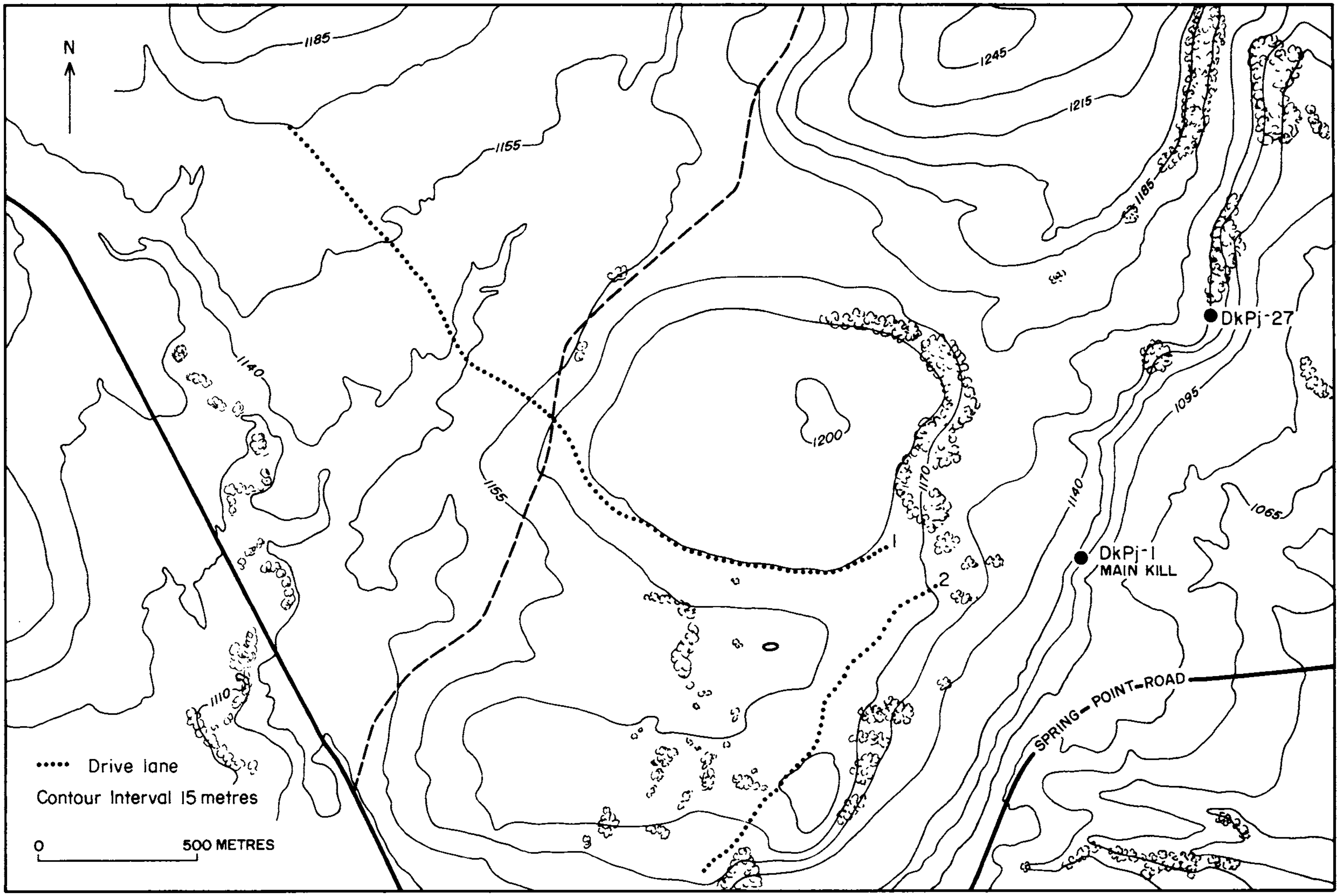

Figure 16. Location of the Head-Smashed-In (DkPj-1) and Calderwood (DkPj-27) buffalo jumps.

following year we conducted detailed excavations at the north end of the processing site in an area intentionally selected because of its distance from the most heavily used part of the site (Brink et al. 1986). In so doing, we had hoped to avoid some of the confusion of the core area of the site where several thousands of years of bison processing are compressed into an unstratified soil averaging 15 cm in thickness. The major thrust of the 1985 season was the excavation of four contiguous 2 x 2 m units at the south end of the core area of the processing site, 350 m distant from the 1984 excavations. These excavations were designed to explore a portion of the prairie where a well trench had exposed cultural deposits extending to a depth (50 cm), more than twice what we had previously encountered (Wright and Brink 1986). Unfortunately, the units were placed on the very edge of the higher deposition area, and only a thin strip of our excavations intersected the deeper cultural layers. Continued excavation in this locale was deemed advisable as this area offered at least limited potential to produce some vertical separation of temporally distinct occupations on the site.

Accordingly, we returned to this area in 1986. Two more 2 x 2 m units were placed directly adjacent to those excavated in 1985, along the west edge of the previous units where the deeper cultural materials had been encountered. Excavation methodology was generally similar to that employed in previous seasons. Each unit was divided into 1 m quadrants and 0.5 m subquadrants. Excavation proceeded by arbitrary 10 cm levels until all pits were sterile. All bone identifiable as to anatomical element was mapped in situ. Unidentifiable bone scraps were discarded. Fire-broken rock fragments larger than 5 cm in any dimension were likewise mapped. Initially, chipped stone artifacts were bagged according to the 0.5 m subquadrant and 10 cm vertical level of origin. Soon after the outset of the 1986 season, however, it became apparent that discernable natural stratigraphy was present in the units, and the decision was made to excavate the one as yet unopened 2 x 2 m unit keeping exact provenience of lithic artifacts in three dimensions. Ongoing analysis of these data, combined with radiocarbon dating of the identified natural strata, hopefully will demonstrate if cultural materials are indeed layered in proper temporal sequence in this area of higher deposition.

SOILS AND STRATIGRAPHY

The area of the 1986 excavations is a relatively flat portion of the prairie, lying just east of the toe of the slope which leads up to the slump blocks and topple at the base of the cliff (Figure 17). Although difficult to discern, it appears that a small, localized depression acted as a sedimentary trap here, thus accounting for the increased soil deposition. Our testing suggests that this minor basin is only about 500 square metres in size. Within the basin, a well-developed, dark brown Ah soil horizon extends to about 50 cm below surface. At the edges of the basin, the Ah horizon pinches out to a layer averaging 15 cm thick. Below the Ah (or probably an Ahk) horizon is a thick, light brown, silty Ck horizon. This loess deposit is at least several metres thick and is believed to overlie weathered sandstone bedrock. The contact between the Ah horizon and the underlying sterile loess is marked by a proliferation of wedge-shaped cracks where dark organic soil plunges as much as 50 cm into the loess (Figure 18). These are almost certainly dessication cracks rather than root casts. The unit floors exhibited a polygonal patterning of organic soil extending into the loess typical of dessication cracks. Soils here are classified as a Rego Chernozem.

Within the sedimentary basin the Ah horizon displays internal stratification. Beneath an extremely thin sod layer there is a 45 cm thick classic Chernozemic Ah, except in about the middle of the horizon where a distinct lens of fine to medium sand truncates the organic soil (Figure 18). This lens appeared throughout the 8-square-metre excavation area at a fairly consistent depth of about 25-35 cm below surface and averaged about 10 cm in thickness. It is noteworthy that the portions of the Ah horizon both above and below the sand lens were densely packed with bison bone, fire-broken rock and lithic artifacts, but the lens itself was nearly sterile. Hence, it would appear that an interval of site abandonment occurred during which time sterile sediments were laid down in the small depositional basin. The exact time period represented by this sterile sand lens is unknown, but the approximate age of this deposit has been bracketed by radiocarbon assays on bone taken from above and below this horizon. These dates are 800 ± 90 years B.P. (AECV 374) and 1360 ± 140 years B.P. (AECV 375), respectively. These dates are

Figure 17. The 1986 excavation area at Head-Smashed-In.

compatible with the styles of projectile points recovered from the same stratigraphic contexts. With the generally slow rate of soil deposition that characterizes the whole processing site area, it is tempting to suggest that a 10 cm thick lens of sand would have built up slowly over a long period of time. However, given the proximity of the excavation area to the toe of the slope up to the cliff, it is equally possible that the sand layer was deposited in a short period of time by colluvial action. During summer downpours, we have witnessed torrential rains wash large amounts of loose soil downslope. Although it seems unlikely, the sand lens could have been deposited in a single year.

Whatever the case, the presence of this nearly sterile layer offered the first opportunity we have had at the processing site to recover cultural materials in a stratified sequence. Given the obvious history of severe rodent disturbance over the entire area, as well as the abundant evidence of multiple occupation and compressed temporally discrete events, this stratified sequence is anything but a veritable Pompeii. Yet the presence of an intervening sterile lens, in addition to the spread of artifacts throughout a nearly 50 cm thick horizon instead of the usual 10-15 cm thick deposit, represents a significant improvement over previous conditions. For this reason, much of the analysis of the

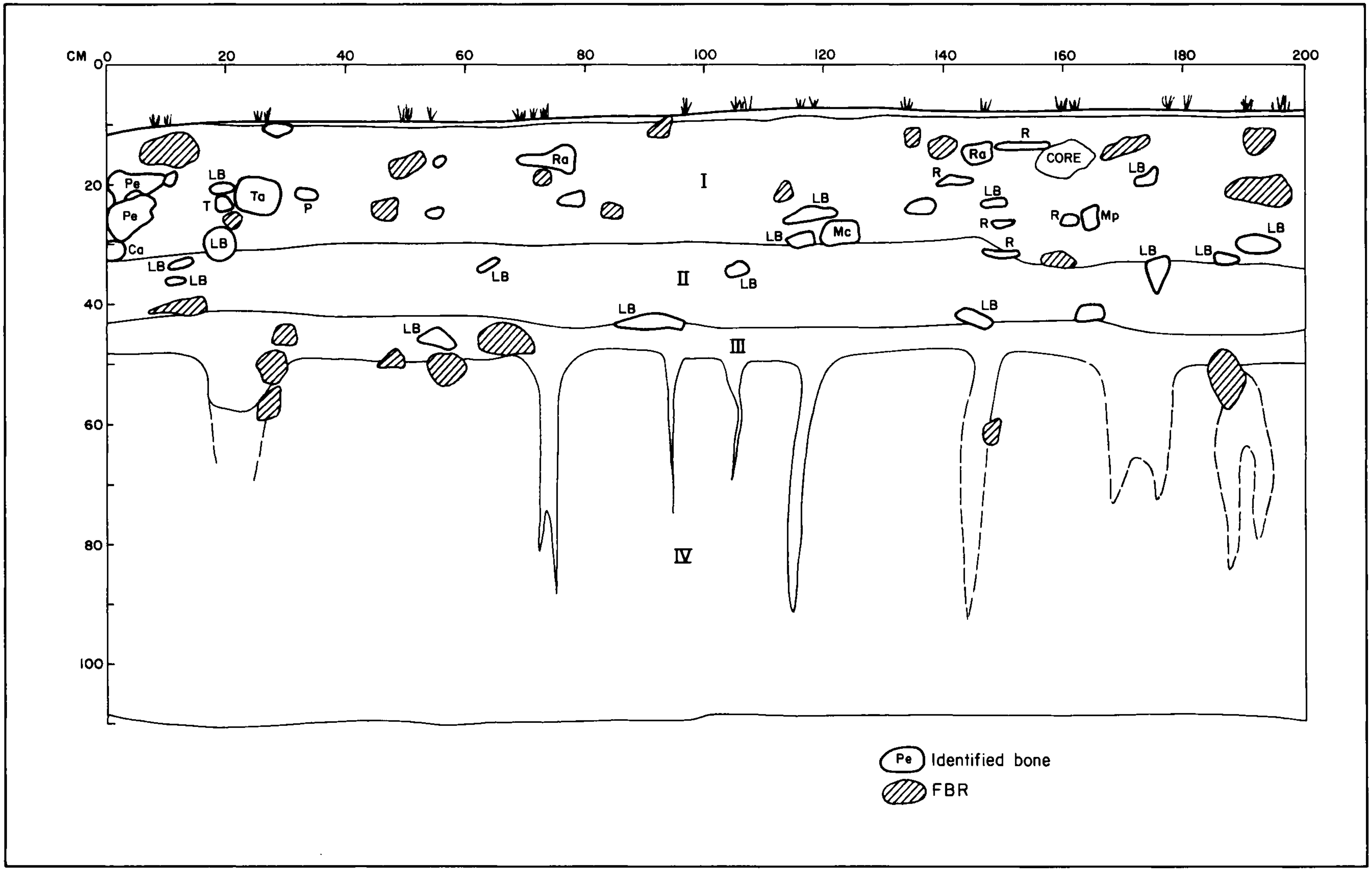

Figure 18. Soil profile from excavations at the Head-Smashed-In processing area.

1986 data will focus on the problem of separating out assemblages which are believed to be more or less temporally discrete.

EXCAVATION RESULTS

Fauna

Analysis of the faunal remains recovered in the 1986 excavations is still underway. It is evident that a pattern of processing activity, comparable to results yielded in our investigations elsewhere in the processing area (Brink et al. 1985, 1986; Wright and Brink 1986), is emerging here. The recovery techniques used in the 1986 excavations were the same as those used in the 1984 and 1985 field seasons (Brink et al. 1986; Wright and Brink 1986). A total of 3,141 specimens was identified to the level of species and anatomical element. Of these, the vast majority were large mammal bones identified as bison. Elements represented are predominantly longbone fragments, carpals, tarsals and phalanges. There are relatively fewer amounts of rib fragments, skull pieces, teeth and vertebrae. The fragmentary condition of the limb bones presumably reflects intensive processing for the rendering of bone grease and marrow. A full species list has not yet been compiled, but tentatively it appears that no further additions to those identified during the 1984 field season (Brink et al. 1986) will be forthcoming. It should be noted that once again there is a good representation of canid, either dog or wolf.

Lithic Assemblage

Excavations in the processing area at HSI in 1986 resulted in the recovery of a total of 5,284 flaked stone artifacts and 15 ground stone tools. A preliminary examination of the flaked stone assemblage indicates that the bulk of this material is debitage (4,768 - 90.2%), with fewer amounts of tools (364 - 6.9%) and cores (152 - 2.9%). The initial impression of this assemblage is that it nearly duplicates the results obtained elsewhere in the processing area, in terms of both raw materials and artifact morphology (Brink et al. 1985, 1986). Approximately a third of the flaked stone tools is projectile points, the vast majority of which falls into the range of variation of the Old

Women's and Avonlea types. The remainder of the tools consists largely of marginally modified expedient flake tools, with significantly fewer amounts of formed bifacial or unifacial tools which are either exhausted or in fragmentary condition. Cores are predominantly bipolar pebble cores of chert or silicified sediment, with a few simple cobble cores of local materials such as argillite.

The debitage appears to fall into two general categories: small maintenance debris derived primarily from exotic, fine-grained materials and relatively larger primary and secondary reduction flakes of local materials. This dichotomy in the applications of local versus non-local materials cross-cuts all aspects of the assemblage and presumably reflects site specific considerations of economical use of the available lithic materials. Fine-grained lithic materials have been observed to be scarce in the vicinity of the site; hence, these materials appear in the assemblage as tiny pieces of maintenance debris and small exhausted or unusable formed tool pieces. Coarse-grained local materials provided much of the heavy duty hardware at the site: hammerstones, pestles, anvils, and simple flake or core butchering tools. It would appear that every effort was made to get the most out of the lithic resources. This consideration is manifest in the assemblage in that virtually every sizeable lithic item has been used or reused.

As we had hoped, the excavations in the relatively deep sedimentation area of the processing site did yield stratified cultural materials. Although the results have not yet been fully tabulated, there appears to be a definite stratigraphic separation of the Old Women's Phase and Avonlea materials. Avonlea material was found below the distinct sterile sand lens that blankets the excavation at a depth of below 20 cm. The focus of the analysis of the lithic material from this deposit will attempt to augment our understanding of the chronological ordering of these particular artifact styles and to investigate the premise that the lithic resource base and reduction strategies in the processing area underwent change in the Late Prehistoric Period. Such change was observed in the lithic assemblage recovered by Reeves in his excavations of the kill site (Reeves 1978, 1983b).

Ceramics

A total of 99 pieces of pottery was recovered in the block excavation. With the exception of three rimsherds and one small shoulder sherd, these are all small body sherds in very crumbly condition. The largest sherd is less than 5 cm in any dimension. The decoration on the body sherds is limited to a fabric impression which appears as either smoothened or truncated cord-wrapped stick impressions. For the most part, these fragments are unanalyzeable, other than providing paste and temper characteristics. It is quite likely that many of the specimens were derived from a few common pots; however, the fragmentary condition prohibits reconstruction.

The three rimsherds recovered have been classified as Saskatchewan Basin Complex pottery after Byrne (1973). Two of these rimsherds were recovered from level 1 (0-10 cm below surface), and the other was recovered in level 4 (30-40 cm b.s.) from the base of the largely sterile lens of sand discussed above. The latter rimsherd is of particular interest because it has been decorated with an alternate pinched lip impression that is a characteristic attribute of pottery associated with the Avonlea Phase in southern Alberta (W. Byrne, personal communication 1987). The identification of this rimsherd as belonging to the Avonlea Phase component, and its stratigraphic position just beneath the sand lens, are in agreement with the recovery of Avonlea style projectile points and a date of 1360 ± 140 years B.P. (AECV 375) from this same depositional unit. The frequency of other sherds by level is as follows: level 1 (0-10 cm b.s.) - 70, level 2 (10-20 cm b.s.) - 15, level 3 (20-30 cm b.s.) - 8, and level 4 (30-40 cm b.s.) - 3.

Fire-broken Rock

The recovery of an enormous quantity of fire-broken rock (FBR) in 1986 is consistent with the interpretation that the block excavation lies in the heart of the processing area. Most of the rock exhibits the crenelated fractures, reticulated surfaces, and friable condition characteristic of stone that has been heated to a high temperature and subsequently quenched. Most likely these rocks were used as boiling stones for cooking and the rendering of bone grease. The procedure used for the FBR analysis duplicates the procedure used during the 1983, 1984 and 1985 seasons (Brink et al. 1985, 1986; Wright and Brink 1986). The preliminary results of the FBR analysis indicate that a total of 1919 pieces, weighing a total of 320.15 kg, were recorded from our 8-square-metre excavation. With the exception of two small pieces, all were recovered from within 50 cm of the surface. Of the total, only 183 pieces (9.5%), weighing 42.55 kg (13.3%), were the sandstone which outcrops at the site. Virtually all of the remaining FBR consisted of quartzite and other rock types not available in the immediate site area. The considerable effort undertaken to transport large amounts of these raw materials to the site attests to their superior properties as boiling stones.

Features

Only two features were encountered during the 1986 excavations. One of these is the western extension of a boiling pit feature encountered in the 1985 excavations and compares favorably both in content and dimensions with those described from the 1983 and 1984 seasons (Brink et al. 1985, 1986). The second feature is a bone upright feature, the principle elements of which are a pair of left distal bison tibias (Figure 19). The tibia shafts had been pushed or driven down into a sterile, buff-coloured silt with the articular ends up. Similar bone uprights were found in the adjacent block excavation in 1985 (Wright and Brink 1986), and the possibility that these are associated is presently being considered.

SCREENING DAM FILL

As mentioned above, a second and relatively minor component of the 1986 field season included a brief testing of the archaeological richness of the dirt which forms an earthen dam near the head of the spring channel which bisects the site (see Figure 17). Many decades ago (pre-1949), a rancher used a piece of heavy machinery to scrape the sides and bottom of the channel at the toe of the slope below the kill site and used the accumulated earth to build a dam across the channel. This ponded spring water for the rancher's cattle. The volume of the dam is about 2,000 cubic metres. Since the channel originates at the spring

Figure 19. Bone upright feature at Head-Smashed-In.

head in the heart of the kill site, it has been notoriously rich in bones and artifacts washed downslope from the kill. Amateur and professional archaeologists alike have collected from both the top of the dam and the top of the channel for years. It was from the top of the dam that, in 1949, Wettlaufer surface collected the base of a Scottsbluff point which is still the only evidence for the possible use of the jump in Paleo-Indian times.

As part of Alberta Culture's plan to have an extensive outdoor hiking trail system at Head-Smashed-In, it was decided to have the dam removed. This would restore the physical appearance of the site to something more similar to its prehistoric condition. It was recognized that the dam would contain many thousands of artifacts, albeit all of them out of context. The opportunity to recover large numbers of artifacts was regarded as an important means to augment the existing collections, especially with regard to obtaining specimens for display in the interpretive centre. Artifacts from the dam would be ideal for this purpose.

Accordingly, a test was conducted to see if the dam fill contained sufficient numbers of artifacts to warrant the labour involved in recovery. A front-end loader removed about 20 buckets (approximately

25 cubic m) from several different parts of the dam. This earth was then screened using two power screens with 1/4 inch (0.6 cm) mesh. Similar to our excavations, initially we retained all cultural materials except small pieces of fire-broken rock and unidentifiable bone fragments. However, it soon became apparent that the fill was exceedingly rich in well-preserved faunal material, and we found ourselves becoming increasingly strict with regard to which fragments were saved. Since all materials lacked provenience, it is unlikely that less complete elements will have any significant value as either analytical or display items.

No formal tabulation or analysis of the materials has been performed nor is any intended. Indeed, as of this writing, much of the recovered material has already made its way into various displays in the HSI interpretive centre. The purpose of our screening exercise was to determine whether the dam fill appeared rich enough in material remains to warrant complete screening. It was our conclusion that it did. The dam will soon be completely removed and stored in a new, off-site location to be screened over the next several years of the ongoing archaeological field project.

SUMMARY

The 1986 field season at Head-Smashed-In was small in scale relative to previous years but was rewarding in that an 8-square-metre area was excavated in a unique portion of the processing site. The increased deposition within the small sediment trap has produced a stratification of cultural materials which had not been evident in other areas on the prairie. True, this layering spans only 45 cm of soil within which several thousands of years of butchering activities are compressed. Furthermore, rodent disturbance, as well as mixing of deposits as caused by repeated re-use of the site (especially the excavation and re-use of features), likely have blended together numerous separate archaeological deposits. Nevertheless, the situation is markedly improved from previous years' findings and presents an opportunity to compare and contrast assemblage components recovered from a stratified sequence.

Analysis of much of the 1986 materials from HSI has only just begun, and no substantial interpretations are yet available. In general, the faunal, lithic and other artifactual materials are similar to and consistent with those recovered from previous excavations in the processing area. Faunal material is badly dessicated and often poorly preserved. Identifiability of elements is low. It would appear that processing of bison bones for marrow and grease is extreme, although this interpretation is tempered by the severe taphonomic agents believed to be active at the site throughout the span of its use. These latter processes could well mimic the pattern of cultural processing. Preliminary impressions of the patterns of element representation suggest that, for the most part, appendicular carcass portions were transported downslope for further processing. Skull and vertebrae fragments are relatively uncommon. This is consistent with interpretations of the faunal remains encountered in previous excavations (see Brink et al. 1986). Pending further analysis, it is suggested that this pattern is a result of recognition of differential utility of carcass portions by the prehistoric hunters (Binford 1978).

Lithic artifacts, fire-broken rock and features likewise exhibited similarities in number, kind and distribution to the results of our adjacent 1985 excavations. It is noteworthy that once again our excavations of the processing area below the HSI kill site have failed to turn up any evidence as to the use of the area by the earliest users of the jump. The 5,500 year old Mummy Cave Complex artifacts and fauna recovered by Reeves (1978, 1983b) from the kill site have remained conspicuously absent on the prairie level despite research spanning four decades. Considering the size of the sample of archaeological materials now recovered from the processing area and the widespread nature of these diverse research programmes, it seems warranted to conclude that some remarkably different pattern of bison butchering and processing was in operation during the Mummy Cave occupations of the site. Apparently, carcass portions were not transported down from the kill to the prairie but instead may have been butchered solely at the kill, after which the site was abandoned. Processing of carcasses may simply have shifted locations. However, given the small size of the slump blocks on which the kills took place, the rugged nature of the kill topography relative to the level prairie, and the difficulties of accessing water, boiling stones and other processing materials, the hypothesis seems unlikely.

Though purely speculation at this point, a more plausible explanation may be that these Middle Prehistoric hunters essentially did not process bison remains beyond simple primary butchering. Frison (1982:200) has noted that Late Prehistoric bison kills are characterized by evidence of intensive processing of the carcasses, including severe reduction of bone for marrow and grease extraction and the association of hearths and stone boiling pits. This scenario is entirely consistent with the abundant evidence of processing at HSI by Late Prehistoric hunters. Frison (1982) goes on to note, however, that this model of bison utilization does not apply to Paleo-Indian bison kills on the Plains. These latter sites tend to be characterized by a pattern of low level and highly selective utilization of carcass portions. It may be that the Middle Prehistoric use of HSI was more in keeping with the Paleo-Indian model of large game utilization than with the Late Prehistoric pattern.

Carrying the argument a step further, it is also evident that subsequent uses of the jump in Late Middle Prehistoric times by makers of Pelican Lake and Besant projectile points are very poorly represented in the processing area. Although not absent, like the Mummy Cave materials, four seasons of excavations on the prairie have yielded only a handful of points identified as belonging to either of these two types, and this is out of a sample of well over 1000 points. Viewing the situation from the narrow focus of a single site, it is tempting to suggest that intensive bison processing is a decidedly Late Prehistoric phenomenon, poorly expressed or entirely absent in earlier periods. At least at HSI, this appears to be the case. However, this problem requires much further analysis, including a re-examination of the HSI kill site fauna combined with continued excavations of the kill deposit and comparative analysis with other Middle Prehistoric bison kills.

THE 1986 SEASON AT THE CALDERWOOD JUMP

One of the exciting discoveries of the continuing research associated with the HSI project is the existence of an elaborate system of drive lane cairns which we now know were designed to funnel animals to more than one kill location. While it had been known that the gathering basin at HSI possessed one of the largest and most complex systems of drive lanes known anywhere on the Plains (Reeves 1978), it was assumed that this network was intended to direct bison to a single kill: the cliffs at HSI. Part of our research mandate, to better understand all aspects of the site complex, included a thorough mapping of most of the surviving drive lanes and the collecting basin (Reeves 1985) and an attempt to interpret the function of cairns and lanes (Brink and Rollans 1986; Rollans 1986). In the course of this work, it became apparent that the hypothesis of a single kill location could not accommodate the findings of the drive lane research. The placement of various lane complexes prompted speculation that numerous kill sites may exist along the sandstone escarpments to the north of HSI. Reeves (1985) speculated that as many as 13 additional kill sites may have been used.

In 1985 a brief attempt was made to investigate the possibility of additional kill locations. This consisted of surface examination of promising areas based on suitable topography and the termination of drive lanes. Time and resource allocations did not permit the testing of potential kill locations. It was hoped that some new kills might be identified on the basis of surface exposure of bone; such was not the case. This search for new kill sites still needs to me completed.

A second buffalo jump was visited and tested in 1985: the Calderwood jump (DkPj-27). This is not considered here as a new discovery because the existence of the jump had been known for some time (Reeves, personal communication 1985). However, the kill site had never been investigated nor, apparently, had it been subjected to vandalism. To gain a rudimentary understanding of the nature and extent of the site, its cultural affiliations and its potential relationship to HSI, we explored the site contents with two 1 x 1 m units. The results of this work have been reported elsewhere (Marshall and Brink 1986) and will not be repeated here. Over the course of the fall of 1985, it was decided that more extensive excavations would be conducted in 1986 and that the results would be employed by Marshall as the basis for a Master's thesis.

THE CALDERWOOD SITE

DkPj-27 is located about 1 km northeast of HSI, along the same exposure of Porcupine Hills sandstone which forms the jump-off at HSI (Figure 16). The upland prairie which leads to the edge of the Calderwood jump is fairly level for a distance of about 300 m west of the kill site (though rugged in places due to severe wind deflation). Continuing further west, the land rises gradually and then forms a valley situated between two small, local prominences to the north and south. This valley or pass between these two small hills is most likely the route used to drive animals to the kill; this is supported by the occurrence of drive lanes through the pass. Approaching the edge of the cliff, the weathered bedrock outcrops flush with the prairie surface forming a sharp, abrupt lip to the jump-off. At the presumed jump-off point, directly above the heaviest concentration of buried faunal remains, the cliff attains a height of 6 m. Below this vertical drop, the ground surface, composed of loosely consolidated sand, silt and chunks of toppled bedrock, angles steeply (c. 35-40^{o}) down another 50 m before levelling off into a trough or U-shaped notch at the bottom of the slope (see Figure 20). Most of the animals driven over the cliff likely would have tumbled a full 60 m to the bottom of the slope. The tilted beds of sandstone at the bottom of the slope - probably the result of a major topple or slump event - have produced the notch configuration which probably helped to contain any animals not killed outright by the fall.

The base of the U-shaped notch likely was the scene of the killing and much of the primary butchering. This landform rises gently to the north, is about 120 m in total length from north to south, and has only a few metres of roughly level ground at the base of the notch before rising up to the east and west sides. Due to these topographic constraints, it is speculated that the total site area would be fairly small, being restricted essentially to fairly level portions of the bottom of the notch. We estimate the site area does not exceed 750 square metres. Much of this area is unsuitable for excavation, especially at the south end of the site, due to an abundance of bedrock topple (see Figure 21). Beyond the confines of the kill site, the lands drop off to the north, east and south, to the rolling prairie some 50 m below. Aside from the

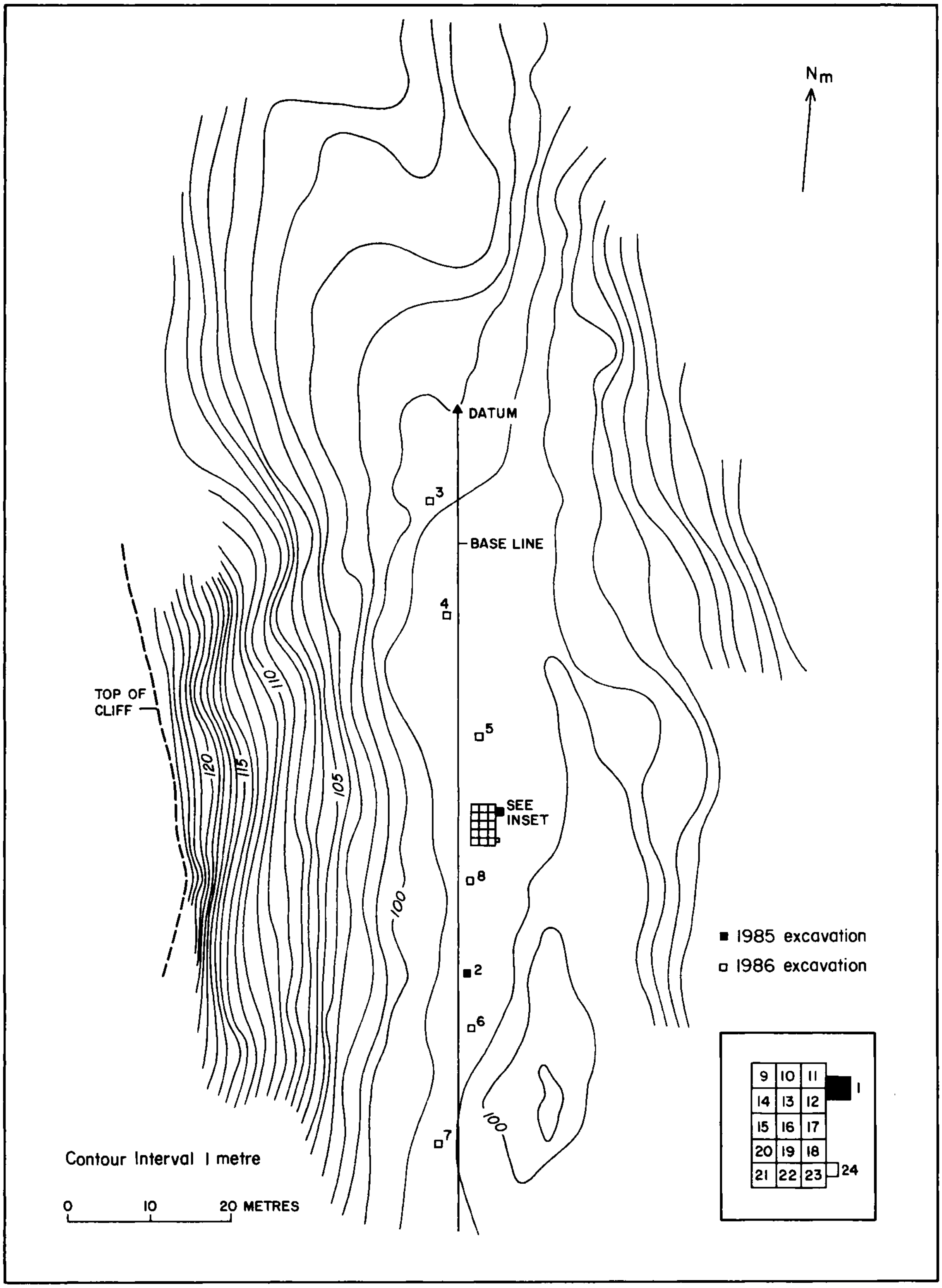

Figure 20. Topographic map of the Calderwood Buffalo Jump and map of excavation unit placement.

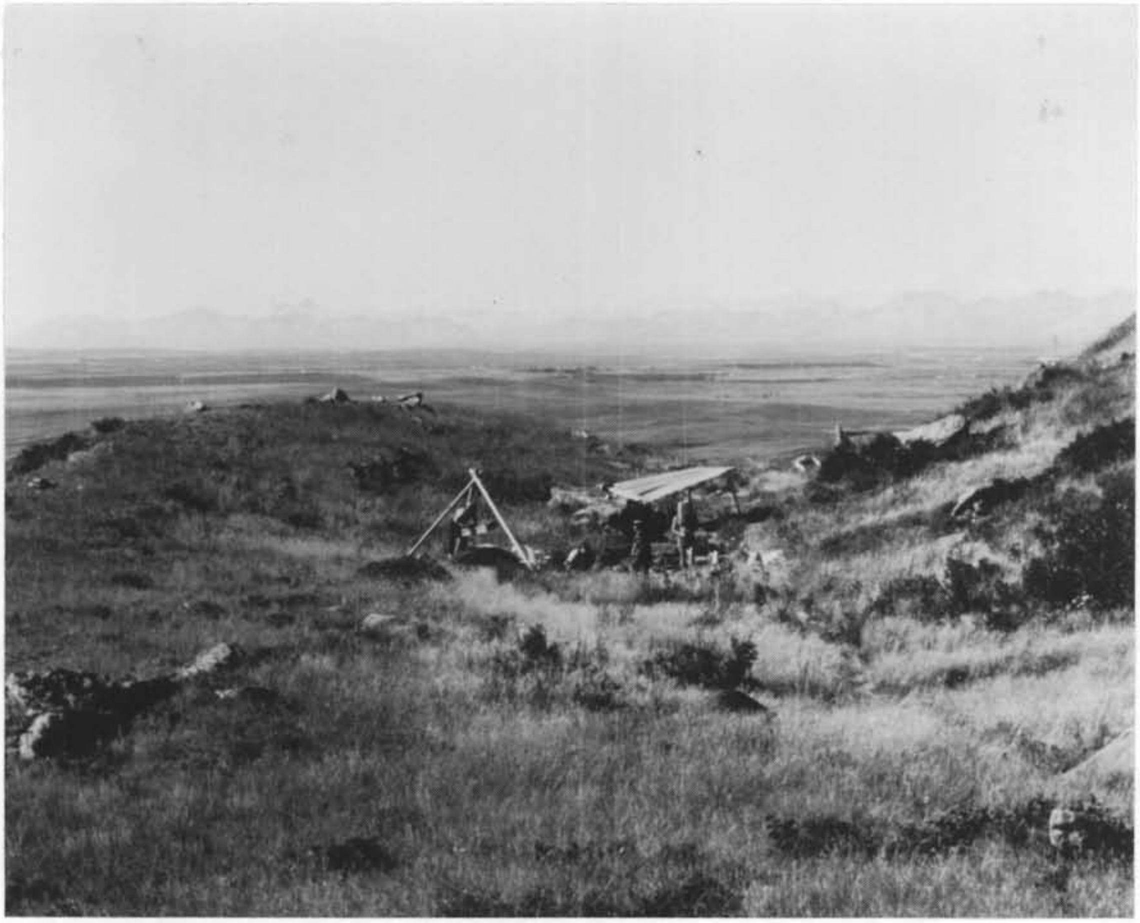

Figure 21. Excavations at the Calderwood Buffalo Jump. Pits are situated in the bottom of the notch below the cliff.

immediate kill site, there is no adjacent area to which carcass portions could have been transported for further butchering and processing. The nearest area suitable for this task would have been the extensive prairie below the kill. Cursory examination of the surface of the prairie in 1983 did result in the identification of scattered lithic artifacts. Years ago, Reeves had recorded this area as DkPj-3 and suggested that the materials belonged to a camp/processing site which was probably associated with the nearby jump, but the area has never been tested.

METHODOLOGY

Fieldwork in 1986 commenced with the placement of a north/south baseline running essentially down the centre of the notch and spanning nearly the entire length of the potential kill area (100 m). To supplement the information obtained from the two units excavated in 1985 (units 1 and 2), an additional six 1 x 1 m squares (units 3-8) were placed along the length of the baseline. Excavation of these test units helped to determine the most productive parts of the site. For example, unit 3, at the far north end of the baseline, was nearly sterile, and the next units to the south, units 4 and 5, were likewise characterized by a low yield of cultural material. At the far south end, ample bone was encountered in stratified layers, but the massive amounts of toppled bedrock made excavation extremely difficult or impossible. Based on the 1985 and 1986 tests, it was decided to concentrate excavations in the vicinity of the centre of the notch where stratified cultural material appeared to be plentiful and topple, while present, was not insurmountable. An area was chosen for the excavation of 15 contiguous 1 x 1 m units (Figure 20).

The excavation of both the test units and the block area employed 10 cm arbitrary levels. While both natural and cultural stratigraphy were present, information gleaned from the test units suggested that it would be exceedingly difficult to proceed with excavation via the use of natural stratigraphy. At times, layers of bone and natural strata were clearly discernable and would have been relatively easy to follow in the floors of the units. At other times, however, the convoluted topography of the base of the notch combined with the complex depositional history at the site (as discussed below) resulted in a merging and splitting of natural and cultural deposits. Combined use of arbitrary levels and careful profiling of the walls of the block unit hopefully will permit a reconstruction of site formation processes and events.

All identifiable bone was mapped in place, as were all features and fire-broken rock. Chipped stone artifacts were bagged according to the 1 x 1 m unit of origin. All excavated materials were passed through a 1/4 inch (0.6 cm) mesh. Bone fragmentation was extreme in some levels, especially where the bone lens had experienced severe burning. We did not attempt to collect all unidentifiable bone fragments. Instead a single unit was selected from which all bone was saved. The 5 x 3 m block unit was opened and excavated to a depth of 30 cm below surface. Since our 1985 tests had indicated that cultural materials would extend to a depth of 1 m, it was decided that the time remaining in the 1986 season would only permit full excavation of a smaller area. Accordingly, the southern portion of the block (units 15-23) was selected and excavated to a depth of 1 m below surface. This 9-square-metre block was then further reduced to a 4-square-metre area and was shoveled to a final depth of 1.9 m. No evidence of site use was detected below the depth of 1 m. Upon completion, the west, south and east walls of the block excavation were profiled, and radiocarbon samples were extracted from the west wall.

SOILS AND STRATIGRAPHY

The deposition and stratigraphy at the Calderwood jump is complex and will be only briefly outlined in this preliminary report. The soil profile exhibited in an off-site unit (3) was essentially similar to that of HSI and is classed as a Rego Chernozem (J. Doormar, personal communication 1986). In the areas undisturbed by cultural activity, a 50 cm thick dark brown chernozemic Ah horizon is underlain by at least several metres of a light brown Ck horizon. This latter deposit is composed of a sandy silt with occasional fragments of weathered sandstone bedrock.

Within the boundaries of the kill, the profile has been dramatically altered by human activity. The primary agents of deposition are believed to be aeolian and colluvial action. Wind blown silts have settled out and slowly accumulated below the cliff. Added to this incremental deposit are large and small blocks of toppled bedrock. The erosion of these blocks has resulted in the deposition of loose sand and heavily weathered bedrock. A third sedimentary process believed to have been important in site formation is the downslope movement of unconsolidated sediments. During spring snow melt and heavy rainstorms, the silts and sands which drape the surface of the talus slope below the kill are probably washed downslope and deposited in the base of the notch. Finally, the repeated use of the jump has left thick deposits of bison bones, at least in the upper 1 m of the soil profile.

Figure 22 presents a profile of the west wall of the block excavation. This edge of the excavation unit was closest to the centre of the U-shaped depression (notch) and, for this reason, revealed the

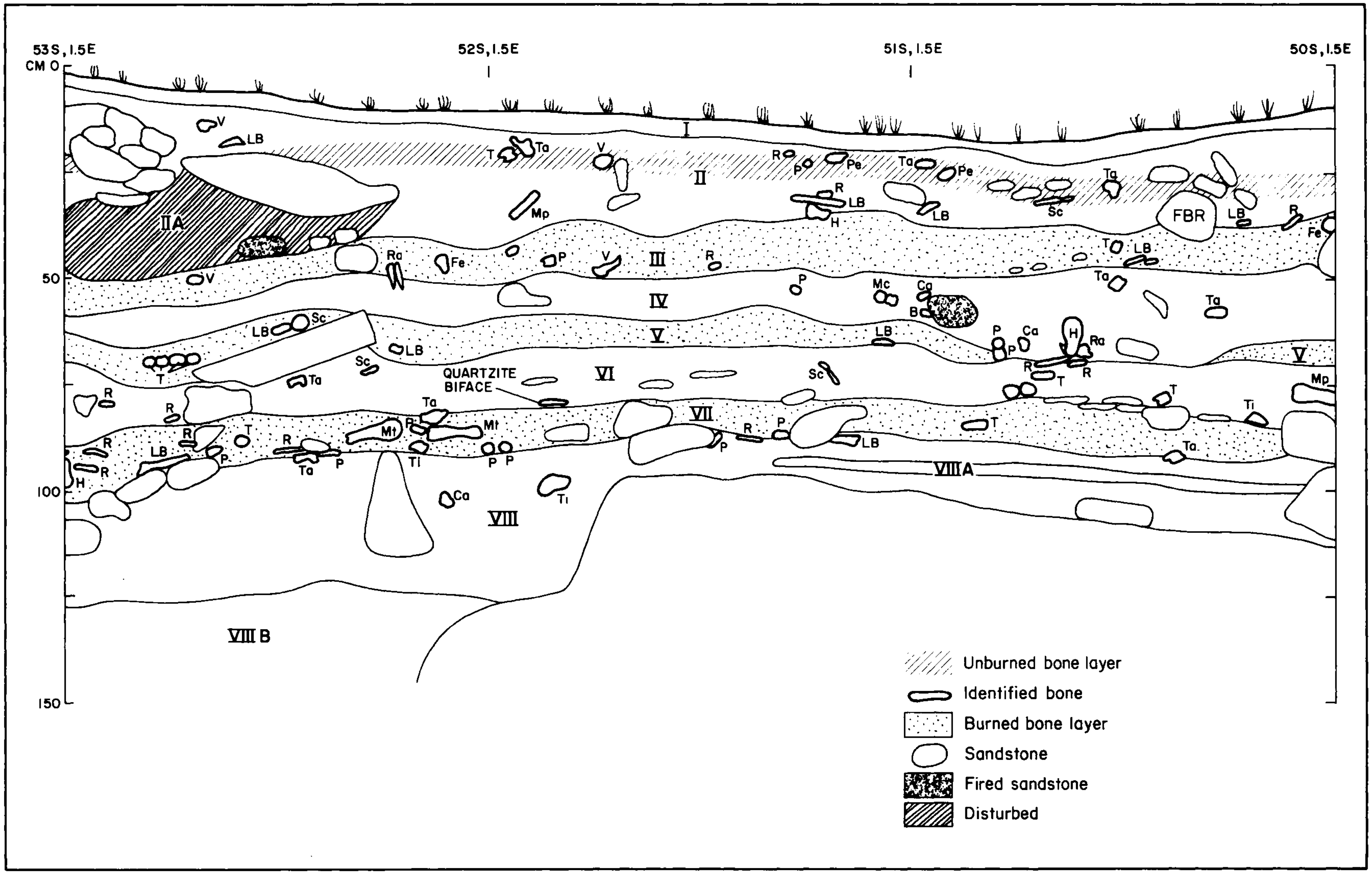

Figure 22. Soil profile, west wall, block excavation at the Calderwood Buffalo Jump.

clearest record of deposition at the site. Toward the east end of the excavation, the ground surface began sloping back up, following the tilted bedrock. As this occurred, depositional layers which appeared clearly separated in the west profile began to pinch together. Figure 23, the south wall profile, demonstrates this compression of strata from west to east. The enhanced resolution of the stratigraphy at the west end of the excavation can be attributed to the higher rate of deposition and minimal erosion which would typify the lowest point of the depression in contrast to the inclined areas to either side.

Although the stratigraphy displayed in the west wall is far from crystal clear, it is suggested that four major cultural strata can be delineated. In Figure 22, these strata are layers II, III, V and VII. In layer II, the hatched line, which lies at a depth of about 10-15 cm below surface, is a thin layer of unburned and fairly well-preserved bison bones. Layers III, V and VII are all thicker, heavily burned bone lenses. These three layers, especially layer III, all appear very black in the profile due to the presence of massive amounts of charred bone. Pockets of white, calcined bone were common in parts of layer V but rare in the other two burned horizons. Separating these four bone deposits were layers of lighter coloured, sandy silt particles mixed with sandstone fragments, as well as the occasional piece of burned and unburned bone. In no cases were the intervening sediments culturally sterile. Nevertheless, the transition between the major bone lenses and the intervening mixed sediments was usually quite marked. The presence of bone elements within the layers which separated the bone lenses is believed to be due to disturbance by burrowing animals and especially by downslope movement of bone and sediment from the talus slope to the west.

Whether or not the four bone layers each represent a single use of the jump is still problematic. Multiple radiocarbon samples taken from different sections of the profiles may have to resolve this issue. Likewise, ongoing analysis of the lithic artifacts and faunal material may help clarify the sequence of site use. Pending these results, it is currently our suspicion that the four layers of bone identified between 10 and 100 cm below surface represent four individual episodes of bison killing at DkPj-27. Based on radiocarbon dates obtained from test unit 1, the earliest use of the site appears to be about 2,800 years ago and

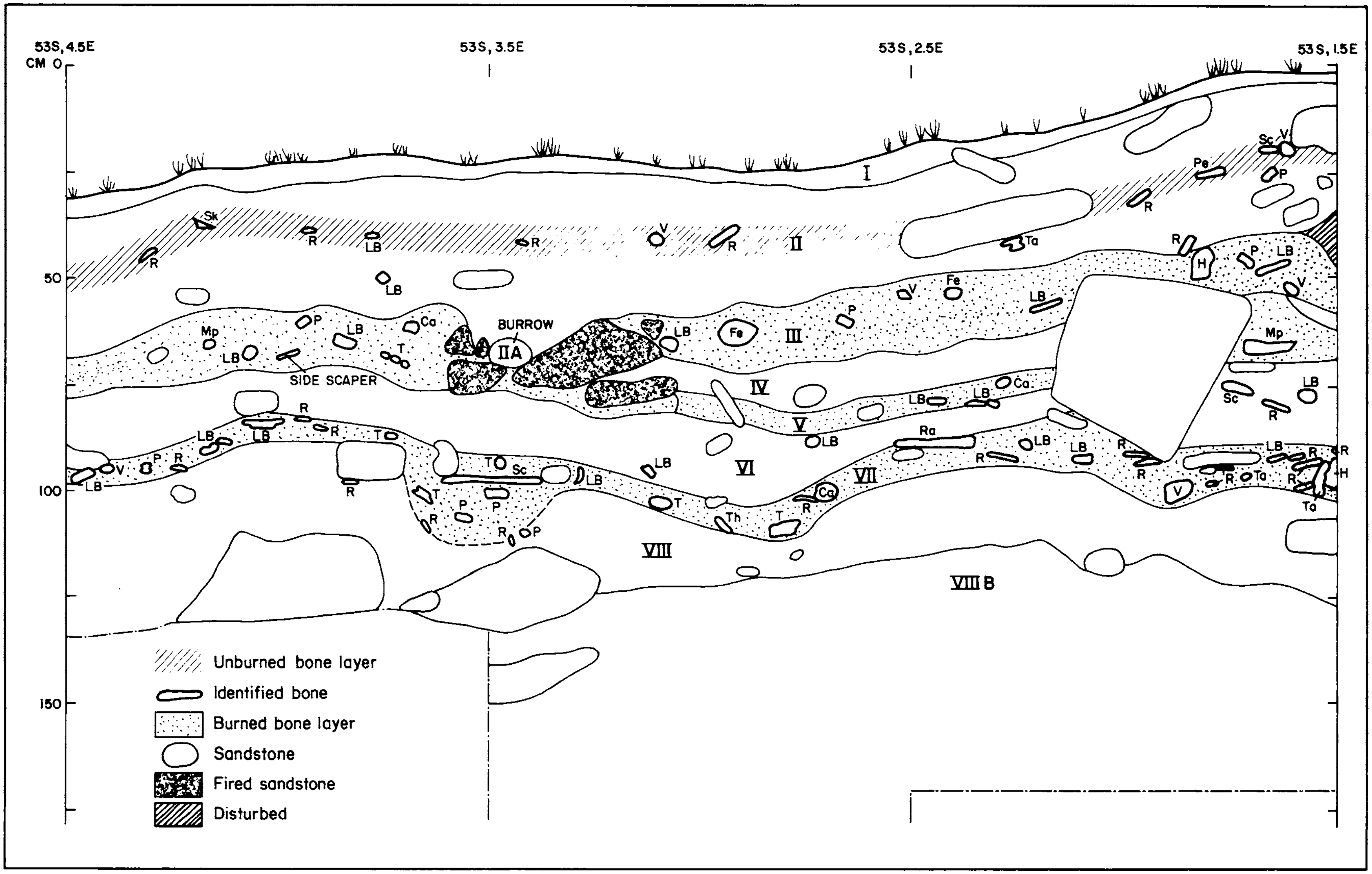

Figure 23. Soil profile, south wall, block excavations at the Calderwood Buffalo Jump.

the latest about 200 years ago (Marshall and Brink 1986:157). Although our 1985 tests identified three distinct bone layers, compared with four in 1986, our preliminary analysis of the 1986 data suggests that all kills were conducted within this same time period. That a fewer number of and more shallowly buried bone layers were recorded in the 1985 test unit 1 is probably a result of the fact that this unit was placed to the east side of the block excavations where the strata were more compressed.

EXCAVATION RESULTS

Faunal Remains

A total of 11,225 identifiable bison bone elements and fragments, weighing 232.02 kg, were recovered during the 1986 season. All were classified as the present species, Bison bison. Remains of other species were rare. A small amount of non-bison material was recovered during excavation, but it has not yet been identified. This material is thought to include small rodents, such as the Richardson's ground squirrel (Spermophilus richarsonii), and canid remains of dog (Canis familiaris) or wolf (Canis lupus).

The first bone lens was encountered by the end of Level 1 (0-10 cm b.s.), almost directly under the sod layer, and continued into Level 2 (20-30 cm b.s.). The lens was quite distinct, although not highly visible in profile. This upper bone lens is thought to represent a discreet kill event as it was separated from the underlying bone lenses by relatively sterile soil. Bone preservation was generally good, with both whole elements and large fragments noted.

By Level 4 (30-40 cm b.s.) massive amounts of heavily charred and burned bone covered the excavation floors. Calcined bone was evident and appeared as distinct pockets. All bone was highly fragmented and difficult to identify, but that identified consisted largely of small, dense bones such as carpals, tarpals and phalanges. This rich lens began near the top of the level and extended to 40-45 cm below surface. Very little soil matrix was mixed with the bone which suggests that a great deal of bone must have accumulated before burning occurred. The upper and lower zones of the lens appear to be equally calcined, so the fire must have consumed the entire bone lens.

Another bone lens was encountered at the base of Level 5 (40-50 cm b.s.). This appeared as a well-defined lens located between 45-60 cm below surface. The lens contained unburned and burned elements but not to the extent of the overlying lens. Clearly, the fire was less intense. The density of bone was also less than the previous event, the burned and charred bone appearing largely in localized pockets. Most of the bone was fragmented, but articulations of both hind and fore limb elements were noted. This lens was separated above and below by a thin, relatively sterile layer.

The lowest deposit of bison bone was encountered in Level 8 (70-80 cm b.s.) and was located between 75-90 cm below surface. Within this isolated lens were scatters of highly fragmented burned and calcined bone but also a good deal of unburned elements. The unburned bone included many whole elements which deteriorated badly upon exposure and removal from the matrix. This lens differed from the others as the unburned bone was particularly decayed, possessing a "punky" texture, and often difficult to excavate.

By Level 10 (90-100 cm b.s.) the incidence of bone dramatically decreased, and there was no indication in the remaining levels of any kill deposits. At this point, the matrix became relatively hard and compact and is thought to represent natural deposition of slope wash and aeolian sediments. Occasional, small fragments were encountered to Level 17 (160-170 cm b.s.), but these are thought to represent inclusions which have been redeposited from the previous kill. Excavation was completed at a final depth of 200 cm.

A frequency list for the entire assemblage is presented in Table 5. This table quantifies the bison assemblage, which contains a total of 6,453 catalogued elements. The frequency of anatomical elements may reflect butchering practices carried out at DkPj-27, but it must be noted that these frequencies are based on arbitrary levels, not cultural layers, and may not represent certain patterning perceived in the individual kill deposits.

It appears from the frequency of elements recovered that at least initial butchering was conducted at the site. At the Calderwood Buffalo Jump, there is presumably both a kill location and processing area. Therefore, the kill would have been immediately followed by primary

Table 5. Frequency of bone elements (NISP), DkPj-27.

Element	Frequency	Percentage
Skull	299	3.5
Mandible	130	2.0
Hyoid	12	0.2
Atlas	25	0.4
Axis	17	0.3
Cervical vertebrae	119	1.8
Thoracic vertebrae	162	2.5
Lumbar vertebrae	55	0.9
Sacrum	21	0.3
Caudal	32	0.5
Ribs	346	5.4
Sternebra	2	0
Pelvis	117	1.8
Scapula	141	2.2
Humerus	180	2.8
Radius	170	2.6
Ulna	95	1.5
Scaphoid	121	1.9
Lunate	104	1.6
Cuneiform	115	1.8
Pisiform	37	0.6
Magnum	125	1.9
Unciform	96	1.5
Fifth metacarpal	10	0.2
Femur	151	2.3
Patella	17	0.3
Tibia	155	2.4
Lateral malleolus	55	0.9
Astragulus	220	3.4
Calcaneus	145	2.2
Navicular cuboid	166	2.6
Cuneiform pes	111	1.7
First tarsal	10	0.2
Second tarsal	8	0.1
Metacarpal	131	2.0
Metatarsal	134	2.1
Metapodial	264	4.1
First phalanx	441	6.8
Second phalanx	458	7.1
Third phalanx	137	2.1
Proximal sesamoid	265	4.1
Distal sesamoid	95	1.5
Long bone fragments	141	2.2
Epiphysis	2	0
Costal cartilage	3	0
Skull fragments	34	0.5
Tooth fragments	84	1.3

Table 5. continued

Element	Frequency	Percentage
Upper tooth	183	2.8
Incisor/canine	79	1.2
Lower molar/premolar	202	3.1
Rib fragments	136	2.1
Vertebral fragments	94	1.5
Intervertebral disc	55	0.9
Unknown	16	0.3
Total	6543	100.0

butchering of the carcasses. Portable units may have been taken downslope for further processing. Consequently, not all anatomical elements would be transported from the kill site. During initial butchering, decisions must have been made as to the particular value of a given element. Thus, much of the remaining elements predictably would be the least desirable or low utility elements (Binford 1978). Those regarded as highly desirable, more useful elements were carried away to a processing area or campsite.

Lithic Assemblage

A total of 582 lithic artifacts were recovered at the Calderwood Buffalo Jump during the 1986 season. The assemblage consists of 579 flaked stone artifacts and debitage and three ground stone tools. The flaked stone assemblage consists of 494 pieces of debitage, four cores and 81 retouched artifacts. The retouched artifacts include 45 projectile points and point fragments. The projectile points illustrate different styles characteristic of both the Late and Middle Prehistoric periods and represent varieties of both atlatl darts and arrowheads (see Figure 24). Where possible, projectile point classification was based on known point typologies (after Reeves 1983a). Otherwise, simple morphological descriptions were used.

All lithics were sorted into six classes, following an abridged version of that employed for HSI, and represent the products and by-products of stone tool manufacture (Brink et al. 1985:313).

Figure 24. Projectile points recovered from the Calderwood Buffalo Jump.

Distribution of the assemblage by lithic category and material type is presented in Table 6.

The lithic assemblage recovered from the Calderwood Buffalo Jump represents different stages in lithic reduction, including a number of large quartzite flakes and heavy tools associated with the early stages of tool manufacture. Presumably, these were used as cutting or chopping tools. Retouch flakes, having a wide variety of cutting and chopping edges, were likely used in the disarticulation of bison carcasses. Cores were reduced to produce large, coarse flakes with some individual flakes being unifacially and bifacially retouched for use as scraping tools.

Non-local material is represented by small, usually broken tools, especially projectile points and small, thin resharpening flakes. Scarcity of complete tools suggests that they were carried away from the site, presumably for future use. Tools produced of fine quality,

Table 6. Raw material distribution by artifact class.

Raw Material	Artifact Class* 1	2	3	4	5	6	Total
Quartzite	311	3	16	3	4	3	340
Quartz	3	1					4
Chert	44		3		28		75
Swan River Chert	8				1		9
Knife River Flint	5				3		8
Obsidian	71		2		7		80
Porcellanite	2						2
Silicified Sediment	34	1			8		43
Petrified Wood		1			1		2
Local Argillite	13		2				15
Fine Non-silicified sediment	3						3
Other (not identified)			1				1
Total	494	4	26	3	52	3	582

*1 - Debitage
2 - Cores
3 - Marginally Retouched/Utilized Flakes
4 - Unifaces
5 - Bifaces
6 - Unmodified/Groundstone Tools

non-local materials were probably not manufactured on the site but prepared beforehand. This concures with Reher and Frison's (1980) model of prehistoric hunters "gearing up" in advance of communal hunts. In sum, it appears the lithic assemblage from DkPj-27 represents an assortment of raw materials manufactured to produce a functional tool kit necessary for use in primary butchering activities conducted at the site.

Fire-broken Rock

Excavation yielded 167 pieces (66.32 kg) of fire-broken rock. The vast majority of FBR is defined as non-local materials as seen in the biased count (144 - 86.2%) and weight (62.4 kg - 94.0%). Most of the material is quartzite, which does not occur in the immediate vicinity of the site but was transported from till deposits and locations near the Oldman River (Brink et al. 1985:105-106). The abundance of imported material suggests that sandstone was used sparingly.

The size distribution presented in Table 7 shows that the majority of FBR (88.1%) is less than 10 square cm in size. The properties of heat transfer and distance to the raw material may be factors in size, urging recycling. In addition, it should be noted that some FBR was heavily oxidized, indicating intense and direct heat exposure. While it is not possible at this time to differentiate FBR utilized at the site with that created by fire, it is plausible that burning of the bone lenses was responsible for some of the material identified as FBR.

Features

Only one possible feature was recovered. This appeared as a concentration of FBR in a roughly circular pattern in Unit 8, Level 6 (50-60 cm b.s.). Approximately 40 cm in diameter, it contained several large broken and unbroken quartzite cobbles and fired sandstone. Inside and around the FBR, the floor produced a reddish stained soil and a scattering of charred and calcined bone. This cluster may have been hearth matrix material associated with the FBR. Alternatively, it could simply have been caused by firing of the bone lens at this level.

Table 7. Size distribution of FBR by material type.

Size (sq. cm)	Non-sandstone (primarily quartzite)	Sandstone
0-5	n = 37 % = 22.2	n = 11 % = 6.6
5-10	n = 88 % = 52.7	n = 11 % = 6.6
10-15	n = 18 % = 10.7	n = 1 % = 0.6
15-20		
> 20	n = 1 % = 0.6	
Total	144	23

However, it is conspicuous as no discrete concentrations of FBR were found in any other unit.

SUMMARY

The 1986 season at the Calderwood Buffalo Jump (DkPj-27) included the excavation of six additional 1 x 1 m test units and a block area 15 square metres in size. This represents approximately 2.8 percent of the estimated total area of the kill site deposits. The placement of test units in a north-south line along the base of the notch below the cliff helped to clarify the size and nature of subsurface deposits and to determine the most productive areas for further excavation. This decision took into account our two primary concerns: the presence of stratified layers of bison bones and a relative absence of toppled sandstone bedrock. The eventual site of the block excavation met both these concerns.

Preliminary results of the Calderwood excavations indicate that the jump was used a minimum of four times between 2,800 and 200 years ago. Additional radiocarbon samples were taken in 1986 and likely will help clarify the chronology of the site. Stratified layers of bison bone were best displayed in the west end of the block excavation and were more compressed in shallower soil to the east side. This variation within a very small area was a result of site topography as controlled by the configuration of local bedrock. There may yet be other areas of the site where factors of deposition have preserved and separated additional kill events; that is, the four layers recognized in the 1986 excavations could each be compressions of several kill events which took place in fairly rapid succession and which might be preserved elsewhere at the site in separate context. One suggestion of this possibility was noted in test unit 6, where butchered bison bones were encountered at a depth of 1.4 m below surface. Whether this is an earlier kill episode or simply a greater depth of burial of the lowest kill deposit in the block excavation (layer VIII, Figure 22) is not known. Samples of the unit 6 bone layer have been submitted for radiocarbon dating.

It is equally possible that the jump was infrequently used and that the bone layers we recorded are the result of single-use episodes. The great depth (c. 10 m) of the bone deposits at the nearby HSI kill site and the long cultural-historical sequence exhibited at the site are evidence that HSI was the primary target for bison drives. The Calderwood jump may have been one of a series of alternate kill locations that were used only when certain conditions existed which made the use of the HSI kill unacceptable. The most likely such condition would have been the placement of a suitably sized herd of bison in the immediate vicinity of the Calderwood jump. The topographic swale or pass which leads from the collecting area to the jump is relatively small and only opens into one tributary "finger basin" of the entire collecting area. In contrast, the HSI kill is fed by a large, broad pass which opens into the whole of the 40 square km gathering basin. It seems probable that the Calderwood jump would have been used when herds were already grazing in or very near the small pass leading to the jump, and that herds found outside of this restricted area were likely driven to the HSI kill site or to other kill locations still undiscovered.

Faunal material from the excavations was abundant but generally poorly preserved. The best preserved layer was the most recent kill event, encountered at a depth of about 15 cm below surface. None of the bone from this episode was burned, hence the percentage of identifiable bone was relatively high. All other bone layers were characterized by an abundance of charred and calcined bone. However, even within the small area excavated it was apparent that the entire bone deposits were not evenly burned (see Figure 25). The percentage of identifiable bone in these lower layers was quite low. Tens, if not hundreds, of thousands of tiny charred and calcined bone fragments made up the bulk of these layers. Identifiable specimens tended to be the hard, dense elements such as phalanges, carpals, tarsals and long bone shaft fragments.

Lithic artifacts were relatively rare at the Calderwood jump. A total of only 582 specimens were recovered: 81 formed tools, 494 flakes and debitage, four cores and three ground stone tools. Of the formed tools, 48 specimens are identified as projectile points. The majority of the points (n=28) consist of very small, unanalyzable fragments. Twenty specimens were complete enough to permit detailed examination. This number is quite low compared with the generally high occurrence of points at bison kill sites in southern Alberta (Forbis 1962; Reeves 1978). If

Figure 25. Bone layer at Calderwood Buffalo Jump. Note partial burning of metatarsals, tarsals and proximal ends.

points are used primarily for killing, their relative paucity at the Calderwood site may attest to the lethal nature of the kill. Point types identified suggest that the primary users of the site were makers of the Old Women's and Pelican Lake phase projectile points. A few possible Besant points were recovered, as were several specimens believed to belong to the Mummy Cave or, more generally, the Plains Archaic Complex. These latter points are problematic in that no radiocarbon dates have yet been obtained which support use of the site during time periods consistent with these Middle Prehistoric varieties. The samples submitted from the 1986 excavations may alter this situation.

The severe burning of most of the bone lenses at DkPj-27 remains a puzzle. Bone will burn when fresh and full of grease but not as well after prolonged exposure. This suggests that the site area was repeatedly burned shortly after at least three of the kill events.

Frison (1970:6) has raised the possibility that bison kill sites were intentionally burned by the hunters as a means of clearing the site for subsequent use. The alternate hypothesis is that natural fires swept over the region igniting the bone. Arguing against the latter scenario is the fact that wind-swept grass fires generate little heat, and the necessary coincidence that natural fires would occur shortly after each kill episode. In other words, we doubt that most prairie fires would generate sufficient heat during their short life span at a specific spot to cause the bison bone to char and become calcined as exhibited in the layers at the Calderwood jump. Our own experiments suggest that fresh bison bones burn quite well if added to a hot fire but are otherwise hard to ignite. The presence of fire-broken rock at the site indicates that culturally initiated fires were a feature associated with site use. At the time of site abandonment, hunters may have intentionally thrown discarded bone into the fires in attempt to burn off much of the waste material.

Analysis of the Calderwood Buffalo Jump archaeological material is continuing as a Master's thesis project. Examination and comparison of the 1986 excavation data promise to provide an interesting adjunct to our knowledge of bison jumping at Head-Smashed-In and to our growing understanding of the prehistoric use of a large region - not just a single site - for orchestrating communal bison kills.

LOCATIONAL VARIABILITY OF ARCHAEOLOGICAL SITES IN THE PEACE RIVER - GRANDE PRAIRIE REGION OF NORTHWESTERN ALBERTA

By
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INTRODUCTION

Archaeological site databases, whether we like them or not, are here to stay. While they serve a useful function in the management of the resource, there has been little attempt to explore these databases for their potential to yield information regarding prehistoric settlement patterning. With the large amount of data being generated by impact assessment surveys, I think it is worthwhile to explore pattern recognition in the database. This may be particularly crucial in an area where the known site density is rather low.

One of the major functions of research staff of the Archaeological Survey of Alberta (and historical resource managers everywhere) is the assessment of proposed development areas for their potential to contain archaeological sites. On the bases of previous experience, the ethnographic record, the existing site record, some select physiographic variables and some soul-searching, recommendations are made for or against the conduct of impact assessment programmes. In certain types of development, such as large dams, extensive roads, power lines or pipelines, sites almost certainly exist somewhere in the project area. We have much more difficulty assessing smaller, localized developments, such as gas wells or gravel pits. These difficulties aside, it is worth examining if we are detecting a wide range of prehistoric and historic settlement patterning with the existing site record, especially in an area where the known site density is low.

Note: This paper was originally read at the Saskatchewan-Alberta Dialogue (SAD) Symposium, held in Edmonton in January, 1986.

If we reflect on the probable range of settlement patterns that have been possible over the last ca. 10,000 years, we can expect a certain amount of redundancy to be present in locational data, due largely to physiographic and subsistence resource constraints. It is common practice when surveying, for example, to expect sites to occur in areas where contemporary settlements, campsites and so on exist today. In addition, fish capability and ungulate capability have been investigated in northeastern Alberta (Donahue 1976) and have been shown to have significant bearing on site density in certain areas.

Northwestern Alberta is an area of quite low site density. It includes about one third of the area of the province and only four percent (ca. 700) of all known sites (ca. 18,000). Half of the sites in this region are concentrated in the Grande Prairie and Peace River areas. It is my guess that about half of these have been recorded through impact assessment projects.

This paper analyzes geographic variability in known site locations in northwestern Alberta and identifies potentially important differences between two specific regions. These are preliminary results of ongoing research that also includes investigation of the utility of experimental variables in predicting site locations.

THE SAMPLE

Locational data were tabulated for 284 prehistoric and historic sites that could be plotted on four 1:250,000 NTS map sheets (83M, 83N, 84C and 84D), between 55 and 57^{0} north latitude and 116 and 119^{0} west longitude. The total area comprises over 58,500 square km (Figure 26). I should note that the site record contains Borden numbers for approximately 100 additional sites whose precise locations are not known. The sample comprises 235 prehistoric sites, 33 historic age sites, and 16 sites whose general age is not known. Thirty-four percent of the sample consists of lithic scatters; 22 percent are isolated finds; and 31 percent are "campsites." Also represented are three trading posts, eight buildings, and seven other kinds of sites whose "function" could be easily debated. Eighty-seven (31%) sites have not been classified into any of the common types.

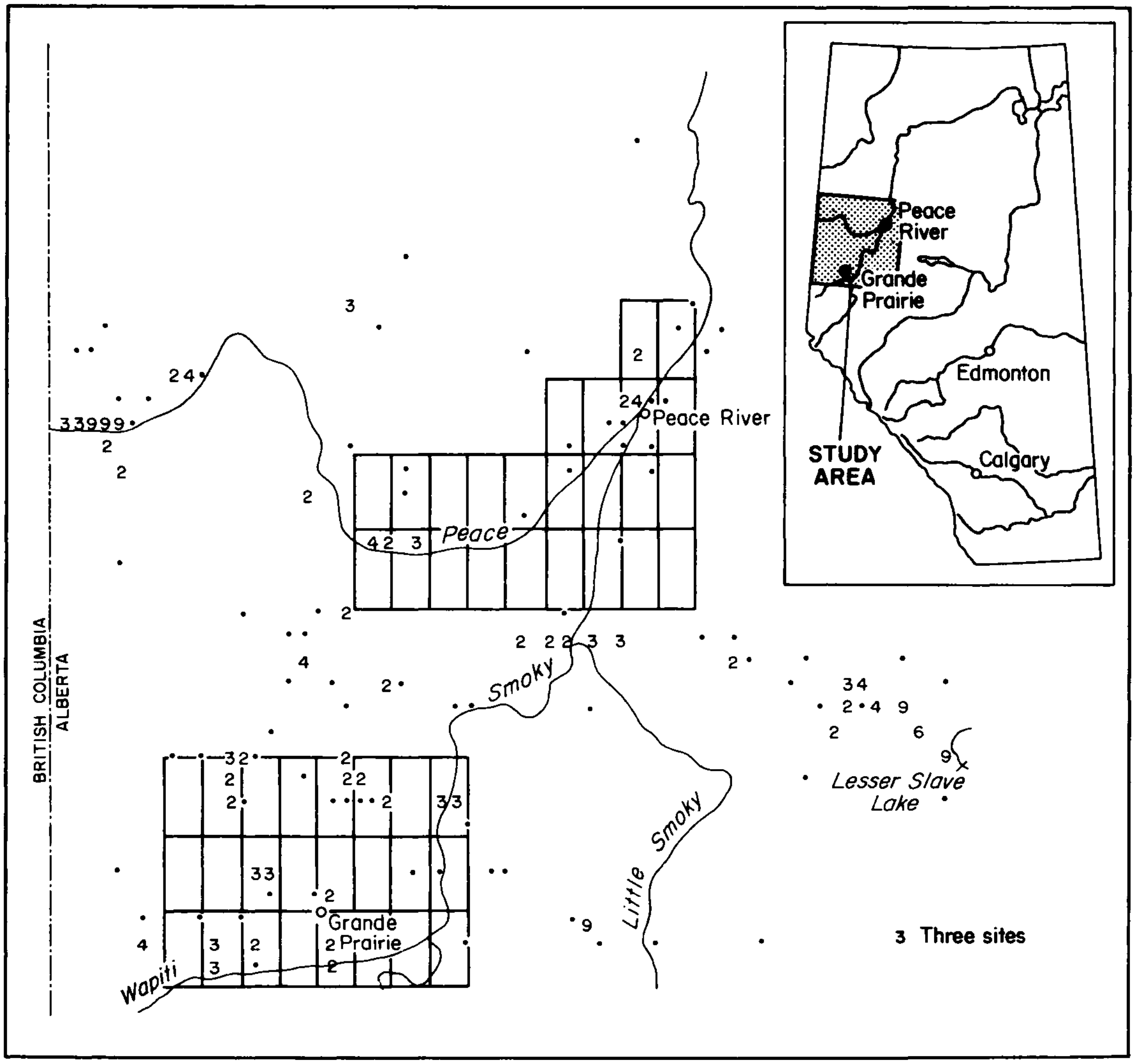

Figure 26. Locations of archaeological sites in the study area and distribution of Borden blocks analyzed in the Peace River and Grande Prairie regions.

The two smaller samples that I will be comparing are from 24 minor Borden blocks around each of the towns of Grande Prairie and Peace River. These samples contain a total of 72 sites (Grande Prairie=41, Peace River=31): 62 prehistoric sites, eight historic sites and two sites of unknown age. Twenty-six percent of these sites are isolated finds; 32 percent are lithic scatters; and site type cannot be assigned to 31 percent of this smaller sample. The reasons I chose these two areas for comparison are that they both include major towns, they are both close to major rivers and relatively large lakes (Clairmont Lake in

Peace River; Bear Lake in Grande Prairie) and, in general, they contain similar environments.

THE DATA

For the entire sample of 284 sites, 25 variables were recorded. Of these, 15 are used in the analyses to follow. Knowing that metric multivariate statistics would be the major analytic method used, these variables needed to be at least ordinal in nature, and most are continuous. The variables used are as follows:

(1) Horizontal distance to nearest water (WAHO)
(2) Direction to water (WADR)
(3) Vertical distance to water (WAVE)
(4) Distance to major river/lake (WAMA)
(5) Slope within 500 m (SLOP)
(6) Direction of major slope (SLDR)
(7) Overview (OVER)
(8) Topographic position (TOPO)
(9) Distance to buildings (BLDG)
(10) Distance to historical trail (TRAIL)
(11) Distance to road (ROAD)
(12) Distance to archaeological site(SITE)
(13) Fish capability (FISH)
(14) Waterfowl capability (FOWL)
(15) Ungulate capability (UNGU)

The variables latitude, longitude and elevation are omitted since they would no doubt combine into very strong factors of overall percent of variability explained and tell us nothing more than where sites are located. In addition, I decided to omit the variables of distance to road and distance to historic trail because, in this highly cultivated region, section roads are ubiquitous - everything is close to a road - and the historic trail data are not complete for the southern part of the area of concern.

ANALYSES

In mathematical terms, what are the most important factors with respect to site location? This kind of question is first asked in exploratory data analysis regardless of whether factor analysis, scaling routines or other multivariate techniques are employed. What are the groups of highly intercorrelated variables, and of these what are the sets of semi-independent ones? The factor analysis yielded five factors for the remaining 13 variables, accounting for a total of 66.2 percent of the total variance in the correlation matrix (Table 8).

The first factor is easily explained as distance to nearest water. It includes both vertical and horizontal distances to the nearest water source, with topographic position being a much smaller contributor. This factor accounts for 18.4 percent of total variance. The second factor (15.8% of variance) is not easily explained and consists of distance to buildings, as well as waterfowl and ungulate capability. I would call this largely a resource capability factor and, secondarily, a cultural presence factor. The third factor (12.6%) is also problematical, consisting of distance to major water, distance to nearest archaeological site and fish capability. This is an interesting factor, with two distance variables and a limited state resource capability variable (fish) because it may reflect some settlement patterning. It appears that the distance to known sites is closely related to distance to major water source, and, in turn, these are related to fish capability. The fourth factor is an exposure (or access) factor, consisting of slope and water direction (11.3%). The final factor is an overview factor, consisting largely of overview itself and, less so, of slope within 500 m (8.1%).

The discovery that distance to water is the most important factor for the region overall may not be surprising to some; however, it must be kept in mind that this does not mean distance to water best explains site location. Rather, distance to water best accounts for metric variability in the correlation matrix of all variables. There is actually little indication of directionality to these factors, and distance to water may explain site type or site size, conditions over which I have no control here. Note also that all factors explain only 66 percent of total

Table 8. Factor analysis of 284 sites by 13 variables.

Rotated Factor Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
WAVE	.89	.12	-.12	.03	.15
WAHO	.86	-.14	.10	.09	-.05
TOPO	-.48	-.09	-.47	.21	-.18
BLDG	-.16	.74	-.17	.01	.13
FOWL	.29	.70	.28	-.05	-.17
UNGU	.02	-.69	.13	.04	.16
WAMA	.18	-.15	.75	.02	-.11
SITE	-.10	.13	.70	.07	.27
FISH	-.05	-.27	.61	.03	-.18
SLDR	.09	-.04	-.06	.87	-.07
WADR	-.03	-.00	.12	.87	.00
OVER	.11	-.23	.08	-.10	.81
SLOP	.05	.42	-.23	.04	.45

Factor	Eigenvalue	Pct of Var	Cum Pct
1	2.38	18.4	18.4
2	2.05	15.8	34.2
3	1.63	12.6	46.8
4	1.47	11.3	58.1
5	1.04	8.1	66.2

variance in the correlation matrix and that distance to water explains only 18.4 percent. Thus, while distance to water may be the most important factor derived in this analysis, a single factor which explains only one fifth of total variance is not satisfactory, especially when the entire solution leaves 34 percent of variance unaccounted for. But observe also that factors 1 and 3, both strong water factors, together account for 30 percent of total variance (about one half of the total explained).

If we turn to the smaller sample of sites from the Grande Prairie and Peace River regions and undertake a similar analysis, much the same solution is achieved (Table 9). Again, a distance to water factor is obtained which accounts for 21 percent of variance. Another general water factor, consisting of distance to major water source and fish capability (and distance to buildings), accounts for 16 percent. The third factor (14%) is the exposure or access factor again (slope direction and direction to water), and the final two factors are dominated by ungulate capability and overview. In this analysis, 69 percent of total variance is explained, a slightly better solution than that achieved with the larger sample. Here the water factor accounts for 37 percent of variance, again about half of total variance explained.

In comparing the two analyses, it is important to note that overall variability is explained in much the same way in both large and small samples and that, in both analyses, some 30 percent of variability remains unexplained with the current set of variables. Thus, these two areas can be considered representative of the range of site conditions that exist.

The next problem is to determine if there are significant differences in site location between the two areas. Are the same determinants of site location present in each area? Are there patterns which we could attribute to settlement and subsistence traditions? This problem is approached with discriminant analysis, which seeks an equation by which sites can be classified as belonging to either of the two regions. Thus, knowing which variables are most important in differentiating the two regions can be useful in demonstrating whether or not those variables are equally important in each area.

The discriminant function derived (Table 10) is capable of correctly assigning the small sample of sites to the Grande Prairie or Peace River regions with 80.28 percent accuracy, using only seven of the 13 variables. The analysis shows that, with the shortened variable list, sites can be located to either Grande Prairie or Peace River with a high degree of accuracy. In contrast to the factor analyses above, differences between sites in the two regions are best expressed with the variables of fish capability, topographic position, distance to

Table 9. Factor analysis of 17 sites by 13 variables.

Rotated Factor Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
WAVE	.87	-.20	.06	.14	.08
WAHO	.80	.22	.29	.08	.20
SLOP	.55	-.47	-.20	.20	-.16
WAMA	.02	.80	.07	.29	-.26
FISH	-.25	.71	.07	-.00	.12
BLDG	-.11	-.60	.29	.08	.01
SLDR	.06	-.04	.89	.03	.06
WADR	.05	.00	.89	-.03	-.14
UNGU	.16	.29	-.07	.77	-.04
TOPO	-.11	.17	-.00	-.76	-.21
SITE	-.47	.02	.21	.47	.05
OVER	.23	-.13	-.05	.14	.82
FOWL	.33	-.38	.03	-.04	-.46

Factor	Eigenvalue	Pct of Var	Cum Pct
1	2.73	21.0	21.0
2	2.08	16.0	37.0
3	1.81	14.0	51.0
4	1.32	10.2	61.2
5	1.03	8.0	69.2

buildings, waterfowl capability, vertical distance to water, distance to nearest archaeological sites and direction to water. It is interesting to note that distance to water is not identified as a significant variable. This analysis suggests that understanding differences in site locations between these two areas requires reference to different variables than in the region as a whole.

Now with a good idea of the relationships involved between sites and geographic factors, we can take a third major step and examine simple frequency distribution of select variables. This should allow bounds to

Table 10. Multiple discriminant analysis of 71 sites in Grande Prairie and Peace River areas.

(a) Summary Table

Step	Entered	Wilks' Lambda	Sig.
1	FISH	.77005	.0000
2	TOPO	.71251	.0000
3	BLDG	.67588	.0000
4	FOWL	.63777	.0000
5	WAVE	.61600	.0000
6	SITE	.58473	.0000
7	WADR	.56118	.0000

(b) Unstandardized Canonical Discriminant Function Coefficients

	Func 1
WADR	-0.4075768E-02
WAVE	0.5813777E-02
TOPO	1.078789
BLDG	-0.4703918
FISH	-0.8709363
FOWL	0.2804663
SITE	0.1414734
(CONSTANT)	-0.2969703

(c) Classification Results

Actual Group	No. of Cases	Predicted Group Membership 1	2
Group 1 Grande Prairie	41	33 80.5%	8 19.5%
Group 2 Peace River	40	6 20.0%	24 80.0%

Percent of "grouped" cases correctly classified: 80.28%

be set on major patterns. This information could be used to help reconstruct settlement patterns with known limits to the distances, slopes and site exposures involved and could help guide management of the resources.

ANALYSIS OF FREQUENCY DISTRIBUTIONS

The preceding multivariate analyses identified a select few variables from those initially gathered which explain much of the variability in archaeological site locations. To understand more completely why sites are located where they are and to speak in physical terms about certain limits to their distributions, we need to examine closely the actual frequency distributions. The variables examined here figured strongly in both the general analysis and in the Grande Prairie - Peace River discriminant analysis. They include distance to water, fish and waterfowl resource capability, distance to nearest archaeological site, slope and water direction, and distance to nearest building. The following discussion compares the 24 Borden block areas around each of the towns of Grande Prairie and Peace River.

Distance to Major Water

In Figure 27, separate histograms are plotted for the two areas, showing frequency of sites with kilometre distances from a major river or lake. There are weak trimodal distributions with slight differences in actual modes in each area of comparison. The Grande Prairie distribution peaks at 0.5 km, falls off rapidly at 2.5 km, and peaks again at 10.0 km or more. The Peace River distribution has two strong peaks: one at 0.3 km; the other at 5.3 km. In both cases, there appears to be strong concentration of sites in the 0 to 2.0 km area, a shortage of sites in the 2.0 to 4.0 km range, a recurrence, particularly in the Peace River area, of sites in the 4.5 to 6.5 km range, then a peak in the 8.0 to 10.0 km range, especially in the Grande Prairie area.

Vertical Distance to Water

This variable exhibits sharp bimodality in each of the regions of concern (Figure 28), with peaks at 15 and 100 m above water in the Grande

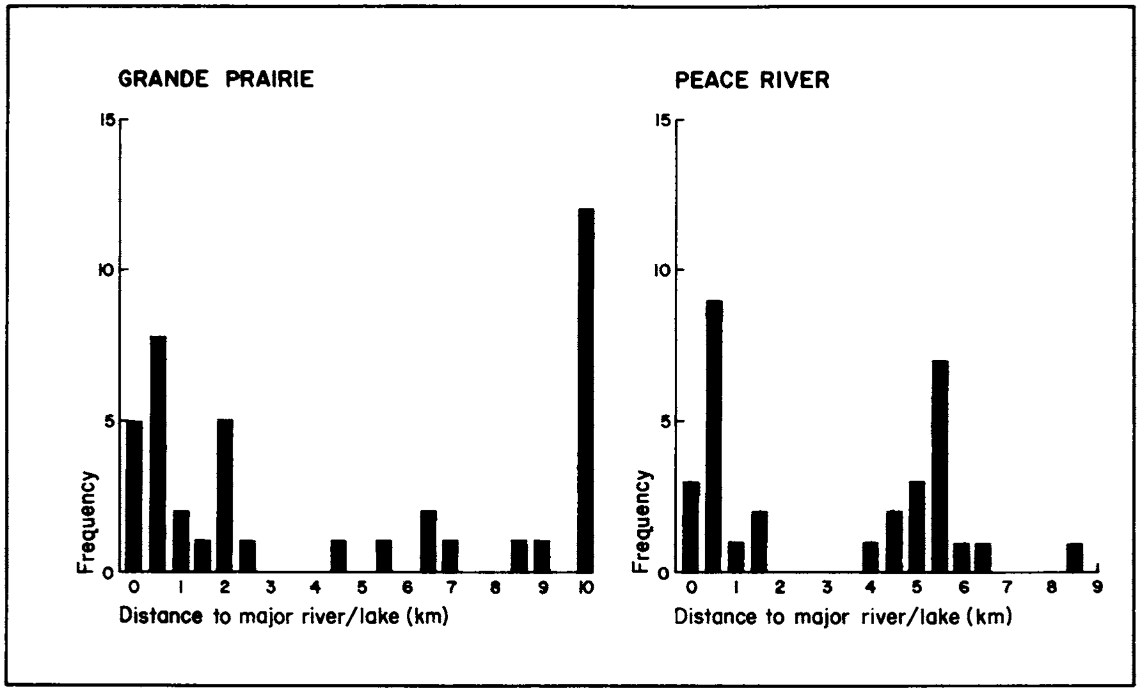

Figure 27. Histograms of distance to major river or lake, Grande Prairie and Peace River regions.

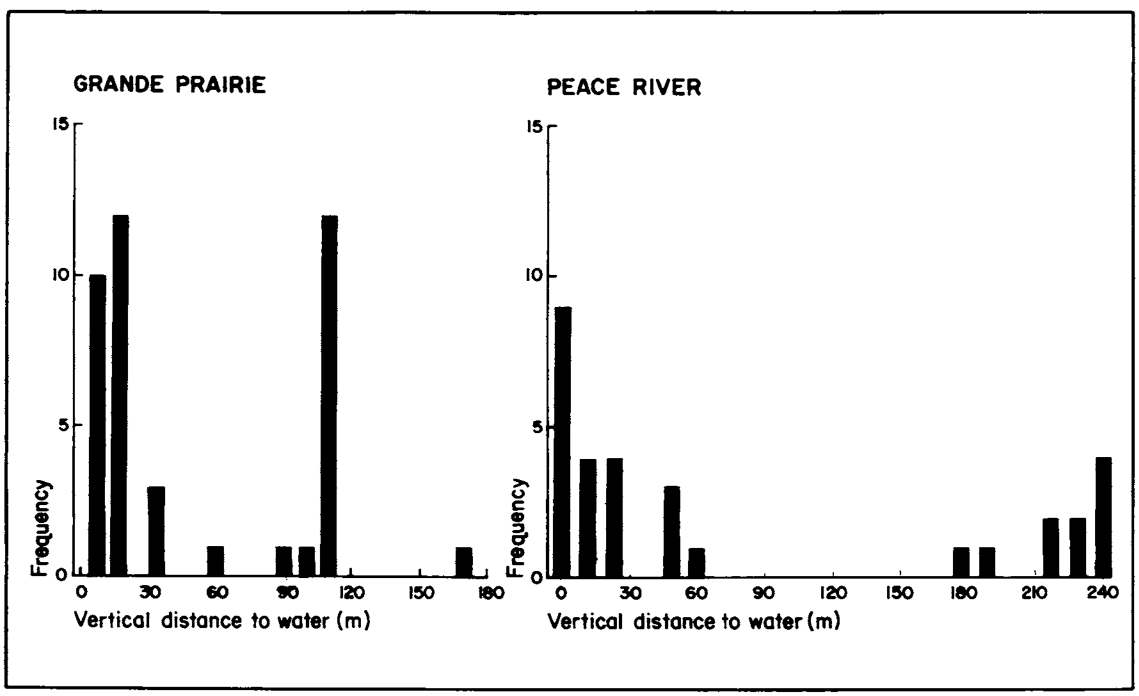

Figure 28. Histograms of vertical distance to nearest water, Grande Prairie and Peace River regions.

Prairie region and at 0 and 240 m above water in the Peace River region. Essentially, these distributions show a strong tendency for sites to be located either very close to water level or at the valley top. The differences in scale simply reflect the differences in relative topography between the two areas.

Distance to Buildings

As can be seen in Figure 29, most sites tend to be situated quite close to existing buildings (well within 1 km). The Peace River distribution exhibits some bimodality with a secondary grouping of sites between about 1.75 and 2.5 km from buildings.

Direction to Water

In both the Grande Prairie and Peace River regions, there is a strong tendency for the closest water source to be located south of the sites; that is, sites tend to be found on the north side of rivers, creeks, lakes and sloughs (Figure 30). This tendency is most marked in the Grande Prairie area, while in the Peace River area a tendency also exists for sites to be located either on the west or east sides of the nearest water source. Furthermore, while a few sites are situated on the south side of water in the Grande Prairie area, no sites in the Peace River area exhibit this characteristic.

Distance to Archaeological Site

Figure 31 clearly shows that most archaeological sites are located within about 2 km of the nearest other site. There is no doubt that a fair amount of sampling bias is reflected here; however, the modes in each area are at about 500 m. This can be interpreted as being indicative of strong cultural selectivity in site location over a considerable period of time. Those instances where sites are 10 km or more distant from the nearest site are likely due to surveys in areas which have witnessed little intensive investigation.

Fish Capability

On the whole, the Grande Prairie area exhibits more sites in areas with severe restrictions to fish than does the Peace River area. In the

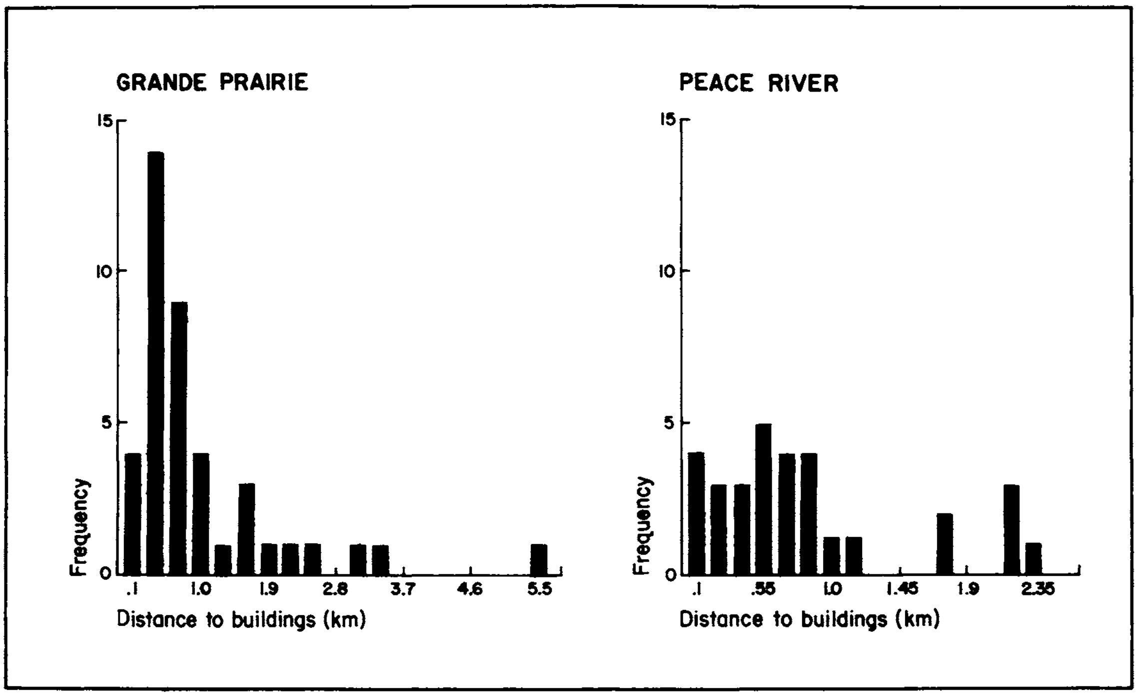

Figure 29. Histograms of distance to nearest buildings, Grande Prairie and Peace River regions.

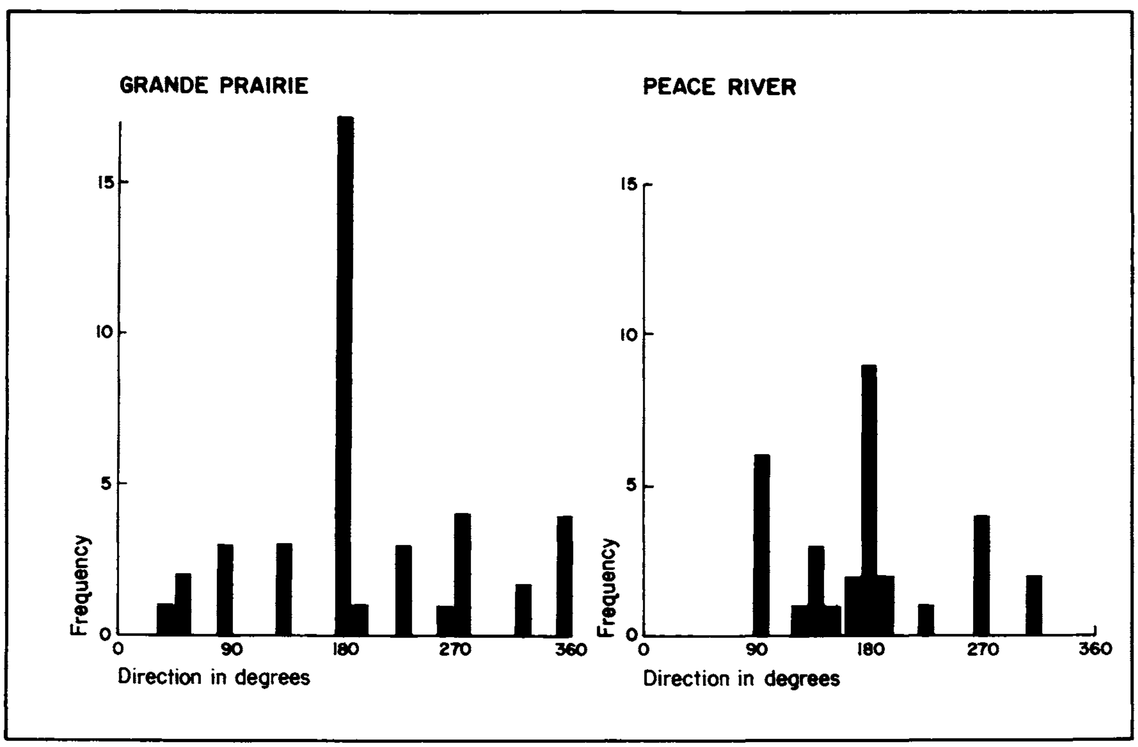

Figure 30. Histograms of direction to nearest water, Grande Prairie and Peace River regions.

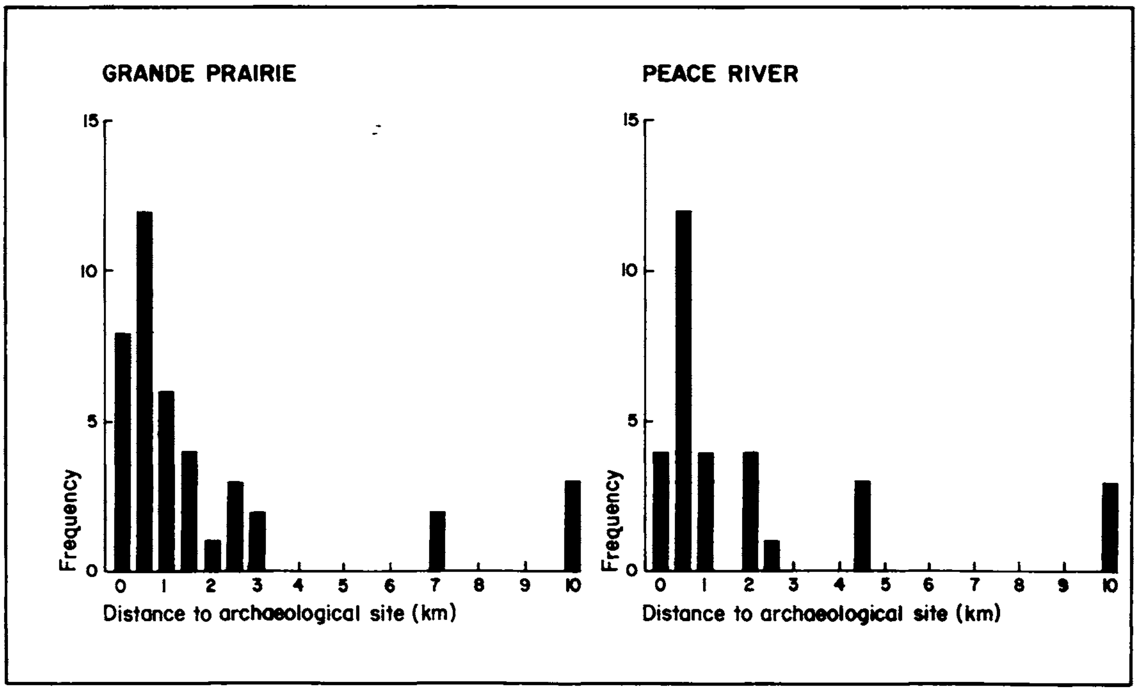

Figure 31. Histograms of distance to nearest archaeological site, Grande Prairie and Peace River regions.

latter area, sites tend to be located in areas with only slight restrictions (Figure 32). In other words, fishing may have been a more important subsistence activity in the Peace River region than in the Grande Prairie region.

Waterfowl Capability

In opposition to the fish capability values, the Grande Prairie area shows more sites located in areas with slight or no limitations to waterfowl than does the Peace River area (Figure 33). In the Peace River area, all sites are in zones with severe restrictions on the availability of waterfowl.

INTERPRETATION OF FREQUENCY DISTRIBUTIONS

Leaving aside the difficulties in estimating the effects of sampling bias in the preceding analyses, several settlement pattern inferences can be suggested. In the early days of the SARG project (Gumerman 1971), it was clear that southwestern American archaeologists were dealing with a

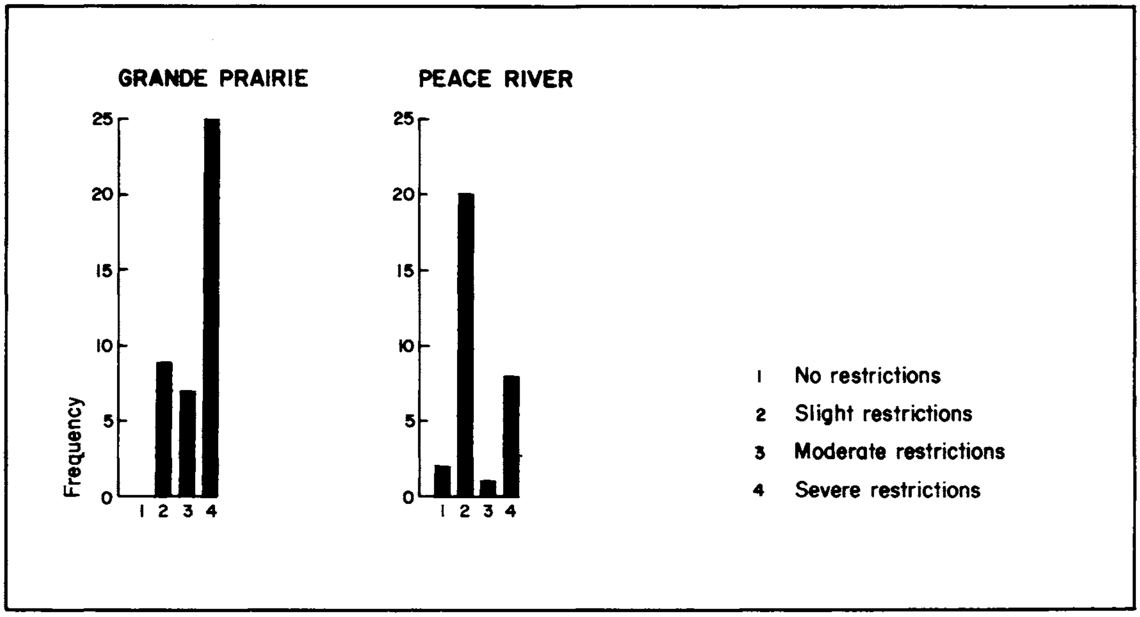

Figure 32. Histogram of fish capability, Grande Prairie and Peace River regions.

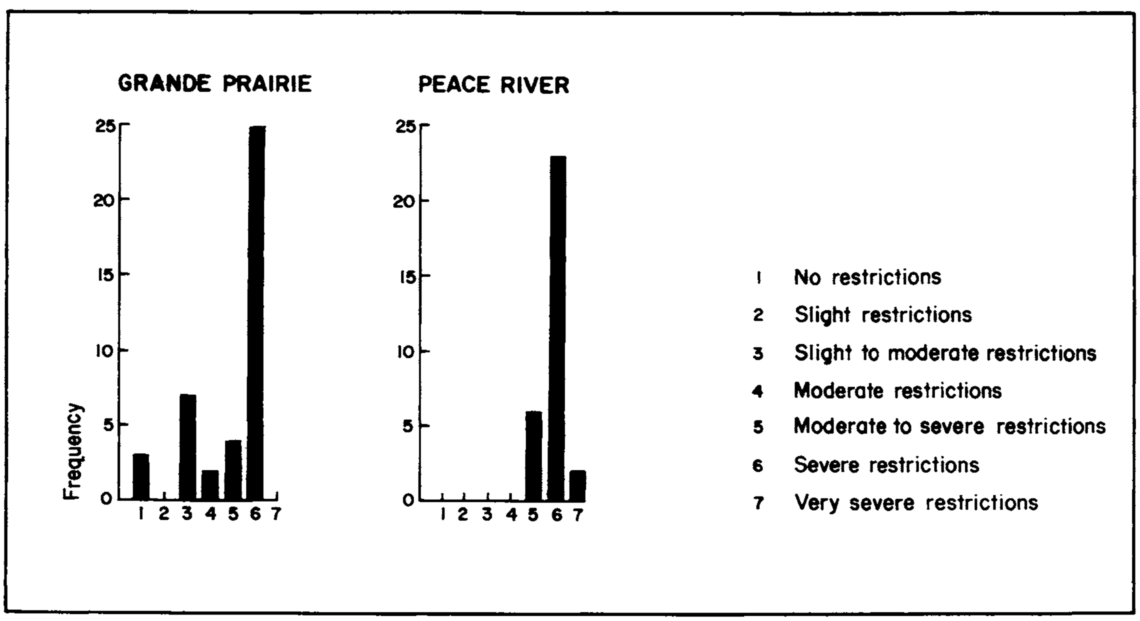

Figure 33. Histogram of waterfowl capability, Grande Prairie and Peace River regions.

vast number of sites with relatively precise chronological controls. This is not the case here, and the interpretation of northwestern Alberta site location must cover the entire period of some 10,000 years of human occupation.

On the whole, site distributions appear to exhibit a consistency which is perhaps the result of physical constraints imposed on general patterns of hunter-gatherer behaviour. The distributions noted in distance to water and in fish and waterfowl resource capability are likely complementary in nature; that is, apart from water being a critical resource in itself, sites in the Grande Prairie region may have been located so as to take advantage of waterfowl resources, while in the Peace River region they were positioned to take advantage of fish resources. Indeed, it is conceivable that prehistoric patterns of resource exploitation could have ranged over both areas, with appropriate seasonal scheduling of these two resources. The limitations to daily and extended foraging may be evident in the multi-modal nature of the distributions. Over the long term, one could expect that sites would tend to become concentrated in areas about 4 and 10 km from major water sources.

The notion that long-term patterns of occupation would tend to be controlled by physical constraints is supported by the distributions of sites in their proximity to present and past cultural features. In the vernacular, if it is a good place to live now, it likely was a good place in the past as well.

CONCLUSIONS

The patterns observed demonstrate that we can detect substantial differences in the structure of site location variation between two quite similar regions and possibly set limits for them. It is clear also that evidence of contemporary cultural activity needs to be more fully explored as a potential predictor of historical resource locations.

There are many other ways to look at the problem of site location determinants, for example, by site type. While data for prehistoric site types are vague and mostly based on individual researcher's judgements, with sufficient sample sizes one could examine, for example, differences between historic and prehistoric sites in general. Thus, we see that with the current sample (Table 11), prehistoric sites in the combined total sample appear to occur mainly at midslope, while the historic sites are concentrated at midslope and at the base of slopes. In fact, a statistically significant relationship exists for the entire sample of 278 sites in this regard.

The bimodal and trimodal distributions also reveal important clues with respect to the functioning of prehistoric societies. For example, the distributions of distance of sites to water may be an indication of daily and extended foraging radii. It may be that the higher waterfowl capability of the Grande Prairie area allows for more sites to be located 10 or more km from major water. More such relationships are no doubt present.

It should be clear to all that the sample has an annoying sampling bias. The problem of predicting site location probably requires substantially more information on where they are not found. With a comparative set of such locations as gas wells or pipeline areas that have been examined with negative results, similar analyses to those presented here could potentially contribute to the prediction of site presence across a wide variety of environmental conditions.

Table 11. Topographic position.

Age	Top of Slope	Midslope	Base of Slope	Row Total
Prehistoric	45	160	40	245 88.1%
Historic	8	14	11	33 11.9%
Column Total	53 19.1%	174 62.6%	51 18.3%	278 100.0%

Chi-Square	D.F.	Significance
7.54454	2	0.0230

ANALYSIS AND PREDICTION OF HISTORICAL RESOURCE POTENTIAL OF AGGREGATE SOURCE LOCALES IN SOUTHEASTERN ALBERTA

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INTRODUCTION

In 1985, Lifeways of Canada Limited conducted a research project designed to:

> 1) develop an evaluation system by which aggregate resource locales could be assessed for historical resource potential, 2) test this system on a sample drawn from 407 designated aggregate resource locales . . . located within 386 quarter sections, 3) assess the relative historical potential of the specified borrow pits and 4) develop a sieve criteria for management use by which future aggregate source locales may be evaluated (Loveseth and Van Dyke 1985:1).

The study summarized here is a continuation of that research utilizing data generated by the Lifeways study, as well as new information. The main objectives of this study were to identify descriptive variables and analytic methodologies which may be useful in predicting the historical resource potential of aggregate source locales and to produce a list of aggregate source locales in the southeast quarter of the province specifying the likelihood of presence or absence of historical resources for each locale. For specific predictions and data see Damkjar 1986.

The study was carried out in two stages. The first stage involved the analysis of 66 aggregate source locales for which historical resource potential was previously determined by Lifeways (Loveseth and Van Dyke 1985), plus one source evaluated by Bobrowsky and Gibson (1986). Each borrow pit was described in terms of 51 variables and relationships between these variables, and the presence or absence of historical resources were evaluated. Six variables were identified (through discriminant analysis) which, as a group, appear to provide the greatest potential for predicting presence or absence of historical resources (see Damkjar 1986).

In the second stage, 254 aggregate source locales for which historical resource potentials were not known were described in terms of the six significant variables. Applying the discriminant functions from stage 1, predictions were made regarding historical resource potential.

METHODS

UNIT OF ANALYSIS

In this study, the aggregate source locale forms the unit of analysis, whereas the Lifeways study employed the quarter section containing the aggregate source as the unit of analysis. This change in approach was taken because, as pointed out by Loveseth and Van Dyke (1985:9), quarter sections often display as much internal variability in the descriptive variables being measured as exists between aggregate source locales. Using quarter sections as the unit of analysis results in measurements which either describe an arbitrary point (e.g., centre of the quarter section) or provide only a generalized measure of the entire quarter section. In either case, a suitable characterization of the aggregate source locale may not result. Moreover, the degree to which suitable characterization is achieved cannot be determined. By restricting the unit of analysis to the borrow source, less intra-unit variability is encountered because aggregate source locales are usually much smaller than a quarter section and are usually restricted to a particular landform or topographic feature. Also, all descriptive variables refer specifically to the aggregate source locale.

In some cases, borrow pits are divided to form two or more units of analysis. This occurs when the aggregate source straddles the boundary between two or more quarter sections. Because the archaeological field studies carried out by Lifeways focussed on quarter sections, only a portion of such aggregate sources has been assessed for historical resource potential, and, consequently, such aggregate sources are divided into two units of analysis, as having known or unknown historical resource potential. Alternatively, some quarter sections contain two or more gravel pits, each treated as a separate unit of analysis.

Data concerning locations and extent of aggregate source locales were obtained from Alberta Transportation. Files pertaining to each source were examined, and appropriate maps and other documentation were copied. However, the quality of available documentation varies considerably. In some cases, maps are detailed and recently updated. In other cases, only rough, small-scale maps (usually several decades old) exist. Some maps indicate the extent of existing or planned excavations, while others merely show where aggregate testing has taken place. Moreover, not all aggregate source locales have been mapped. Many are documented only by reservation application for future aggregate testing of one or more quarter sections, usually with no reference to the specific location of the aggregate source. The location of some poorly or undocumented sources
could be determined from 1:50,000 NTS maps and/or air photographs. Others could be located with reasonable certainty by identifying landforms which typically contain aggregate materials. When an undocumented aggregate source occurred in a quarter section with little internal variability in the six variables used for prediction (in stage 2), an arbitrary location was chosen, and historical resource potential was predicted for that location.

Where documentation was particularly poor or absent, and no appropriate landform could be identified, the aggregate source was not used in developing criteria for prediction. Also, some quarter sections reserved for aggregate purposes do not actually contain aggregate sources but merely provide vehicular access to a source. These were not included in the analysis. As a result of the variability in documentation, a total of 31 aggregate sources could not be included in the study. Of the 73 aggregate sources with known historical resource potential, 67 could be analyzed, and of the 279 sources with unknown resource potential, 254 could be analyzed.

VARIABLES

Thirty-seven variables were initially recorded for each of the 67 aggregate sources of known heritage resource potential, and an additional fourteen variables were produced through transformation of existing variables. Table 12 provides a list of the 51 variables, and the major categories are summarized below.

Local Topography

Maximum elevation and minimum elevation above sea level in the unit of analysis were recorded to the nearest 25-foot (7.62-metre) contour interval using information available from 1:50,000 NTS map sheets. Relief equals maximum elevation minus minimum elevation. Median elevation was obtained by summing maximum elevations and dividing by two.

Regional Topography

A circle with a radius of 1.5 km from the centre of the aggregate source was drawn on the appropriate 1:50,000 NTS map sheet to define the "region." Maximum and minimum regional elevations were recorded to the nearest 25-foot contour interval. Median regional elevation was obtained by summing maximum and minimum regional elevations and dividing by two. Regional relief was found by subtracting minimum from maximum regional elevation. Relative elevation is the difference between median elevation and regional median elevation. A positive value indicates that the aggregate source has a relatively high elevation compared with the region. A negative value indicates a relatively depressed aggregate source elevation.

Topographic Complexity

Topographic complexity within the aggregate source locale was measured in two ways. Topographic complexity 1 is defined as the maximum number of intersections of a straight line and a single contour line. This is designed to provide a measure of topographic undulation. Topographic complexity 2 is defined as the maximum number of intersections of a straight line and any contour lines within the unit of analysis. This provides a more general measure of topographic complexity.

Aspect

Aspect refers to approximate horizontal visibility from the highest point in the aggregate source locale. Straight line visibility was measured every thirty degrees (i.e., twelve rays) for a maximum distance

Table 12. List of descriptive variables recorded in stage 1 of analysis.

1. Maximum elevation: elevation above sea level of highest point in unit of analysis, measured to the nearest 25 feet (7.62 metres) from 1:50,000 NTS maps

2. Minimum elevation: elevation of lowest point in unit of analysis

3. Median elevation: maximum elevation minus minimum elevation divided by two

4. Relief: maximum elevation minus minimum elevation

5. Maximum regional elevation: elevation (to nearest 25 feet) above sea level of highest point within 1.5 km of centre of aggregate locale

6. Minimum regional elevation: elevation of lowest point within 1.5 km of centre of aggregate locale

7. Median regional elevation: maximum regional elevation plus minimum regional elevation, divided by two

*8. Regional relief: maximum regional elevation minus minimum regional elevation

*9. Relative elevation: median elevation minus regional median elevation

*10. Topographic complexity 1: maximum number of times a single contour can be intersected by a straight line within the unit of analysis

*11. Topographic complexity 2: maximum number of times contour lines can be intersected by a straight line within the unit of analysis

12-23. Aspect (1-12): Visibility measured every 30° (0-360°)

*24-27. Aspect (NE, SE, SW, NW): mean of the four rays falling within each 90° directional sector

*28. Mean aspect: sum of aspects 1-12 divided by 12

*29. Elevation of major water source: measured to nearest 25-foot interval

*30. Distance to major water source: horizontal distance measured to nearest 50-metre interval

*31. Nature of major water source: (e.g., lake, river, tributary)

*32. Elevation of minor water source

Table 12. continued

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*33. Distance to minor water source

*34. Nature of minor water source: (e.g., stream or slough)

*35. Elevation of nearest water source: (i.e., nearest of major or minor water source)

*36. Distance to nearest water source

*37. Nature of nearest water source

*38. Elevation relative to major water source: elevation of major water source minus median elevation of aggregate source

*39. Landform: based on airphoto interpretation

*40. Surficial geology: as recorded in 1985 study (Lifeways 85-5C)

*41. Land use: as recorded in 1985 study (Lifeways 85-5C)

*42. Vegetation: as recorded in 1985 study (Lifeways 85-5C)

*43. Agricultural potential: based on Canada Land Inventory

*44. Wildlife (ungulates) capability: based on Canada Land Inventory

*45. Wildlife (waterfowl) capability: based on Canada Land Inventory

*46. Sport fish capability: based on Canada Land Inventory

47. Area of aggregate source: to nearest 1000 square metres

48. Area disturbed: within aggregate source to nearest 1000 square metres

*49. Area undisturbed: area of aggregate source minus area disturbed

*50. Historical resources: presence or absence of historical resources

51. Number of historical resources

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*Indicates variable used in univariate analysis.

of 10 km. Visibility was determined by drawing a profile (based on intersections with contour lines) for each ray and determining the limits of visibility with a straight line originating at the aggregate source. Northeast, southeast, southwest and northwest directional sectors (i.e., 0-90^{o}, 90-180^{o}, 180-270^{o}, and 270-360^{o}) were calculated by summing visibilities for the four appropriate rays in each sector and dividing by four. Mean aspect was obtained by summing all twelve rays and dividing by twelve.

Water Source

Three variables each were recorded for the nearest major water source and the nearest minor water source: elevation (horizontal), distance (from centre of the aggregate source), and nature. The major water source is any permanent body of water. The minor water source is a small creek or slough (including intermittent ones). Measurements were taken from 1:50,000 NTS map sheets - elevation to the nearest 25-foot contour interval and distance to the nearest 50 m. Nature of water bodies included lake, major river, major tributary, minor tributary, intermittent creek and slough.

In addition, elevation, distance and nature of the nearest water source were recorded as separate variables. Elevation relative to major water source was found by subtracting elevation of the major water source from median elevation of the aggregate source.

Landform

The major landform within the aggregate source locale was identified from stereo-pairs of airphotos. Possible landforms included floodplain, river terrace, slope, linear prairie edge, desiccated prairie edge, tributary or slough on flat prairie, major slough on flat prairie, glacial feature, hummocky terrain (prairie), and river gravels (bars, bed). Not all of these landforms were present.

Surficial Geology

Surficial geology, as recorded by Loveseth and Van Dyke (1985), includes alluvium, gravel and sand; ground moraine; hummocky disintegration moraine, subtle; hummocky disintegration moraine, modest;

end moraine, veneered till; end moraine, veneered till, modest; hummocky end moraine, mainly till; bedrock upland veneered with till; collapsed ice-contact satisfied drift; flood eroded sediments; ice-marginal channel, silt and clay; ice-marginal channel, gravel and sand; outwash deposits; colluvium and alluvial fan deposits; lacustrine sediments; alluvium sand, silt and clay, some gravel; bedrock exposures; Pleistocene lacustrine sediments; and eroded slope. Not all of these were present.

Land Use

Land use is categorized as in Loveseth and Van Dyke (1985:9): undisturbed or grazed lands, partially or ploughed lands, partially developed lands, and fully developed or urbanized lands.

Vegetation

Vegetation, as recorded by Loveseth and Van Dyke (1985:9), refers to carrying capacities of native grasslands in hectares per animal per month. The four categories are less than 0.91 ha/animal/month, 0.92 to 1.2 ha/animal/month, 1.3 to 1.8 ha/animal/month, and more than 1.8 ha/animal/month. The information is taken from Smoliak et al. (1982:18).

Agricultural Potential

Agricultural potential for cultivated field crops is ordered into seven classes: no significant limitations, moderate limitations, moderately severe limitations, severe limitations, very severe limitations, not feasible, and no capability. Information is taken from appropriate 1:250,000 Canada Land Inventory maps.

Wildlife (Ungulates) Capability

Capability for wild ungulates is ordered into seven classes: no significant limitations, very slight limitations, slight limitations, moderate limitations, moderately severe limitations, severe limitations, and no ungulate production. Capability ratings do not generally reflect present land use. The information is taken from appropriate 1:250,000 Canada Land Inventory maps.

Wildlife (Waterfowl) Capability

Waterfowl potential is ordered into seven classes: no significant limitations, very slight limitations, slight limitations, moderate limitations, moderately severe limitations, severe limitations, and no waterfowl production. Capability ratings do not generally reflect present land use. The information is taken from appropriate 1:250,000 Canada Land Inventory maps.

Sport Fish Capability

Sport fish potential is ordered into four classes: no significant limitations, few or minor limitations, several minor or few serious limitations, and numerous and severe limitations. Capability ratings do not necessarily reflect present fish populations. The information is taken from appropriate 1:250,000 Canada Land Inventory maps; however, map areas 72L and 82I are not yet covered by this map series. Information for these areas was obtained from the Lethbridge office of Alberta Forestry, Lands and Wildlife.

Area of Aggregate Source

The area of the aggregate source was measured to the nearest 1000 square metres using a digitizing tablet and an Apple II computer. Only those sources for which there was adequate documentation were measured. In many locales, part of the source had already been removed or heavily disturbed so area disturbed was also measured to the nearest 1000 square metres. Area undisturbed is the difference between the two measurements.

Historical Resources

Presence or absence of archaeological, historical or palaeontological resources within the aggregate source was based on the field work conducted by Lifeways in 1985 and Bobrowsky and Gibson in 1986. The number of historical resources within the aggregate source locale was also recorded.

RESULTS

UNIVARIATE ANALYSIS

The first stage of the analysis involved comparing aggregate sources with and without historical resources in terms of single variables. Of 67 aggregate source locales, fourteen contain historical resources. To minimize redundancy, only thirty of the 51 recorded variables were used in the stage 1 analysis (Table 12). Data for selected variables were tabulated and distributions graphically illustrated (e.g., Figures 34-37). Aggregate sources with and without historical resources are tabulated and illustrated separately. Where appropriate, chi-square and G-statistic values were calculated (see Damkjar 1986). Probabilities presented below are based on the chi-square values. The statistics were computed using Stateview (Feldman and Gagnon 1985) and an Apple Macintosh microcomputer.

Median Elevation

No systematic variation relative to presence/absence of historical resources is apparent.

Relief

Aggregate sources containing historical resources tend to have slightly greater relief than aggregate sources without historical resources. This is supported by a chi-square value significant at the .01 level (X^2=11.5; df=3).

Regional Relief

No systematic difference between the two distributions is apparent.

Relative Elevation

There is a complete absence of historical resources at aggregate locales with relative elevation less than -50 feet (Figure 34). Chi-square is significant at .01 level (X^2 with continuity correction=5.8; df=1).

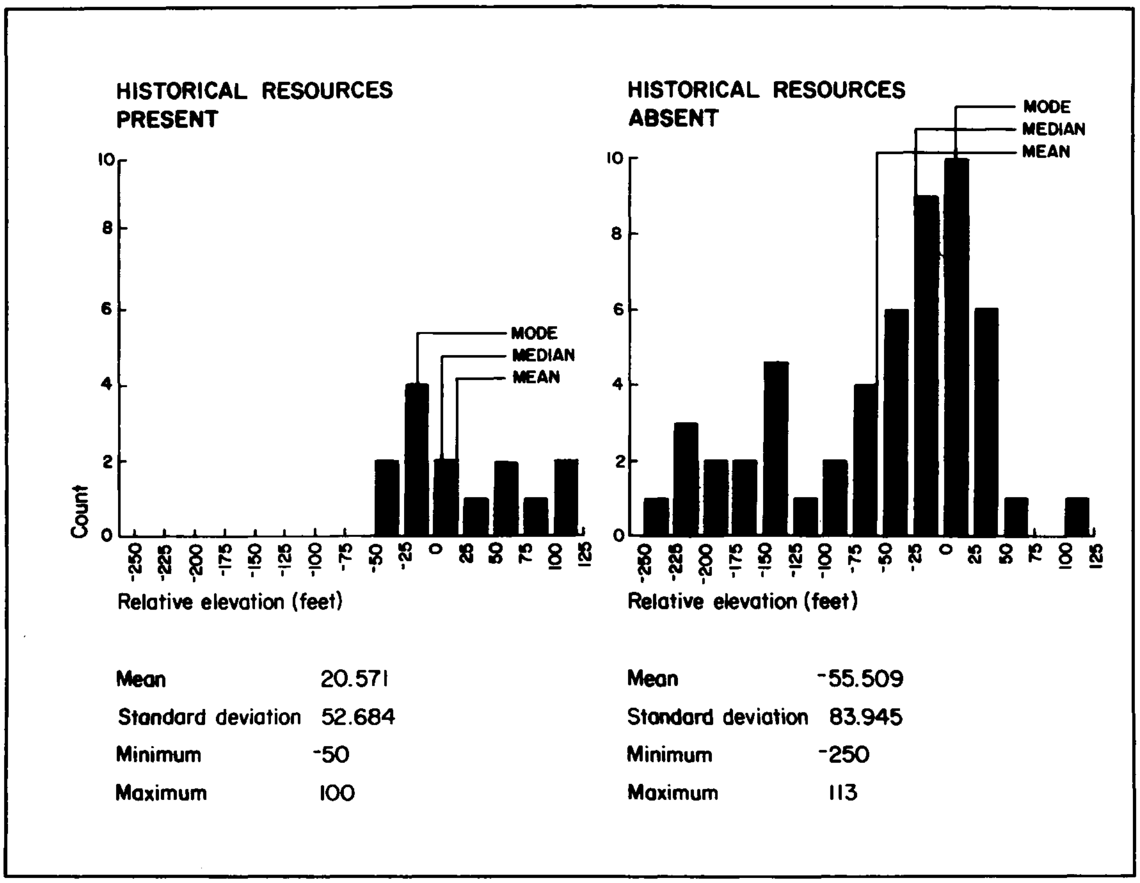

Figure 34. Descriptive statistics and barchart of relative elevation (feet).

Topographic Complexity 1

There is some difference between the two distributions, but chi-square indicates no significance (X^2=1.6; G=1.6; df=2).

Topographic Complexity 2

Aggregate source locales containing historical resources have proportionally higher incidences of two to six intersections; however, chi-square indicates no significance (X^2=2.3; G=2.2; df=2).

Aspect (NE, SE, SW, NW)

In all four directional sectors, aggregate sources with very low visibility tend not to contain historical resources. This is especially apparent in the southeast directional sector (Figure 35). Chi-square indicates a significant association between visibility in the southeast

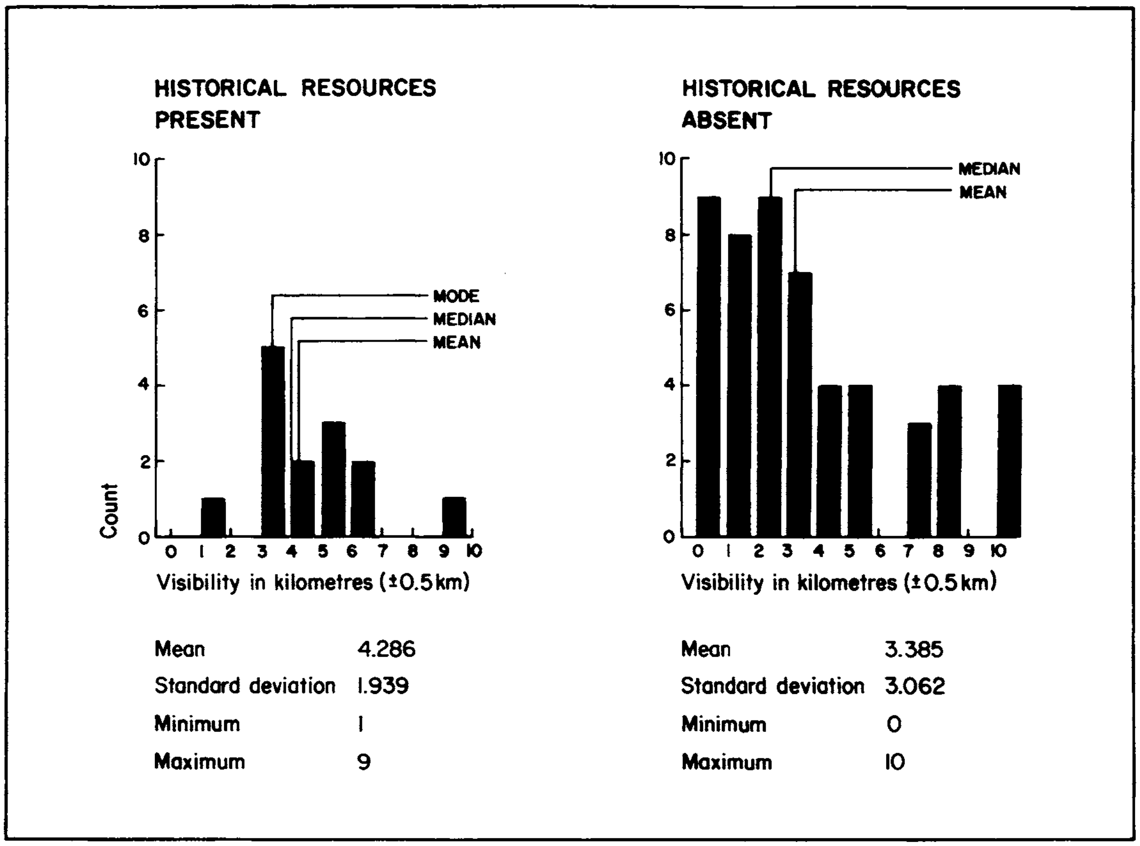

Figure 35. Descriptive statistics and barchart of aspect (visibility) in southeast directional sector (km).

direction and presence/absence of historical resources at the .01 level (X^2 with continuity correction=7.9; G=11.5; df=1).

Mean Aspect

Aggregate sources with mean visibility of less than 2 km do not contain historical resources. "Low" (0-1 km) and "high" (2-10 km) visibility are significantly associated with presence/absence of historical resources at the .02 level (X^2 with continuity correction=6.2; G=1; df=1).

Elevation of Major Water Source

No systematic differences between the distributions are apparent.

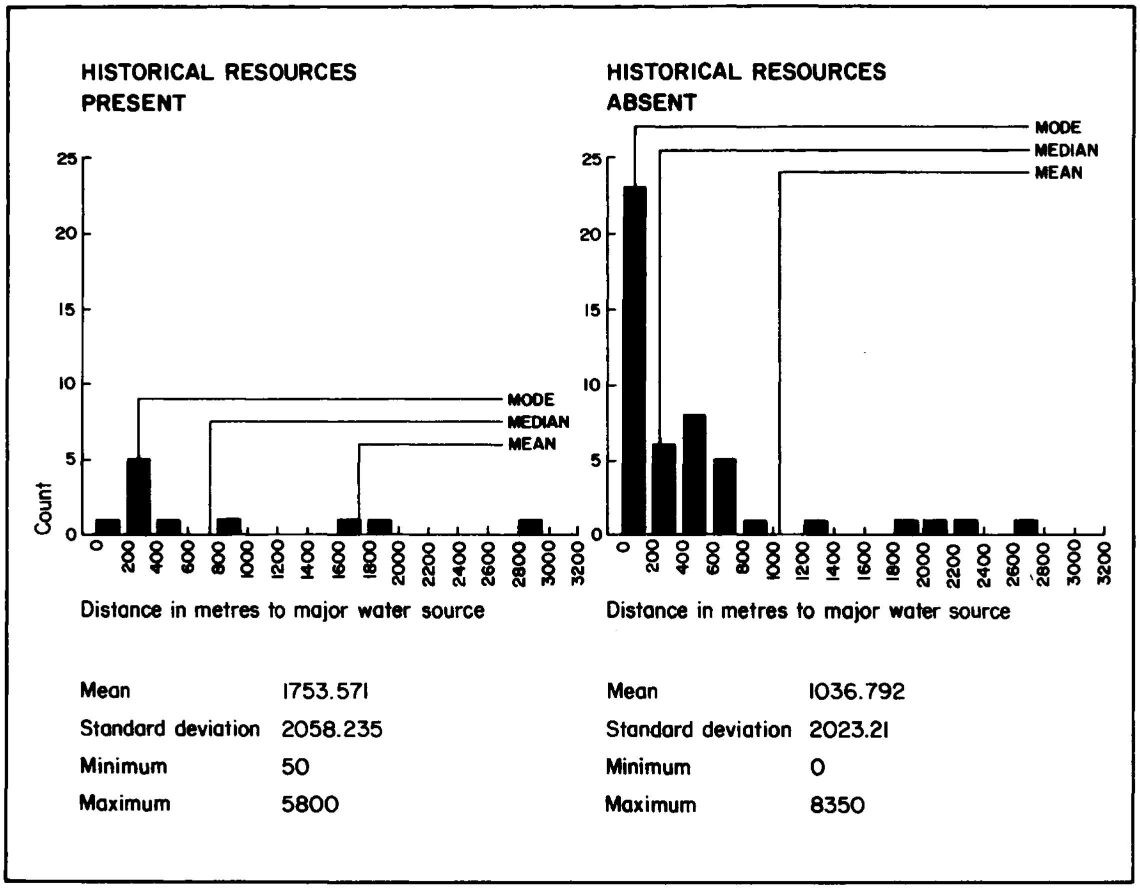

Figure 36. Descriptive statistics and barcharts of distance (m) to major water source.

Distance to Major Water Source

There are proportionally few aggregate sources containing historical resources within 200 m of the major water source (Figure 36). The (chi-square) association is significant at the .05 level (X^2 with continuity correction=5.1; G=7.9; df=1).

Nature of Major Water Source

Most aggregate sources have a river as their major water source; however, proportionally few of these contain historical resources. The (chi-square) association is significant at the .05 level (X^2=8.0; G=7.7; df=3).

Elevation of Minor Water Source

No systematic difference between the two distributions is apparent.

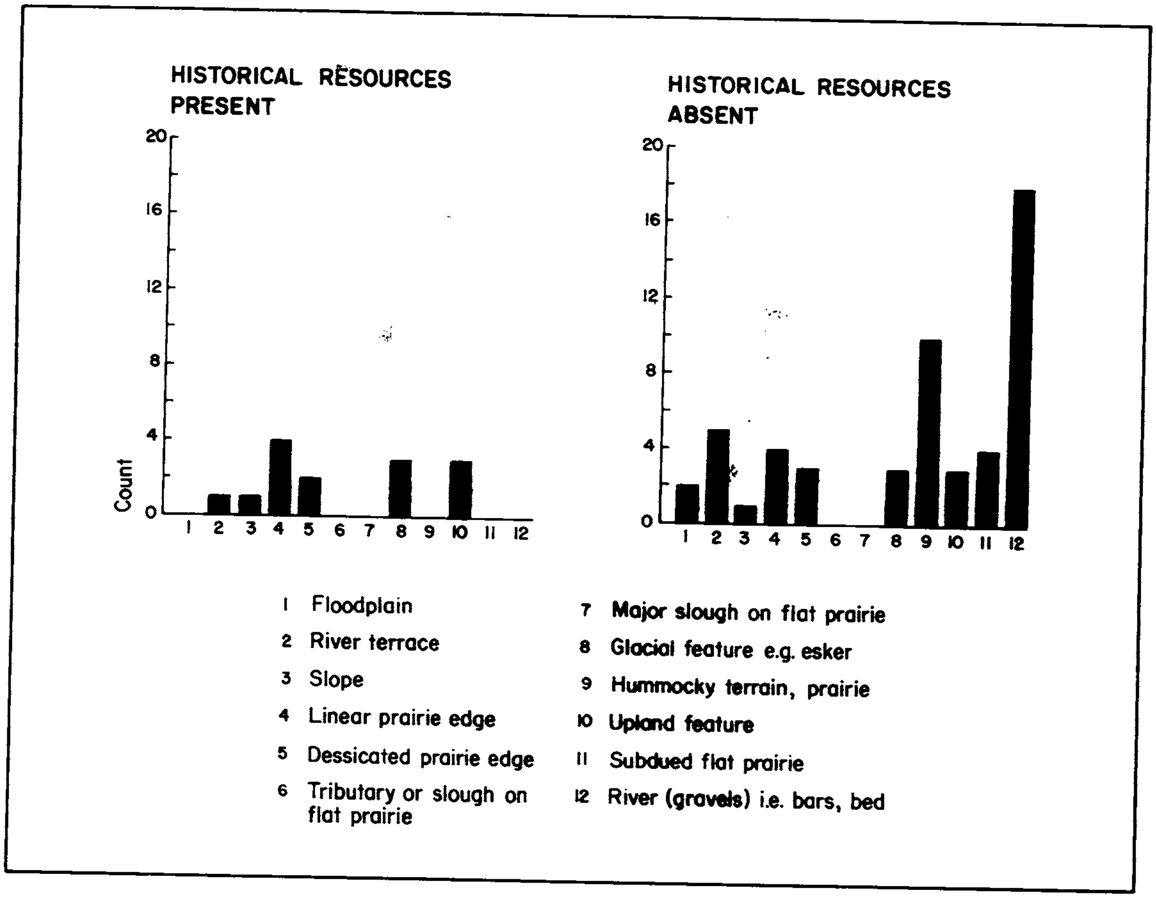

Figure 37. Barchart of landform.

Distance to Minor Water Source

Historical resources are relatively common at aggregate locales with the minor water source 600 to 1000 m away and relatively uncommon when the minor water source is more than 1000 m away. However, chi-square analysis indicates little significance (X^2=4.4; G=4.2; df=2).

Nature of Minor Water Source

There are slight differences between the two distributions; however, chi-square analysis does not indicate significant association (X^2=3.2; df=3).

Elevation of Nearest Water Source

No systematic differences between the two distributions are apparent.

Distance to Nearest Water Source

Aggregate locales with historical resources occur with relatively low frequency within 100 m of water and relatively high frequency within 700 to 1000 m. A chi-square analysis indicates significant association between distance to nearest water source and presence/absence of historical resources at the .05 level (X^2=9.5; G=8.7; df=3).

Nature of Nearest Water Source

Most differences between the two distributions appear to be due to the fact that aggregate locales containing historical resources rarely have rivers as their nearest water source. Chi-square analysis indicates association between historical resource potential and nature of nearest water source at the .001 level of significance (X^2=17.9; G=16.4; df=3).

Elevation Relative to Major Water Source

Aggregate sources containing historical resources tend to have higher elevations relative to major water source compared with aggregate sources without historical resources. However, based on chi-square analysis, the association is significant at only the .10 level (X^2=5.3; df=2).

Landform

Historical resources are commonly associated with aggregate locales at prairie edges and glacial or upland features but never with river gravels or hummocky terrain (Figure 37). Association between river gravels and presence/absence of historical resources is significant (based on chi-square analysis) at .05 level (X^2 with continuity correction=4.9; df=1).

Surficial Geology

No significant differences between the distributions are apparent.

Land Use

No significant differences between the distributions are apparent.

Vegetation (Carrying Capacity)

Historical resources are absent where carrying capacity is high (less than 0.91 ha/animal/month) and relatively common where carrying capacity is low (greater than 1.8 ha/animal/month). Based on chi-square analysis, associations are significant at the .05 level (X^2=7.8; df=3).

Agricultural Potential

No significant differences between the two distributions are apparent.

Wildlife (Ungulates) Capability

No significant differences between the two distributions are apparent.

Wildlife (Waterfowl) Capability

No significant differences between the two distributions are apparent.

Sport Fish Capability

A relatively high proportion of aggregate locales containing historical resources have numerous and severe limitations for sport fish capability. Chi-square analysis indicates association at only the .20 level of significance (X^2=4.3; df=2).

Area Undisturbed

Historical resources are relatively uncommon at aggregate locales with less than 80,000 square metres of undisturbed surface. Chi-square analysis indicates the association is significant at the .10 level (X^2 with continuity correction=3.2; G=4.7; df=1).

Summary

There are undoubtedly many factors affecting associations between the variables used in this study and presence or absence of historical resources at aggregate source locales. However, many of the associations can be understood as a consequence of the fact that gravel pits located in river bars and/or beds do not contain historical resources. Such locales have low relief, low relative elevations and low aspect (visibility) due to walls of the river valley. They are close to the major and/or nearest water source (i.e., river), are low in elevation relative to the river, have river gravels as their associated landform, and have relatively high fish capability. Many of these trends are redundant, simply representing different measures of the same association. Twenty-seven percent of the 67 surveyed aggregate locales are situated in river bars and/or beds. Assuming a similar frequency among the 254 non-surveyed aggregate sources, approximately 63 can be predicted, with considerable confidence, to contain no historical resources.

DISCRIMINANT FUNCTION ANALYSIS

In order to isolate which variable(s) best reflect the associations noted above and also account for other patterning in the data, stepwise discriminant function analyses were conducted. This work was done on the University of Alberta mainframe computer using the Michigan Interactive Data Analysis System (MIDAS; Fox and Guire 1976).

All of the variables used in the previous descriptive, univariate analysis were employed in generating the discriminant functions. Two stepwise analyses (forward and backward) were conducted, and discriminant functions were derived. A third discriminant function was derived by combining the variables selected in the stepwise analyses. Significance levels for inclusion in the stepwise functions were set at 0.1.

Forward Stepwise Analysis

The forward stepwise analysis selected four variables for inclusion in the discriminant function: distance to nearest water source, elevation relative to major water source, vegetation (carrying capability), and wildlife (waterfowl) capability (Table 13A).

Backward Stepwise Analysis

The backward stepwise analysis selected four variables for inclusion in the discriminant function: regional relief, relative elevation, vegetation (carrying capacity), and wildlife (waterfowl) capability (Table 13B).

Table 13. Three sets of discriminant functions used for predicting presence/absence of historical resources. Functions A and B are derived through Forward and Backward stepwise analyses. Variables for Function C are selected by combining A and B.

A Discriminant Function Results derived through Forward Stepwise Analysis

Equality of Covariances: DF=10,2527.2 F=3.7108 SIG=.0001

Discriminant Functions:

Historical Resources?	(1) "absent"	(2)"present"
CONSTANT	-17.857	-29.266
El. Rel. Mj. Wt.	.25136 -1	.46960 -1
Vegetation	5.1173	6.8953
Dist. Nr. Wt.	.62599 -2	.98721 -2
Fowl	4.2558	4.9527
GEN VARIANCE	.14640 +9	.55258 +9
N	53	14

B Discriminant Function Results derived through Backward Stepwise Analysis

Equality of Covariances: DF=10,2527.2 F=3.2231 SIG=.0004

Discriminant Functions:

Historical Resources?	(1) "absent"	(2) "present"
CONSTANT	-18.652	-29.552
Rgnl. Rlf.	.29622 -1	.43529 -1
Reltv. Elv.	.38446 -1	.71613 -1
Vegetation	5.1363	7.0830
Fowl	4.3814	5.1044
GEN VARIANCE	.41099 +8	.64553 +7
N	53	14

C Discriminant Function Results derived by combining Forward and Backward Analyses

Equality of Covariances: DF=21,2083.0 F=4.3150 SIG=.0000

Discriminant Functions:

Historical Resources?	(1) "absent"	(2) "present"
CONSTANT	-20.095	-32.429
Rgnl. Rlf.	.25363 -1	.34269 -1
Rel. Elv.	.20777 -1	.40403 -1
Elv. Rel. Mj. Wt.	.11489 -1	.22986 -1
Vegetation	5.2667	7.2528
Dist. Nr. Wt.	.74402 -2	.10173 -1
Fowl	4.4373	5.1881
GEN VARIANCE	.10471 +16	.28056 +16
N	53	14

Combined Analysis

The six variables selected through the stepwise analyses were forced into a third discriminant function (Table 13C).

Scatterplot Analysis

In order to better understand the interrelationships of the six variables selected through stepwise discriminant analysis, a scatterplot was produced for each pair with presence or absence of historical resources indicated. An example is shown in Figure 38. (Note that overlying data points of the same category [present or absent] appear as single data points.) There is considerable overlap in all of the distributions; however, in several cases they differ in some portion of the plot. The main trends are summarized below, excluding those already apparent from the earlier univariate analysis.

- Aggregate sources with high regional relief and low relative elevation do not contain historical resources.
- Aggregate sources with high regional relief and high elevation relative to major water contain historical resources, while those with high regional relief and low elevations relative to major water do not contain historical resources.
- Aggregate sources with low waterfowl capability and comparatively high relative elevation commonly contain historical resources.
- Within each vegetation category, aggregate sources with relatively high elevation relative to major water commonly contain historical resources.

EVALUATION OF DISCRIMINANT FUNCTIONS

From the scatterplots, it is apparent that the discriminant functions should have greater explanatory/predictive power than any single variable alone. To assess the usefulness of the functions, it is desirable to test them on a known sample not used in deriving the function. One method of so doing is to derive a function from half the sample and try to predict the other half. However, because only fourteen locales contain historical resources, the present sample is too small for subdivision.

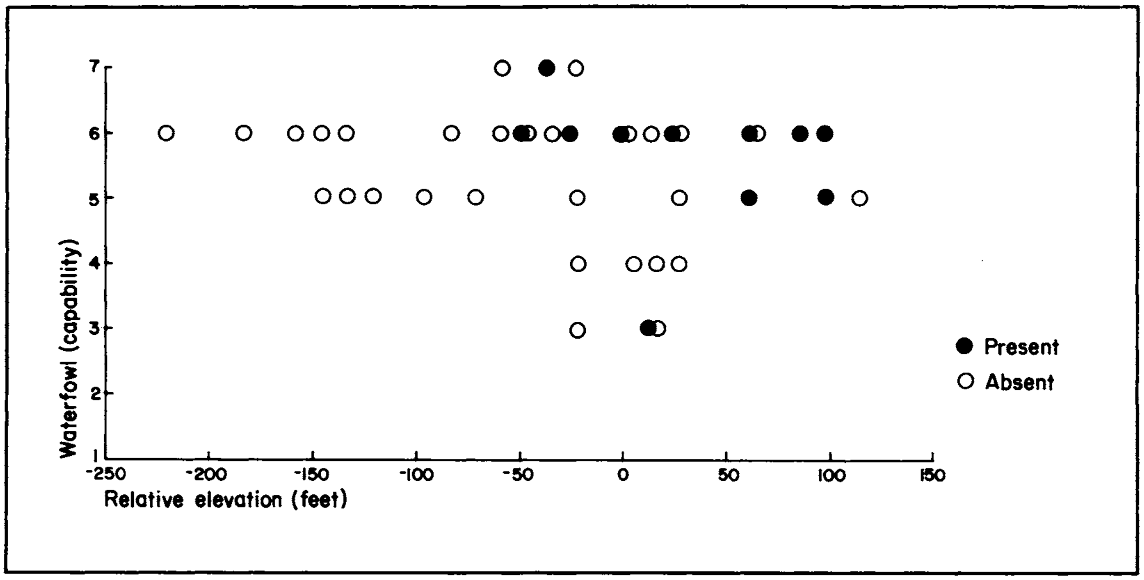

Figure 38. Example of scatterplot analysis - relative elevation (feet) vs. waterfowl capability.

Another method of evaluating discriminant functions is to "predict" the sample used in deriving the function. This was done with each of the three functions. Figure 39 shows the distribution of actual and predicted historical resource potential for each function. The forward-derived function correctly predicted historical resource potential in 85 percent of cases. The backward-derived and combined functions both had a success rate of 88 percent. However, while absence of historical resources is correctly predicted in 90.6 to 92.5 percent of cases, presence of historical resources is correctly predicted only 64.3 to 71.4 percent of the time. In other words, aggregate locales which contain historical resources would be incorrectly predicted to have no historical resources 28.6 to 35.7 percent of the time.

If there is to be error in the predictions, it may be preferable from a historical resource management perspective that aggregate sources be incorrectly predicted to contain historical resources rather than the reverse. There are several ways to generate more "conservative" predictions.

Posterior Probability

Historical resources occurred in 20.9 percent of the aggregate sources surveyed by Lifeways. In generating the predictions used above,

Forward-derived discriminant function:
(POSTERIOR PROBABILITY = PROPORTIONAL)

Predicted \ Actual	PRESENT	ABSENT
PRESENT	9 (13.4%)	5 (7.5%)
ABSENT	5 (7.5%)	48 (71.6%)

Backward-derived discriminant function:
(POSTERIOR PROBABILITY = PROPORTIONAL)

Predicted \ Actual	PRESENT	ABSENT
PRESENT	10 (14.9%)	4 (6.0%)
ABSENT	4 (6.0%)	49 (73.1%)

Combined discriminant function:
(POSTERIOR PROBABILITY = PROPORTIONAL)

Predicted \ Actual	PRESENT	ABSENT
PRESENT	10 (14.9%)	4 (6.0%)
ABSENT	4 (6.0%)	49 (73.1%)

Figure 39. Predicted and actual presence/absence of historical resources for three discriminant functions with posterior probability = proportional.

it was assumed that historical resources would occur with similar frequency in the non-surveyed sample. One way to generate more "conservative" predictions is to change this probability for purposes of prediction. This can be done by specifying a "posterior probability" other than proportional (i.e., other than 0.21/0.79) when generating predictions using discriminant functions.

A second set of predictions was calculated using the same discriminant functions as before but with a posterior probability of 0.5/0.5 - in other words, with the assumption that any gravel source has a fifty percent chance of containing historical resources. Figure 40 summarizes the predictions with posterior probability set at 0.5/0.5. Between 82.1 and 86.6 percent of all cases were correctly predicted (slightly lower than before). However, of all aggregate sources containing historical resources, between 85.7 and 92.9 percent were correctly predicted - a considerable improvement.

Examining Scores

Discriminant function predictions are based on the values or scores which result when data for each aggregate locale are entered into a pair of equations (see Table 13). The two values always sum to 1 and classification or prediction is based on which of the two is highest (i.e., over 0.5). Some indication of the certainty with which classifications are made can be gained by examining the two values. If they are close to 0.5, the resulting prediction can be considered weak or at least suspect. If the values are less similar (e.g., 0.1 and 0.9), the prediction is more clear cut.

Grouping Predictions

Another method of generating more conservative predictions is to apply all three discriminant functions to each case and, if any of the predictions point to presence of historical resources, assume such resources are present. When this is done with the first set of predictions (i.e., those with proportional posterior probability), overall correct prediction goes up to 89.5 percent, and, more importantly, presence of historical resources is correctly predicted 92.9 percent of the time. When this method is applied to the second set of

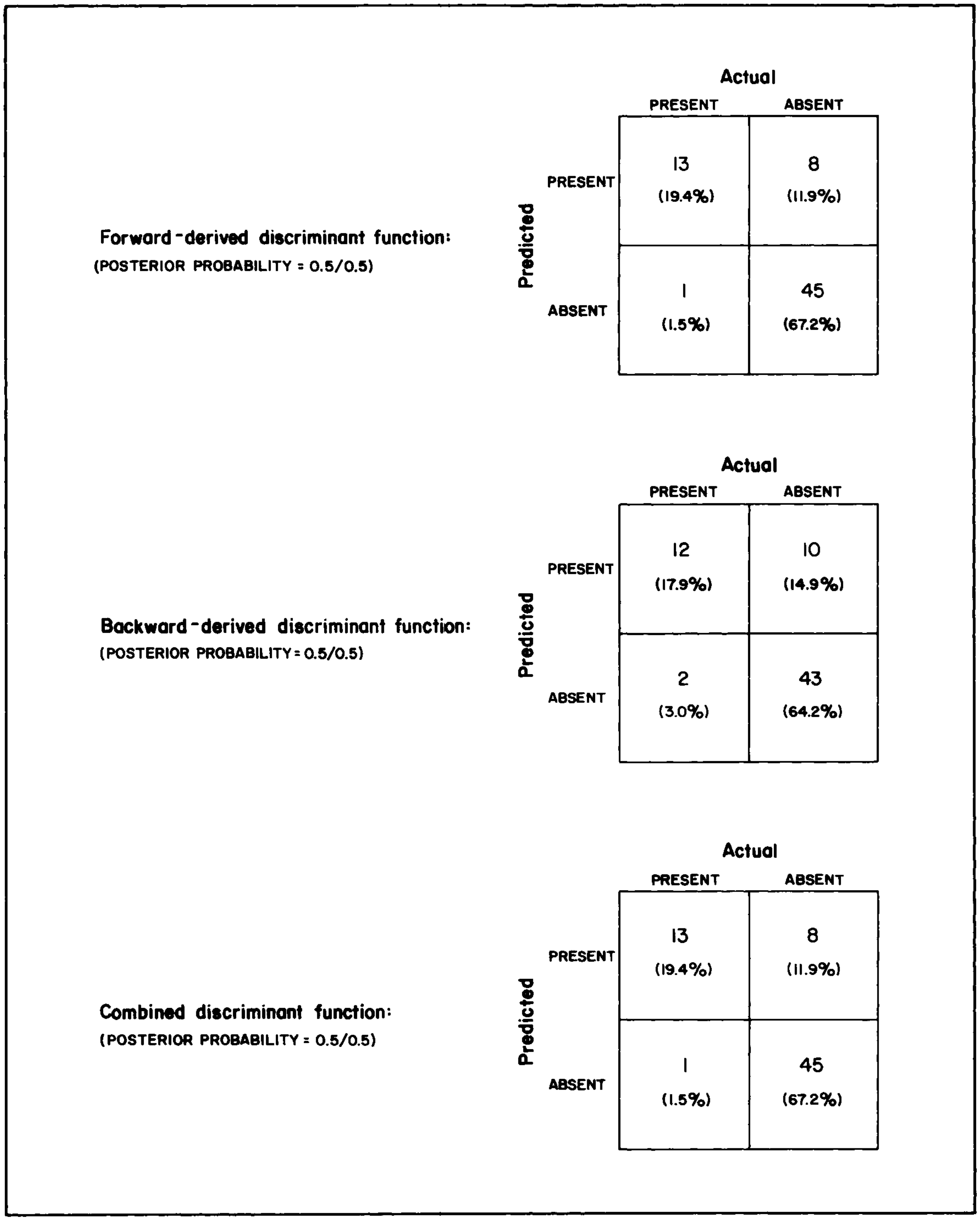

Figure 40. Predicted and actual presence/absence of historical resources for three discriminant functions with posterior probability = 0.5/0.5.

predictions (posterior probability set at 0.5/0.5), overall accuracy drops to 82.1 percent, but the presence of historical resources is correctly predicted in 100 percent of cases (Figure 41).

CONCLUSIONS

The study summarized here (Damkjar 1986) set out to develop methods of predicting historical resource potential of aggregate sources in the southeast quarter of Alberta and, using those methods, predict historical resource potential of 254 aggregate sources. Development of a predictive methodology began with univariate analysis of thirty variables for 67 aggregate sources of known historical resource potential. This was necessary for two reasons. First, it was hoped that a number of the variables would provide good predictive power. Second, it is important in any predictive plan to understand the behaviour of variables being used for prediction. The analysis showed that there was predictive potential in many of the variables examined, but much of it was redundant. Specifically, much of it could be explained in terms of proximity to rivers. In future historical resource management of aggregate sources, the descriptive analysis in this report should prove useful for comparison and assessment. In terms of making specific predictions, however, it became evident that a multivariate method was needed.

Discriminant function analysis provides a potentially powerful method for classification or prediction. Since the earlier univariate analysis had indicated considerable overlap or redundancy in the data, stepwise discriminant techniques were employed to isolate those variables which, as a group, provide the best predictive value. This does not mean that these variables, on an individual basis, are the best predictors. Waterfowl, for example, has very little predictive value in isolation. However, in a multivariate context, waterfowl obviously provides predictive information not available from other variables.

A variety of approaches to generating predictions using the discriminant functions are presented. Emphasis is placed on correctly predicting presence of historical resources. Overall accuracy averages around 90 percent and, depending on which approach is used, correct

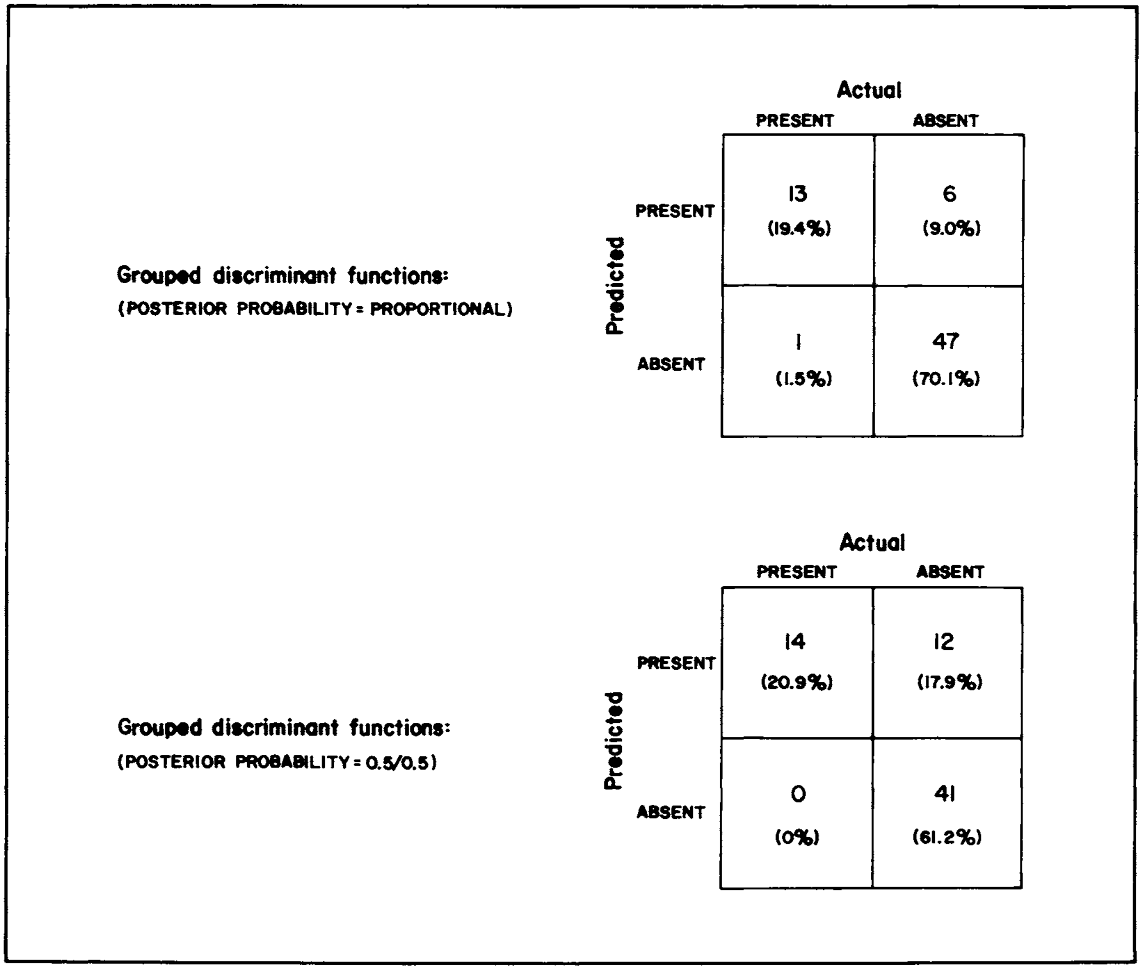

Figure 41. Predicted and actual presence/absence of historical resources for grouped discriminant functions with posterior probability = proportional and 0.5/0.5, respectively.

prediction of historical resource presence is achieved in 64.3 to 100 percent of cases.

It is important to keep in mind that evaluation of predictive accuracy of the discriminant functions has been done by "predicting" the sample from which the discriminant functions are derived. The utility of the functions in correctly predicting historical resource potential of the non-sampled aggregate sources rests entirely on the assumed representativeness of the surveyed sample. Therefore, it is recommended that a sample of the non-surveyed aggregate sources be examined in order to test the predictions in Damkjar (1986). Furthermore, findings of this study apply only to aggregate sources within the prescribed geographic area.

PRELIMINARY REPORT ON THE 1986 EXCAVATIONS AT THE STRATHCONA SITE

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INTRODUCTION

The Strathcona site (FjPi-29) is located on a North Saskatchewan River terrace on the east side of the city of Edmonton (Ives 1985:3). The site area presently includes at least 20,000 square metres (Pyszczyk 1985:6), although the original areal extent cannot be known due to recent site destruction. Since archaeological work began at the site in 1976, researchers have variously viewed the site as a lithic workshop and quarry with only limited habitation (Ives 1985; Newton and Pollock 1985), a combination workshop/campsite (Helmer et al. 1986; Pyszczyk 1985), or simply a habitation site (Driver et al. 1982).

The University of Calgary's Department of Archaeology undertook its sixth field season at the site in 1986, beginning on May 1 and concluding on September 1. During this time, 27 one-metre units were completely excavated and another two were partially excavated. Twenty-six of the 27 completed units were situated in a contiguous block excavation which was the focus of this season's research. The remaining completed unit and the partially finished units were part of a salvage operation designed to recover cultural material from a sump pit slated to be constructed on the site in 1987. The sump pit will drain the waterlogged northeast portion of the site so that excavations can be undertaken in that area in 1988 to determine if faunal preservation is improved relative to the remainder of the site.

METHODOLOGY

As has been the case over the last five field seasons, most of the excavation was undertaken by students from the University of Calgary's archaeology field school. As well as the 15 students who took part in the field school, over fifty members of the public participated in a volunteer programme at the site. Each volunteer worked a four-day period, participating in both excavation and preliminary cataloguing.

The location for this season's excavation was chosen on the basis of the results of a four-year, site-wide sampling programme designed to define the nature of the intrasite variability at FjPi-29 (Helmer et al. 1986). The type and duration of occupation at FjPi-29 are crucial to defining the site's role in the parkland settlement and subsistence system. Although much is now known about the lithic reduction activities at FjPi-29, it has proven very difficult to obtain information about the other activities that may have occurred at the site during its occupation. A possible hearth located in Unit 91 in 1984 (Helmer et al. 1986:189), in combination with the apparently high concentration of faunal remains (1986:360), suggest that this area might represent a habitation location at the site. Therefore, a block excavation was initiated around Unit 91 in 1986.

RESULTS

Previous excavations at FjPi-29 have identified cultural remains dating from the Historic through to the Early Middle Prehistoric Period (Helmer et al. 1986:267-268). The 1986 excavations uncovered nothing new in this regard; the culturally diagnostic material recovered consisted of two Oxbow projectile point fragments and one Besant projectile point. The absence of stratigraphic layers at the site has caused considerable trouble in the ordering and interpretation of the remains recovered from the site, and, in this regard, the projectile points from the 1986 excavation do have some significance. Both Oxbow point fragments came from near the base of the excavation, while the Besant point came from the upper portion of the site. This may indicate that vertical stratification does indeed exist in the remains, a point made previously by Pyszczyk (1985) and Helmer et al. (1986) but contested by Driver et al. (1982). A single large charcoal fragment was recovered from approximately the same depth as the Oxbow point fragments. It was hoped that this might provide some absolute dating control on the lowest occupation at the site since the fragment appeared to come from an undisturbed context. The date obtained, 130 ± 90 years B.P. (AECV 308C), is clearly not compatible with the excavated remains. The charcoal was obtained from a situation some 5 to 10 cm below a rodent burrow and was apparently introduced to the lower portion of the site from that source.

Extensive refitting analysis is currently underway in an attempt to circumvent the problem of the absence of stratigraphic layering at the site. This project has only just begun and, due to its time-consuming nature, only limited results have been achieved thus far. One aspect of the results worthy of note, however, is the great success attained in refitting a distinctive pitted cobble of fire-broken rock (FBR). Some three-quarters of a single, large cobble has been reconstructed from 31 small fragments. The fragments come from eight different 1 x 1 m units and represent a maximum depth difference of 20 cm (658.83 to 659.03 m above sea level) and a maximum depth difference of 18 cm in any one unit. If the fragmentation of this cobble can be assumed to represent a single event or occupation (a reasonable assumption given that large quantities of suitable raw material for stone boiling are readily available, and it would not be necessary to reuse old, scavaged rock fragments), then it may be that this 20 cm zone of the site does represent a single, discrete occupation. Of further interest in this regard is that both Oxbow projectile point fragments come from below this zone (658.69 and 658.72 m above sea level), while the Besant point comes from above it. (Although the exact location is not known, it is between 659.37 and 659.35 m above sea level.) As this analysis progresses further, it may be that at least three cultural horizons will be definable. Other goals of the refitting analysis include a better definition of stone boiling technology, lithic reduction sequences and activity loci.

A reasonable quantity of FBR is present in the remains from the site area excavated this year. In other areas of the site, the presence of FBR has been interpreted as debris from general campsite living activities rather than as special debris (Driver et al. 1982:180). With the exception of processing areas associated with communal kills, such as at Head-Smashed-In Buffalo Jump (Brink et al. 1986:105-110), this is probably a valid assumption in Alberta. Since good success has been attained in the refitting of FBR from the excavation, it is quite probable that stone boiling did take place in the immediate area of the excavation and that the area does represent some type of habitation locus as had been originally predicted.

The possible hearth feature that was the initial reason for excavating in this area is located at the base of the zone encompassed by the reconstructed FBR cobble. Whether or not this feature is a hearth, it does appear to be associated with the proposed occupation defined by the FBR refitting analysis. A hearth would be necessary to heat the stones used in the boiling process, and such an association of these features would be a good indication of domestic activity. However, the proposed hearth feature remains somewhat of an enigma, despite the fact that the three units adjacent to it were all excavated. As in 1984, no quantity of charcoal was recovered in the area, although isolated small flecks were scattered throughout the vicinity. Also, there was no clear continuation of the FBR alignment into the other units, although a vague circular pattern some 1.5 to 2.0 metres in diameter might be construed. (Detailed examination of the FBR spatial patterning has not yet been completed.) It is hoped that the status of this possible feature will be more clearly defined when the remaining analysis is complete.

A feature found in Unit 162 also suggests the presence of a domestic activity locus in the excavated area. It appears that a pit was dug some 15 to 25 cm into the soil. At its base, there is a lens of mixed sandy and finer-sized material. The purpose or cause of this feature is not certainly known. The dimensions of the feature and its chronological affiliation are not perfectly understood since only a portion of the feature was included in the excavation area; however, it does appear to originate in the upper 5 to 16 cm of the deposit. This would suggest that it is associated with the Besant portion of the excavation. If this does prove to be the case, it would suggest that this area of the site, including both the middle and upper proposed occupations, might have been connected with domestic activities over an extended period of time.

The presence of faunal remains in the excavation area could also be indicative of domestic activity. Some faunal material was recovered, but, as seems to be the case at Strathcona in general, it was mostly in poor condition. This suggests that much of the original material may have been lost due to various degradative processes. In terms of the Strathcona site, the quantity of bone recovered in 1986 is fairly large (by number of pieces, about 10% of the excavated remains, but many of the pieces were very small). The material was fairly completely disarticulated, as would be expected in a consumption or terminal processing location. If the bones had laid on the surface for any length of time, other non-human taphonomic agents might have been a cause of this dispersal. The poor condition of the bone might indicate a period of weathering on the surface. On the other hand, some butchering marks were observed on the remains.

Most of the bone recovered was large ungulate and some was definitely Bison. A variety of bone elements were recovered, both axial and appendicular, but limb bones appear to dominate the assemblage. Some relatively meatless bones, such as the phalanges, metapodials and the mandible, are included. These meatless bones might have been utilized for their marrow. It is conceivable that the remains resulted from an isolated kill in the immediate vicinity, where it would have been possible to return much of the carcass to camp. In turn, this might suggest that, although the area examined is a domestic activity area, the occupation may have been short-term. A better understanding of the faunal evidence must await the completion of this aspect of the analysis.

Lithic usewear analysis is also being employed to help define what types of activities were undertaken in the 1986 excavation area. Both tools and resharpening flakes are being employed in the analysis. The latter are particularly relevant since it is probable that tools resharpened in the excavation area also became dull due to use there. The problem associated with the usewear analysis is that quartzite was the most commonly used lithic material, and it has proven very difficult to analyze due to its toughness and resistance to wear. Recently, success has been realized by using micropolish analysis with both quartzite (Kooyman 1985) and quartz (Sussman 1985). Based on these two studies, it appears feasible to distinguish between working dry hide, antler, bone, wood (and perhaps between hard and soft woods), fibrous plants and non-fibrous plants. Dry hide, plants, bone and hardwoods have all been shown to develop microwear polishes in experiments with quartzite from the site area. A sample of resharpening flakes has also been examined and at least some of these apparently demonstrate usewear polish. A pilot study has been initiated using quartzite from sources in the immediate vicinity of the site. As this experimental programme and analysis progresses, it should allow much more precise definition of the types of activities that occurred at the Strathcona site.

This year's lithic analysis focussed on defining which lithic reduction stages are represented in the remains. This information in turn allows an assessment of the role of stone tool manufacture in site activities. The frequencies of raw material, finished tools, various flake categories (sharpening, decortication, resharpening, etc.) and fabricators are all being employed in this assessment, as is the extent of platform and dorsal surface flake scarring. (For a discussion of this last point see Magne [1985] and Morrow [1984].) The tools that were manufactured and/or used on the site are also being examined to clarify the role of stone tools in site activities. The usewear characteristics of resharpening flakes and tool edges are a major component of this analysis, but the frequency of bifacial reduction flakes and the typological classification of finished and unfinished tools are also elements of it. Although the analysis is not yet complete, the basic nature of the remains can be seen in some of the results from a sample of seven of the excavation units.

The results are much as has been found in previous seasons. Roughly three-quarters of the lithic material is quartzite, and another 10 to 15 percent is petrified wood. Some 90 percent of the lithic remains are debitage. About 6 percent of the lithics are "manufacturing tools," such as hammerstones and cores, and only 4 percent are other tool types. Given these figures, tool use appears to have been unimportant relative to tool manufacture, but this assumption should be tempered with the knowledge that the percent calculations are based on number of pieces. Over half of the lithic remains are shatter fragments, many of which are quite small. It is probably preferable to examine the relative importance of lithic manufacturing in site activities by examining only "intentional" debitage (flakes), particularly when considering materials such as quartzite that experience considerable shattering during reduction. Only about 35 percent of the lithic remains are flake debitage, hence manufacturing debris does not actually dominate the assemblage. This point can be further emphasized by examining estimates of the number of flakes one might expect would be produced during the manufacture of various tool types.

Magne (1985:96) undertook experimental stone tool manufacture in connection with his research. The records of these experiments include the number of flakes resulting from the manufacture of each individual stone tool. Six unimarginal tools were manufactured, requiring an average of 14 flakes to produce. These tools are comparable to the edge-modified flakes present in the Strathcona assemblage. The two ovoid bifaces produced are reasonable analogues for the other tools present in the assemblage. They required an average of 48 flakes to manufacture. Something over 1200 manufacturing flakes would then be expected in the assemblage if the 27 edge-modified flakes and 18 bifacial tools recovered had been produced on the site. The assemblage includes only 468 flakes, after the resharpening flakes have been excluded. (These latter are a result of maintenance rather than production.) There is insufficient debitage to account for even the manufacture of the tools presumed to have been used on the site. Although these estimates probably do not accurately reflect the exact situation at FjPi-29, they are broadly analogous, and the results are sufficiently clear to indicate that tool manufacture supplementary to that required for on-site activities did not occur. Hence, stone tool manufacture did not dominate site activities.

The details of lithic reduction at FjPi-29 cannot be elaborated prior to the completion of the analysis, but material representative of all stages in the tool production sequence is present. Bipolar flakes (approximately 1% of the lithic remains) and primary and secondary decortication flakes (approximately 5%) are representative of an early stage in reduction. The various secondary and thinning/reduction flakes (approximately 15%) relate to an intermediate stage, as do sharpening flakes (approximately 10%; see Magne [1985:106-107] concerning sharpening flakes in lithic reduction). The final stages in biface production are indicated by bifacial reduction flakes (approximately 2% of the lithic remains). Sharpening of used tools is indicated in the remains by the presence of resharpening flakes (approximately 2%). The relative role of each stage in the reduction procedure is not yet known.

CONCLUSION

The initial results of the 1986 field season at FjPi-29 suggest that the area excavated was a domestic or habitation area, with lithic reduction probably occurring only as a result of immediate use demands. The lithic reduction analysis suggests that all stages in the lithic reduction sequence are represented in the site remains and that this portion of the site resulted from a habitation occupation rather than a lithic workshop. In addition, the presence of non-meaty bones in the faunal assemblage indicates that the occupants had sufficient time to undertake a variety of tasks, such as bone marrow extraction. It is suggested that this would not have been possible at a specialized lithic workshop site, and, therefore, the occupation in this portion of FjPi-29 could not have been of this nature. The other cultural remains recovered seem compatible with such an interpretation.

It is possible that at least three different occupations occurred at this location on the site. Refitting analysis was employed to clarify the stratigraphy of the site, and the results also suggested a threefold division of the site. The uppermost occupation dated to the Besant time period, based on a projectile point recovered in the excavation. The lowest occupation was dated to Oxbow times, also based on an excavated projectile point. The middle occupation could not be directly dated but obviously occurred between the other two.

A CRITIQUE OF MEDICINE WHEEL ASTRONOMY

By
Steven C. Haack

INTRODUCTION

The development of the human mind, both in terms of biological evolution and the endless variety of cultural inventions which give it form and expression, has centred largely about man's manipulation of the environment: the ability to pick up pieces of it and chip, mold, cut and entwine them. The early world was given meaning by the ability to inspect and experiment with it, and the resultant technologies opened new vistas and set constraints upon every aspect of life. An interest in the form and motion of the sky was at the basis of man's most fundamental construction of the world, but the sky confronted our ancestors with a very special problem. Its diurnal and seasonal cycles and the caprices of its weather encompassed all and dictated the activities and often the survival of man. Yet it stood far outside his ability to manipulate or control. Even an understanding of the motions of the sky made no contribution to its control. The heavens posed the first purely intellectual problem.

Efforts to control the sky took the form of populating it with gods with whom deals could be struck. Contracts written in ritual and sacrifice were offered to the cosmic powers in the hopes that they would respond with bountiful harvests, mild winters, plentiful game and adequate rainfall.

Attempts to comprehend the motions of the sky were rarer and less ostentatious. Generally taking the form of tracking the motions of the celestial bodies through their seasonal cycles, recording paths and events and, in some cases, attempting to predict them, these activities form the core of the discipline of archaeoastronomy. A number of early civilizations displayed a propensity for such activities. In the case of the ancient Chinese, the evidence is quite clear: thousands of written records exist which establish a careful, systematic study of the heavens. There are many more instances (in Egypt and Mesoamerica, for example) in which the tangible artifacts of such activity have been tragically destroyed. However, traces of records and peripheral remains attest to a persistant interest in the mechanics of the sky.

There are also a number of borderline cases wherein considerable effort was expended in activity which may have been related to the study of the sky, but the evidence is sketchy and unclear. The formulations of standing stones throughout Britain exemplify this class of evidence, as do the medicine wheels constructed by inhabitants of the northern Plains of America. The purpose of this paper is to study the medicine wheels in the context of the hypothesis that they were constructed to facilitate the study of the motions of the sky.

SOME FUNDAMENTALS

The earth rotates from west to east causing all of the celestial bodies to cross the sky from east to west. Each object moves along a path which consists of a circle centered about the earth's axis of rotation. We can project the earth's equator into the sky to form the celestial equator. The angular distance of an object above or below the celestial equator is known as its declination, the celestial analog to latitude on the surface of the earth. Ignoring the very long-term variation known as precession, the declination of a particular star does not change by any amount detectable without the use of modern instrumentation.

The declination of the sun changes dramatically, however, cycling through a full 47 degrees in the course of a year. This is because the earth's axis of rotation is not perpendicular to the plane of its orbit. As shown in Figure 42, the sun appears to lie on the celestial equator at the time of the spring equinox. As the earth moves along its orbit, the sun's declination increases until it reaches a maximum of 23.5 degrees on the day of the summer solstice. The declination of the sun then decreases, and the passage of three months brings the sun back to the equator at the autumnal equinox. In another three months, its declination decreases to -23.5 degrees at the winter solstice. Although there is a lag of a couple of months between the extremes of the sun's declination and the extremes in temperature, the correspondence is an

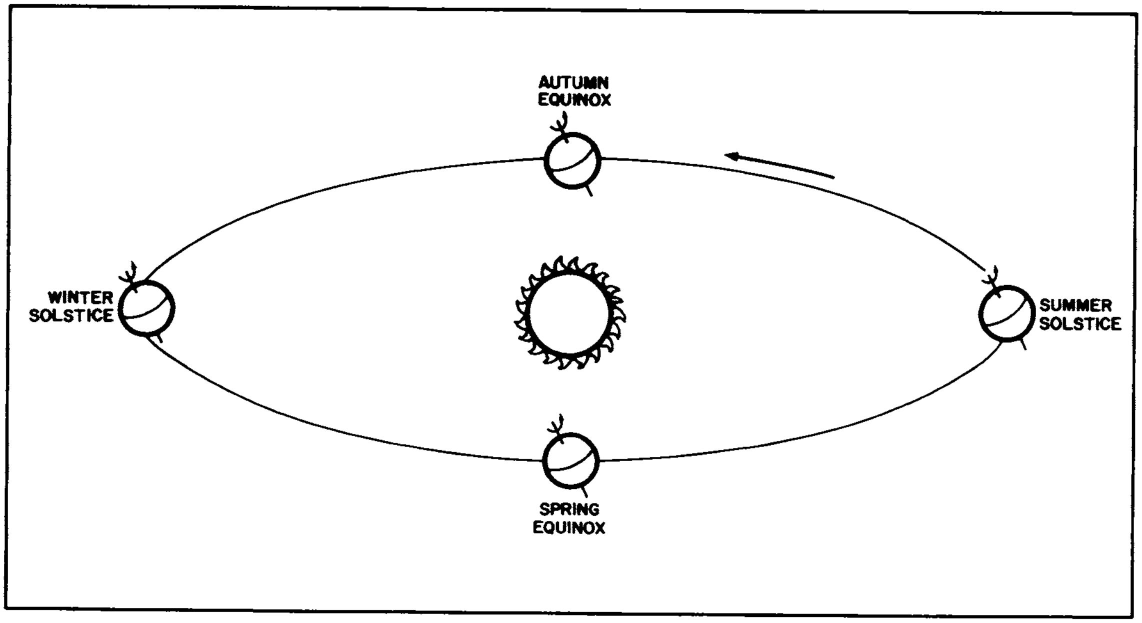

Figure 42. An oblique view of the earth's orbit around the sun.

obvious one and was surely one of the first celestial-terrestrial links realized by primitive man.

The point on the horizon at which the sun rises changes with its declination. As can be seen in Figure 43, the angular distance along the horizon, with respect to due east, at which one observes an object to rise depends upon the latitude of the site and the object's declination. It should be stressed that, unless the observer is standing on the equator and/or the declination of the object is zero, this angle is not equal to the object's declination. Rather, the application of spherical trigonometry shows that:

(1) $$\alpha = \arcsin \frac{\sin \text{(declination)}}{\cos \text{(latitude)}}$$

where α is the angle of the rising point measured along the horizon from due east.

An inspection of the above equation shows that when the sun's declination is 23.5 degrees (summer solstice), α is 90 degrees at latitude 66.5 degrees. This is the latitude of the arctic circle, thus the equation is consistent with the observation that the sun touches the horizon at midnight on that day but does not set for the observer standing at that latitude. Above that latitude, the equation has no

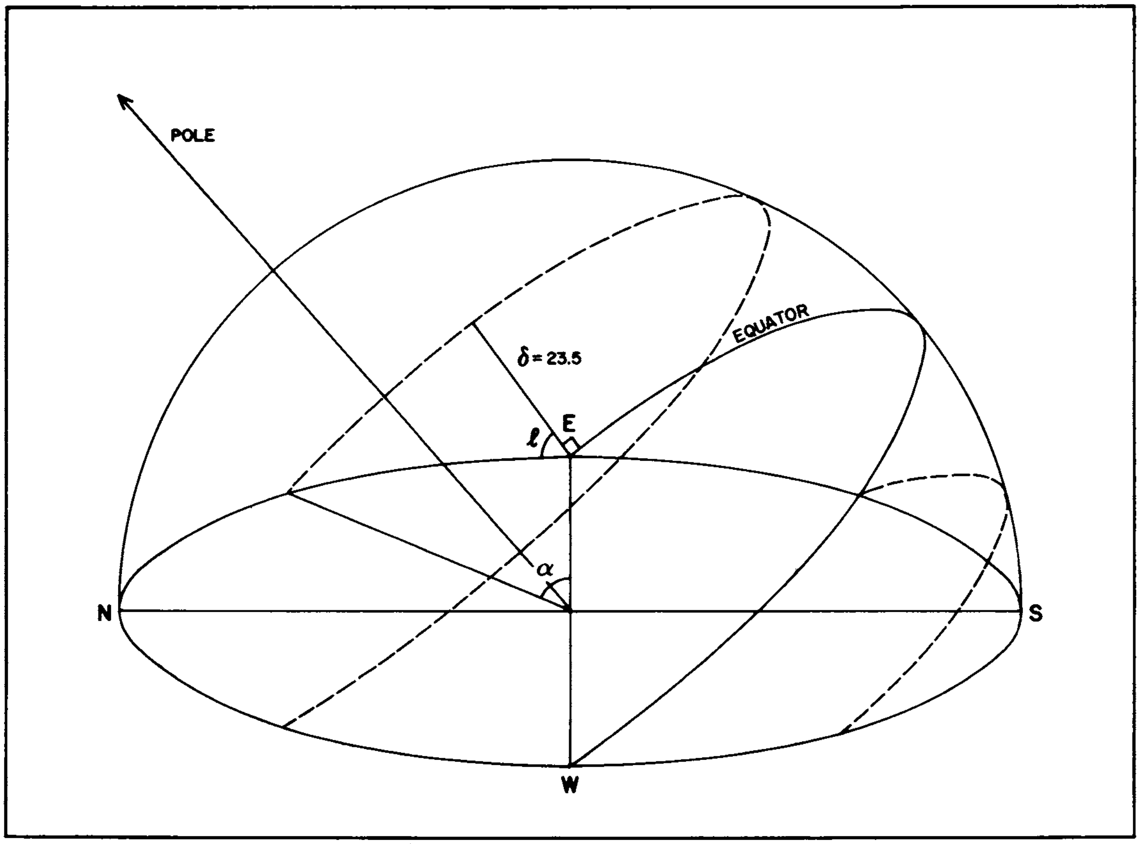

Figure 43. On the day of the summer solstice, the sun travels across the sky along the upper dotted line. Its declination, δ, is 23.5 degrees at this time. The angle ℓ is the same as the latitude of the site. The angle α is the angular distance along the horizon from due east of the sun's rising point.

solution, meaning that the sun does not touch the horizon at all until, of course, its declination decreases.

Figure 44 shows the variation in α from a site of 51 degrees latitude throughout the year. The enormous variation in α would certainly have caught the attention of anyone who watched the sky, and the notion that they may have tracked the point of sunrise, marked its extremes and used these observations to measure time makes sense. This is the hypothesis forwarded by a number of authors and one which we will now inspect.

SOLSTICE ALIGNMENTS

An inspection of the site maps and descriptions for 67 medicine wheels (Archaeological Society of Alberta 1976; Kehoe and Kehoe 1979;

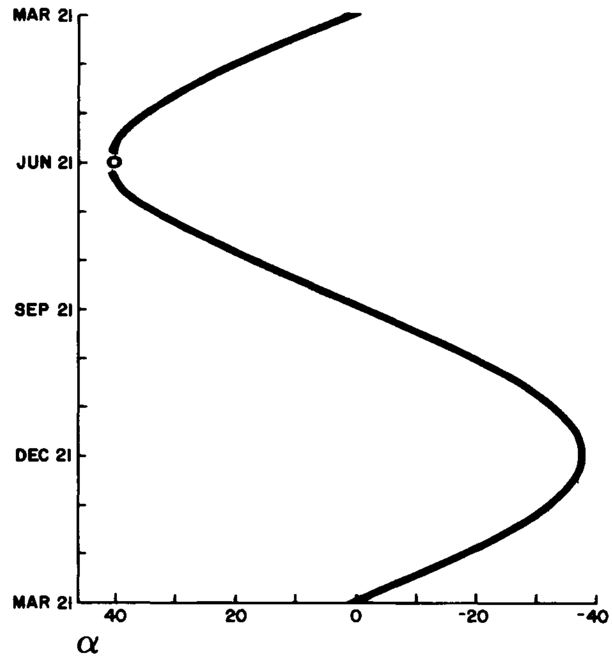

Figure 44. The yearly variation of α as measured from a site at latitude 51 degrees. Considering that the position of the sunrise changes very slowly about the time of the equinoxes and the small angular diameter of the sun (shown at summer solstice), an alignment must be quite accurate to establish the day of the solstice.

Quigg 1984) demonstrated that the majority, consisting of single cairns, simple rings or broad accumulations of stone with no perceptable structure, have no possible astronomical significance. Although this by no means constitutes evidence against the hypothesis that some medicine wheels have astronomical alignments, the fact that 54 of the 67 initially could be placed in this category indicates that any astronomically significant feature is exceptional, and the astronomical hypothesis does not offer any comprehensive explanation of these puzzling structures.

Of the remaining examples, twelve had strings of stones or pairs of cairns which could have been used to establish lines which pointed to within a few degrees of the summer solstice sunrise. It has also been suggested that some medicine wheels show alignments to the rising points of bright stars (Eddy 1974, 1979). A site often mentioned in this regard (Big Horn) was chosen for analysis and will be dealt with in the next section.

An initial inspection of the twelve sites chosen for possible solstitial alignments introduced questions concerning the logistics of establishing accurate, useful sightlines. Although the sun is bright enough to dominate the sky, its angular diameter is quite small. It can be easily eclipsed by the tip of the finger held at arm's length. A sightline accurate enough to follow the daily progress of the sun around the time of the solstice should be accurate to within a few tenths of a degree, but, in most cases, the forward cairn of the proposed sightline consists of a sprawling mass of rock subtending some five or ten degrees, while the rising sun subtends only one half of a degree. Sightlines made of two posts on either end of a very long baseline would have been much more accurate, and it is hard to believe that this would have escaped the attention of anyone actually involved in studying the sun's motion. In that, in some cases, the foresight cairn consists of many tons of rock, the astronomical hypothesis demands that we believe that the natives undertook many hours of hard labor which, indeed, rendered the sightline less accurate than it was when it consisted of two small piles of stones. Again, this does not prove that medicine wheels were never set up to record the position of the summer solstice sunrise. However, it does indicate that if they were, accuracy was probably of no particular interest, and, therefore, the use of medicine wheels to establish a calendar date is not a very viable possibility. Furthermore, it suggests that, in many cases, it would be advisable to approach archaeological theories experimentally. In the present case, going out to a high hill around the time of the summer solstice and attempting to construct the means to follow the sun's motion would make the above-mentioned problems abundantly clear.

We have as yet to actually test the hypothesis. To do so, we must use it to make a specific prediction which can be confirmed or refuted by the data. It would be nice if we could find a pair (or more) of variables which should relate to one another in a specific way if the hypothesis is true. Medicine wheels take a wide variety of forms and the ones which feature possible solstitial alignments do not stand out in any particular way. Variables involving the actual structures, such as baseline length, cairn size or auxilliary features, do not appear capable of offering the test needed. However, there is another variable which is accurately established and which should be directly tied to another variable: geographic latitude. As shown in Figure 43 and equation (1), the angle α depends both upon the latitude of the site and the declination of the object. If a number of baselines at different latitudes are to point at the summer solstice sunrise, the variation in their latitudes should render a systematic variation in the angle α. Figure 45 illustrates the results of this test. There is no systematic relationship between latitude and the angle α. Even if we knew what we were looking for before selecting data points, it would be difficult to select them in such a manner as to support the astronomical hypothesis.

STELLAR ALIGNMENTS

We now turn our attention to the possibility that certain medicine wheels were constructed to indicate the rising points of various bright stars. Here we are once again faced with some initial problems concerning the usefulness of such alignments. As pointed out earlier, while the sun's declination varies dramatically with the seasons, the declinations of the stars do not change over any short timescale. Why, then, would one want to denote the rising point of a particular star? It has been proposed the the rising time of a particular star with respect to the rising time of the sun would be of value in determining the day of the year. This is true; the ancient Egyptians defined the first day of the year as the day that Sirius was first visible before sunrise (the heliacal rising). It is certainly possible that the American natives were aware that this was a phenomena which could be employed to establish an accurate calendar. But why would they have to indicate the rising position of the star in question? They certainly would have been familiar enough with its position with respect to the visible stars to have been able to anticipate the position and approximate time of its rising. Again, the above questions do not, in themselves, undermine the astronomical hypothesis. We must invent a test which the hypothesis can pass if and only if it is correct.

In the case of solstitial alignments, there was a single target: the summer solstice sunrise. However, here there are many possible targets. The summer sky has many conspicuous stars which may have been

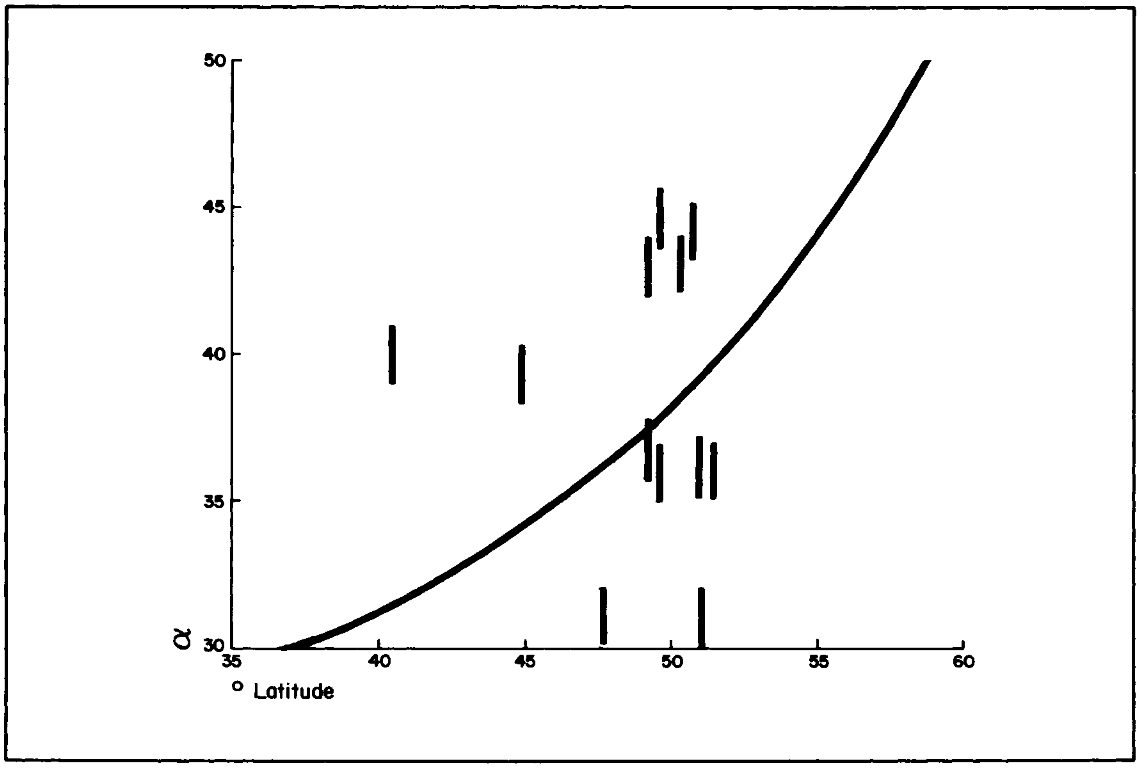

Figure 45. The angle α of the rising solstice sun as a function of latitude is indicated by the line. Not only do the data points from twelve selected sites fail to lie closely to the line, they also fail to follow the upward trend of the line.

good targets for establishing the date according to a heliacal sunrise. Since there is no reason to select particular stars as targets, we are faced with an immediate problem: how do we test the hypothesis of an alignment when we do not know specifically what alignments we should expect? The solution lies in the establishment of a probability. In other words, do medicine wheels feature more alignments to possible targets than would be expected from assemblages of randomly distributed cairns?

There are about twelve stars in the summer sky, bright enough to be considered possible targets, which lie between declinations -35 degrees and +35 degrees. To this we can add the solstice sun and the Pleiades, a conspicuous cluster of stars which is often mentioned in the ethnographies of Plains tribes.

In his 1974 paper, Eddy shows alignments at the Big Horn Medicine Wheel directed to the rising points of Aldebaran, Rigel, Sirius and both the rising and setting summer solstice sun. Is this likely to happen if the cairns are randomly distributed? What is the probability of such an impressive array of alignments?

The centers of the cairns involved cannot be determined to an accuracy better than plus or minus one degree in azimuth. (This corresponds to about 0.7 degrees in declination.) We also have to deal with the refraction of the starlight as it passes through the atmosphere and the amount of its light which is absorbed. Both of these processes affect the position of the star when it is first visible, and both are highly variable. Estimating conservatively, we find that a particular cairn-to-cairn sightline covers about two degrees of declination. Any of the target stars lying within that range could be argued to be the object of that sightline.

The proposed alignments at the Big Horn site involve both lines radiating from the central cairn and lines drawn between pairs of outlying cairns. When all possible pairs of cairns are considered, we find ten alignments which are directed into the area of the sky between the declinations of -35 degrees and +35 degrees. Since there are fourteen targets, each two degrees wide, distributed over 70 degrees of the sky, the probability that a single random line pointing into this part of the sky hitting one of the targets is (14 x 2)/70 or about 40 percent. What is the probability of five hits out of ten alignments? The formula for this, found in most mathematical handbooks, is:

$$P = \sum_{X=I}^{N} \frac{N!}{X!\,(N-X)!} \; Q^{X} \, (1-Q)^{(N-X)}$$

where N is the number of random lines, I is the number of hits, and Q is the probability of each hit. Inserting the numbers, we have:

$$P = \sum_{X=5}^{10} \frac{10!}{X!\,(10-X)!} \; (.40)^{X} \, (.60)^{(10-X)} = .36$$

There is a 36 percent chance that five or more alignments would result if the Big Horn Medicine Wheel were built with the same basic configuration but with no intentionally constructed astronomical alignments.

The numbers used are all debatable; others may have different estimates of accuracy of the sightlines or the numbers of acceptable target stars. However, no reasonable manipulation of the numbers can make the Big Horn alignments appear unlikely to have happened by chance. The other four medicine wheels analyzed in this way were even less impressive; probabilities of the alignments being the result of chance ranged from 64 to 85 percent. Statistical tests cannot prove a negative, however. We have not established that Big Horn or any other medicine wheel was not intended to be used as astronomical observatories, but it is reasonable to demand that the hypothesis pass the above test, and its performance is not impressive.

CONCLUSIONS

The present study yields both specific and general conclusions which are worthy of consideration. The astronomical hypothesis as applied to medicine wheels fails to pass two simple tests. Not only does it appear unlikely that they were used for the purpose of making astronomical observations, it also appears unlikely that the structures of this nature could have been useful in this manner even if the orientations were more convincing. None of this should really come as a surprise. There is no indication that the Plains Indians were ever particularly interested in establishing an accurate calendar. Any periodic event in which they were interested, such as the right time for planting, was attended by any number of environmental clues. A familiarity with the motions of the sky was undoubtedly part of the assemblage of observations which they brought to bear upon the problem of time determination; however, a general knowledge of the changing star patterns was probably sufficient for their purposes.

The weaknesses of the astronomical hypothesis as applied to medicine wheels are typical of those which have surfaced elsewhere. In recent years, a number of classical assertions in archaeoastronomy have been brought into question. Even Stonehenge, the archetype of prehistoric astronomy, has been shown to lie on foundations considerably weaker than those granted to it by the popular press, if not by the scientific community. This also should come as no surprise. Particularly in a young discipline, the temptation to bring a wide range of phenomena under the umbrella of a single coherent explanation is quite strong. The realm of ancient civilization is especially vulnerable to the over-extension of a particular hypothesis since little tangible evidence can be accumulated in counterpoint. In the absence of hard evidence, an idea which seems reasonable or is based upon popular preconceptions needs little circumstantial evidence to appear quite convincing.

The fundamental basis of archaeoastronomy lies on firm ground: clearly the sky has been a focal point of interest throughout time. A careful study of the subject will certainly yield fascinating insights into the past for some time to come. However, there are a number of pitfalls which must be born in mind if the disciple is to develop with a sound structure.

It is tempting, when studying cultures of the past, to view them in the context of the concepts and motivations which make sense to the modern mind. The rationalists' outlook upon the universe as a mechanistic, cause-and-effect system which can be subjected to analysis may seem to offer a comprehensive explanation of the practices of primitive people. However, those people were largely of a mystical outlook who perceived the world as working according to principles which would be quite alien to us. Their motivations would puzzle us, and our propensity for the detailed analysis and restructuring of our surroundings may well seem pointless from their viewpoint.

The ideal starting point from which to approach the problem posed by a cryptic artifact or practice lies within a through understanding of the ethnography of the people involved. Clearly, this is not available in many cases. When it is not, it is essential to bear in mind that our framework of ideas and motivations are historically quite young and may translate poorly into other cultures and times.

ACKNOWLEDGEMENT

The author is grateful to Pat Wendt for her remarks on the manuscript.

EATING ROCKS: PEBBLE CHERTS, FALL-OFF CURVES AND OPTIMAL DIET THEORY

By
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INTRODUCTION

During a tour of historical resource sites in the Neutral Hills of east central Alberta in July of 1986, we were shown a site our guide thought to be most peculiar. On the gentle slope of a small rise on the southern slopes of the hills, a round cut had exposed a site composed of chert pebbles. Our guide thought the site was unusual because only one artifact type appeared to be present in the assemblage - split pebbles. What he had discovered, of course, was a chert pebble quarry.

The discovery was not a new one, however; Quigg (1977, 1978) surveyed the area in 1976 and noted that sites in the region are dominated by "bipolar pebble technology." Quigg termed the phenomenon the "Neutral Hills Pebble Industry" (1977:58). While his observations were based for the most part on survey and surface collections, one "tipi ring" (camp) site (FbOr-57) was chosen for excavation. Over 81 percent of the assemblage from the site was found to be attributable to split pebble technology. A review of the composition of the surface collected material from Quigg's 1976 survey underlines the significance of the chert pebble raw materials in the Neutral Hills region.

CHERT PEBBLES IN THE NEUTRAL HILLS

Collections from 82 sites recorded by Quigg (1977) in the Neutral Hills and surrounding area were examined. To identify possible differences between the site assemblages, the region was stratified into four groups: the Neutral Hills, adjacent slopes, Nose Hill and the outlands (Figure 46). The collections from the sites located in these respective areas were then examined and described in terms of raw material type and artifact type. The information categories and data

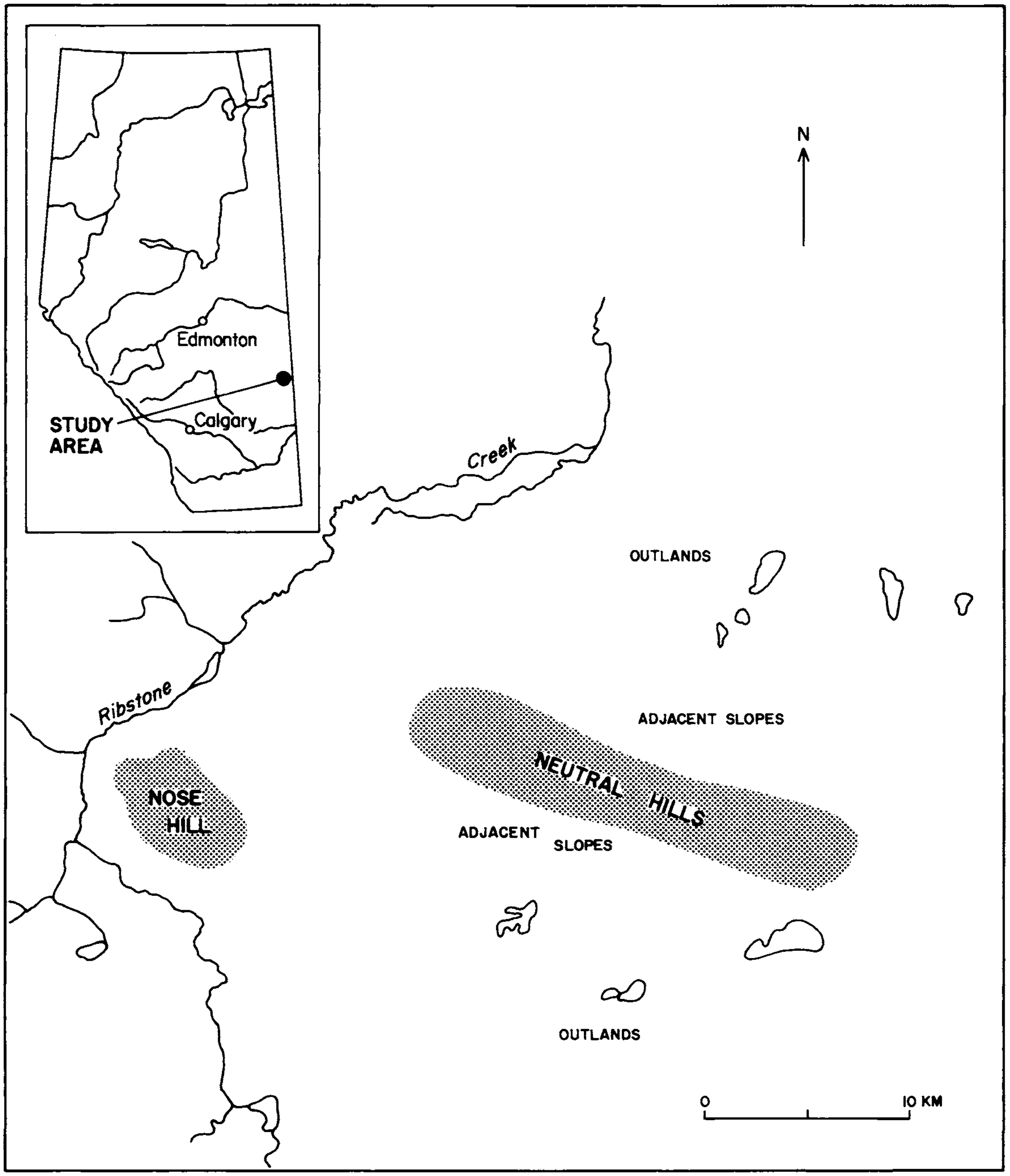

Figure 46. The Neutral Hills region showing the general locations of four study areas: the Neutral Hills, the adjacent slopes, Nose Hill and the outlands.

recorded are shown in Table 14. From these data, a series of graphs were made to identify general trends or patterns occurring between the combined assemblages of the different areas.

Plotting the occurrence of the two dominant raw material types (chert and quartzite) over the four areas shows the overwhelming predominance of chert over quartzite in the Neutral Hills sites and the gradual decrease and change to approximately equal proportions in the sites located more than 5 km from the hills (outlands; Figure 47). Figure 48 displays the proportions of chert split pebble detritus to quartzite in the sites within the different areas. While showing a trend identical to that in Figure 47, Figure 48 demonstrates the relative importance of the chert pebble as compared with quartzite as you move away from the hill quarries. Another interesting trend is displayed in Figure 49. The occurrence of split pebble chert debitage in the site assemblages decreases as you move from the Neutral Hills to the outlands, while concomitantly there is an increase in the proportion of tools (scrapers and projectile points). We must assume, of course, that the site assemblage samples we looked at are generally indicative of what is actually in the sites and that the collection methodology is generally correct (i.e., quarries are quarries and camps are camps). I think the patterns which result from the data support these assumptions, at least in a general way. Our total for chert pebbles - 77.5 percent of the total assemblage recovered from the camps in the hills proper - when compared to Quigg's (1978:19) total of 81.6 percent suggests relative congruence.

DISCUSSION

Of particular interest in the study of the presence and use pebble cherts in the Neutral Hills is the fact that the pebble cherts appear to be more highly regarded than the other raw material (quartzite), which likely is equally available and abundant in the area. Comparing the use of pebble cherts vis-a-vis quartzite and other raw materials in the Neutral Hills sites with sites in other areas of the province, we see a hint of the importance of this raw material and the bipolar technology in Alberta's prehistory. (Note also Reeves' identification of chert pebble

Table 14. List of site types, raw materials and artifact types from sites recorded in the Neutral Hills region of east central Alberta (from original survey data collected by Michael Quigg in 1976 [Quigg 1977, 1978]).

	NEUTRAL HILLS			ADJACENT SLOPES			NOSE HILL			OUTLANDS		
	Quarry	Camp	Total	Quarry	Camp	Total	Quarry	Camp	Total	Quarry	Camp	Total
Number of Sites	12	21	33	0	20	20	0	8	8	1	20	21
Assemblage Total	188	102	290		115	115		95	95	14	231	245
Raw Material - Pebble Chert	161	79	240		69	69		41	41	13	117	130
- Quartzite	27	23	50		41	41		51	51	1	114	115
Artifact Types - S.P. Core	116	40	156		56	56		26	26	10	40	50
- S.P. Flake	56	24	80		13	13		15	15	5	57	62
- Total Debitage	172	64	236		69	69		41	41	11	97	108
- Scraper					2	2		1	1		8	8
- Point		4	4		3	3		2	2		10	10

S.P. = split pebble

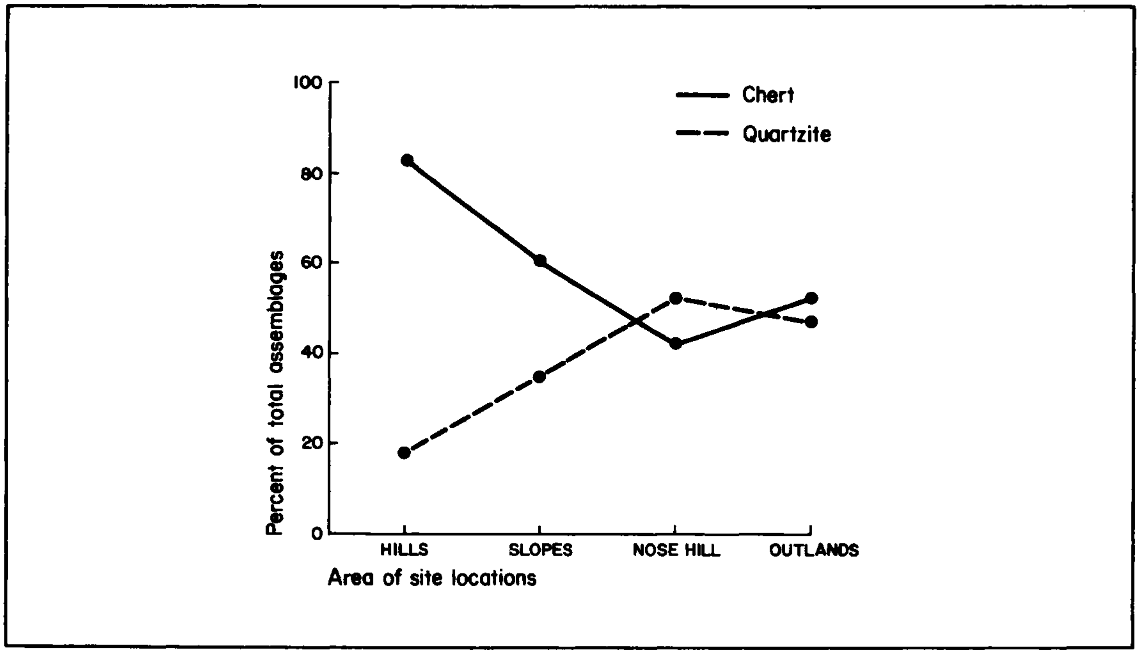

Figure 47. Proportions of chert and quartzite artifacts are shown to change relative to one another in sites located in the Neutral Hills study area. While the percentage of chert in the site assemblages decreases, the amount of quartzite increase as you move out from the Neutral Hills area to the surrounding outlands.

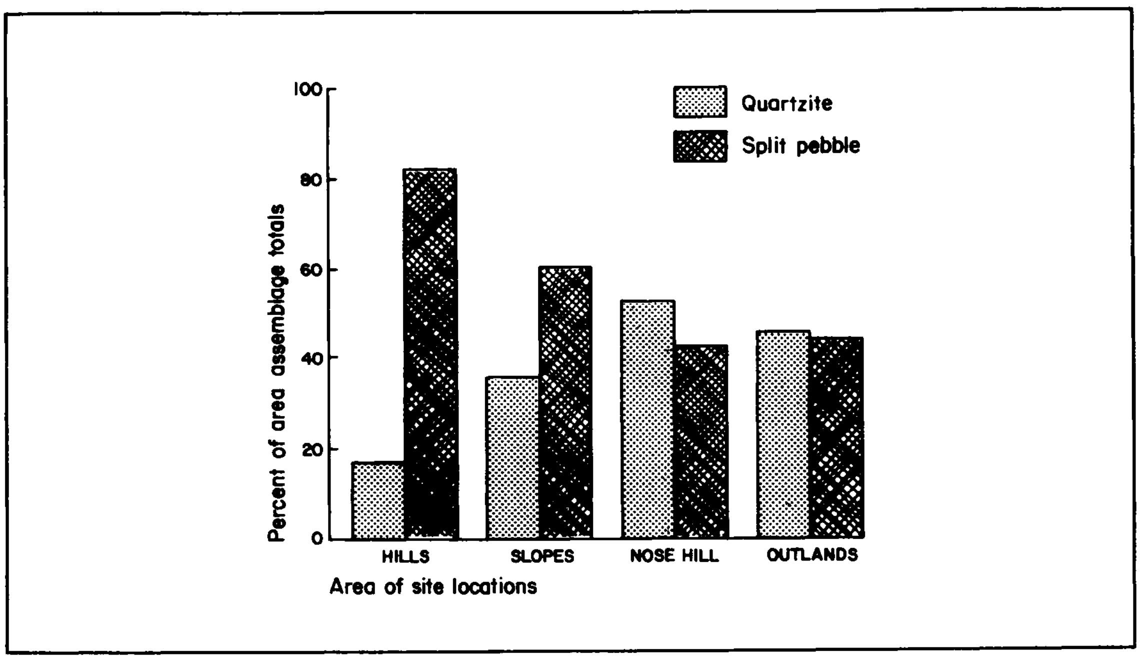

Figure 48. Proportion of split pebble detritus compared to quartzite detritus in sites recorded in the Neutral Hills study region. Note that while the percentage of split pebble detritus decreases as you move out from the hills into the adjacent outlands, the relative proportions are still relatively high.

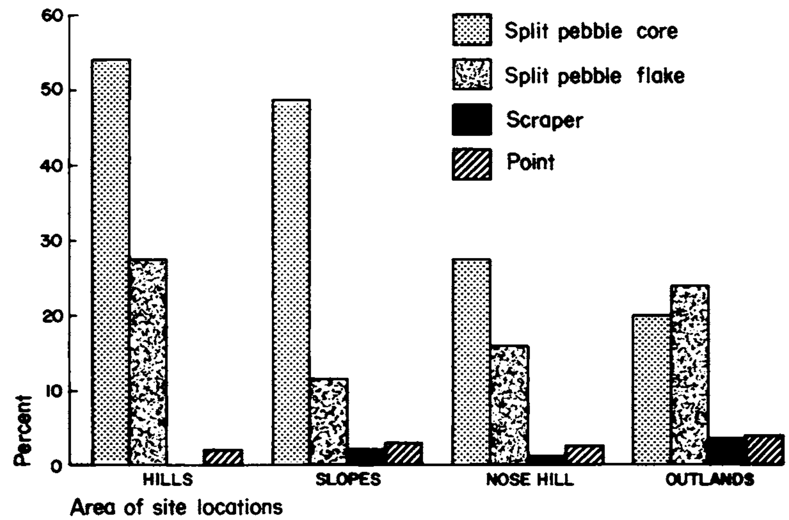

Figure 49. The proportion of split pebble detritus is plotted against the proportion of tools found in the sites in the four areas of the study region. Note the increase in the occurrence of tools moving away from the hills vis-a-vis the decrease in split pebble detritus.

utilization in Pass Creek valley, which he refers to as "Rundle Technology" [1972:110].) At the Strathcona site, located on the outskirts of Edmonton, Pyszczyk (1985) recorded that 26.5 percent of the tools recovered could be classified under the bipolar nomenclature; of these, 25 percent were bipolar split pebbles. In 1981, Driver et al. (1982) recovered bipolar artifacts from the Strathcona site that accounted for 27.8 percent of the total tool assemblage. The importance of bipolar technology and split pebble cores is also apparent in the materials recovered from recent excavations at Head-Smashed-In Buffalo Jump (Brink et al. 1985, 1986). In 1983, bipolar cores made up 81.6 percent of the total number of cores recovered and 20.3 percent of the total number of tools (artifacts sans debitage; Brink et al. 1985). In 1984, similar proportions were recovered: bipolar cores made up 86.5 percent of the total number of cores and 18.3 percent of the total number of tools. The proportions of chert to quartzite in the Head-Smashed-In assemblages for 1983 and 1984 are in the area of 32 percent for cherts and 41 percent for quartzite (Brink et al. 1985, 1986).

While chert and quartzite make up a significant portion of the assemblages of Head-Smashed-In and Strathcona, a variety of other raw material types are present as well. Thus, we have relatively high diversity (richness) of raw material types. This is at odds with the situation in the Neutral Hills where the raw material diversity (richness) is low. This pattern of low diversity is also present in the Athabasca River valley at the source area for Beaver River Sandstone (Ives and Fenton 1985:38). Assemblages near the source were observed to be composed of high, if not exclusive, proportions of Beaver River Sandstone. Not unexpectedly, the proportions decrease with a corresponding increase in distance from the source. A pattern emerges wherein the number of material types (NMT) found in any assemblage is dependent upon the absolute abundance of the preferred types. Thus, the total NMT decreases with an increase in the availability or abundance of preferred or highly ranked types. The obvious assumption being made here is that one raw material will be preferred over another. However, Reher and Frison (1980) argue that the richness of an assemblage may be due to the "mobility" and "residential dispersion" of groups.

> Assuming access to an uplifted area and to a roughly equal number and diversity of resources, differences in assemblage diversity should be due to differences in residential dispersion during the gearing-up season. Traveling in a centralized group and gearing up at one or a few main quarries results in low assemblage diversity. If gearing up is accomplished in the context of dispersed family units, high assemblage diversity results (1980:128-129).

While I would agree with Reher and Frison's observation that "superior" (highly ranked or preferred) materials were selected over lesser materials (1980:127) and that concentrating on "one or a few main quarries results in low assemblage diversity," I would argue that assemblage diversity (richness) is first a function of relative abundance of preferred types regardless of the nature of group size and mobility. In actuality, these latter factors of group size and mobility complicate the equation somewhat and should be considered in addition to the abundance of material types. The NMT present in an assemblage is dependent upon the availability of preferred materials.

Renfrew (1977) discusses the pattern of decreasing abundance of a commodity with increasing distance from source under the rubric of the "Law of Monotonic Decrement," which simply put says that the frequency of occurrence of an item declines with increasing distance from the source. Hodder (1974), Sidrys (1977) and others have explored some of the properties of such distributions through regression analysis.

The focus of the discussions by researchers such as Renfrew (1977), Hodder (1974) and Sidrys (1977) is on trade and exchange of items from a single source. However, raw material types commonly used in Alberta are more homogeneously distributed. With the exception of unique situations such as the Neutral Hills pebble cherts and the Beaver River Sandstone source area, raw materials such as quartzite are readily available in the many stream bed and till outcrops throughout Alberta. While trade and exchange of exotic items such as Knife River Flint and obsidian occurred, selection and utilization of most material types for everyday use likely was dependent upon abundance of known, locally available types. Thus, the process of acquisition is more closely related to foraging than to dependence upon trade and exchange.

If it can be assumed that the user was aware of the relative properties of the various raw material types available to him or her with respect to the job at hand, it can be assumed that some materials would be ranked over others. The model which follows this process of selecting raw material types is contained most closely in Optimal Diet theory (see Charnov 1976; MacArthur and Pianka 1966; Pyke et al. 1977; Sih 1979). Like our assumption above that the user is notably familiar with the material types available to him, the model of optimal diets assumes that "a predator has perfect knowledge of available resources [to make the rankings]" (Hespenheide 1980:74). The properties of optimal diet which are of interest here are as follows:

(1) whether or not a food type should be eaten is independent on the abundance of that food type and depends only on the absolute abundances of food types of higher rank. So, in theory, an animal should never specialize on a "less preferred" food type regardless of its abundance.

(2) in general, as the abundance of a preferred food type included in the diet increases, the number of less preferred food types included in the optimal diet will

shrink. In other words, increasing food abundance should lead to greater food specialization. And, in particular, as the abundance of an item included in the optimal diet becomes infinitely large, all food items of lower rank are dropped out of the diet.

(3) a food type is either completely included in the optimal diet or completely excluded from it. In other words, if a food type is included it should be eaten whenever encountered, and if excluded it should never be consumed. Hence, animals should never exhibit "partial preferences" (Pyke et al. 1977:141).

One of the important patterns which Hespenheide (1980:75) notes is that the effect of reducing the absolute densities of highly ranked items is to enlarge the optimal set of items (Hespenheide 1980:75).

> . . . if the densities of prey items . . . are normally distributed . . . the resource diversity of optimal diets will normally be intermediate in size. If predator population density is relatively low . . . prey abundance will be high relative to predator needs, and optimal resource diversity of predator diets will be low. As population size of the predator increases, both relative and absolute densities of preferred items . . . decrease and the optimal resource diversity expands (Hespenheide 1980:75).

In the archaeological record it might be expected that human populations increase over time, and that over time group populations become more familiar or restricted to one region. Our analogy thus would see the assemblages of early populations exhibit low diversities of preferred material types and later assemblages display greater diversity. One of the limiting factors in this proposition may involve the accumulation of greater knowledge of the resource base over time. The idea is that early populations would have been less knowledgeable of the potential of their surroundings and therefore less likely to access or utilize the full complement of available resources.

Models which describe the distributions of raw materials in the archaeological record remain scarce. Examples of studies which describe patterns of trade and exchange are more often than not restricted to unique or highly visible exotic items (Hodder 1974; Sidrys 1977). Patterns and models of the more common, everyday, utilitarian lithic resources, are less well known. In this descriptive report, the optimal diet model is proposed as a means of describing patterns of lithic raw material utilization. The optimal diet model is one of several models subsumed under a body of ecological theory known as optimal foraging theory. Recognizing that there are and will be limitations to the applications of foraging models, the identification of patterns in the archaeological record which conform to or may be described by optimal foraging models is nevertheless encouraging.

> Demonstrable regularities conforming to mathematically simple forms are still disappointingly few in archaeology, and their analysis raises new and interesting questions. For there is hope that many archaeological distributions from different times and places, and entirely independent in the circumstances of their formation, can be expressed in this way. If it is the case that these distributions share basic, simple properties, the same may be true also for the processes generating them. And the understanding of these cultural processes is the ultimate goal of our investigation (Renfrew 1977:73).

THE TRIANGULAR PROJECTILE POINT IN PLAINS PREHISTORY: A PREFORM TRADE HYPOTHESIS

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INTRODUCTION

Head-Smashed-In Buffalo Jump in southwestern Alberta is one of the largest and most extensively studied jumps in the northwestern Plains. Excavations in the deeply stratified kill site deposits in 1965, 1966 and 1972 revealed a sequence of site use extending back more than 5,500 years (Reeves 1978, 1983b). Additional studies of the butchering/processing area below the kill by the Archaeological Survey of Alberta from 1983 to 1986 have added substantially to the lithic artifact sample (Brink et al. 1985, 1986). The artifact inventory of the kill site deposits is dominated by the occurrence of stone projectile points. More than 3,000 point specimens account for over half of the recovered lithic assemblage. Reeves (1978, 1983b) has observed that the principal lithic materials used to make these points were obtained from a variety of distant sources, including Palaeozoic cherts from sources in the Rocky Mountains of Alberta and British Columbia; Madison Formation cherts from Montana; obsidian from the Yellowstone area; Kootenay argillite from British Columbia; and Knife River Flint from North Dakota. Subsequent investigations indicate that Swan River Chert, possibly derived from Saskatchewan, is also an important part of the assemblage (Brink et al. 1985, 1986). The considerable distance from which many of these materials were derived (approximately 1000 km in the case of Knife River Flint) suggests that trade was a means by which some of these raw materials must have been obtained.

Traditionally, most archaeologists have argued that exotic raw materials were obtained through trade and that the production of the finished artifacts was presumably completed by the people who imported the raw materials. However, recent analysis of the lithic assemblage from the processing area at Head-Smashed-In revealed that on-site reduction of these materials was minimal (Brink et al. 1986; Dawe 1987). In addition, an important component of the Head-Smashed-In processing area assemblage is a distinctive point preform completely formed except for the notches. This paper will argue that these projectile point preforms, fashioned from imported exotic raw materials, may well have been obtained through trade in their essentially completed form. That is, not only were these preforms not manufactured on site, but they were also not fashioned locally from imported blanks of exotic raw materials.

Projectile point preforms compose a significant component of the Head-Smashed-In assemblage. Of the 758 points recovered from the processing area, 85 (11.2%) are classified as preforms. The great majority of these were crafted from exotic raw materials. Triangular point preforms would have been a logical component of a tool kit brought to communal kill sites, as such artifacts could have been notched on site to retip arrows broken during the operation of the buffalo jump. Indeed, Reher and Frison (1980) have argued that communal bison kills, by virtue of being well-planned events, would be characterized by prepared and curated tool kits intentionally brought to the site in anticipation of expected needs.

The suggestion that preformed points were manufactured at distant quarry sources and traded in their notch-ready form has major implications for the assumptions behind the formulation of Plains point typologies. As well, the long-distance trade of completed preforms calls into question the use of projectile points as indices of ethnic or tribal affiliation and raises issues pertaining to the sources of high quality lithic materials. The following discussion will explore both the rationale and implications of projectile point preform trade in the Late Prehistoric Period.

LITHIC REDUCTION AT HEAD-SMASHED-IN

At Head-Smashed-In, the locally available lithic materials are characterized as coarse grained with poor conchoidal fracture. Fine-grained materials are available only from sources quite distant to the site. A dichotomy was observed between those projectile points made of local or regionally available materials and those made of exotic materials. Projectile points made of local materials tend to be poorly manufactured, usually by the marginal retouch of flakes obtained from small bipolar cores. The reduction debris of local material is represented by all stages of the manufacturing process, including bipolar cores and primary, secondary and small tertiary debris. It appears that projectile points made of local materials were expediently produced on site.

On the other hand, projectile points of exotic raw materials are typically well made. However, the raw materials are rarely represented in the debitage assemblage by anything other than very tiny tertiary debris. Obviously, projectile points and point preforms of exotic materials were made elsewhere and brought to the site in finished or nearly finished form.

THE TRIANGULAR PROJECTILE POINT AS A PREFORM

Unnotched, triangular arrow points have been recovered from the campsite or processing area associated with virtually every investigated Late Prehistoric communal bison kill but rarely from the associated kill site deposits themselves. Characteristics of unnotched, triangular points from Head-Smashed-In and numerous other Late Prehistoric sites indicate that these are notch-ready points with no hafting modification, no basal grinding and no use wear. With the addition of notches, the points would be ready to use.

The large number of point bases in the processing area at Head-Smashed-In (approximately a 2:1 base to tip ratio) indicates that frequent retipping of arrows was taking place. Such retipping or retooling can be regarded as a normal consequence of the high breakage incidence and short tool use lives of hafted tools (Keeley 1982) and can account for the need to have replacement preforms available in some quantity. An example that illustrates a desire to have such preforms at hand for insurance might be provided at the Braden burial site (see Muto 1971). Of 152 triangular dart (?) points recovered, only two were notched; the others were interpreted as being blanks or preforms from the final stages of reduction. The specimens illustrated by Muto could be interpreted as a good supply of preforms to accompany the deceased on his long journey.

Unnotched, triangular points are now generally regarded as projectile point preforms by Plains archaeologists (see Fredlund 1981). The occurrence of preforms at Plains sites has often been interpreted as evidence of on-site manufacture (e.g., Fredlund 1979; Frison 1973:64). Examination of the debitage at Head-Smashed-In indicates that there is little evidence to support on-site manufacture of either the arrowheads or preforms from exotic materials. Preforms may have been transported to the site in a notch-ready stage as a contingency measure to ensure a supply of replacement tips in the event of point breakage. Since the raw materials from which these preforms and projectile points were made came from widespread and distant sources, it seems reasonable to postulate that they were obtained through trade.

If trading of projectile points did occur, it would seem practical to trade preforms rather than finished arrowheads. Preforms might be less prone to breakage than a notched point, but more importantly an unnotched form would provide more flexibility for notching the point specifically to fit the shaft. Arrow shaft parameters were likely not of universal dimensions, and pre-notching a point before the actual time of hafting could severely restrict the success of integrating the point with the shaft. Grinnell (1923:178) observed an acute awareness by the Cheyenne arrow makers to precisely proportion their arrows.

> There was a great difference in arrows, and it was essential for the best work that the shaft should be properly proportioned. The proportions between the shaft, head, and feather were quite definite, and if these were preserved the arrow did excellent work; otherwise it was a failure.

Other factors which would encourage the importation of notch-ready preforms to Head-Smashed-In, and which could presumably apply to other Plains communal bison kills, include a lack of suitable local materials for the manufacture of projectile points, a high demand for the quick replacement of broken or exhausted tools, and the inefficiency of transporting raw material in bulk form.

Although, the suggestion that unnotched, triangular points are preforms is not new, archaeologists have failed to consider the possibility and consequent implications of preform trade. Projectile point morphology is usually regarded as a compromise between an idealized intended form, or "mental template," and idiosyncratic variation introduced by the lithic craftsman. Frequently cited sources of introduced variability include raw material constraints, the skill level of the manufacturer, functional requirements, and cultural variables. However, projectile point morphology is assumed to be primarily the result of attributes imparted by the users of the point.

If preform trade occurred, particular attributes would be introduced at different stages of the manufacturing process. Base and blade edge configurations would be developed at the time of preform manufacture, whereas notching characteristics would be imparted at the time of notching and retooling. What happens, therefore, to the typological placement of an artifact that has crossed two or three cultural/ technological boundaries?

THE CASE FOR TRADE

The possibility of projectile point trade has seldom been considered in assemblage analyses. The presence of exotic lithics from distant sources at communal bison kill sites has led Reher and Frison (1980) to suggest that materials were acquired by direct access to stone quarries. Furthermore, they believe the relative amounts of exotic materials at a particular site could be used to provide a mobility index (Reher and Frison 1980). They discount trade as a likely means of lithic raw material acquisition on the Plains but offer no good evidence to support that opinion.

Unfortunately, there appears to be little direct ethnographic or historic documentation to support the idea of point preform trade. By the time most ethnographers had arrived on the scene, metal points of European origin had already replaced lithic points from the aboriginal tool kit. Ewers (1958:70), for example, notes that ". . . elderly Indians born in the 1850s could not remember the use of stone arrowheads. . . ." The trade of metal points in Protohistoric times provides an analogy for what may well have been an earlier trade of stone counterparts. There is some evidence to suggest that trade of arrows occurred (Driver 1975:172). As well, one finds occasional references to the ceremonial exchange of bows and quivers of arrows. David Thompson was the recipient of such a gift presented by a Kootenay chief (Hopwood 1971:218).

The case for trade of projectile points and preforms also implies a certain degree of craft specialization and the control of desirable lithic sources. That arrowhead-making duties were the lot of skilled flint-knappers is a common theme in ethnographic accounts.

> Considerable skill was recognized in chipping the flint to be used for knives as well as for arrow points. Old men were often requested to prepare such blades and points for others (Honigmann 1946:52).

Relegation of difficult flint-knapping duties to elders may have been a recognition of their enhanced skill at this task, as well as a means to ensure their continued participation in the group. Grinnell (1923:178) writes that the manufacture of arrows by at least one group of Cheyenne was the work of an elder craftsman. In this case, however, it is apparent that he actually sold his produce in lots.

> The old-time arrow makers always made arrows by tens, and those of each ten were the same; thus each man bought his arrows in tens and all were alike.

As mentioned above, projectile points recovered at Head-Smashed-In are often extremely well made (especially the Avonlea points), but such fine examples are rarely executed in local stone. The implication is that tools were manufactured not just by craftsmen but by specialists who resided in the area in which the raw material was obtained. It might be speculated that the craftsmen living near such a source area could actually control the distribution of that resource by deliberately manufacturing point preforms for the purpose of trade.

THE EVIDENCE FROM HEAD-SMASHED-IN

If projectile point preforms were in fact obtained through long-distance trade and brought to Head-Smashed-In, rather than manufactured on site or in the site vicinity, the following propositions should apply to the lithic assemblage:

(1) Unnotched, triangular preforms should be represented in the assemblage.

In four years of excavation in the processing area at Head-Smashed-In, a total of 758 projectile points and point fragments were recovered. Of these, at least 85 (11.2%) are unnotched, triangular to slightly ovate preforms. No use wear or grinding is apparent on these. With the addition of notches, these points could be considered complete (Figure 50c).

(2) There should be a lack of primary and secondary reduction debris of the exotic lithic materials from which these preforms were manufactured.

At Head-Smashed-In, the debitage of these materials is characteristically small and appears to represent rejuvenation or notching. Cortex on this debitage is rare. Tool blanks, cores or core shatter of these materials are virtually absent (Brink et al. 1986; Dawe 1987).

(3) Evidence of manufacturing breakage on unfinished arrowheads should be the result of notching failure.

Several preforms recovered at Head-Smashed-In do appear to have been broken by a transverse fracture initiated from a single notch. One Knife River Flint preform (Figure 50d) is of particular interest as it apparently broke upon completion of the first notch and was then discarded. No edge grinding or use wear is evident on this specimen.

(4) Projectile points of roughly contemporary age and made of a specific exotic material would tend to share similar attributes excluding those associated with notching.

Given contemporaneous assemblages, there should be less observed variation of preform characteristics among specimens from specific quarry sources than is evident between points manufactured from lithic materials obtained from different quarries. The largely unstratified nature of the Head-Smashed-In processing area assemblage makes evaluation of this postulate difficult. However, in general it was observed that points of any given type manufactured from similar exotic raw materials showed more overall morphological similarity than was observed of projectile points of different raw materials. Figure 50 shows a broken finished point, (Figure 50b) complete with notching and basal grinding, compared with an unnotched preform (Figure 50a) broken by snap fractures. Aside from the

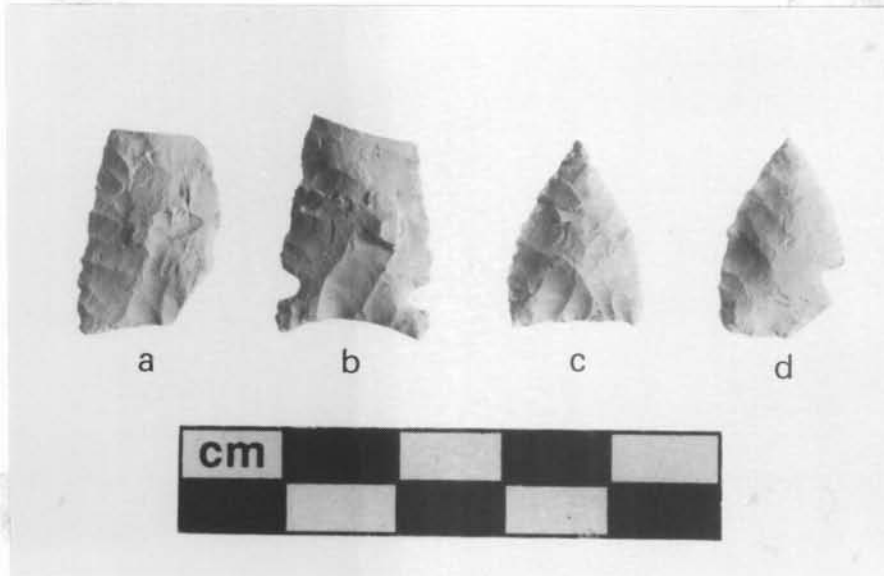

Figure 50. Sample of projectile points from the processing area at Head-Smashed-In Buffalo Jump. Projectile point preforms - a and c; Avonlea projectile point - b; unfinished projectile point - d.

notches and grinding, these points are identical in every respect. Both are of the same peculiar, imported chert, and the flaking characteristics are so nearly duplicated that one suspects they were made by a single craftsman.

(5) Contemporary projectile points made of lithics from different quarries would tend to have different planform characteristics but similar notching characteristics.

The Head-Smashed-In data have not been sufficiently quantified to support this contention. However, a projectile point sample obtained from the Vore site includes materials from three principal and equally quite distant sources. Although the overall dimensions of these were observed to be different, some similaritiy was observed of the notching dimensions (Reher and Frison 1980:105, 107).

If we can assume that there was a trade of projectile point preforms, there could be an expected bimodal aspect to morphological variation in a projectile point sample based on observations of the preform design and notching characteristics. Variability represented at the preform stage should be raw material specific, and, at any particular time, the preform characteristics of common materials might reflect similarities over the entire range of their distribution. Notching characteristics, if imparted by the end-user, would exhibit similarities regardless of the raw material used and could be expected to be both temporally sensitive and spatially discrete. However, to date Plains point typologies and analyses rarely have considered morphological variation within and between projectile point samples of disparate raw materials, with few exceptions (e.g., Reher and Frison 1980).

ETHNICITY

Most of the excavations at communal bison kill sites in the last three decades have focussed on examination of the kill site deposits. A major reason for excavation of such deposits was to obtain temporally diagnostic projectile points in stratified contexts to enable the formulation of regional chronologies. The basis for such chronologies was the establishment of projectile point seriation based on changes in formal variation through time.

In 1958, MacNeish differentiated Plains and Prairie Side-notched point types in his typology of Late Prehistoric arrowheads (MacNeish 1958). Observed covariation of certain attributes of these types led to the further elaboration in the typological schemes of Forbis (1962, 1977) and Kehoe (1966, 1973). The value of the point typologies as chronological indices has been demonstrated at those sites where the typologies were formulated, but other attempts to use them have met with variable results, from confirmation (see Vickers 1986) to criticism (see Fredlund 1981; Whelan 1976).

Fredlund (1981:74) suggests that, as the database of Late Prehistoric Period sites increases, the validity of the typologies of Kehoe and Forbis fail to be corroborated. A probable explanation of why these typologies show variable applicability is that they are too often applied out of the context of the lithic reduction system in which they were devised. Moreover, the issues of the validity of a particular typology rarely address the fundamental assumptions upon which they are based - that projectile points convey signals of ethnic affiliation and that the style expressed is necessarily regarded as emblemic (after Wiessner 1983) of the user group. Furthermore, projectile points are often assumed to convey ethnic identity apparently because their elaborate form has been interpreted as evidence of long use life and, hence, curation. Coupled with an extremely high archaeological visibility of this artifact type, arrowheads have achieved an archaeological significance that probably overemphasizes their prehistoric value.

Although Forbis (1962, 1977) used his typology of Late Prehistoric points to provide a seriation of chronologically sensitive points, others inappropriately assume that a typology with demonstrable temporal sensitivity must also be culturally sensitive. In other words, morphologically similar sets of points occurring in a defined region during a relatively restricted period of time are believed to be indicative of a particular ethnic group. Claims for ethnic affiliation of specific point types abound in the literature (e.g., Greaves 1982; Kehoe 1973; Reeves 1983a).

One reason for believing that Late Prehistoric projectile points are good carriers of emblemic style is that points are assumed to have been highly curated and maintained. For example, Fawcett states:

> It is assumed that a great deal of effort was expended manufacturing and maintaining projectile points. As a result, they have a long tool use life or curation rate (1980:8).

Although projectile points were highly curated in the sense that they were often transported over considerable distances and were not be discarded until broken, care must be taken not to confuse curation with a long use life. David Thompsons' observations in the late 1700s indicate that the use life of stone arrowheads was short. In reference to the arrowheads used by the Snake Indians, Thompson noted that "they were all headed with a sharp, smooth, black stone (flint) which broke when it struck anything" (Hopwood 1971:193). The delicate nature of arrowheads is again indicated with reference to the Kootenay.

> . . . their only arms were a few rude lances, and flint-headed arrows. Good bowman as they are, these arrowheads broke against a shield of tough bison hide, or even against thick leather could do no harm; their only aim was the face (Hopwood 1971:261).

Similarly, the Peigan chief, Kootenae Appee, complained to Thompson about the effectiveness of stone arrowheads on grizzly bears: ". . . our arrows were headed with stone, which broke on them" (Hopwood 1971:269). Moreover, Thompson keenly observed which individuals and groups were in possession of metal ("ironshod") arrowheads as opposed to stone points, as well as the relative numbers of these in each quiver. The more durable metal points were observed to be clearly the superior medium, and those who were in possession of these had a definite advantage over those who were not. The frequent bother of retipping stone points made them economically undesirable once metal points became available.

The evidence suggests that, in terms of their use life, arrowheads were extremely expedient tools, often used only once, broken and then discarded. This probably explains the incredible numbers of arrowheads recovered at Head-Smashed-In and other buffalo jump sites. If arrowheads were viewed as having short use lives, it seems difficult to believe that a great investment in signalling ethnicity would have been lavished upon these artifacts. It can be argued that arrowheads were not intended to convey ethnic identity, rather the variation expressed may have been merely conventions of habit. When emblem and ownership were important, as among the Cheyenne for example, such was imparted to the arrow by painting the shaft (see Grinnell 1923:183). Similarly, Ewers (1958:122) observed of the Blackfeet:

> Arrowmakers could tell their finished products by minor differences in construction, as well as by the number, widths, and colors of painted stripes under the feathering.

Not only did the shaft surface provide more latitude than the point for design, but the shaft would have the added benefit of longevity. The great investment in time required to make a shaft would enhance the likelihood that it would be curated.

> Men always gathered up their arrows, devoting much time to searching for them and trying never to lose one. They were too hard to get and cost too much effort to be wasted (Grinnell 1923:178).

Therefore, if any intended signalling of ethnic affiliation occurred on the arrow at all, design features imparted to the shaft would appear to have been the best means to convey such identity. The features on the point which are regarded in Plains point typologies as the most likely to convey style occur at the notched area near the base. However, this portion of the artifact would be largely obscured upon hafting. Given the short use life of arrowheads and the near invisibility of their most unique features when hafted, it seems unlikely that the projectile point was ever intended to play an emblemic role.

CONCLUSIONS

Recent excavations at Head-Smashed-In Buffalo Jump in southwestern Alberta have provided a large inventory of Late Prehistoric projectile points. Attempts to classify the points using typologies established for the northern Plains met with only marginal success (Brink et al. 1985:105). It may be inappropriate to apply typological formulae developed at other sites to describe the morphological variation of the Head-Smashed-In sample. The analysis of the lithic assemblage from Head-Smashed-In suggests that there is a need to evaluate each assemblage in the context of site specific environmental and cultural factors (Brink et al. 1986:172; Dawe 1987). It is necessary to view point typologies in the context of the total lithic reduction sequence at each site.

At Head-Smashed-In, the absence of locally available, fine quality lithics which would have been required to replace broken arrowheads appears to have resulted in the importation of exotic materials in the form of finished projectile points or point preforms. The Head-Smashed-In assemblage is characterized by a multitude of arrowheads of exotic materials, but there is very little evidence of primary or secondary reduction of these lithic types. It is evident that projectile points were often brought to the site in the form of notch-ready preforms and that those made of exotic materials may represent imports obtained by trade. Notching was done on site at the time of retooling to fit particular design requirements of the haft and perhaps to satisfy idiosyncratic preferences.

Stone projectile points should be regarded as expedient tools having short use lives. The large numbers of unnotched, triangular point preforms often noted in campsites associated with communal bison kills may reflect a frequent pattern of retooling as a result of the breakage of points at such kill sites. The trade of projectile point preforms may have been a regular means of acquiring replacements for broken points where the materials for the manufacture of such were not available. Projectile point preforms might be viewed as something of a commodity in the Late Prehistoric Period. Formal variation of projectile points may reflect stages of manufacture attributable to different cultural groups. An assemblage containing such forms may be interpreted erroneously as being representative of the distribution or affiliation of a single ethnic unit. This possibility has been overlooked in the analysis of Plains lithic assemblages.

The arguments presented above are not intended to be a compelling demonstration that notch-ready projectile point preforms were the object of trade in the Late Prehistoric. However, there is sufficient evidence to warrant serious consideration of this hypothesis due to its important implications for Plains point styles, ethnicity, trade and craft specialization.

ACKNOWLEDGEMENTS

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ENVIRONMENT CANADA, PARKS, ARCHAEOLOGY IN ALBERTA, 1986

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INTRODUCTION

The Archaeological Research Services Unit of the Western Regional Office of Environment Canada, Parks directed a total of 115 projects during 1986. Of interest in this discussion are 88 projects which related to national parks in Alberta. These projects included 44 Archaeological Resource Impact Assessments (ARIAs), four projects involving monitoring, two mitigative excavations and 38 special projects (Table 15). As has been the case in previous years, a number of projects (21%) were completed under contract. A total of 154 new sites were recorded in the Alberta parks during 1986, and 35 previously recorded sites were reassessed (Table 16). This paper consists of brief summaries of the investigations and results of major projects carried out in 1986. Some special projects not discussed in detail, but worthy of note, are briefly mentioned below.

During 1986, the Archaeological Research Services Unit began developing a computer-based informational management system. This project, including the entry of management data, will continue in 1987. A number of in-house projects in the areas of planning, collections management and storage were also completed in 1986. A contract for the organization of historic period collections (Anna Curtis) and another concerning administration and organization of records, reports and library materials (Kathy Dilts) were also initiated. A final comprehensive faunal analysis of Jasper House materials by Carlann Thomas and Gwyn Langemann and a dendrochronological study of the Jasper area by Forintek Canada were administered in a contract basis. Susan Langley of the University of Calgary carried out underwater archaeological studies at Waterton Lakes National Park. Finally, during the 1986 field season, a successful volunteer fieldwork programme was initiated. Volunteers in

Alberta parks were either university students or graduates in anthropology/archaeology and gained practical experience in a wide variety of field situations. A list of all Alberta projects and researchers is given in Table 15. All projects under the financial management and administrative responsiblity of the Head of Archaeological Research, Planning and Development Division.

Results from all projects will appear in one or more of the following: unpublished in-house manuscripts, external publications, or one of Environment Canada, Parks' three publication formats - the Microfiche Report Series (MRS), Research Bulletin series, or Studies in Archaeology, Architecture and History. Access to or information on these reports can be obtained from the Archaeological Research Services Unit, Calgary.

Banff National Park Field Programme, 1986 (Daryl Fedje and Alison Landals)

A number of different projects were undertaken in Banff National Park in 1986, including Archaeological Resource Impact Assessments (ARIAs), mitigative excavations and monitoring. Projects were completed both in-house and on a contract basis.

The most extensive fieldwork was related to the twinning of the Trans-Canada Highway. Portions of the Norquay site, 156R (EhPv-15), were scheduled for impact during the landscaping of the Norquay Interchange and, thus, required additional mitigation. A small crew carried out excavations during a six week period in the summer of 1986. Investigations were directed towards examination of an undisturbed component below Mazama Ash which contained a large quantity of lithic remains, including many exotic material types. Although a great deal of debitage was present, no diagnostics were recovered.

Prior to construction of the wildlife fence through the Eclipse site, 62R (EhPv-14), a series of shovel tests were excavated along the surveyed fence line. One test revealed the presence of a previously unrecorded component at the site, well below the Mazama Ash level. A very limited one week excavation in the area of the find revealed a considerable quantity of lithic material from a well-defined Early

Prehistoric component. Two relatively complete points and four fragmentary specimens were recovered. These are classed as Early Stemmed points. A report on the results of the Norquay site and Eclipse site excavations will be completed in 1987.

A total of 23 ARIAs and monitoring projects were undertaken in Banff National Park in 1986. Most were relatively minor in extent, involving assessment of linear developments (such as roads and trails) or areal developments (such as hotel and campground expansions). Two sizeable ARIAs were done under contract by Bison Historical Services: the Banff Townsite Peripheral Land-use Study and the Cascade Borrow Pit expansion. These studies resulted in the recording of one palaeontological, 23 prehistoric and six historic sites. Another ARIA of note was completed in response to the proposed expansion of the Banff Springs Hotel golf course. An intensive foot survey and shovel testing programme was implemented in the golf course area, resulting in the discovery of 12 previously unrecorded sites. Intensive visual reconnaissance, shovel testing and excavation of a test trench in the area of a pit-house site 356R (EhPv-12), first reported by Harlan Smith in 1913, demonstrated that the pit-house features have been either destroyed or covered over by road and fairway construction. Shovel tests in the area revealed many lithic artifacts; however, these could not be definitely attributed to the pit-house occupation. Since golf course expansion will not entail further land modification in this area, additional investigations were not warranted.

In addition, a two-person crew spent approximately two weeks on a programme of preliminary assessment of various cultural resources in the Bow and Red Deer river valleys. At site 362R (EhPw-3) in the Bow River area, a single house pit was tested. In the Red Deer River valley, two sites with associated cultural depressions were examined. At site 418R (EkPx-4), ten cultural depressions were located, two of which were subjected to preliminary testing. At site 1214R (EkPx-13), one depression was encountered. A quantity of bone and a few lithic items were recovered from features at each of these sites. Bone and charcoal samples have been submitted for radiocarbon dating. During this programme, a tipi-ring site, 1324R, was also discovered in the Big Horn Creek area of Ya-Ha-Tinda Ranch.

Archaeological Resources Data Recording and Compilation (Kevin Montgomery)

Last year's reorganization of the Western Region's archaeological resource inventory system has proved to be successful in improving management of the data, as well as the resources themselves. However, the greater demands placed on inventory data as a result of this reorganization have revealed several inadequacies in the basic data collection procedures. A rapidly growing inventory and increased management concerns relating to archaeological resources have produced a need for greater standardization and objectivity in the archaeological data. In response, a new field recording procedure and a new special purpose field recording form for Western Regional archaeological resources have been developed and are currently in the review stage. The recording system is based on a multiple choice format designed to maintain consistency and allow for efficient computer data entry and also to provide the basis for establishing a comparative site significance rating system over the next fiscal year. The Environment Canada, Parks, Western Region Archaeological Site Data Inventory Form was developed in conjunction with a comprehensive guide to archaeological resource recording, in general, and the new inventory form, in particular. It is hoped that this manual will abolish any uncertainties and simplify the task of recording an archaeological site.

A related project is the development of a manual establishing guidelines for the management of archaeological resources within parks. This document will serve as the blueprint for producing Archaeological Resource Descriptions for each national park in the aim of promoting increasing park involvement in the management of these resources.

Jasper National Park Field Programme, 1986 (Rod Pickard)

A number of different projects were undertaken in Jasper National Park in 1986, including ARIAs, regional inventory, research excavations and a mitigative excavation (Figure 51). These projects were implemented both in-house and on a contract basis by a number of different researchers (Table 15).

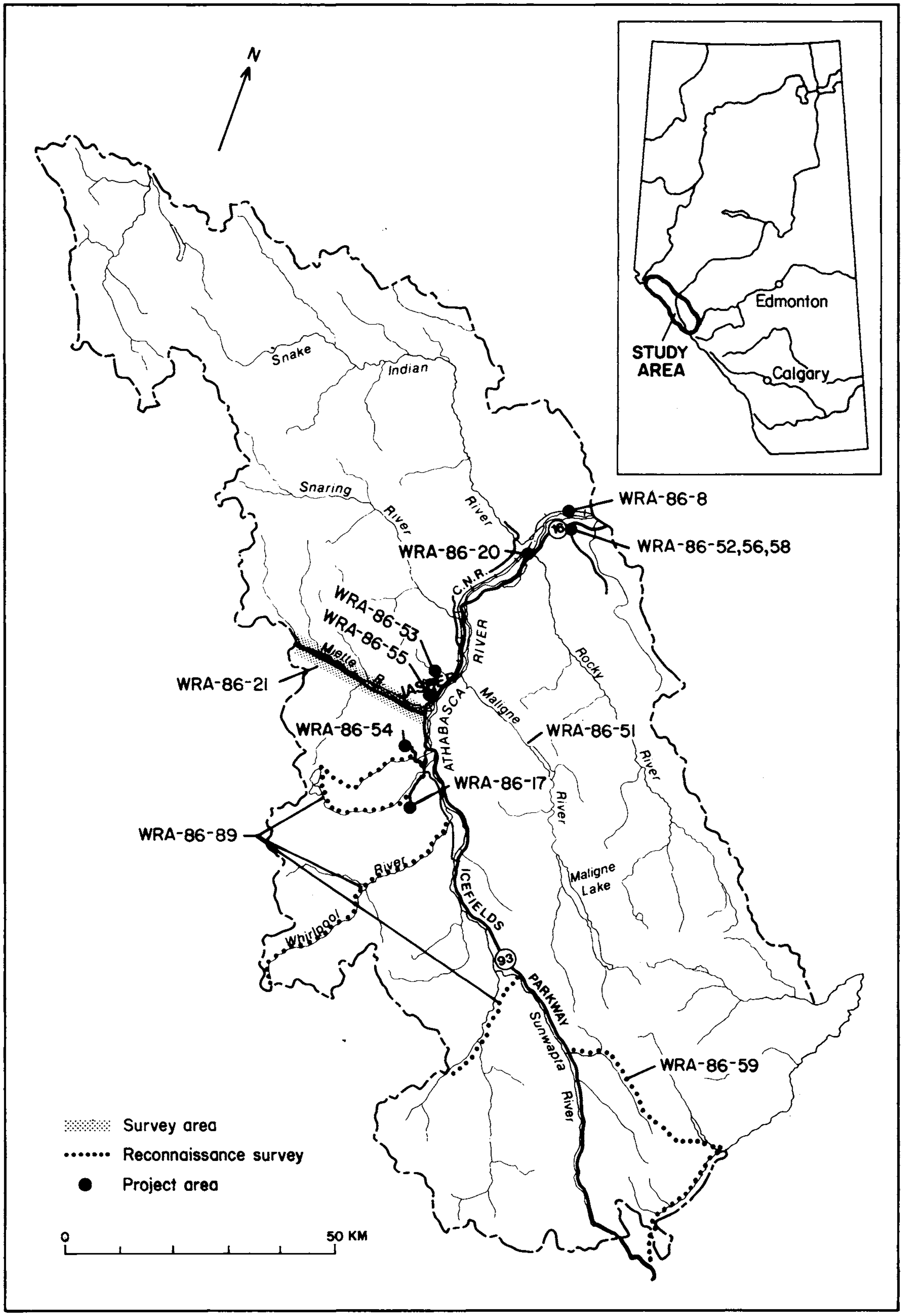

Figure 51. Locations of 1986 ARIA and survey projects in Jasper National Park.

The third and final year of historical resource inventory saw the completion of the Miette River section of the Yellowhead Corridor from Jasper townsite to the Yellowhead Pass. A total of 71 sites were recorded, relating primarily to the Grand Trunk Pacific and Canadian Northern railways. Other historic sites included structures and features associated with a graphite mine, outfitters' camps, cairns, a grave and numerous dumps. In contrast to the area from Jasper Townsite to the East Park Gate, only 12 prehistoric sites were recorded within the 1986 study area; five of these were isolated finds. The Jasper Historical Resources Inventory was designed to locate and preliminarily assess resources within the high-use Yellowhead Corridor in order to prepare a management plan to facilitate the protection, development and interpretation of these resources. With completion of the 1986 field programme, these goals can now be addressed in coming years.

The final season of fieldwork at the National Historic Site of Jasper House consisted of a three-week programme with a small volunteer crew. The Jasper House project has successfully established a preliminary inventory of features and structures relating to the ca. 1830-1884 Hudson's Bay Company occupation and subsequent occupations at Jasper House. The location and dimensions of a large building were delineated during the 1986 season. In late October, all archaeological grid markers were removed, excavations were backfilled and a line of benchmarks was established along the river bank to monitor the long-term impact of river erosion. To date, only a small percentage of the site has been excavated, since the programme has been geared towards inventory for the purpose of site documentation and protection. The final report on Jasper House will be completed in 1987.

A small, one week excavation was also undertaken at the Track site, 198R (FhQl-6). This special project, funded by the CNR, was designed to further examine a stratified site which was briefly investigated in 1983 (prior to the twinning of the track) and to determine whether impact to the site as a result of the development was still occurring. Although cultural material recovery was quite limited, three well-separated cultural components were clearly defined. The lowest was located below an ash identified as St. Helen's Yn (dated at ca. 3300-3500 years B.P.), and associated with an Oxbow-like projectile point recovered in 1983.

The two upper components are both above the ash level. Two radiocarbon dates have been submitted, but the results are not yet available. A report on the results of the Track site excavations has been completed (Pickard 1987)

A total of 11 ARIAs were completed in Jasper National Park in 1986. Two of these projects consisted of trail assessments: the South Boundary Trail was contracted to Bison Historical Services and the Tonquin Loop/Whirlpool Valley trails to I.R. Wilson Consultants. The remainder of the ARIAs consisted primarily of small linear assessments. One of these, the Miette Hot Springs Road, resulted in a small mitigative excavation at site 1073R (FhQl-29), completed under contract by I.R. Wilson Consultants. All cultural material was recovered from beneath a volcanic ash, unidentified as yet. Two Middle Prehistoric projectile points and a number of lithic remains were recovered.

A final project was the initiation in 1986 of the development of an Archaeological Resource Description Manual for Jasper National Park. This manual will use the information gathered from the regional inventory and other pertinent archaeological sources in order to facilitate better management and park planning within the context of the environmental assessment and review process. Writing of the manual will continue in 1987, and eventually similar documents will be developed for other parks within Western Region.

Historical Resource Salvage Archaeology Programme in Alberta's National Parks (Ian Sumpter)

During the 1986 field season, in response to a number of proposed land-modifying developments, the Archaeological Research Services Unit's salvage crew undertook archaeological investigations in Banff, Elk Island and Waterton Lakes national parks (Table 15). Based upon the field results of 33 projects, recommendations forwarded to pertinent Environment Canada personnel varied from "no further work warranted" to "additional archaeological conservation/mitigation studies required."

Within Banff National Park, a five week field schedule involved a total of 19 projects, including 15 archaeological resource impact assessments, three monitoring projects and a general heritage site inventory programme (Figures 52, 53 and 54). In all, the field studies were productive in locating eleven historic sites, two prehistoric sites and one prehistoric/palaeontological resource (Table 16).

In Elk Island National Park, a total of five ARIAs were conducted during a two week period (Figure 55). Investigations within proposed project zones resulted in the discovery of two palaeontological sites and one prehistoric subsurface isolated find. One historic period features and four previously recorded prehistoric sites were revisited and subjected to further evaluative testing (Table 16).

Finally, a total of nine ARIAs were undertaken in Waterton Lakes National Park, extending over a three-week period (Figure 56). Heritage concerns were noted for five of the nine development-related projects, resulting in the evaluation of seven known prehistoric sites and the recording of three new resources - one historic period site and two prehistoric sites. Of note were archaeological investigations undertaken at Linnet Lake, in the vicinity of site 646R (DgPl-18). In response to proposed boat launch improvements, preliminary excavations within the development zone yielded a high frequency of cultural items, including a small number of Late and Middle Prehistoric projectile points. Associated with gravelly alluvial and colluvial deposits, these horizon markers evidenced buried cultural components within the the project right-of-way extending back approximately 3,500 to 4,500 years before present. Initial investigations by Reeves (1969) at this site resulted in the recovery of his Early Prehistoric cultural complexes, Lake Linnet I and II (Reeves 1971, 1975). Because the site was assessed as having high archaeological significance (Reeves 1971), additional mitigative excavations are scheduled at this locale in the upcoming field season.

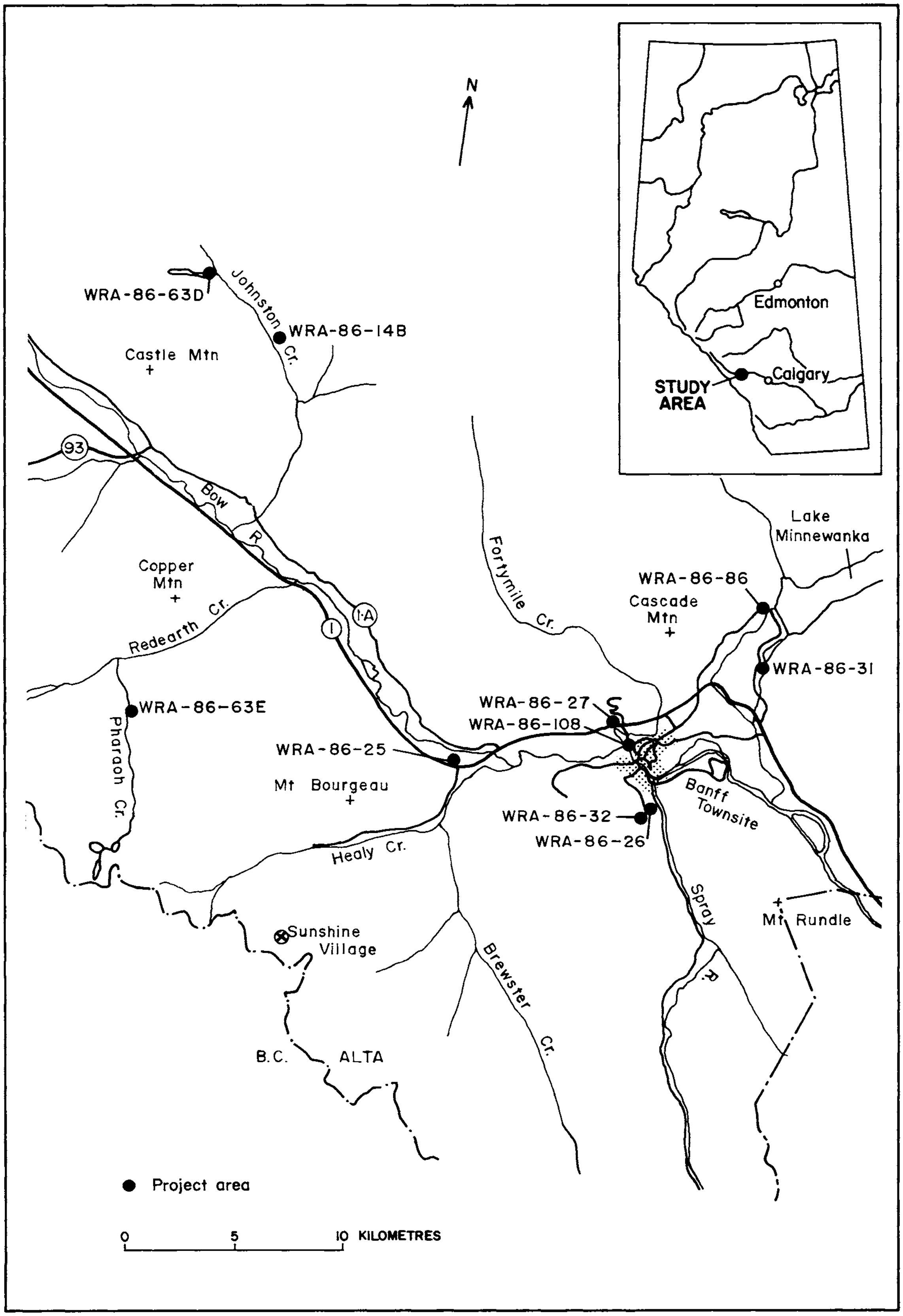

Figure 52. Locations of 1986 ARIA projects in the Banff Townsite area.

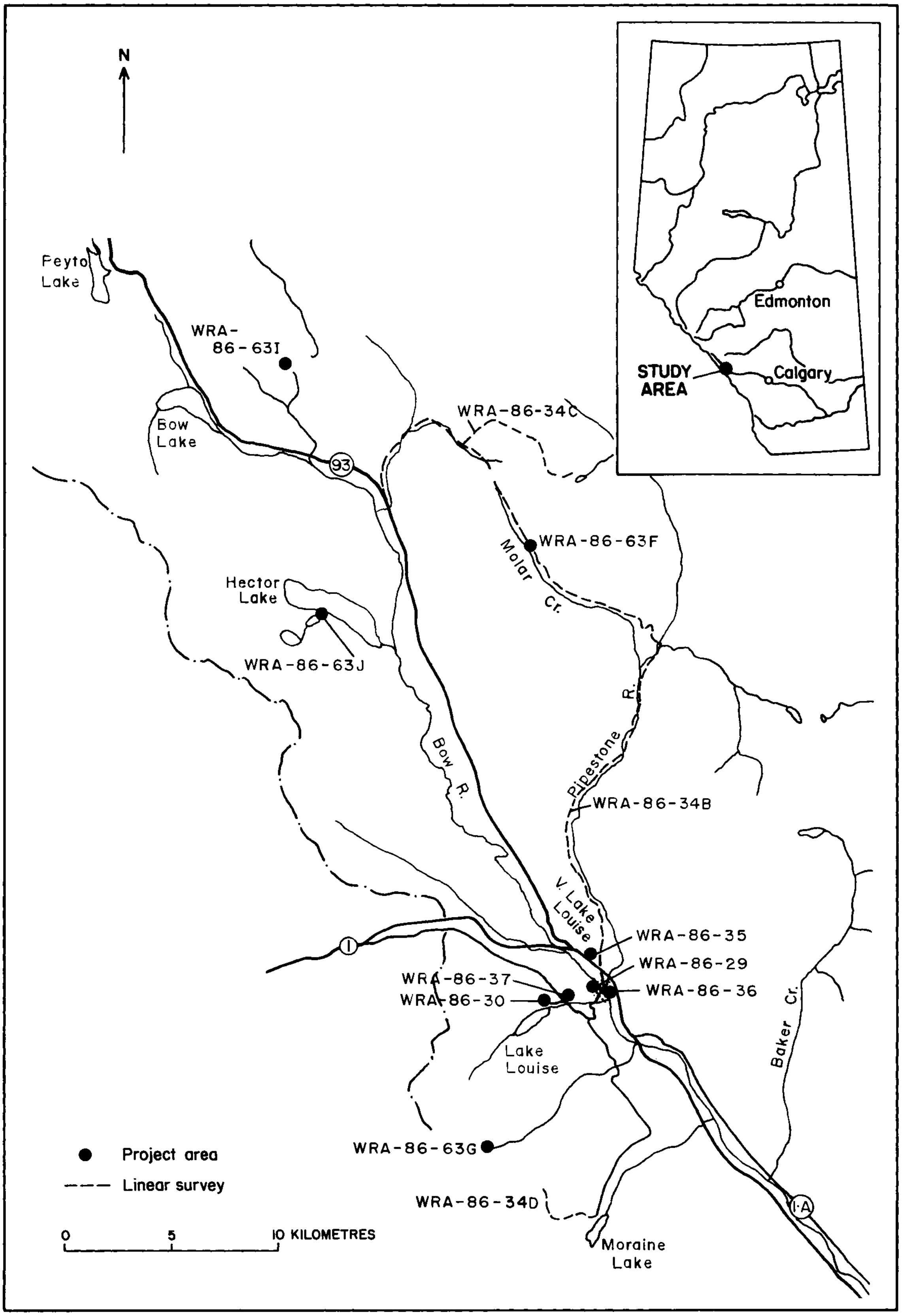

Figure 53. Locations of 1986 ARIA projects in the Lake Louise area.

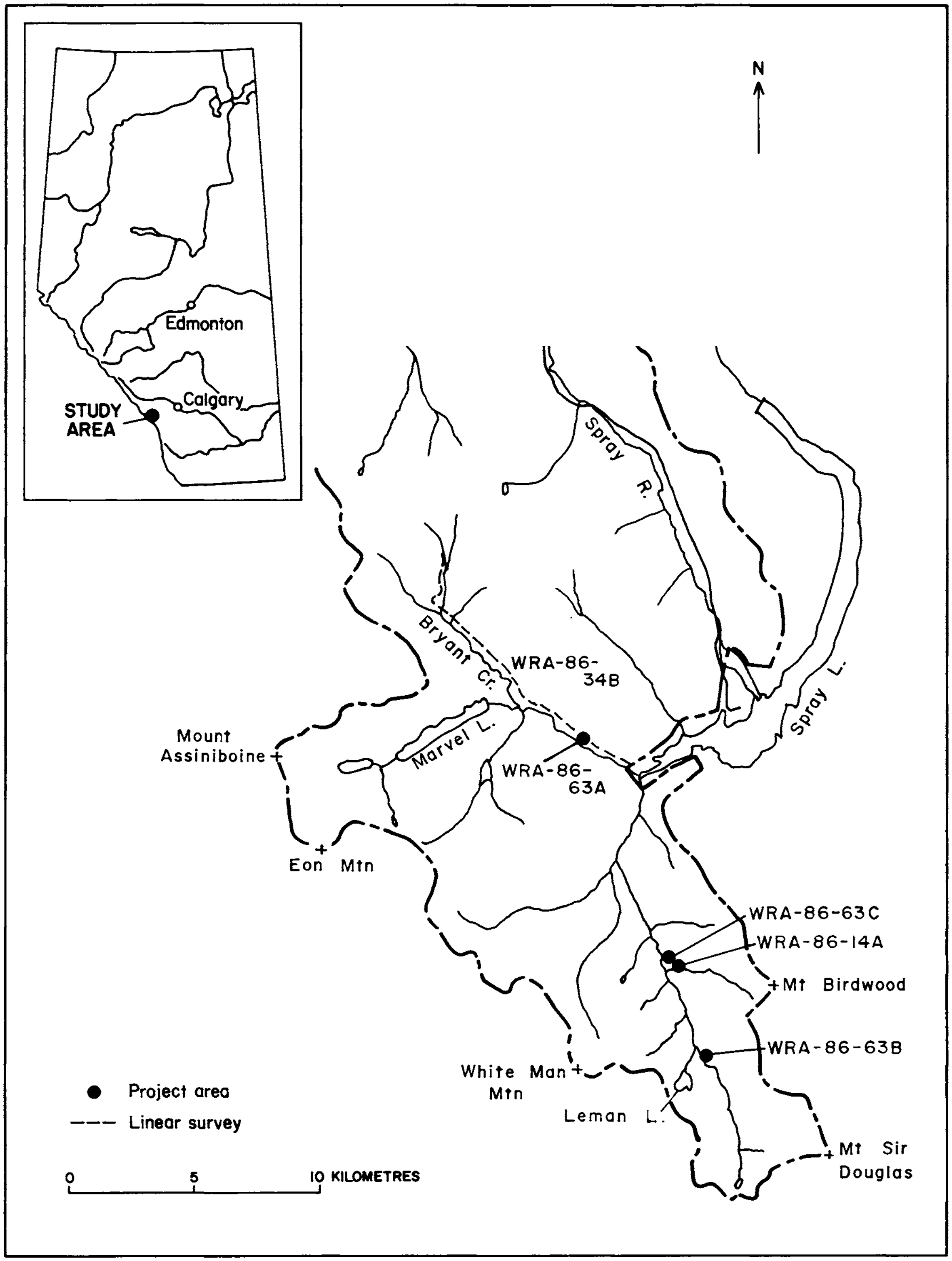

Figure 54. Locations of 1986 ARIA projects in southern Banff National Park.

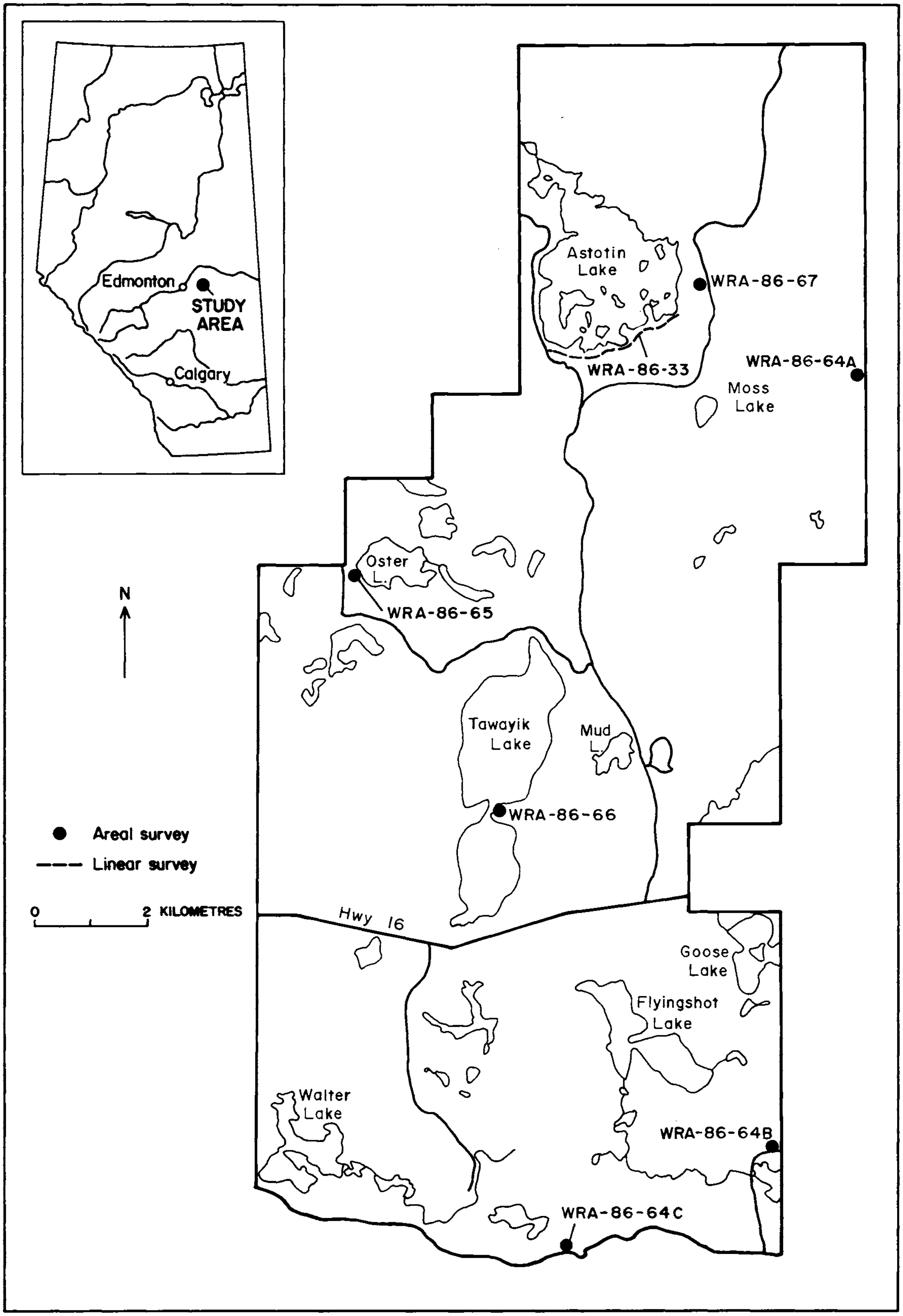

Figure 55. Locations of 1986 ARIA projects in Elk Island National Park.

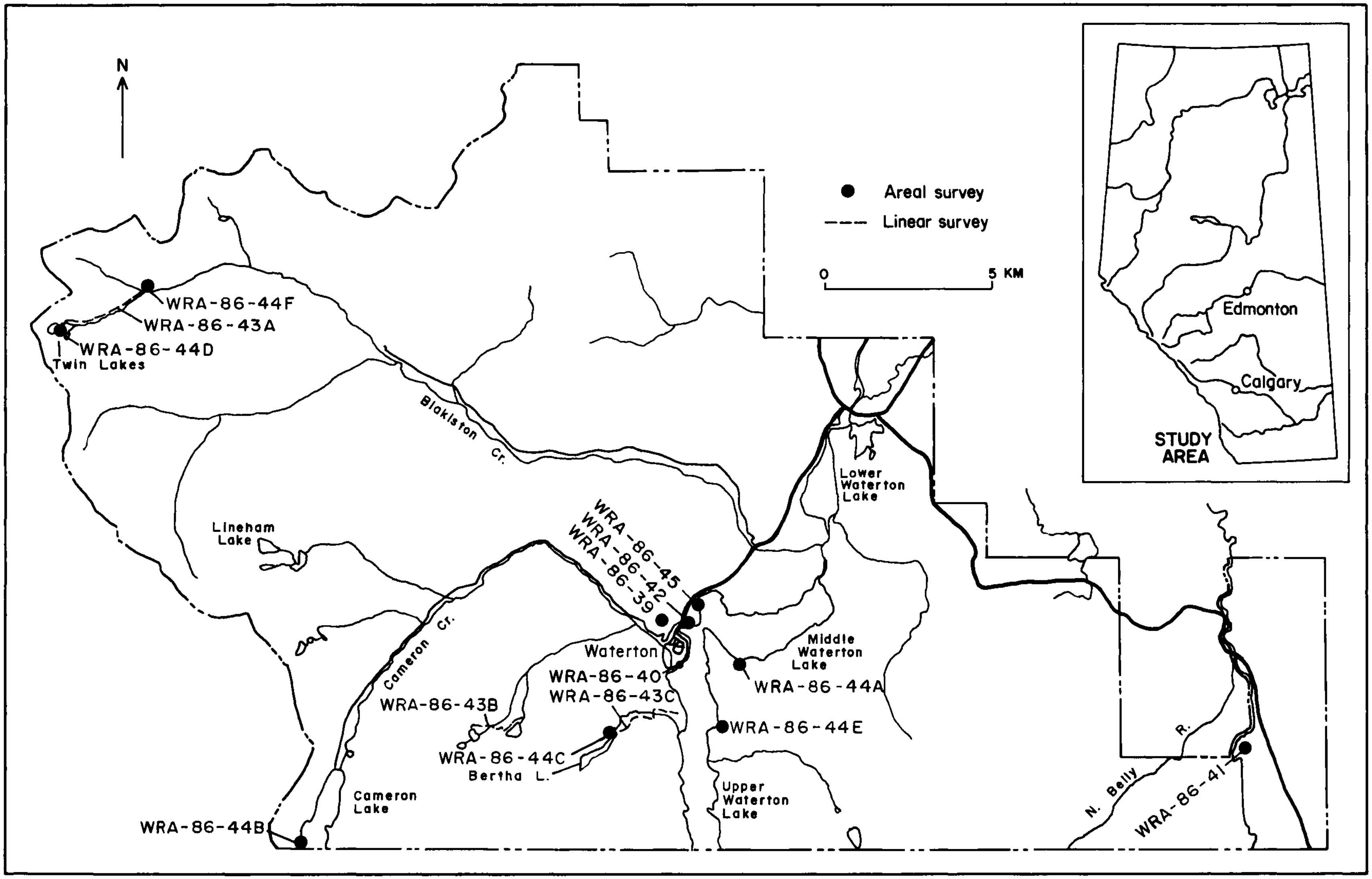

Figure 56. Locations of 1986 ARIA projects in Waterton Lakes National Park.

Table 15. Projects conducted/implemented in Alberta by the Archaeological Research Services Unit, Environment Canada, Parks, Western Region.

Project Number	Researcher	Project Description
WRA-86-1	Ian Sumpter	ARIA - Golf Course Sewage Field Expansion, Waterton Lakes National Park
WRA-86-2	Kevin Montgomery	Special Project - Archaeological Resources Management Guidelines Preparation, Western Regional Office
WRA-86-3	Rod Pickard	Special Project - Archaeological Resource Description/Manual Preparation, Jasper National Park
WRA-86-4	Daryl Fedje	ARIA - Banff Springs Hotel and Golf Course Expansion, CP Hotels, Banff National Park
WRA-86-5	Glenn Webber	Special Project - Archaeological Specimens Processing, Western Region Sites (contract)
WRA-86-6	Ian Sumpter	ARIA - Prince of Wales Hotel Underground Electrical Line Installation, Waterton Lakes National Park
WRA-86-7	Daryl Fedje	Mitigation - Twinning Trans-Canada Highway Phase II, Site Mitigation and Construction Monitoring, Banff National Park
WRA-86-8	Rod Pickard	Special Project - Track Site (CNR) Archaeological Investigations and Reporting, Jasper National Park
WRA-86-10	Bison Historical Services Ltd.	ARIA - Cascade Borrow Pit Expansion (contract), Banff National Park
WRA-86-11	Daryl Fedje	Special Project - Banff Springs Golf Course Pit-house Preliminary Investigations, Banff National Park
WRA-86-13	Don Steer	Special Project - Society for Historical Archaeology Newsletter Current Research Submissions, Western Regional Office
WRA-86-14	Bill Perry	ARIA - Palliser, Johnston Creek and Pipestone Pass Warden Cabins, Banff National Park

Table 15. continued

Project Number	Researcher	Project Description
WRA-86-15	Bison Historical Services Ltd.	Special Project - Feasibility Study, Approaches to the Predication and Management of Archaeological Resources in Western Region (contract)
WRA-86-16	Heather D'Amour/ Kevin Montgomery	Special Project - Computer-based Informational/Management System for Archaeology, Western Regional Office
WRA-86-17	Malcolm James	ARIA - Edith Cavell Road, Jasper National Park
WRA-86-20	Rod Pickard	Special Project - Jasper House 1986 Archaeological Investigations, Site Rehabilitation and Final Reporting, Jasper National Park
WRA-86-21	Malcolm James	Special Project - Archaeological Resources Inventory, Jasper National Park
WRA-86-23	Alison Landals	ARIA - Moose Meadows Borrow Pit Testing Assessment and Monitoring, Banff National Park
WRA-86-24	Bison Historical Services Ltd.	ARIA - Banff Townsite Peripheral Land-use Area (contract), Banff National Park
WRA-86-25	Ian Sumpter	ARIA - Trans-Alta Utilities Sunshine Substation Access Road, Banff National Park
WRA-86-26	Ian Sumpter	ARIA - Rimrock Hotel Development, Banff National Park
WRA-86-27	Ian Sumpter	ARIA - Timberline Lodge Development, Banff National Park
WRA-86-28	Bill Perry	ARIA - Hoodoos Self-guiding Trail, Banff National Park
WRA-86-29	Ian Sumpter	ARIA - Lake Louise Pedestrian Pathway Circulation System, Banff National Park
WRA-86-30	Bill Perry	ARIA - Chateau Lake Louise Development, Banff National Park

Table 15. continued

Project Number	Researcher	Project Description
WRA-86-31	Ian Sumpter	ARIA - Two Jack Lake Campground, Banff National Park
WRA-86-32	Ian Sumpter	ARIA - Upper Hot Springs Development, Banff National Park
WRA-86-33	Ian Sumpter	ARIA - Shoreline Trail, Elk Island National Park
WRA-86-34	Bill Perry	ARIA - Back Country Trail Improvements, Banff National Park
WRA-86-35	Ian Sumpter	ARIA - Lake Louise Inn Housing Development, Banff National Park
WRA-86-36	Ian Sumpter	ARIA - Visitor Reception Centre/Park Offices, Banff National Park
WRA-86-37	Ian Sumpter	ARIA - Sewage Lagoon Rehabilitation, Banff National Park
WRA-86-38	Ian Sumpter	ARIA - Lake Louise Campground Rehabilitation, Banff National Park
WRA-86-39	Bill Perry	ARIA - Bear Hump Trail Reconstruction, Waterton Lakes National Park
WRA-86-40	Ian Sumpter	ARIA - Townsite Campground Toilet Building Construction, Waterton Lakes National Park
WRA-86-41	Ian Sumpter	ARIA - Belly River Group Tenting Building Construction, Waterton Lakes National Park
WRA-86-42	Ian Sumpter	ARIA - Emerald Bay Shoreline Day-use Area, Waterton Lakes National Park
WRA-86-43	Ian Sumpter	ARIA - Back Country Trails, Waterton Lakes National Park
WRA-86-44	Ian Sumpter	ARIA - Back Country Campsites, Waterton Lakes National Park
WRA-86-45	Ian Sumpter	ARIA - Linnet Lake Boat Launch, Waterton Lakes National Park

Table 15. continued

Project Number	Researcher	Project Description
WRA-86-51	Malcolm James	ARIA - Maligne Lake Road, Jasper National Park
WRA-86-52	Malcolm James	ARIA - Miette Hot Springs Road, Jasper National Park
WRA-86-53	Malcolm James	ARIA - Pyramid Lake Road, Jasper National Park
WRA-86-54	Malcolm James	ARIA - Marmot Road, Jasper National Park
WRA-86-55	Malcolm James	ARIA - Cabin Creek Water Supply Line, Jasper National Park
WRA-86-56	Malcolm James	ARIA - Pocahontas Trail Development, Jasper National Park
WRA-86-57	Malcolm James	ARIA - Jasper Townsite Redevelopment, Jasper National Park
WRA-86-58	Ian Wilson	Mitigation - Miette Hot Springs Road, Site 1073R (contract), Jasper National Park
WRA-86-59	Bison Historical Services Ltd.	ARIA - South Boundary Trail (contract), Jasper National Park
WRA-86-61	Don Steer/ Heather D'Amour	Special Project - Archaeological Research Unit Volunteer Programme, Western Regional Office
WRA-86-63	Bill Perry	ARIA - Primitive Campsite Development, Banff National Park
WRA-86-64	Ian Sumpter	ARIA - Borrow Sources, Elk Island National Park
WRA-86-65	Ian Sumpter	ARIA - Oster Lake Group Camp Redevelopment, Elk Island National Park
WRA-86-66	Ian Sumpter	ARIA - Preliminary Archaeological Assessment of the Narrows Site (521R), Elk Island National Park
WRA-86-67	Ian Sumpter	ARIA - Sandy Beach Campground Improvements, Elk Island National Park

Table 15. continued

Project Number	Researcher	Project Description
WRA-86-80	Susan Langley	Special Project - Preliminary Underwater Reconnaissance of "The Gertrude," Waterton Lakes National Park
WRA-86-81	U of C/ Alison Landals	Special Project - Tabulation, Cross-tabulation and Graphics, Banff Lithic Assemblages (contract), Western Regional Office
WRA-86-82	Archaeological Research Services Unit Staff	Special Project - Four Mountain Parks Core Concepts Review/Western Regional Office Input - Archaeological Resources, Western Regional Office
WRA-86-83	Harold Hussey	Special Project - Specialty Services/Products for Archaeology (contract), Western Regional Office
WRA-86-84	Alison Landals	Monitoring - Twinning Trans-Canada Highway Phase III, Site Mitigation and Construction Monitoring, Banff National Park
WRA-86-85	Barry Warner	Special Project - Vermilion Lakes Site Macrofossil Identification (agreement), Western Regional Office
WRA-86-86	Ian Sumpter	Monitoring - Lake Minnewanka Dam Spillway Development, Banff National Park
WRA-86-87	Bill Perry	Monitoring - Lake Louise Underground Power/Telephone Line Installation, Banff National Park
WRA-86-88	Anna Curtis	Special Project - Archaeological Collections Management (contract), Western Regional Office
WRA-86-89	Ian Wilson	ARIA - Tonquin Loop and Whirlpool Valley (contract), Jasper National Park
WRA-86-90	Ben Hjermstad	Special Project - Jasper Inventory Support Programme (contract), Western Regional Office
WRA-86-91	Forintek Canada/ UBC	Special Project - Jasper House Dendrochronological Project (contract), Western Regional Office

Table 15. continued

Project Number	Researcher	Project Description
WRA-86-92	RIDDL/SFU	Special Project - Accelerator Mass Spectroscopy Radiocarbon Dating (contract), Western Regional Office
WRA-86-93	Brian Vivian/ Kathy Dilts	Special Project - Administrative Support Programme for Archaeology (contract), Western Regional Office
WRA-86-94	Ben Hjermstad	Special Project - General Support Programme for Archaeology (contract), Western Regional Office
WRA-86-95	Rick Lalonde	Special Project - 1986 Drafting Support (contract), Western Regional Office
WRA-86-96	Don Steer/ Alison Landals	Special Project - 1986 ASA Occasional Paper Submission, Environment Canada, Parks, Archaeological Research Services Unit, Western Regional Office
WRA-86-97	Harold Hussey	Special Project - Soil Profile (Transfer) Exhibit for Archaeology (contract), Western Regional Office
WRA-86-98	Brock University	Special Project - Western Region 1986 Radiocarbon Dating (contract), Western Regional Office
WRA-86-99	Alison Landals	Special Project - Western Region 1986 Faunal Remains Identification, Western Regional Office
WRA-86-100	Carlann Thomas/ Gwyn Langemann	Special Project - 1986 Jasper House National Historic Site Faunal Analysis (contract), Western Regional Office
WRA-86-101	Heather D'Amour/ Kevin Montgomery	Special Project - Implementation of Collection Management System, Archaeological Research Services, Western Regional Office
WRA-86-102	Heather D'Amour	Special Project - Archaeology Lab Specimens Storage Review and Implementation, Western Regional Office

Table 15. continued

Project Number	Researcher	Project Description
WRA-86-103	Susan Langley	Special Project - Underwater Salvage Archaeology, Emerald Bay (agreement), Waterton Lakes National Park
WRA-86-104	Ian Sumpter	Special Project - Western Region General Site Inventory Programme, Western Region Office
WRA-86-105	Kevin Montgomery	Special Project - Preparation of Guide to the Environment Canada, Parks, Western Region Archaeological Site Data Inventory Form, Western Regional Office
WRA-86-108	Bill Perry	Monitoring - Mineral Springs Hospital Construction, Banff National Park
WRA-86-109	Helen Lemon	Special Project - Acquisition and Transfer of Fort St. James Archaeological Specimens from Parks Headquarters (contract), Western Regional Office
WRA-86-110	Don Steer	Special Project - 1986/1987 Archaeological Research Services Unit Functional Review, Western Regional Office
WRA-86-111	Don Steer	Special Project - Archaeological Research Unit Functional Review/Preparation of Position Analysis Schedules, Western Regional Office
WRA-86-112	Rod Pickard/ Heather D'Amour/ Kevin Montgomery	Special Project - Archaeological Resource Management Seminars, Western Regional Office
WRA-86-114	Rod Pickard	ARIA - Borrow Sources, Jasper National Park
WRA-86-115	Daryl Fedje	Special Project - Resource Assessment for Banff Resource Description Program, Western Regional Office

Table 16. Summary of sites assessed in western region national parks in Alberta in 1986.

Project Number	Parks Number	Site Type
Banff National Park		
WRA-86-115	24R	Prehistoric campsite
WRA-86-7	62R	Prehistoric campsite
WRA-86-27	98R	Historic campsite
WRA-86-7	156R	Prehistoric campsite/quarry
WRA-86-24	167R	Historic cabin
WRA-86-24	168R	Historic cold cellar
WRA-86-24	169R	Historic Chinese shanty town
WRA-86-24	170R	Historic dump
WRA-86-24	171R	Historic cold cellar
WRA-86-28	354R	Prehistoric campsite
WRA-86-24	355R	Prehistoric campsite
WRA-86-4	356R	Prehistoric pit-houses/historic dump
WRA-86-24	358R	Prehistoric campsite
WRA-86-115	362R	Prehistoric pit-house
WRA-86-115	418R	Prehistoric pit-houses
WRA-86-29	941R	Historic road
WRA-86-26	1109R*	Historic dump
WRA-86-29	1110R*	Historic structure
WRA-86-104	1111R*	Historic storehouse
WRA-86-30	1112R*	Historic Chateau Lake Louise
WRA-86-104	1113R*	Historic structure
WRA-86-104	1114R*	Historic structure
WRA-86-115	1115R*	Prehistoric pictographs
WRA-86-24	1116R*	Historic campsite
WRA-86-32	1117R*	Historic hot-springs
WRA-86-14	1124R*	Historic Warden cabin
WRA-86-14	1125R*	Historic Warden cabin
WRA-86-63	1126R*	Historic structural remains
WRA-86-34	1127R*	Historic Warden cabin
WRA-86-29	1128R*	Historic Warden cabin
WRA-86-24	1185R*	Prehistoric campsite
WRA-86-24	1186R*	Prehistoric campsite
WRA-86-24	1187R*	Historic structural remains
WRA-86-24	1188R*	Historic structural remains
WRA-86-24	1189R*	Historic powerhouse
WRA-86-24	1190R*	Prehistoric campsite/palaeontological site
WRA-86-24	1191R*	Historic structural remains
WRA-86-24	1192R*	Prehistoric campsite
WRA-86-24	1193R*	Historic mineshaft
WRA-86-24	1194R*	Prehistoric campsite
WRA-86-24	1195R*	Prehistoric lithic scatter
WRA-86-24	1196R*	Prehistoric campsite
WRA-86-24	1197R*	Prehistoric campsite

Table 16. continued

Project Number	Parks Number	Site Type
Banff National Park continued		
WRA-86-24	1198R*	Historic Upper Bankhead townsite
WRA-86-24	1199R*	Prehistoric lithic scatter
WRA-86-24	1200R*	Prehistoric campsite
WRA-86-4	1202R*	Historic structural remains
WRA-86-4	1203R*	Historic campground
WRA-86-4	1204R*	Prehistoric quarry
WRA-86-4	1205R*	Historic dump
WRA-86-4	1206R*	Historic dump
WRA-86-4	1207R*	Prehistoric campsite
WRA-86-4	1208R*	Prehistoric lithic scatter
WRA-86-4	1209R*	Prehistoric faunal scatter
WRA-86-4	1210R*	Prehistoric campsite
WRA-86-4	1211R*	Historic refuse scatter
WRA-86-4	1212R*	Historic dump
WRA-86-4	1213R*	Historic foundation
WRA-86-115	1214R*	Prehistoric pit-houses
WRA-86-24	1226R*	Prehistoric lookout
WRA-86-24	1227R*	Prehistoric lithic scatter
WRA-86-24	1228R*	Prehistoric campsite
WRA-86-24	1229R*	Prehistoric campsite
WRA-86-24	1230R*	Prehistoric campsite
WRA-86-24	1231R*	Prehistoric campsite
WRA-86-24	1232R*	Prehistoric lithic scatter
WRA-86-24	1233R*	Prehistoric lithic scatter
WRA-86-24	1234R*	Prehistoric campsite
WRA-86-24	1235R*	Prehistoric lithic scatter
WRA-86-24	1236R*	Prehistoric lithic scatter
WRA-86-24	1237R*	Palaeontological site
WRA-86-24	1238R*	Prehistoric lithic scatter
WRA-86-24	1239R*	Prehistoric campsite
Elk Island National Park		
WRA-86-67	504R	Prehistoric campsite
WRA-86-65	521R	Prehistoric campsite
WRA-86-65	814R	Prehistoric lithic scatter
WRA-86-64	1063R	Historic road
WRA-86-67	1074R	Prehistoric campsite
WRA-86-64	1121R*	Palaeontological site
WRA-86-64	1122R*	Palaeontological site
WRA-86-43	1123R*	Prehistoric isolated find

Table 16. continued

Project Number	Parks Number	Site Type
Jasper National Park		
WRA-86-8	198R	Prehistoric campsite/palaeontological site
WRA-86-20	230R	Historic Jasper House
WRA-86-21	492R	Historic cabin/prehistoric scatter
WRA-86-21	1025R	Prehistoric indeterminate
WRA-86-21	1042R	Prehistoric isolated find
WRA-86-58	1073R	Prehistoric lithic scatter
WRA-86-21	1134R*	Prehistoric isolated find
WRA-86-89	1135R*	Historic camp
WRA-86-21	1136R*	Historic road
WRA-86-21	1137R*	Historic dairy
WRA-86-21	1138R*	Historic camp
WRA-86-21	1139R*	Historic cabin
WRA-86-21	1140R*	Historic cabin
WRA-86-21	1141R*	Historic cabin
WRA-86-21	1142R*	Historic structure
WRA-86-21	1143R*	Historic isolated find
WRA-86-21	1144R*	Historic railway bridge
WRA-86-21	1145R*	Historic dump
WRA-86-21	1146R*	Historic dump
WRA-86-21	1147R*	Prehistoric isolated find
WRA-86-21	1148R*	Prehistoric isolated find
WRA-86-21	1149R*	Historic depression
WRA-86-21	1150R*	Historic structure
WRA-86-21	1151R*	Historic structure
WRA-86-21	1152R*	Historic cabin
WRA-86-21	1153R*	Historic dump
WRA-86-21	1154R*	Historic structural remains
WRA-86-21	1155R*	Historic structural remains
WRA-86-21	1156R*	Historic dump
WRA-86-21	1157R*	Historic structure
WRA-86-21	1158R*	Historic structure
WRA-86-21	1159R*	Historic cabins
WRA-86-21	1161R*	Historic structure
WRA-86-21	1162R*	Historic cabin
WRA-86-21	1163R*	Historic structure
WRA-86-21	1164R*	Prehistoric campsite
WRA-86-21	1165R*	Historic dump
WRA-86-21	1166R*	Historic dump
WRA-86-21	1167R*	Historic depressions
WRA-86-21	1168R*	Historic structural remains
WRA-86-21	1169R*	Historic cabin
WRA-86-21	1170R*	Historic structural remains
WRA-86-21	1171R*	Historic cabin
WRA-86-21	1172R*	Prehistoric lithic scatter

Table 16. continued

Project Number	Parks Number	Site Type
Jasper National Park continued		
WRA-86-21	1173R*	Historic mine
WRA-86-21	1174R*	Historic corral
WRA-86-21	1175R*	Historic flume
WRA-86-21	1176R*	Historic depression
WRA-86-21	1177R*	Historic structural remains
WRA-86-21	1178R*	Prehistoric campsite
WRA-86-21	1179R*	Historic Warden cabin
WRA-86-21	1180R*	Historic ski hill
WRA-86-21	1181R*	Historic oven
WRA-86-21	1182R*	Prehistoric isolated find
WRA-86-21	1183R*	Historic grave
WRA-86-21	1184R*	Historic cabins
WRA-86-21	1256R*	Prehistoric/historic campsite
WRA-86-21	1257R*	Prehistoric cairn
WRA-86-89	1258R*	Historic campsite
WRA-86-89	1259R*	Prehistoric quarry
WRA-86-89	1260R*	Historic cabin
WRA-86-89	1261R*	Prehistoric/historic campsite
WRA-86-89	1262R*	Historic campsite/prehistoric isolated find
WRA-86-89	1263R*	Prehistoric lithic scatter
WRA-86-89	1264R*	Historic sawmill
WRA-86-89	1265R*	Historic logging camp
WRA-86-89	1266R*	Prehistoric campsite
WRA-86-89	1267R*	Prehistoric isolated find
WRA-86-89	1268R*	Prehistoric isolated find
WRA-86-89	1269R*	Prehistoric lithic scatter
WRA-86-89	1270R*	Prehistoric lithic scatter
WRA-86-89	1271R*	Prehistoric lithic scatter
WRA-86-21	1301R*	Historic structural remains
WRA-86-21	1302R*	Historic survey marker
WRA-86-21	1303R*	Historic cabins
WRA-86-21	1304R*	Historic dump
WRA-86-21	1305R*	Historic dump
WRA-86-21	1306R*	Historic dump
WRA-86-21	1307R*	Historic structural remains
WRA-86-21	1308R*	Historic internment camp
WRA-86-21	1309R*	Historic structural remains
WRA-86-21	1310R*	Historic structural remains
WRA-86-21	1311R*	Historic railway station
WRA-86-21	1312R*	Historic dump
WRA-86-21	1313R*	Historic structure
WRA-86-21	1314R*	Historic structural remains
WRA-86-21	1315R*	Prehistoric campsite
WRA-86-21	1316R*	Historic dump

Table 16. continued

Project Number	Parks Number	Site Type
Jasper National Park continued		
WRA-86-21	1317R*	Historic refuse scatter
WRA-86-21	1318R*	Prehistoric campsite
WRA-86-21	1319R*	Historic depression
WRA-86-21	1320R*	Prehistoric campsite
WRA-86-89	1321R*	Historic structural remains
WRA-86-89	1322R*	Prehistoric lithic scatter
WRA-86-89	1323R*	Historic grave
WRA-86-115	1324R*	Prehistoric tipi ring campsite
WRA-86-115	1325R*	Historic structural remains
Waterton Lakes National Park		
WRA-86-42	570R	Prehistoric campsite
WRA-86-109	639R	Prehistoric campsite
WRA-86-45	646R	Prehistoric campsite
WRA-86-44	690R	Prehistoric campsite
WRA-86-44	692R	Prehistoric campsite
WRA-86-43	693R	Prehistoric campsite
WRA-86-44	740R	Prehistoric fishing camp
WRA-86-43	778R	Prehistoric campsite
WRA-86-44	1069R*	Prehistoric isolated find
WRA-86-6	1118R*	Historic hotel
WRA-86-43	1120R*	Prehistoric lithic scatter

*Denotes sites recorded in 1986. These sites include prehistoric, historic and palaeontological finds. Although all have been recorded using the Environment Canada, Parks recording system, not all will be given Borden designations.

COLLECTION AND SUBMISSION OF SAMPLES FOR RADIOCARBON DATING

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GENERAL CRITERIA FOR SELECTING MATERIAL FOR DATING

The most suitable samples for radiocarbon dating are carbon-rich materials such as charcoal and wood. Other organic materials, such as peat and gyttja (lake mud), can also be used. Biogenically derived calcium carbonate, such as that found in shells and bone, can be dated; however, due to contamination problems (see below), the protein collagen is usually isolated from bone and dated. Similarly, if the sample is large enough, the protein conchiolin may be extracted from shells and dated (Bradley 1985). Other materials of archaeological interest that have been radiocarbon dated, albeit in some cases experimentally, include mortar (Van Strydonck et al. 1986), sherds and ceramics (De Atley 1980), and blood residues on stone tools (Nelson et al. 1986).

When selecting material for radiocarbon dating, two considerations should be of paramount importance: first, to collect and submit only those samples that will produce valid, interpretable results and second, to minimize post-collection contamination. Hence, there must be a clear understanding of the stratigraphic position of the sample and how it relates to the rest of the site or section. Additionally, there should be an awareness of the possible sources of sample contamination so that field notes and submission forms will contain sufficient information for the radiocarbon laboratory to process the sample appropriately and produce a useful date.

Material for radiocarbon dating should be derived from as narrow a stratigraphic range as possible. This is to minimize the chance that material of several ages may be combined together. For the same reason, samples from several sources or different stratigraphic layers are rarely combined together for dating. The resulting date would be a composite from all the material included and hence meaningless if the time range of those materials is excessive.

Before a radiocarbon sample is collected in the field, both its stratigraphic and archaeologic context must be clearly defined within the site. For instance, does it provide a minimum date for underlying material or a maximum date for overlying material? Is the material in situ (e.g., a tree with roots in place) or could it have been transported to the site (e.g., disarticulated bone)? Has the site's stratigraphic sequence remained undisturbed or has reworking occurred to affect sample context? Is the material likely to be contemporary with the occupation of the site (e.g., bones from animals used as food) or could it be much older (e.g., shells used as ornaments)? Many materials may give dates that are tricky to interpret. For example, charcoal from a hearth will date the material burnt rather than the date the hearth was used. Since old dead wood or driftwood may have been burnt, the date may be older than the date the hearth was used. In this case, the date gives a maximum possible date for the hearth (Polach and Golson 1966:5).

Finally, possible sources and types of contamination should be considered. The major sources of contamination and their effects on the radiocarbon date are as follows:

(1) Roots and rootlets may penetrate into the sample. These roots could be from present-day surface vegetation, in which case they can often be seen by eye or under a dissecting microscope and removed. Alternatively, if the sample is taken from beneath a palaeosol, it may be affected by roots of vegetation that was growing on the palaeosol when it was exposed at the ground surface (Polach and Golson 1966:7). This contamination is difficult to detect. Both sources of contamination will make the radiocarbon date younger than the true age of the sample. Similarly, dates derived from soil organic matter or Ah horizons, may be subject to error because of both continual addition of organic matter and continual humification processes (Paul 1969; Geyh et al. 1983).

(2) Humus materials from decomposition of organic matter in the soil may be translocated by pedogenic processes down the soil profile and may be redeposited at greater depth in the soil. These humus materials may penetrate samples well below the surface organic layer. This contamination would again tend to make the date younger. This source

of contamination is a particular problem for samples from peats (Polach and Golson 1966:7).

(3) Fine detrital carbonate may be mixed with the sample, particularly if the sample is from an area with carbonate bedrock or carbonate-rich tills. This contamination would cause the sample to give an apparent age older than its true age. This source of contamination can usually be detected in organic samples and removed by the radiocarbon laboratory using acid washes. The problem is more acute if the material to be dated is itself composed of carbonate.

(4) "Old carbon" may have been actually incorporated in the structure of the material being dated. In this case, the apparent date is often very much older than the true age (Table 17). This contamination occurs when carbon-containing materials, such as aquatic plants, marl or freshwater shells, are formed in lake waters which may contain dissolved bicarbonate from limestone bedrock, for example (Turner et al. 1983; Karrow et al. 1984). This is sometimes referred to as the "hard water effect."

(5) "Young carbon" may become incorporated within a sample's structure. This problem often occurs with shells and bone because the carbonate material of which they are composed may be involved in exchange reactions with rainwater and/or groundwater, particularly during the transformation of aragonite to calcite (Bradley 1985:55). The effect of this is to make the apparent age younger than the true age (Table 17). For this reason, collagen from bone is generally used for dating, although in older weathered bone the amount of collagen left may be too small (Bradley 1985:56).

(6) The sample may become contaminated by either coal, lignite or bitumen, all of which are sources of "old carbon." This is a problem in many areas in the eastern slopes of the Rockies.

As well as these "environmental" sources of contamination, there are many other factors which influence the production and assimilation of C-14 in organisms and the interpretation of radiocarbon dates. These factors include isotopic fractionation by living organisms and long-term changes in the atmospheric C-14 content and hence the relationship of C-14 years to calendar years (Bradley 1985).

Table 17. The effect of carbon contamination on true sample age.

True Sample Age		500 yr	5,000 yr	10,000 yr
Apparent Age After Contamination By	1%/YC	ns	4,950	9,800
	/OC	ns	5,050	10,050
	5%/YC	ns	4,650	9,000
	/OC	900	5,400	10,400
	10%/YC	470	4,350	8,000
	/OC	1,300	5,800	10,800
	20%/YC	400	3,700	6,800
	/OC	2,200	6,700	11,700
	50%/YC	nd	2,100	3,600
	/OC	6,000	10,500	15,500

YC = modern carbon
OC = old carbon, whose C-14 has decayed to near zero content
nd = no data
ns = not significant

Sources: Table adapted from Tables I and II in Polach and Golson (1966); Thurber (1972, Table 1), and Figures 3.4 and 3.5 in Bradley (1985).

Isotopic fractionation refers to the difference between the C-14/C-12 ratio found in living organisms compared to that of the atmospheric reservoir. Plants, for instance, more readily assimilate C-12 than C-14 during photosynthesis. Thus, the C-14 content of plant tissue is depleted compared to the atmospheric reservoir even before the radiocarbon "clock" is set ticking by the plant's death. The magnitude of this effect varies depending upon the biochemical pathway utilized by the plant for photosynthesis (Olsson and Osadebe 1974). The magnitude of the effect can be estimated by measuring the C-13 and C-12 content of the sample (Olsson and Osadebe 1974).

Most conventional radiocarbon laboratories need a minimum of 5 g of carbon to produce a reliable date, although laboratories using the accelerator technique can process much smaller sample sizes. Many organic materials actually contain quite small amounts of carbon and thus fairly large amounts of material may be necessary to provide a date. Hence, when in the field, an estimate must be made of the size of sample needed for dating to ensure that enough material is collected (see below).

FIELD COLLECTION

Samples intended for radiocarbon dating should be handled in the field as little as possible to avoid introducing contaminants. After note taking, description and photography, samples should be removed from the section/excavation unit, preferably using clean metal trowels, plastic scoops or tweezers rather than hands and placed in a clean, dry plastic bag. Ideally, the sample should not be handled; grease, suntan oil, human hair, tobacco or cigarette ash can all cause contamination (Kra 1985).

Samples must be clearly labelled; this is best done by double-bagging and including the label in the outer bag. Never put a label in with a sample or attach a label to a sample intended for dating; paper, tape, etc. themselves contain carbon compounds and can contaminate the sample. Make sure the label and the sample number are unambiguous.

Samples wrapped in aluminum foil should be placed also inside a plastic bag. Foil tears too easily to be a secure packaging and withstand shipment to a radiocarbon laboratory.

SAMPLE STORAGE AND PREPARATION

To minimize the possibility of contamination or post-collection alteration, samples should be submitted for radiocarbon dating as soon as possible after field collection. In order to avoid fungal growth and bacterial activity, field-moist samples for radiocarbon dating should be kept as cool as possible, preferably in a cold room or freezer. Most samples removed from soil or sediments, even in mid-summer, will contain some moisture. These samples should be oven-dried at $105^{o}C$ overnight and re-packaged in a new, clean plastic bag. It is useful to record the moisture content of the sample since this may act as a guide to how much sample to collect in future situations.

The amount of cleaning and preparation done by the collector depends upon the type and condition of the sample. Generally, physical separation of the sample from the soil or sediment matrix can be done by the collector, whereas preparations involving chemical treatments are best left to the radiocarbon laboratory. Obvious contaminants, such as modern roots, can be removed from the sample by hand-picking with tweezers (Kra 1985). Soil or sediment adhering to bone can be removed by brushing, although brushes made from animal hair or fibre should not be used.

The amount of material needed by a radiocarbon laboratory to derive a reliable date depends on the type of material (which controls its carbon content) and, to some extent, the analytical techniques used by the processing laboratory. Recommended amounts of various types of material for different conventional radiocarbon laboratories are shown in Table 18.

Processing the sample to yield the carbon for analysis results in a great decrease of material. What appears to be a large sample may yield little carbon for dating. This is particularly the case for samples such as highly weathered bone or charcoal mixed with soil matrix. As a general rule, it is better to submit a sample of at least the weight recommended by the laboratory. It is frustrating, as well as a waste of laboratory time, when a date cannot be obtained because of insufficient carbon content, particularly if more material was available than was submitted to the radiocarbon laboratory. If only small samples are available, consideration should be given to submitting the sample to an AMS (accelerator mass spectrometry) laboratory, some of which can produce results from samples as small as 15 mg of carbon (see Beukens et al. 1986, Table 1).

SAMPLE SUBMISSION

Each sample submitted for radiocarbon dating should be accompanied by a sample data form, and a "sample identification number" of twelve characters or less should be clearly and unambiguously designated and included in the packaging of the sample as well as on the data form. An example of the form used by the radiocarbon laboratory at AECV is given

Table 18. Sample sizes suggested by three radiocarbon laboratories.

Sample Type	AECV VEGREVILLE Min. wt.	AECV VEGREVILLE Pref.	BETA ANALYTIC Min. wt.	BETA ANALYTIC Opt.	GEOCHRON Min. wt.	GEOCHRON Pref.
Wood	8	20	3	30-100	3	10-30
Charcoal (clean)	4	10	1	10-20	1	8-12
Peat (clean)	10	20	10	100-200	2	10-25
Shell	20	60	5	50-100	10	30-100
Bone	200	400	200	200-500	25	50-500

All values in grams on dry weight basis
Min. wt. = minimum weight
Pref. = preferred weight
Opt. = optimal weight
Values for AECV provided by Dr. L. David Arnold. Values for Beta Analytic and Geochron taken from the laboratories' information brochures.

in Figure 57. Radiocarbon laboratories require that information on the sample's location and details such as the type and amount of material submitted be included on such forms. This procedure fulfills two functions:

(1) The information helps the radiocarbon laboratory to assess what pretreatments and processing techniques are appropriate for the sample. Field data is important in selecting pretreatments. For example, if the sample comes from an area with a carbonate-rich substrate, it will have to be pretreated for carbonate removal. Similarly, the occurrence of coal outcrops in the vicinity of the site, for instance, should be mentioned. Any treatment of the sample subsequent to collection, e.g. oven drying, removal of modern roots, should also be reported to the laboratory.

(2) Most radiocarbon laboratories regularly submit lists of dates to the journal, Radiocarbon, or some similar publication. Complete information on the submission form ensures that the sample data and date are reported accurately (see Kra 1985).

File Number: ASA-___________

RADIOCARBON AND TRITIUM LABORATORY
Environmental Isotopes Section
Alberta Environmental Centre
Bag 4000, Vegreville, Alberta TOB 4LO

SAMPLE INFORMATION SHEET

LAB RADIOCARBON ID# ___________________
AECV- ___________________ DATE RECEIVED IN LAB ___________________

INSTRUCTIONS: COMPLETE ITEMS BELOW. SUBMIT WITH SAMPLE TO ABOVE ADDRESS.

SUBMITTED BY: NAME AND ADDRESS | PROJECT NAME | PHONE | DATE SUBMITTED

SAMPLE IDENT. NUMBER | DATE COLLECTED

FIELD PACKAGING

PRESERVATIVE:
___ NO
___ YES SPECIFY:

SITE INFORMATION: NUMBER________ | LATITUDE | LONGITUDE

NAME________________

COUNTY________________

____

PROVINCE________________

COUNTRY________________

SAMPLE INFORMATION:

DEPTH BELOW PRESENT SURFACE________________

COORDINATES IN SITE________________

CULTURE/TIME RANGE OF SITE:

PREVIOUS DATES:

SAMPLE MATERIAL: WEIGHT:__________gm

__WOOD __CHARCOAL __BONE __SHELL __CORE __SEDIMENT __WATER __OTHER(specify):

ASSOCIATED CULTURAL, PALEONTOLOGICAL OR
PALEOBOTANICAL MATERIAL:

EXPECTED AGE (on what basis):

IMPORTANCE OF OBTAINING DATE (OR ISOTOPIC ANALYSIS) ON THIS SAMPLE:

Figure 57. An example of radiocarbon sample submission form.

REPORTING AND INTERPRETATION

Because of the possible sources of error, contamination and misassociation of sample and event, it is wise to submit several samples,preferably of different materials, from an event/occupation/horizon. Inferences based on single dates should be treated with caution. A single date, in general, is best used as an indication of age awaiting confirmation.

Radiocarbon dates should always be reported with their standard deviation (1 sigma) and radiocarbon laboratory number.

Two general "corrections" may be applied to radiocarbon dates. Many radiocarbon laboratories correct radiocarbon dates for isotopic fractionation effects using an internationally agreed standard (Olsson and Osadebe 1974). The report from the radiocarbon laboratory should indicate if this correction has been applied. Dates produced in the early days of the technique will probably not have been corrected for fractionation. This correction is often not significant but it can make a difference of several hundred years to the dates of some materials (Olsson and Osadebe 1974; Bradley 1985, Table A.1).

Due to variation in atmospheric C-14 over time, a number of calibration curves or tables have been proposed which attempt to translate from C-14 decay years B.P. to calendar years. The latest versions of these calibrations are given in Radiocarbon, 1986, Vol. 28, No. 2B. If a radiocarbon date is "corrected" using one of these calibrations, the original radiocarbon date with its standard deviation and laboratory number should also be included, together with the source for the calibration and the corrected date. This would permit later revision of the date in the event that the calibration was changed or further refined.

ACKNOWLEDGEMENT

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ALBERTA RADIOCARBON DATES 1982-1986

By
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INTRODUCTION

In 1983, Brumley and Rushworth presented a compilation of radiocarbon dates from Alberta and expressed the hope that the list would be maintained as an information resource for archaeologists in Alberta. The present list is an update to their work and includes additional information, derived mainly from data on file at the Archaeological Survey of Alberta.

SOURCES AND COMPILATION

The list is based primarily on information on file at the palynology laboratory at the Archaeological Survey, supplemented by information provided by research archaeologists at the Survey. The list includes, as far as possible, all dates produced for Survey staff since the compilation of Brumley and Rushworth (1983), together with some dates generated earlier which did not appear on that list and a few dates from other sources. Several dates are associated with palaeoenvironmental studies; all other dates are associated with archaeological sites.

Details of conventions and abbreviations used in the list are provided in Table 19. To a large extent, the information is tabulated in a fashion similar to that of Brumley and Rushworth (1983). However, dates have been reported in radiocarbon years B.P. (i.e., before A.D. 1950), rather than with respect to the Christian calendar.

For the most part, the dates in Table 20 are uncorrected dates. If a C-13 correction has been applied, this is indicated in the comment column. A number of calibrations have been applied over the last few years in attempts to translate from C-14 years to calendar years. Unfortunately, this situation has led to some confusion (see Ottaway 1986). Revised versions of calibrations are now available (see

Radiocarbon, Vol. 28, No. 2B). Because calibrations are still being refined, no attempt has been made to "correct" any of the dates in this table. Hence, unless otherwise stated, all dates are in C-14 years B.P.

Many of the dates are, as yet, unpublished and have been generated in connection with continuing projects. In this case, the principal researcher is indicated in Table 20.

COMMENTARY

Brumley and Rushworth estimated that their date list comprised "at least 80 to 90 percent of all radiocarbon dates available for the province" (1983:143). However, the few dates reported from other than archaeological sites suggest that their estimate was over-optimistic. No claims for completeness are made for the present list.

In recent years, there has undoubtedly been an increase in the number of radiocarbon dates being generated for archaeological sites in the province. Of the 334 dates associated with archaeological sites listed by Brumley and Rushworth (1983), for instance, only 16 dates have cited references between 1960 and 1969, and none are reported prior to 1960. In contrast, in 1986 alone, 54 samples associated with archaeological sites have been submitted for dating through the palynology laboratory at the Archaeological Survey of Alberta. In the Survey's case, the increased radiocarbon dating effort partly reflects the availability of radiocarbon dating facilities within the province at the Alberta Environmental Centre in Vegreville.

However, consideration of Table 21 shows that the areal and temporal disparities in radiocarbon dating noted by Brumley and Rushworth (1983) still exist. Only about 1 percent of the identified sites have any radiocarbon dates associated with them (Table 21). Only 8.5 percent of radiocarbon dates are from the northern third of the province, compared to 17.4 percent from central and 74.1 percent from southern areas. Partly, this discrepancy may result from the fact that conditions for preservation of datable organic material appear to be poor on northern sites; Ives (1981:43) considers that this is due to the generally acid soils. However, the discrepancy must also be a reflection of the fewer sites recorded from the north (Table 21). In itself, this difference in site density from north to south may be related to the fact that the south of the province contains the main population centres, hence most development, and therefore a higher likelihood of site discovery and investigation.

The preponderance of dates from the south is also related to the concentration of research effort on a few sites. In particular, Head-Smashed-In Buffalo Jump stands out as being by far the most dated site. Of the 471 dates reported from archaeological sites on the two lists, 54 (11.5%) are from this site alone.

The majority of dates in Table 20 are not associated with diagnostic material assigned to specific cultural phases. In addition, seven of the dates are "Modern" (i.e., less than 100 years) and therefore are not useful for establishing a chronology. Brumley and Rushworth (1983:144) lamented the fact that only 201 dates were available as "our primary chronometric data base for developing cultural chronologies for the entire province." Indeed, only 176 dates were from unmixed associations. This situation has improved slightly: 15 more useful dates from unmixed associations are now available. However, this has not appreciably improved the temporal definition of most cultural phases since the majority of dates are associated with only two cultural phases: Avonlea (5 dates) and McKean (3 dates).

NOTE

It is intended to produce updates to this list on an annual basis. Researchers having radiocarbon dates from archaeological sites which they would like to bring to the attention of their colleagues are invited to submit information on dates, as given in Table 20, to the Palaeoenvironmental Research Officer at the Archaeological Survey. Dates would then be included in subsequent lists.

CAVEAT

This list is intended purely as an information resource for archaeologists working in the province. Anyone interested in a particular date is advised to go directly to the primary source for more detail.

ACKNOWLEDGEMENTS

I would like to thank my colleagues at the Survey for their assistance and co-operation in compiling this list.

Table 19. Explanation of abbreviations and conventions used in Table 20[1].

Site #	The Borden designation for the site from which the sample was taken. Some samples from non-archaeological sites have been dated; these site are usually associated with palaeoenvironmental studies (e.g., Eaglenest Lake) and are indicated by "PALAEO."
Site Name	If the site has a name, it is included. If the site is unnamed or the name is unknown, the entry is left blank.
ASA #	The number assigned to the sample if it was submitted through the palynology laboratory at the Archaeological Survey and information associated with the sample is on file there. An "F" in this category indicates that some information associated with the sample, usually a sample data form, is on file at the Survey, but not necessarily at the palynology laboratory. A blank entry indicates that no file information is available.
Latitude and Longitude	Latitude (N) and longitude (W) are approximate and are reported to the nearest minute. Values of 30" are rounded down to the nearest minute.
Level	Refers to the vertical provenience of the dated material. Levels are given as stated on the sample data forms or in the reference cited. Where the level is given as a depth beneath surface, it is reported under "Depth." A blank entry indicates that the level was not given or is not defined.
Depth	This is given as cm or m below surface unless otherwise noted. "BD" refers to below datum. For core samples, the surface is the top of the core.
Association	Indicates the cultural association or projectile point type associated with the dated material as given on the sample data forms or in the reference cited. Blank entries indicate that no cultural assignment was made. A query indicates that the association may have been tentative or questionable. Codes may be combined to indicate a mixture of material or transitional phase. "PAL" indicates that the material was associated with a palaeoenvironmental study. The following list shows the possible codes and their definitions.

AG	Agate Basin	MK	McKean
AV	Avonlea	OW	Old Women's
BE	Besant	OX	Oxbow
BH	Boss Hill	PA	Pre-Archaic
BR	Bitterroot	PI	Palaeo-Indian
DU	Duncan	PL	Pelican Lake

	HA	Hanna	SR	Salmon River
	KP	Kootenay Plains	PAL	Palaeoenvironmental study
	MC	Mummy Cave		

Note that Duncan, Boss Hill and Agate Basin were not recognized by Brumley and Rushworth (1983).

Material — Indicates the kind of material that was dated and its condition, when known. These codes may be combined. Blank entries indicate that no information on the type of material dated was available in the sources consulted. Possible codes are as follows:

AP	Apatite	OR	Combined sample of organic material
BO	Bone		
CH	Charcoal	PE	Peat
CO	Collagen	SED	Sediment
CS	Segment of core	SH	Shell
HA	Humic acid	WO	Wood
MA	Marl	B	Burned
MC	Plant remains (leaves, twigs, needles, etc.)	C	Charred
		L	Calcined
		A	Acid treatment
MX	Matrix		

Geochron (dates with the lab. number beginning GX-) reports dates from gelatin. Since gelatin and collagen are synonymous, these dates are coded "CO."

Lab # — The sample number assigned by the radiocarbon laboratory.

C-14 date — The radiocarbon date expressed in radiocarbon years B.P. (i.e., years before A.D. 1950). These are uncorrected dates. Where corrected dates are available, they are flagged by an "*," and the type of correction is given under "Comments." Dates of less than 100 years B.P. are reported as "Modern."

SD — The standard deviation of the radiocarbon date.

Reference(s) — The report(s) or publication(s) that cite the date where further information on the date and its interpretation may be found. In some instances, the date is on file at the Archaeological Survey, but no reference is known or the date is not yet published. If the date is part of a continuing project, or is as yet unpublished, the name(s) of the principal researcher(s) are given. Alternatively, the name of the person who submitted the material for dating is given.

Table 19. continued

Comments	Any special notes are given here. The following codes may also appear:	
	AMS	Accelerator date
	BIT	Bitumen removed
	C-13	C-13 corrected date (i.e., corrected for isotopic fractionation effects)
	P	Pit feature
	UN	Indicates that the date is regarded as doubtful or unreliable, usually by the radiocarbon laboratory.

[1]Note that many categories and descriptions are the same as those in Brumley and Rushworth (1983).

Table 20. Radiocarbon dates from Alberta.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
DhPj-69	Belly Burial	F	49°16'	113°34'	-	-	-	BO	OxA-682	340	70	Ball (1986b)	AMS
DhPj-69	Belly Burial	F	49°16'	113°34'	-	-	-	BO	OxA-384	370	75	Ball (1986b)	AMS
DhPj-69	Belly Burial	F	49°16'	113°34'	-	-	-	BO	Beta-11902	4030	110	Ball (1986b)	UN, AMS
DhPj-69	Belly Burial	F	49°16'	113°34'	-	-	-	BO	Beta-16257	*630	80	Ball	AMS, C-13
DhPj-69	Belly Burial	F	49°16'	113°34'	-	-	-	BO/CO	AECV-195C	310	140	Ball	-
DjOu-4	Forty Mile Coulee East Dam Site	F	49°36'	111°21'	-	3.0 m	-	BO/CO	GX-8400-G	*2850	135	Brumley	C-13
DjOu-4	Forty Mile Coulee East Dam Site	F	49°36'	111°21'	-	3.0 m	-	BO/AP	GX-8400-A	*2900	150	Brumley	C-13
DjPf-4	Blood Coulee Buffalo Jump	F	49°34'	112°55'	-	-	-	BO/CO	AECV-82C	1320	90	Brink	-
DjPn-16	-	ASA-D86-1	49°34'	114°15'	4	30-40 cm	-	BO/CO	AECV-214C	4650	110	Ronaghan	-
DjPn-16	-	ASA-D86-2	49°34'	114°15'	6	50-60 cm	-	BO/CO	AECV-215C	5200	160	Ronaghan	-
DjPn-16	-	F	49°34'	114°15'	F	-	?DU	BO/CO	AECV-220C	4860	90	Ronaghan	-
DjPn-16	-	ASA-D86-5	49°34'	114°15'	B	70-80 cm	BH	BO/CO	AECV-218C	4080	230	Ronaghan	-
DjPn-16	-	ASA-D86-3	49°34'	114°15'	4	30-40 cm	BR	BO/CO	AECV-216C	3960	140	Ronaghan	-
DjPn-16	-	F	49°34'	114°15'	-	-	MK	BO/CO	AECV-219C	3820	100	Ronaghan	-
DjPn-16	-	ASA-D86-4	49°34'	114°15'	4	30-40 cm	OX	BO/CO	AECV-217C	2700	200	Ronaghan	-
DjPn-47	-	F	49°35'	114°12'	-	90-100 cm	-	SO/CH	AECV-108C	6200	120	Ronaghan (1986)	-
DjPn-53	-	F	49°34'	113°14'	-	50-60 cm	-	BO/CO	AECV-115C	450	100	Ronaghan	-
DjPn-53	-	F	49°34'	113°14'	-	20-30 cm	-	BO/CO	AECV-114C	1200	100	Ronaghan	-
DjPn-60	-	F	49°33'	114°18'	1	0-10 cm	-	BO/CO	AECV-221C	470	60	Ronaghan	-
DjPn-66	-	F	49°34'	114°18'	8	70-78 cm	-	CH/MX	AECV-222C	3390	100	Ronaghan	-
DjPn-66	-	F	49°34'	114°18'	9	80-97 cm	-	CH/MX	AECV-223C	4930	110	Ronaghan	-

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
DjPn-66	-	F	49°34'	114°18'	11	100-110 cm	-	CH/MX	AECV-224C	5120	200	Ronaghan	-
DjPn-66	-	F	49°34'	114°18'	6	58-60 cm	-	CH/MX	AECV-225C	4980	90	Ronaghan	-
DjPn-66	-	F	49°34'	114°18'	12	115 cm	-	CH/MX	AECV-228C	6180	110	Ronaghan	above Mazama tephra
DjPn-66	-	F	49°34'	114°18'	14	130-140 cm	-	CH/MX	AECV-229C	6710	180	Ronaghan	approx. same level as Mazama tephra
DjPn-66	-	F	49°34'	114°18'	15	140-150 cm	-	CH/MX	AECV-230C	7050	90	Ronaghan	below Mazama tephra
DjPn-90	-	F	49°35'	114°14'	-	90-100 cm	-	BO/CO	AECV-112C	6040	450	Ronaghan (1986)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	150-160 cm	-	BO	Beta-7718	1660	80	Brink et al. (1985)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	135 cm	-	BO	S-2500	7065	175	Brink et al. (1985)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	10-20 cm	-	BO	Beta-7791	Modern	-	Brink et al. (1985)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	BO	Beta 7792	1620	80	Brink et al. (1985)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	BO	Beta-7793	310	80	Brink et al. (1985)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	BO	Beta-7794	Modern	-	Brink et al. (1986)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	30 cm	-	CH	AECV-21C	1160	50	Brink et al. (1985)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	10-34 cm	-	CH	AECV-22C	1300	70	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-23C	1050	70	Brink et al. (1985)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-54C	800	110	Brink et al. (1986)	P

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-58C	890	120	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-60C	2710	150	Wright et al. (1985), Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-61C	530	140	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-59C	470	110	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	40-50 cm	-	BO/CO	AECV-62	470	150	Brink et al. (1986)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	80-90 cm	-	BO/CO	AECV-63C	1140	90	Brink et al. (1986)	-
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	BO/CO	AECV-64C	190	80	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	BO/CO	AECV-65C	470	90	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	BO/CO	AECV-67C	860	380	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH	AECV-119C	680	150	Brink et al. (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	60 cm	-	CH	AECV-191C	1250	90	Wright and Brink (1986)	P
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-6	49°43'	113°39'	-	-	-	BO/CO	AECV-231C	1280	100	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-7	49°43'	113°39'	-	-	-	BO/CO	AECV-232C	1250	180	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-8	49°43'	113°39'	-	-	-	BO/CO	AECV-233C	1030	150	Brink and Wright	P

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH/SED	AECV-247C	1100	80	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-9	49°43'	113°39'	-	-	-	BO/CO	AECV-234C	1790	80	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-10	49°43'	113°39'	-	-	-	BO/CO	AECV-235C	830	80	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-11	49°43'	113°39'	-	-	-	BO/CO	AECV-236C	1260	90	Brink and Wright	-
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-12	49°43'	113°39'	-	-	-	BO/CO	AECV-237C	1300	70	Brink and Wright	-
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-13	49°43'	113°39'	-	-	-	BO/CO	AECV-238C	870	90	Brink and Wright	-
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-14	49°43'	113°39'	-	-	-	BO/CO	AECV-239C	360	180	Brink and Wright	-
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-15	49°43'	113°39'	-	-	-	BO/CO	AECV-240C	1620	180	Brink and Wright	-
DkPj-1	Head-Smashed-In Buffalo Jump	ASA-D86-16	49°43'	113°39'	-	-	-	BO/CO	AECV-241C	1080	90	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH/SED	AECV-250C	680	120	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH/SED	AECV-248C	410	130	Brink and Wright	P
DkPj-1	Head-Smashed-In Buffalo Jump	F	49°43'	113°39'	-	-	-	CH/SED	AECV-249C	690	150	Brink and Wright	P
DkPj-27	Calderwood Bison Jump	F	49°43'	113°39'	-	10-18 cm	-	BO	GX-11607	*210	160	Marshall and Brink (1986)	C-13
DkPj-27	Calderwood Bison Jump	F	49°43'	113°39'	-	30-40 cm	-	BO	GX-11608	*1830	200	Marshall and Brink (1986)	C-13
DkPj-27	Calderwood Bison Jump	F	49°43'	113°39'	-	55-65 cm	-	BO	GX-11609	*2820	230	Marshall and Brink (1986)	C-13

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
DkPj-27	Calderwood Bison Jump	ASA-D86-51	49°43'	113°39'	1	-	-	BO/CO	AECV-319C	390	100	Brink, Wright, Marshall	-
DkPj-27	Calderwood Bison Jump	ASA-D86-52	49°43'	113°39'	-	-	-	BO/CO	AECV-320C	1310	110	Brink, Wright, Marshall	-
DkPj-27	Calderwood Bison Jump	ASA-D86-53	49°43'	113°39'	-	-	-	BO/CO	AECV-321C	890	110	Brink, Wright, Marshall	-
D1On-3	Larson	F	49°56'	110°18'	1	56-76 cm	AV	BO/AP	GX-9395-A	*1420	150	Laurie Milne	C-13
D1On-3	Larson	F	49°56'	110°18'	1	56-76 cm	AV	BO/CO	GX-9396-G	*1165	125	Laurie Milne	C-13
D1On-3	Larson	ASA-D86-17	49°56'	110°18'	-	65-75 cm	AV	BO/CO	AECV-298C	1190	80	Laurie Milne	-
D1On-3	Larson	ASA-D86-18	49°56'	110°18'	-	70-110 cm	AV	CH	AECV-299C	1210	80	Laurie Milne	-
D1On-3	Larson	ASA-D86-19	49°56'	110°18'	-	70-110 cm	AV	CH	AECV-300C	1140	90	Laurie Milne	-
D1Ou-9	Laidlaw	F	49°55'	111°28'	-	-	-	BO	Beta-11952	3280	110	Brumley (1986)	AMS, 3420+130 (C-13 adjusted)
D1Pa-4	Stalker (Taber child)	-	49°51'	112°9'	-	-	-	BO	-	3550	500	Brown et al. (1983)	AMS, redating Taber child
D1Pb-2	Cranford Gravel Pit	ASA-D86-29	49°50'	112°21'	-	16-24 cm	-	BO/CO	AECV-312C	1770	80	Rebecca Balcom	-
D1Pb-2	Cranford Gravel Pit	ASA-D86-34	49°50'	112°21'	-	18 cm	-	BO/CO	AECV-317C	620	100	Rebecca Balcom	-
D1Pb-2	Cranford Gravel Pit	ASA-D86-35	49°50'	112°21'	-	32-40 cm	-	BO/CO	AECV-318C	1890	80	Rebecca Balcom	-
D1Pb-2	Cranford Gravel Pit	ASA-D86-30	49°50'	112°21'	-	13-18 cm	OW/AV/BE	BO/CO	AECV-313C	1000	90	Rebecca Balcom	-
D1Pb-2	Cranford Gravel Pit	ASA-D86-31	49°50'	112°21'	-	20-30 cm	OW/AV/BE/ MK/PL	BO/CO	AECV-314C	1150	80	Rebecca Balcom	-
D1Pb-2	Cranford Gravel Pit	ASA-D86-32	49°50'	112°21'	-	24 cm	OW/MK/HA	BO/CO	AECV-315C	1000	100	Rebecca Balcom	-
D1Pb-2	Cranford Gravel Pit	ASA-D86-28	49°50'	112°21'	-	20 cm	PL/MK	BO/CO	AECV-311C	1640	120	Rebecca Balcom	-

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
DlPd-3	Ross	F	49°52'	112°31'	I	-	OW	CH	S-2040	Modern	-	Vickers (1987)	-
DlPd-3	Ross	F	49°52'	112°31'	I	-	OW	CH	S-2043	Modern	-	Vickers (1987)	-
EaPh-4	Little Bow River Crossing	F	50°10'	113°18'	-	10-20 cm	-	BO/CO	AECV-155C	940	160	Fedirchuk	-
EaPh-4	Little Bow River Crossing	F	50°10'	113°18'	-	0-10 cm	-	BO/CO	AECV-154C	450	70	Fedirchuk (1986)	-
EaPh-4	Little Bow River Crossing	F	50°10'	113°18'	-	20-30 cm	-	BO/CO	AECV-153C	620	230	Fedirchuk (1986)	-
EaPm-5	Porcupine Hills No. 1	ASA-D86-21	50°1'	114°2'	-	-	-	BO/CO	AECV-302C	Modern	-	Ronaghan	-
EbOp-16	Cactus Flower	-	50°15'	110°38'	-	-	MK	CH	S-1209	3740	100	Rutherford et al. (1981) Sub. by J.H. Brumley	Occupation III
EbOp-16	Cactus Flower	-	50°15'	110°38'	-	-	MK	CH	S-1210	4220	130	Rutherford et al. (1981) Sub. by J.H. Brumley	Occupation VIII
EdOp-1	British Block Cairn	-	50°36'	110°36'	-	10 cm	-	CH	S-1922	2720	220	Rutherford et al. (1984)	-
EdPk-39	Callahan Sand Pit	ASA-D86-23	50°34'	113°48'	2	10-20 cm	-	BO/CO	AECV-303C	8670	230	Ronaghan	-
EgPm-179	Hawkwood	-	51°07'	114°10'	-	-	-	-	RL-1277	6820	280	Van Dyke and Stewart (1985)	-
EgPr-2	Sibbald Creek	F	51°3'	114°52'	-	35-45 cm	-	CH	GX-8810	7645	260	Ball (1983b)	-
EgPr-2	Sibbald Creek	F	51°3'	114°52'	-	25-30 cm	-	CH	GX-8809	5850	190	Ball (1983b)	-
EgPr-2	Sibbald Creek	F	51°3'	114°52'	-	35-40 cm	-	CH	GX-8808	9570	320	Ball (1983b)	UN (Counter malfunction)
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH/A	SFU-314	10900	270	Hobson and Nelson (1984) Fedje (1985)	-

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH/A	SFU-316	11500	300	Hobson and Nelson (1984) Fedje (1985)	-
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH/A	SFU-317	9400	400	Hobson and Nelson (1984) Fedje (1985)	-
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH/A	SFU-318	9800	400	Hobson and Nelson (1984) Sub. by Daryl Fedje	-
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH/A	SFU-346	11700	290	Hobson and Nelson (1984) Fedje (1985)	-
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH	SFU-348	11000	480	Fedje (1985)	-
EhPv-8	Vermilion Lakes	-	51°10'	115°39'	-	-	-	CH	SFU-347	8950	600	Fedje (1985)	-
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	45-70 cm	-	BO/AP	GX-9124-A	*2260	270	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	45-70 cm	-	BO/CO	GX-9125-G	*2885	250	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	30-40 cm	-	BO/AP	GX-9122-A	*1305	160	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	30-40 cm	-	BO/CO	GX-9123-G	*1235	210	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	15-20 cm	-	BO/AP	GX-9120-A	*710	140	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	60-70 cm	-	BO/AP	GX-9118-A	*720	150	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	60-70 cm	-	BO/CO	GX-9119-G	*680	155	Ball (1984)	C-13
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	1.3 m	-	BO/AP	GX-9116-A	*1010	150	Ball (1984)	C-13

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
ElPf-1	Dry Island Buffalo Jump	F	51°56'	112°60'	-	1.3 m	-	BO/CO	GX-9117-G	*905	120	Ball (1984)	C-13
FbPi-1	Miller	F	52°15'	113°22'	2a	40-75 cm BD	-	BO/CO	AECV-288C	350	60	Ball (1986a)	-
FbPi-1	Miller	F	52°15'	113°22'	2c	100-120 cm BD	-	BO/CO	AECV-293C	210	60	Ball (1986a)	-
FbPi-1	Miller	F	52°15'	113°22'	2a	40-75 cm BD	-	BO/CO	AECV-289C	210	80	Ball (1986a)	-
FbPi-1	Miller	F	52°15'	113°22'	2b	75-100 cm BD	-	BO/CO	AECV-290C	230	90	Ball (1986a)	-
FbPi-1	Miller	F	52°15'	113°22'	2b	75-100 cm BD	-	BO/CO	AECV-291C	340	90	Ball (1986a)	-
FbPi-1	Miller	F	52°15'	113°22'	2c	100-120 cm BD	-	BO/CO	AECV-292C	370	90	Ball (1986a)	-
FdOt-1	Anderson	F	52°48'	111°20'	-	-	-	CH	S-1894	1070	80	Quigg	-
FhQl-4	Swan Landing	F	53°19'	117°51'	33	3.3 m	-	CH	S-2178	8675	270	Ball (1983a)	-
FhQl-4	Swan Landing	F	53°19'	117°51'	26	2.6 m	-	HA	S-2179	7010	1560	Ball (1983a)	-
FjPi-29	Strathcona	ASA-D86-36	53°33'	113°23'	J	50 cm	OX	CH	AECV-308C	130	90	Brian Kooyman	-
FkPg-42	Scotford styrene	-	53°48'	113°05'	-	36-40 cm	-	CH	Beta-3504	910	80	Bryan (1982)	-
FlQs-30	Grande Cache Lake	F	53°55'	119°2'	Three	-	MK	CH	S-1888	4605	75	Brink	-
GdQp-1	Tukwakin	-	54°33'	118°37'	3	-	-	BO/B	S-1477	Modern	-	Buchner (1978)	-
GjPx-5	Hidden Creek	F	55°31'	115°57'	2	-	-	CH	Beta-7838	Modern	-	LeBlanc	-
HaPl-1	Alook	-	56°8'	113°51'	-	-	-	BO	DIC-1066	770	70	Sims cited in Gruhn (1981)	Upper B horizon Site formerly HaPl-100
HhOv-73	Bezya	F	57°16'	111°30'	3	-	-	CH	Beta-7839	3990	170	LeBlanc (1985)	-
HkPa-14	Pelican Beach	F	57°48'	112°07'	11	-	-	CH	GX-8811	1940	130	Ives	-
HkPa-14	Pelican Beach	F	57°48'	112°07'	15	-	-	CH	GX-8812	1965	135	Ives	-

Table 20. continued.

Site #	Site Name	ASA #	Latitude	Longitude	Level	Depth	Association	Material	Lab #	C-14 date	SD	Reference(s)	Comments
HkPb-1	Satsi	F	57°45'	112°10'	2.3	-	-	BO/B	GX-9126	Modern	-	Ives	-
IgPc-2	Peace Point	-	59°8'	120°26'	1	160-170 cm	-	BO	SFU-167	2190	270	Stevenson (1986)	-
IgPc-2	Peace Point	-	59°8'	120°26'	6	-	-	BO	SFU-168	1470	130	Stevenson (1986)	-
IgPc-2	Peace Point	-	59°8'	120°26'	7	92-97 cm	-	-	S-2228	1670	105	Stevenson (1986)	-
IgPc-2	Peace Point	-	59°8'	120°26'	13	45-55 cm	-	BO	S-2175	1040	75	Stevenson (1986)	Combined sample of bone
IkOs-1	-	F	59°49'	111°02'	-	37 cm	-	CH	S-1401	1520	95	Pollock	-
IkOs-1	-	F	59°49'	111°02'	-	14 cm	?AG	CH	S-1402	1610	195	Pollock	-
PALAEO	-	-	-	-	-	c. 6 ft	PAL	CS	Beta-2626	4030	60	Bryan (1982)	Bog near FkPg-45
PALAEO	Eaglenest Lake	F	57°46'	112°06'	-	475-485 cm	PAL	CS	GX-8909	10085	245	Vance (1986)	BIT
PALAEO	Eaglenest Lake	F	57°46'	112°06'	-	490-500 cm	PAL	CS	GX-8910	11280	275	Vance (1986)	BIT
PALAEO	Eaglenest Lake	F	57°46'	112°06'	-	270-280 cm	PAL	CS	GX-9308	*8330	320	Vance (1986)	BIT, C-13
PALAEO	Eaglenest Lake	F	57°46'	112°06'	-	0-12.5 cm	PAL	CS	GX-9309	*1280	160	Vance (1986)	BIT, C-13
PALAEO	Eaglenest Lake	F	57°46'	112°06'	-	470-480 cm	PAL	CS	Beta-8287	10740	150	Vance (1986)	BIT
PALAEO	Eaglenest Lake	F	57°46'	112°06'	-	260-270 cm	PAL	CS	Beta-8288	7240	80	Vance (1986)	BIT
PALAEO	Chappice Lake	F	50°10'	110°20'	-	8.14-8.25m	PAL	CS	Beta-9067	5570	80	Vance	-
PALAEO	Chappice Lake	ASA-D86-56	50°10'	110°20'	-	0-20 cm	PAL	CS	AECV-335C	1250	110	Vance	-
PALAEO	Clear Lake	F	57°45'	112°06'	-	390-410 cm	PAL	CS	GX-8361	2800	150	Vance	-
PALAEO	Clear Lake	F	57°45'	112°06'	-	411-417 cm	PAL	CS	S-2096	3320	1180	Vance	-
PALAEO	Joseph Lake	F	53°25'	113°55'	-	440-422 cm	PAL	CS	S-2087	7035	105	Vance	-
PALAEO	Joseph Lake	F	53°25'	113°55'	-	190-200 cm	PAL	CS	GX-8537	2635	160	Vance	-
PALAEO	Sunwapta Pass SP-1	ASA-D86-54	52°13'	117°11'	-	-	PAL	MC	AECV-324C	6850	110	Beaudoin	-

Table 21. Radiocarbon dates and dated archaeological sites by Borden block in Alberta.

Borden Block	Total[1] Sites	Dated[2] Sites to 1982	Other Dated Sites to 1986	Total Dated Sites	% Sites Dated	Dates[2] to 1982	Other Dates to 1986	Total Dates	Dates[2] with Unmixed Assoc. to 1982	Other Dates with unmixed Assoc. to 1986	Total Dates with unmixed Assoc.
DO	937	13	3	16	1.7	20	8	28	12	5	17
DP	1862	44	10	54	2.9	132	77	209	84	7	91
EO	3722	16	1	17	0.5	37	3	40	33	2	35
EP	4588	34	5	39	0.9	47	25	72	24	-	24
EQ	74	-	-	-	-	-	-	-	-	-	-
FO	877	6	-	6	0.7	14	1	15	6	-	6
FP	2673	11	2	13	0.5	28	8	36	16	1	17
FQ	644	7	1	8	1.2	13	2	15	-	1	1
GO	287	1	-	1	0.3	2	-	2	1	-	1
GP	443	5	-	5	1.1	7	1	8	-	-	-
GQ	292	3	-	3	1.0	5	1	6	-	-	-
HO	352	2	1	3	0.9	2	1	3	-	-	-
HP	110	6	1	7	6.3	9	4	13	-	-	-
HQ	145	-	-	-	-	-	-	-	-	-	-
IO	94	1	1	2	2.1	2	2	4	-	1	1
IP	74	2	-	2	2.7	16	4	20	-	-	-
IQ	15	-	-	-	-	-	-	-	-	-	-
Total	17,209	151	25	176	1.0	334	137	471	176	17	193

[1]Information provided by Joan Damkjar, Site Data Compiler, Archaeological Survey of Alberta
[2]Information recompiled from Brumley and Rushworth (1983)

RESEARCH NOTES

"Research Notes" are intended to convey information useful to practising professionals in Alberta in those cases where an entire article is not warranted. Contributions should be brief, with a minimum of text and/or figures, and should be directed to the Head of the Research Section.

Contributions this year include an update on excavations at the Larson site, a report on the Pink Mountain site in British Columbia, a series of preliminary maps showing the distributions of Native groups in western Canada (ca. A.D. 1750 to A.D. 1850), and a consideration of x-ray fluorescence analysis used in obsidian source characterization.

Martin Magne

AN UPDATE ON THE 1986 EXCAVATIONS AT THE LARSON SITE IN SOUTHEASTERN ALBERTA

By
Laurie Milne
Simon Fraser University

The Larson site (DlOn-3) is an Avonlea Phase campsite located about 3 km south of the village of Irvine and 30 km east of Medicine Hat, Alberta. DlOn-3 is several hundred metres north of a bison kill, DlOn-2, originally located by A.L. Bryan in 1965 in Ross Creek valley. DlOn-2 has been visited on a number of occasions in the past 15 years by members of the Southeastern Alberta Archaeological Society. In 1975, a member and trained archaeologist, Veronica Gadd Maltin, discovered a quantity of butchered bison bone, fire-cracked rock and flake debitage eroding from a cutbank along an extinct oxbow on Ross Creek, about 200 m north of DlOn-2. This site was recorded by John Brumley in 1976, designated DlOn-3, and eventually named the Larson site after the landowners, the Larson Cattle Company.

Ross Creek drains the northern slopes of the Cypress Hills and wends its way north and west before entering the South Saskatchewan River east of Medicine Hat. The Ross Creek valley is 0.5 to 1.0 km wide in the Irvine area and is characterized by extensive stands of cottonwood, willow, chokecherry and saskatoon along the valley floor and sagebrush, greasewood and prickly pear cactus on the upper stream terraces and valley wall.

DlOn-3 was tested intermittently throughout the summer of 1982 by Medicine Hat College students and volunteers. Three 1 x 2 m excavation areas were located above hearth features seen eroding from the cutbank which currently delimits the site area. Two cultural levels were recorded. The uppermost level extends from 50 to 70 cm below surface and represents a series of closely spaced Avonlea Phase occupations. The second level is a bone bed about 1 m below surface. It represents butchered bone redeposited from elsewhere and lacks diagnostic artifacts.

In May and June of 1986, Medicine Hat College financed excavation of a further 12 square metres centred on one of the 1982 test pits. These excavations confirmed the existence of several closely spaced Avonlea Phase occupations representing campsite activities. Five radiocarbon dates have been obtained from the uppermost in situ cultural unit:

Sample 1	A.D. 530 ± 150 years B.P.	(GX-9395-A)	Bone
Sample 2	A.D. 785 ± 125 years B.P.	(GX-9396-G)	Bone
Sample 3	A.D. 760 ± 80 years B.P.	(AECV-298C)	Bone
Sample 4	A.D. 740 ± 80 years B.P.	(AECV-299C)	Charcoal
Sample 5	A.D. 810 ± 90 years B.P.	(AECV-300C)	Charcoal

Eight major hearth features are represented in the 18 square metres which have been excavated, and additional features are indicated in the pit profiles. These include stone boiling pits, unprepared hearths and roasting pits. Extensive quantities of fire-cracked rock, ash and heavily butchered bone are also present. Faunal analysis from the 1982 field season shows that bison, pronghorn, dog, swift fox, mink (?) and duck are represented, with bison being prevalent. Foetal bison provides evidence of site seasonality and suggests a late winter occupation. The duck provides weak evidence of spring through fall occupation.

Ten artifacts classes were identified, including projectile points, endscrapers, bifaces, perforating tools, pièces esquillées, cores, marginally retouched flake tools, heavy stone tools, ceramics and bone tools. A piece of dentalia was also recovered in 1986. The lithic types are generally poor quality quartzite, chert and petrified wood, and it appears that locally available lithics were used at the virtual exclusion of imported, finer grained cherts, chalcedonies and obsidian.

Material derived from the Larson site is typical of the Avonlea Phase. It comprises a cultural assemblage whose key diagnostic artifact is a small, side-notched projectile point with low basal edges and fine pressure flaking. As evidence in southeastern Alberta has accumulated, it has become evident that, while Avonlea is represented in excavated sites and surface collections, the materials are not nearly as abundant as those of its Middle Prehistoric precursors (Oxbow, McKean, Pelican Lake, and Besant) or those of the subsequent Late Prehistoric Old Women's Phase, a fact which serves to enhance the importance of Avonlea Phase sites such as the Larson site.

THE PINK MOUNTAIN PALAEO-INDIAN SITE

By
Ian Wilson
I.R. Wilson Consultants Ltd.

A Palaeo-Indian site (HhRr-1), with Clovis, Scottsbluff and Lerma projectile points, has been discovered near Pink Mountain, 150 km northwest of Fort St. John, B.C. (Figure 58). The site extends for more than a kilometre along a ridge overlooking the Sikanni Chief River valley. Surface finds account for a majority of the artifacts observed, but buried cultural materials have been recovered from a loess horizon near the surface. Although initial investigations were brief, the apparent age of the artifacts, the large areal extent of the site, as well as its location within the boundaries of the postulated "ice free corridor" are compelling reasons for further research. No dates were obtained from the site, although the Clovis materials (two projectile point bases; Figure 59a, b) are similar to the point recovered at Charlie Lake Cave near Fort St. John which is radiocarbon dated to about 10,400 years B.P. The complete Scottsbulff point (Figure 59d) is the first identified from an archaeological site in B.C. As well as these point types, a microblade core was also recovered, as were several modified macroblades.

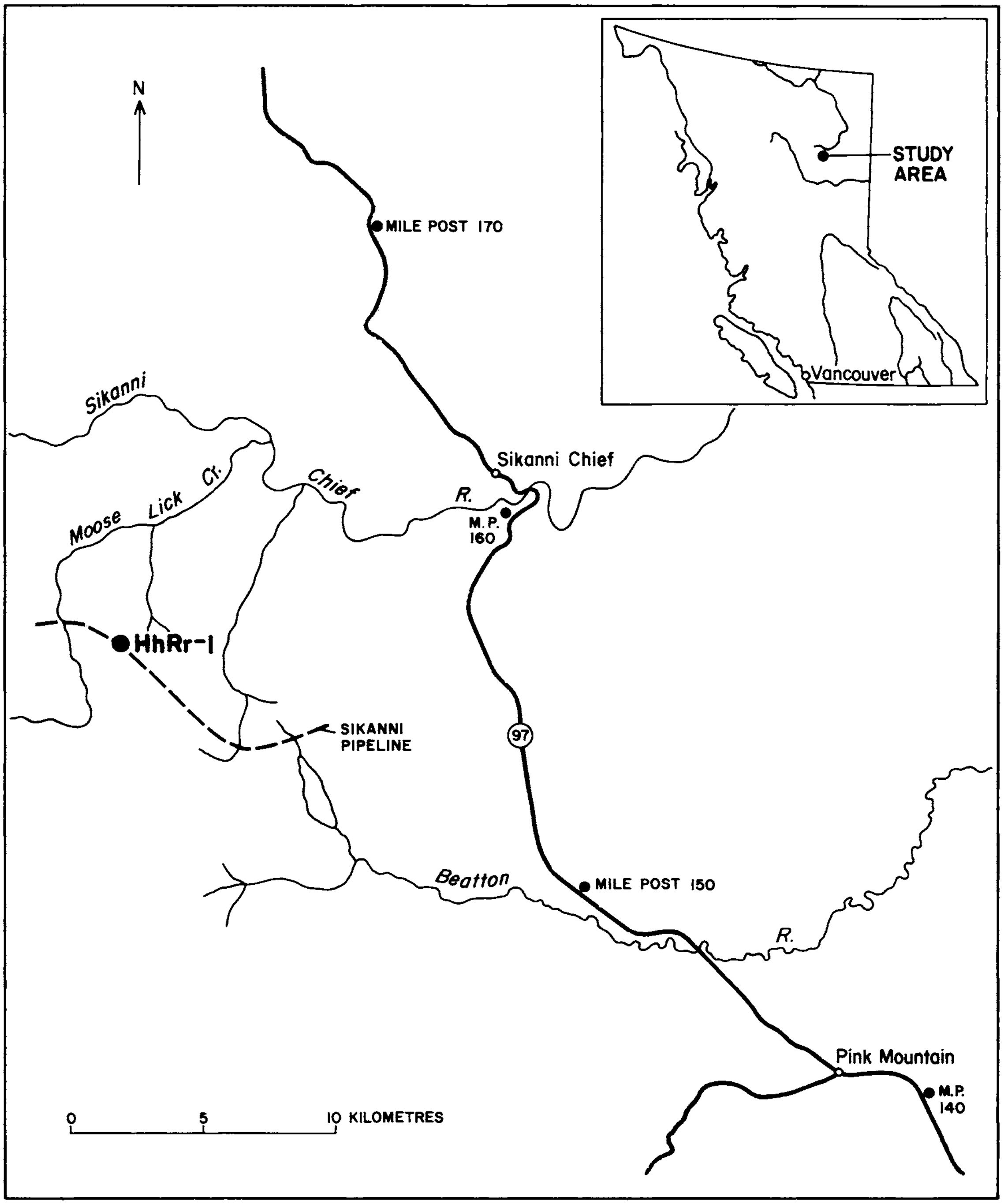

Figure 58. Location of site HhRr-1.

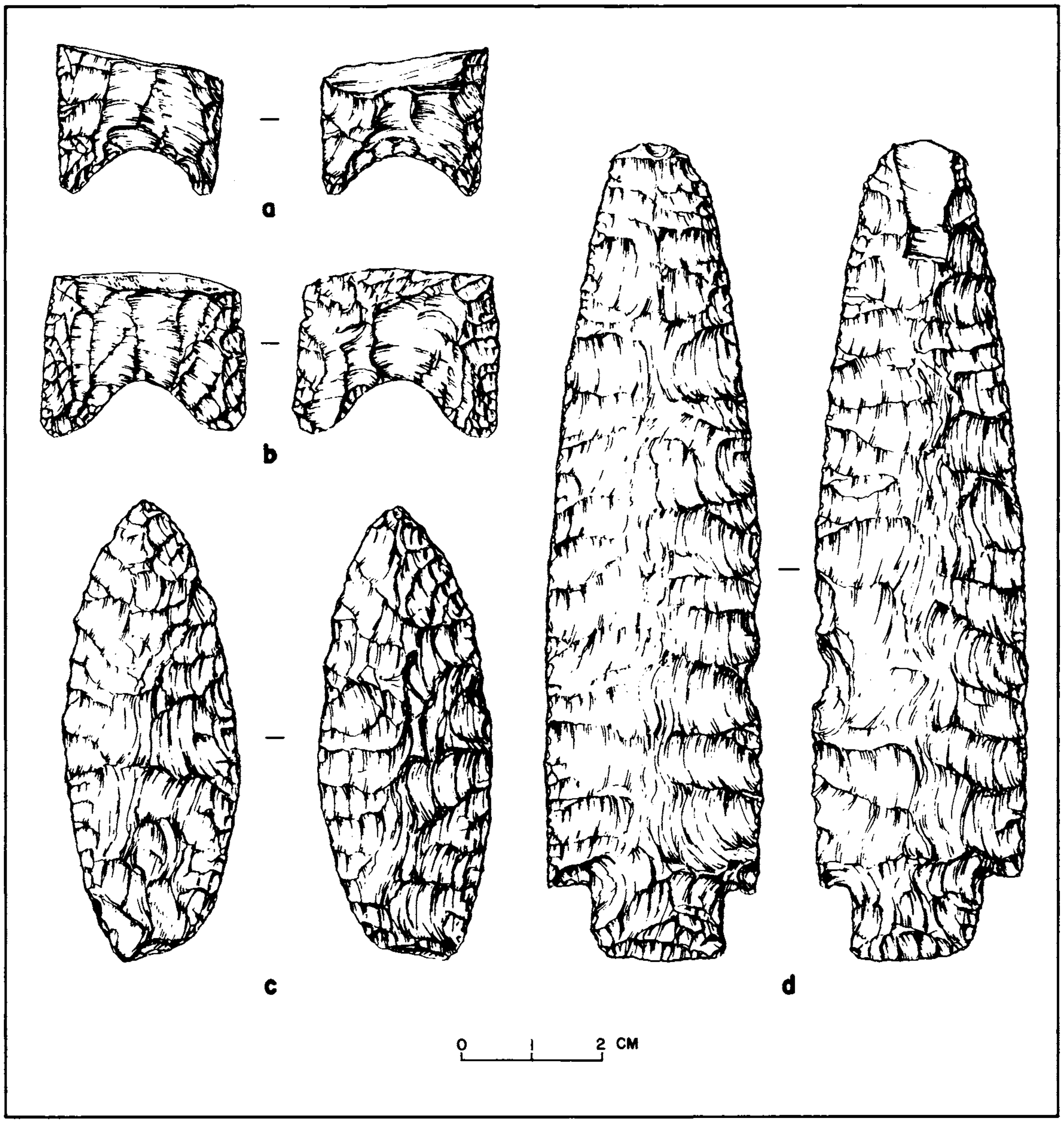

Figure 59. Sample of projectile points recovered from site HhRr-1: Clovis point bases - a and d; Lerma point - c; Scottsbluff point - d.

DISTRIBUTIONS OF NATIVE GROUPS IN WESTERN CANADA, A.D. 1700 TO A.D. 1850

By
Martin Magne
Archaeological Survey of Alberta
and
Contributors to the Saskatchewan-Alberta Dialogue

The maps that appear in the following pages are the product of a brain-storming session held at the conclusion of the Saskatchewan-Alberta Dialogue symposium held in Edmonton in January, 1986. During a discussion aimed at merging archaeological evidence, historic literature, anthropological theory and common sense regarding Native group distributions in the early historic period, the suggestion arose that participants should circulate a set of maps and attempt to compile an acceptable set of standards for this issue. The purpose of such an exercise, with foreseeable limitations, would be to develop a baseline for future studies of this genre. The five maps included here are the results of the ensuing year's correspondence.

The design of this research project was simple. After the initial suggestion to proceed, blank maps were sent to 25 researchers in Alberta and Saskatchewan, along with a letter asking them to outline Native group distributions within their areas of expertise. Fifty-year intervals were chosen, recognizing the difficulties inherent in imposing arbitrary time limits. Five sets of draft maps were returned, with a surprising consistency over the period of A.D. 1700 to A.D 1850. A compilation of these was assembled on a Macintosh computer and redistributed to the original mailing list. Fifteen sets of comments were returned; the maps were revised and drafted as they appear here. During this last compilation, David Meyer and Dale Russell included an extra map showing the routes of travel for writers of "primary published accounts of Native locations," mainly for Saskatchewan. This map was revised to include Alberta and appears here as Figure 60.

These maps contain several limitations that should be noted briefly here. Although this is hard to document throughout western Canada, there is no doubt that Native groups used large areas which overlapped with those of neighbouring groups. Furthermore, the seasonal movements of people were frequently wide ranging. Finally, several severe epidemics had the effect of drastically reducing the sizes of Native populations, as well as leading to considerable geographic displacement.

This exercise appears in "Research Notes" as a means to further refinement. The many comments now in hand with regard to the individual groups have become too cumbersome to compile coherently at this time. Hopefully, this current year will see some additional comments returned, following which a decision can be made as to whether or not to continue this venture in more detail. Please write to the Archaeological Survey of Alberta should you have observations to make.

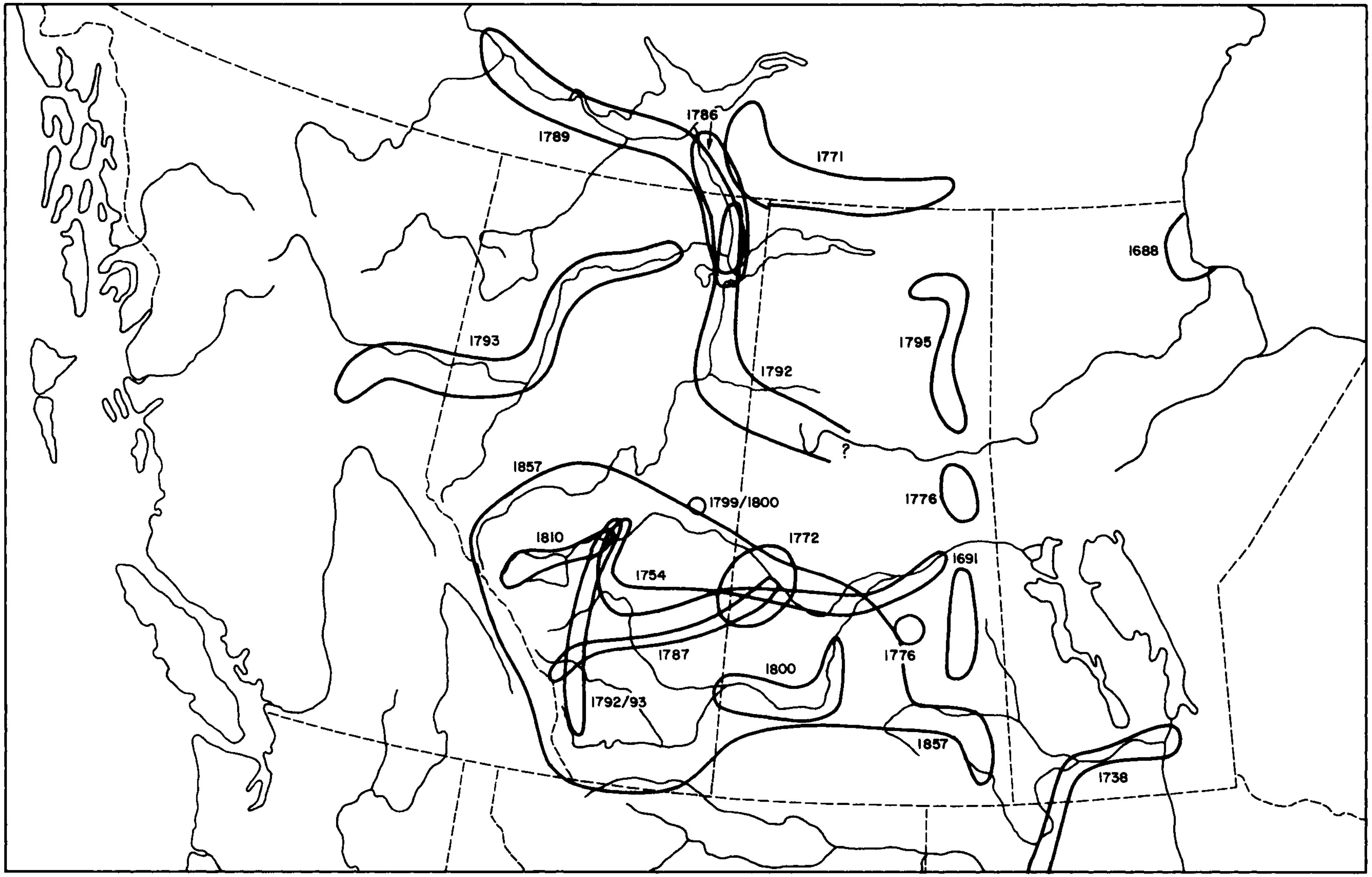
1789
1786
1771
1688
1793
1795
1792
?
1857
1799/1800
1776
1810
1772
1691
1754
1776
1787
1800
1792/93
1857
1738

Figure 60. Dates and general areas of travel of the authors of published primary accounts of Native locations in Saskatchewan and Alberta.

Year A.D.	Author
1688	Henry Kelsey
1691	Henry Kelsey
1738	Pierre La Verendrye
1754	Anthony Henday
1771	Samuel Hearne
1772	Mathew Cocking
1776	Alexander Henry the Elder
1786	Cuthbert Grant
1787	David Thompson
1789	Alexander Mackenzie
1792	Philip Turner
1792/93	Peter Fidler (archival)
1793	Alexander Mackenzie
1795	David Thompson
1799/1800	Peter Fidler
1810	Alexander Henry the Younger
1857	J. Palliser

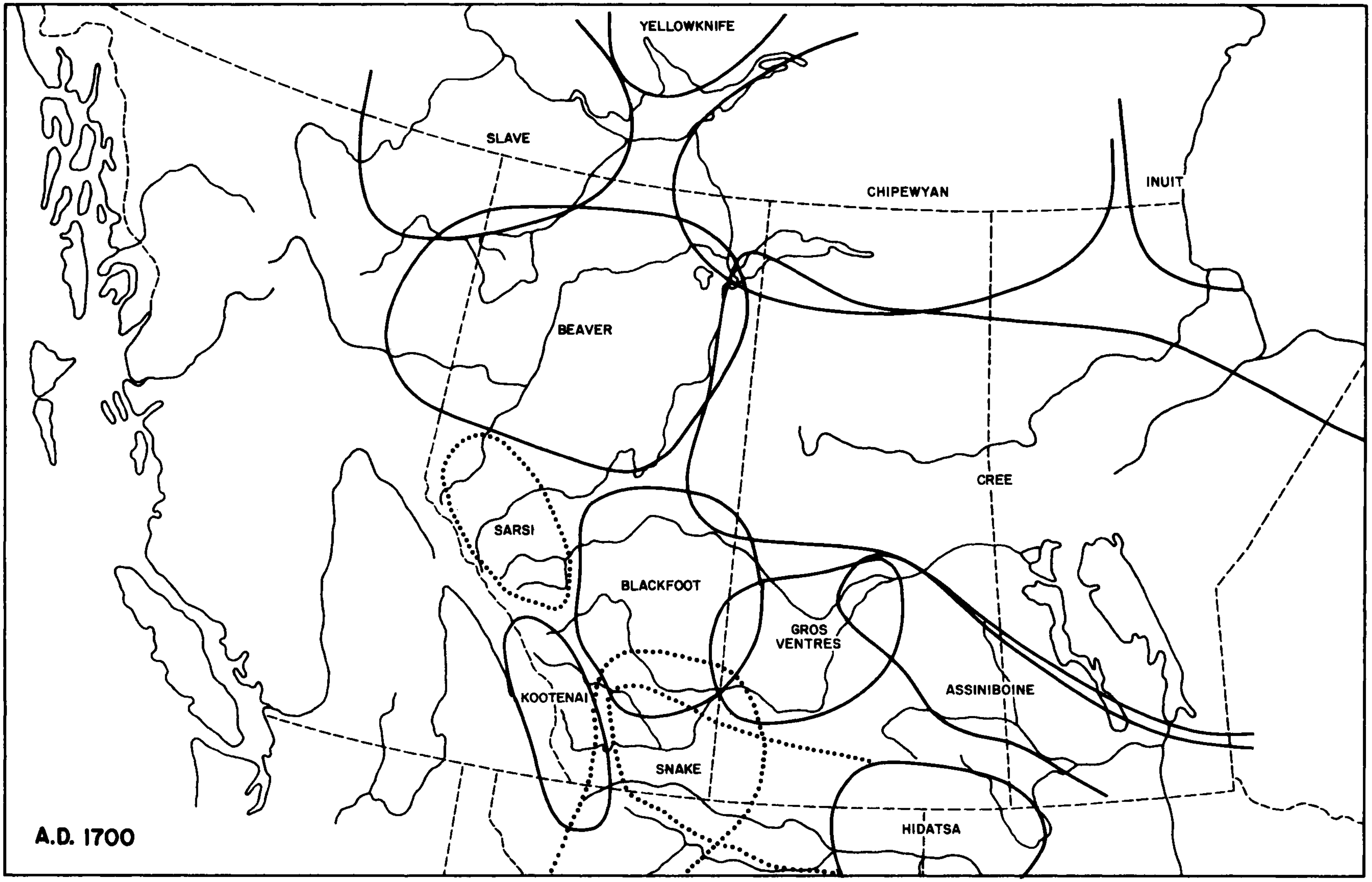
YELLOWKNIFE
SLAVE
CHIPEWYAN
INUIT
BEAVER
CREE
SARSI
BLACKFOOT
GROS
VENTRES
ASSINIBOINE
KOOTENAI
SNAKE
HIDATSA
A.D. 1700

Figure 61. Native group distributions, ca. A.D. 1700.

This map essentially represents the protohistoric situation. Notably, the Hidatsa extension northwestward at ca. A.D. 1725 is documented principally by the Cluny Earthlodge Village on the Bow River in Alberta and by noted ceramic occurrences in southern Alberta and Saskatchewan. The Snake distribution took the form of raiding parties extending into the southwestern Canadian plains and is not intended to indicate permanent occupancy. The Sarsi location is completely speculated at this time. It appears likely from most evidence that Beaver, Chipewyan and Cree used the western end of Lake Athabasca about this time. Certainly, it is clear that Beaver used lands well east of their later historic distributions and that Cree did not venture much farther west than the Athabasca River.

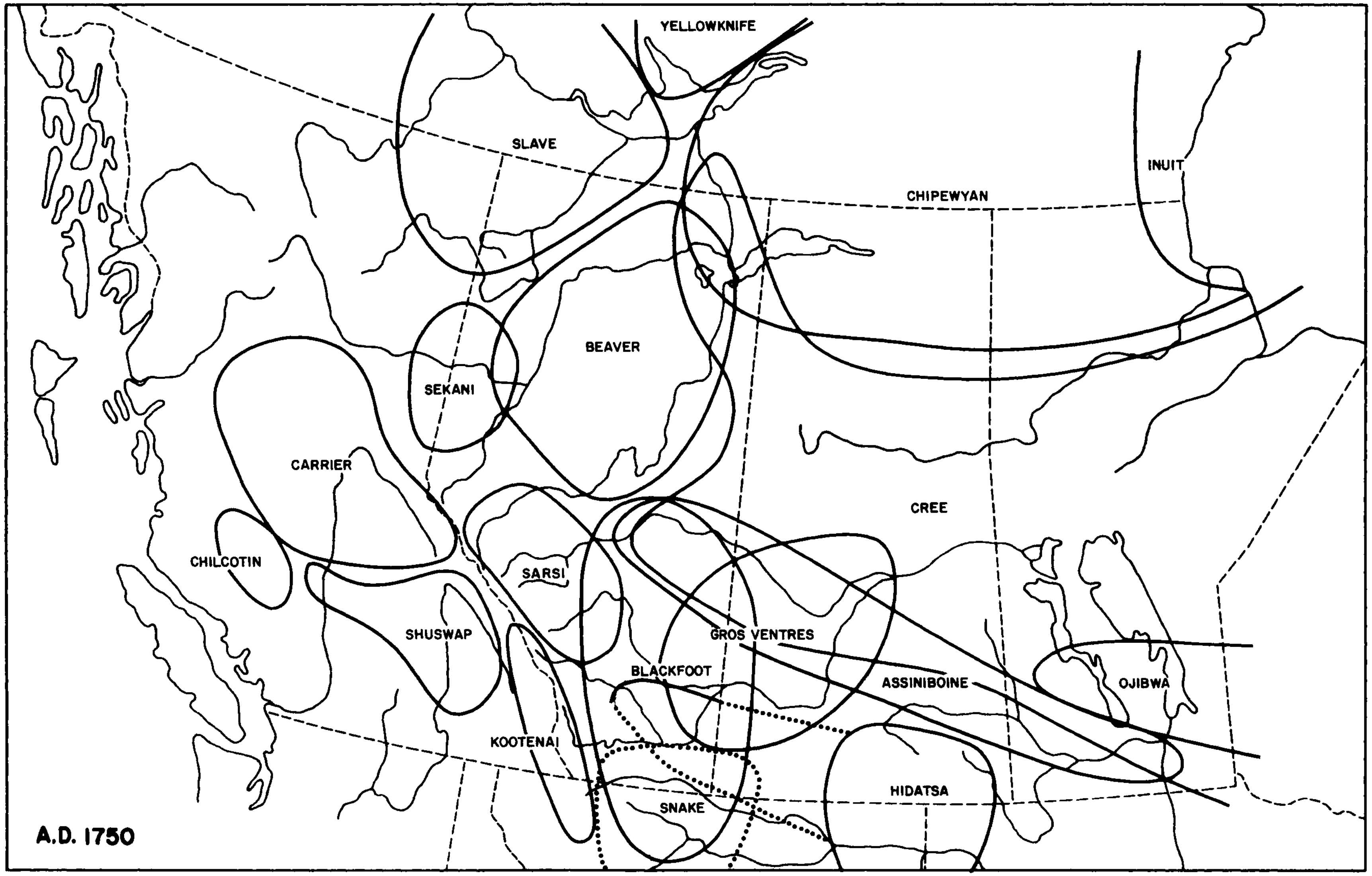
YELLOWKNIFE
SLAVE
INUIT
CHIPEWYAN
BEAVER
SEKANI
CARRIER
CREE
CHILCOTIN
SARSI
SHUSWAP
GROS VENTRES
BLACKFOOT
ASSINIBOINE
OJIBWA
KOOTENAI
HIDATSA
SNAKE
A.D. 1750

Figure 62. Native group distributions, ca. A.D. 1750.

This is a documented period of extensive movements of Native people in the early stages of the fur, gun and horse trade. Many, if not most, initial contacts with Natives began with Creek or Iroquois guides.

Cree began to move westward, encountering resistance from mainly Beaver and Blackfoot, and penetrated the Slave River. Chipewyan were known to travel to Hudson's Bay. A general expansion of Ojibwa distribution began in southern Manitoba. Assiniboine were noted for exceptionally distant travels. The Snake appeared in areas further south, accompanying a southward Blackfoot expansion. At this time, Sarsi were likely well integrated with Blackfoot. The Carrier, Chilcotin and Shuswap distributions are speculated from archaeological, ethnohistoric, and published evidence. Kootenai appear to have been in conflict with Blackfoot and pushed further into the foothills of the Rocky Mountains.

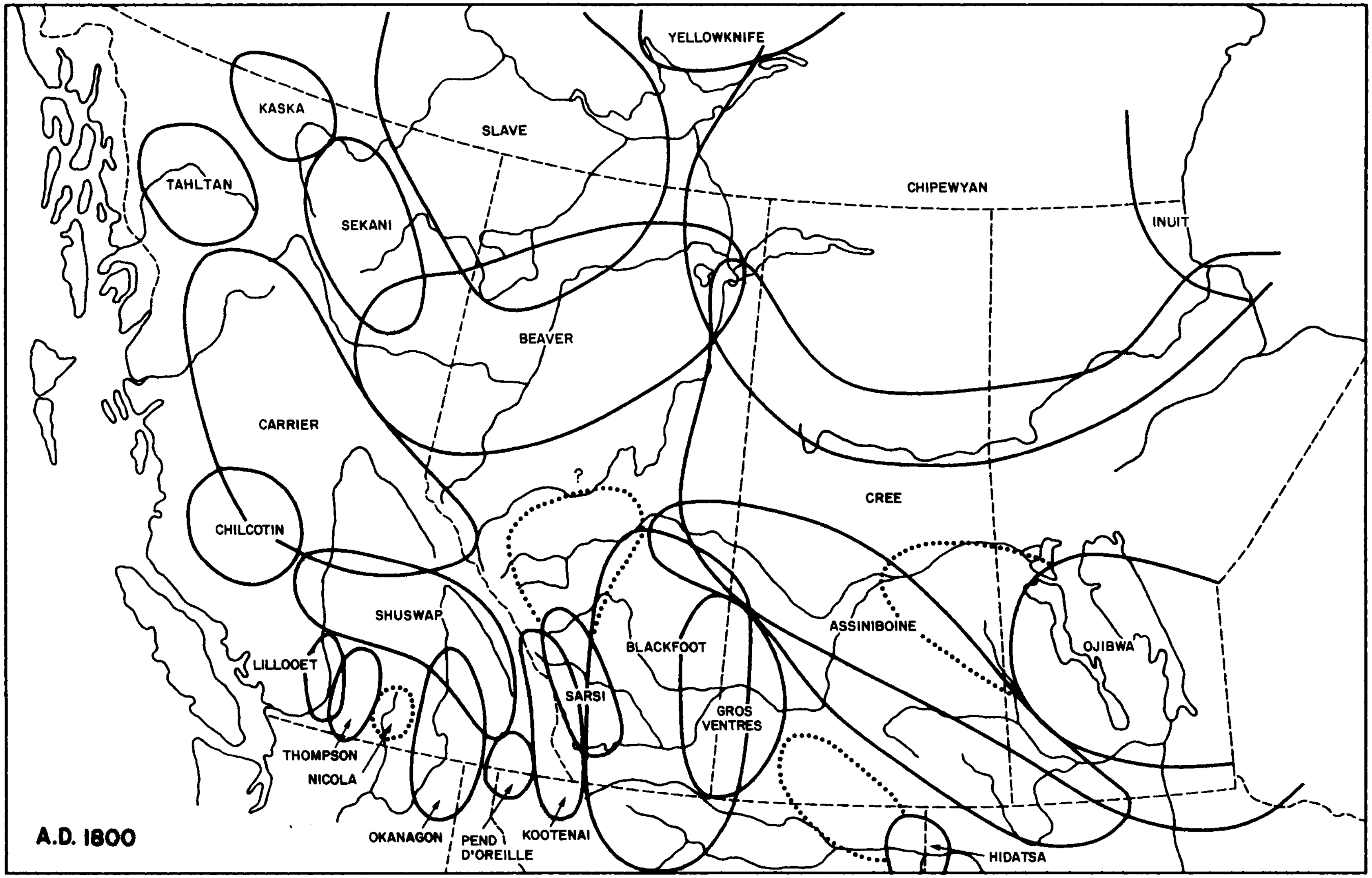
YELLOWKNIFE
KASKA
SLAVE
TAHLTAN
CHIPEWYAN
SEKANI
INUIT
BEAVER
CARRIER
?
CREE
CHILCOTIN
SHUSWAP
ASSINIBOINE
BLACKFOOT
OJIBWA
LILLOOET
SARSI
GROS VENTRES
THOMPSON
NICOLA
OKANAGON
PEND D'OREILLE
KOOTENAI
HIDATSA
A.D. 1800

Figure 63. Native group distributions, ca. A.D. 1800.

The Hidatsa main area of occupation is well documented. As with the Ojibwa, seasonal excursions were likely. Chipewyan travelled through territory immediately south of the Churchill River. Beaver and Sekani were distributed westward into northern British Columbia. Sarsi were known to Vermilion, battling Blackfoot who regularly used southern Alberta and northern Montana. Southern B.C. distributions are largely the observations of James Teit working with Franz Boas.

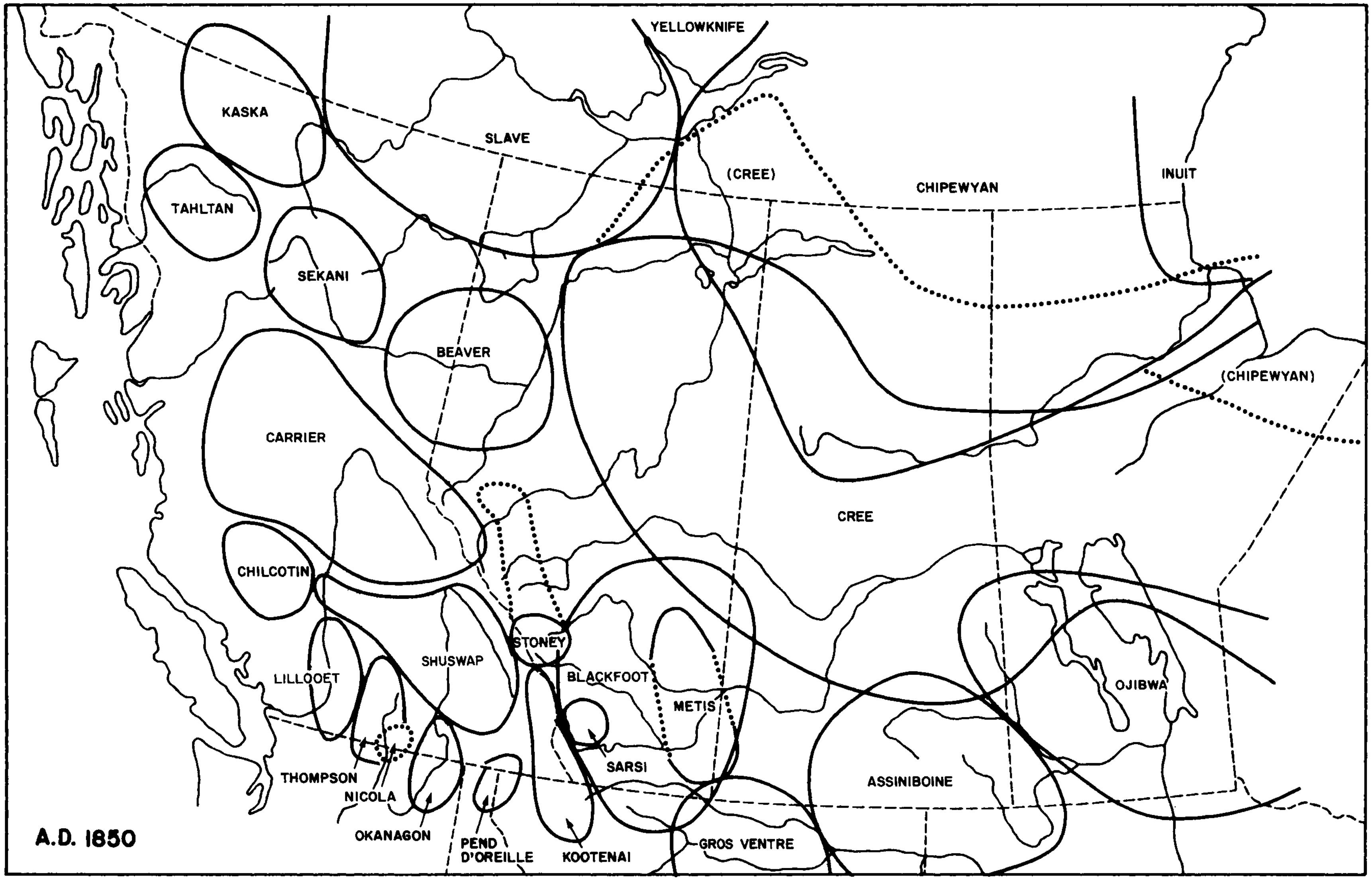
YELLOWKNIFE
KASKA
SLAVE
(CREE)
CHIPEWYAN
INUIT
TAHLTAN
SEKANI
BEAVER
(CHIPEWYAN)
CARRIER
CREE
CHILCOTIN
STONEY
SHUSWAP
LILLOOET
BLACKFOOT
OJIBWA
METIS
SARSI
THOMPSON
NICOLA
ASSINIBOINE
OKANAGON
PEND D'OREILLE
KOOTENAI
GROS VENTRE
A.D. 1850

Figure 64. Native group distributions, ca. A.D. 1850.

By this time, existed a sizeable population of Metis throughout the southern Canadian plains, and their distribution here is intended to indicate the beginning of a general northward movement in Alberta. Also, Stoney Iroquois occupied the Kootenay Plains area of the North Saskatchewan River, with known appearances further north. Most groups had been subjected to smallpox and influenza epidemics and reductions in game. Gros Ventres had moved considerably further south, as had the Assiniboine. Cree had expanded into central Alberta and southern Northwest Territories. Beaver distribution was much further westward than before. Beaver abandonment of the Lesser Slave Lake area is documented.

LIST OF CONTRIBUTORS:

Tom Andrews, Dene Mapping Project, University of Alberta (Dene, Slave, Chipewyan)

Bruce Ball, Archaeological Survey of Alberta (Sarsi, Blackfoot, Gros Ventres)

Jack Brink, Archaeological Survey of Alberta (Blackfoot, Snake, Gros Ventres, Assiniboine, Kootenai, Sarsi, general)

W.J. Byrne, Historical Resources Division, Alberta Culture and Multiculturalism (Blackfoot, Hidatsa)

Maurice Doll, Provincial Museum of Alberta (general)

Anthony Fisher, Department of Anthropology, University of Alberta (general)

Michael Forsman, Archaeological Survey of Alberta (primary accounts)

John Foster, Department of History, University of Alberta (Cree, Blackfoot, Ojibwa, Assiniboine, Chipewyan, Beaver, general)

Cliff Hickey, Department of Anthropology, University of Alberta (general)

Jack Ives, Archaeological Survey of Alberta (Beaver, Slave, Chipewyan, Cree, primary accounts)

Wendy Johnson, Archaeological Survey of Alberta (drafting)

David Meyer, Saskatchewan Research Council (Chipewyan, Cree, Assiniboine, Gros Ventres, Hidatsa, Snake, Ojibwa, Inuit, general)

Pat McCormack, Provincial Museum of Alberta (Beaver, Chipewyan, Cree)

Heinz Pyszczyk, Archaeological Survey of Alberta (primary accounts)

Dale Russell, Saskatchewan Research Council (Cree, Chipewyan, Gros Ventres, Assiniboine, Snake, Ojibwa, Inuit, general)

Rod Vickers, Archaeological Survey of Alberta (Blackfoot, Gros Ventres, Assiniboine, Snake, Hidatsa, Macintosh drafts)

ADDITIONAL SESSION SHAKERS:

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Brian Spurling, Archaeological Resource Management, Saskatchewan Parks, Recreation and Culture

I am grateful to all of these people for their ideas; however, final responsibility for the maps is completely my own.

A CONSIDERATION OF SEMI-QUANTITATIVE X-RAY FLUORESCENCE ANALYSIS USED IN OBSIDIAN SOURCE CHARACTERIZATION

By
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and
J. M. D'Auria
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Obsidian source analysis is an archaeometric pursuit which is appreciated by archaeologists and geologists alike. Applications of this form of scientific enquiry are found throughout the world. Not only does it shed light on the geochemistry of volcanic terrains, but it has been particularly fruitful in elucidating the patterns and paths of material exchange and thus of long-distance contacts, sometimes on a continental scale, among aboriginal societies in the past in North America and elsewhere.

The key to the success of obsidian source analysis in archaeological studies is the fact that natural occurrences of obsidian are relatively rare and that they can usually be distinguished from each other on the basis of their chemical compositions. However, the assumption that the chemical composition of an obsidian flow is uniform throughout and clearly distinct from the chemical composition of all flows in other areas is not always true. For example, Bowman et al. (1973), who tested the assumption of chemical uniformity on a single obsidian flow, concluded that the chemical composition was not uniform, but it varied in a systematic manner. Similarly, although macroscopic homogeneity of the obsidian, a natural volcanic glass, is assumed, this does not always reflect its real nature. Using suitable instruments, both microscopic and submicroscopic inhomogeneities in the form of crystalline inclusions can be observed in some obsidians (for an example, see Appendix B in Godfrey-Smith 1985). It is important to bear these two facts in mind when results of obsidian source analysis are presented. Chemical distinctness and homogeneity are approximations only, and unrecognized flow variability may result in errors of source attribution for artifacts.

In energy-dispersive x-ray fluorescence (ED-XRF), a sample is bombarded with high-energy lines characteristic of a secondary target. This causes lower-energy x-rays, characteristic of the elements in the sample, to be emitted. The x-rays emitted by the sample are detected using a Si(Li) detector and pulse-height analysis electronics. For obsidian analysis, our XRF spectrometer is equipped with a silver (Ag) secondary target, which enables the detection of elements from potassium (K) to niobium (Nb). The XRF spectrometer is operated at 40 keV and 12 to 25 mA; each sample is measured for 10 minutes. Further details of the instrumentation and operation can be found in Nelson et al. (1975) and Godfrey-Smith (1985).

The physical details of x-ray fluorescence are such that x-ray emission by an element is most efficient for x-rays whose energy is just lower than the energy of the x-rays emitted by the secondary target. For an Ag secondary target, the exciting x-rays are at approximately 21 keV, and the detection of x-rays at 3-18 keV is possible. However, the detection efficiency is very much greater in the 13-18 keV range than in the lower part of the x-ray energy spectrum. Although potassium and calcium are present in obsidian in high concentrations (percent by weight), they are detected much more weakly than the trace elements Rb, Sr, Y, Zr and Nb, which are present only in parts per million concentrations.

Because of the manner in which x-rays of different energies are transmitted and absorbed by the obsidian matrix, the thickness of the sample being measured will affect the results. A very thin sample will yield significantly higher values for Fe and slightly lower values for Zr and Nb than a thick sample (see Bollong 1983). In an archaeological application, this may result in slightly different spectra being obtained from a microblade and its core, for example. Since artifacts may vary in thickness from a fraction of a millimetre for retouch flakes to centimetres for large bifaces, scrapers and cores, this source of variability needs to be taken into account in the interpretation of numerical data obtained from the analysis.

Finally, changes in the instrumental setup over time may alter the relative element ratios obtained from the same standard rock. It is very important that such instrumental drift is closely and continually monitored and accounted for during the analysis of artifacts, and that the results of artifact measurements are compared to the results of recent source material measurements.

The foregoing is intended as a cautionary note to potential users of XRF analysis for the source characterization of obsidian artifacts. Intelligent evaluation of true chemical differences must be based on the knowledge of the relative contributions to error from intrinsic chemical differences and the variations in instrumental and artifact parameters. It is important, therefore, to include elemental standards (preferably obsidian source material standards) with every analytical run, since this makes the discrimination of the sources of variation much easier. Unfortunately, despite good experimental procedures, it is possible for errors to occur, especially if the analyst lacks experience. Errors such as these are found in James (1986). The following points endeavour to correct these inaccuracies in order that the data presented therein may be of use without misinterpretation.

(1) The peaks in the second group of peaks in all the spectra in Figures 41 and 42, are Rb, Sr, Y, Zr, Nb, Zr K-beta. They are not, as labeled, Kr, Rb, Sr, Y, Zr, Nb. A typical spectrum, correctly labeled, obtained from Mount Edziza flow type #3 is shown below in Figure 65. Also, the element Ga is incorrectly identified in James (1986:92) as galenium; its correct name is gallium.

(2) The peak attributed to As (arsenic) is actually due to Pb (lead). Such an error of interpretation can occur when two elements emit x-rays of the same energy. In this case, the K-alpha emission line of As (10.54 keV) and the L-alpha emmission line of Pb (10.55 keV) cannot be resolved. The only way to discriminate between the two elements instrumentally is on the basis of the corresponding K-beta and L-beta emission lines. These are 11.8 keV for As and 12.6 keV for Pb. However, because the K-beta and L-beta peak has a much lower intensity than the corresponding K-alpha or L-alpha peak, and the 10.54 keV peak is small in this case, an instrumental resolution is not possible. A properly conservative approach would be to quote the peak as As/Pb, indicating that it could be either or both. Arsenic can be eliminated, however, on the basis of _a priori_ knowledge of geochemistry. This element is not one of the

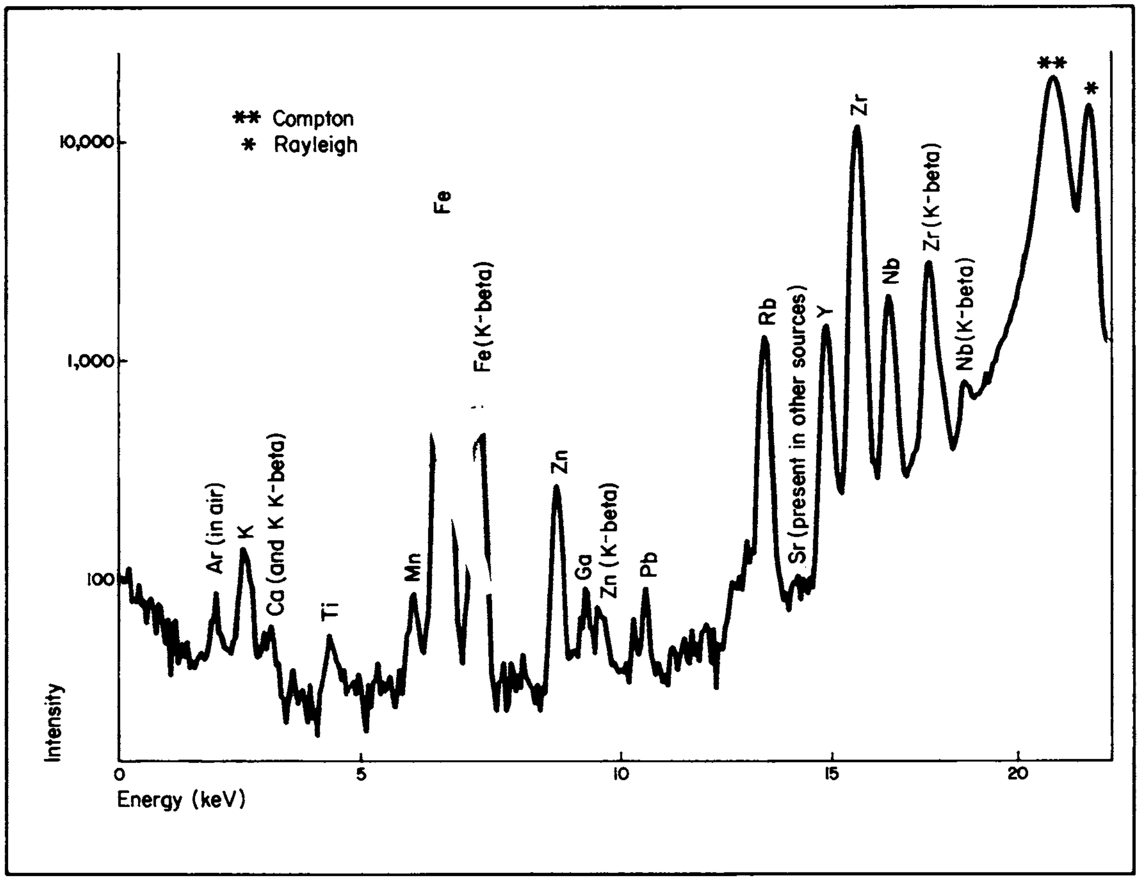

Figure 65. A typical ED-XRF spectrum of an obsidian rock (Mount Edziza, flow #3) showing the elements detected using an Ag secondary target. All peaks are due to the K-alpha x-rays, except where noted.

constituents of rhyolitic obsidian glass (S.E. Calvert, personal communication 1984). Thus, the peak in question should be interpreted as due to Pb.

(3) The vertical scales for all the graphs in Figures 41 and 42 are logarithmic. An unlabelled scale (a practice to be deplored) is normally interpreted as being linear, thus it is particularly important that non-linear scales are clearly marked. With a logarithmic scale, even slight differences in the peak heights on a graph reflect very large differences in peak counts. For example, the source spectra of Suemez Island (Alaska) and Ilgachuz 1 (Central British Columbia) obsidian source material appear very similar, although the element ratios of these sources show them to be distinct (see Figure 66 and Table 22).

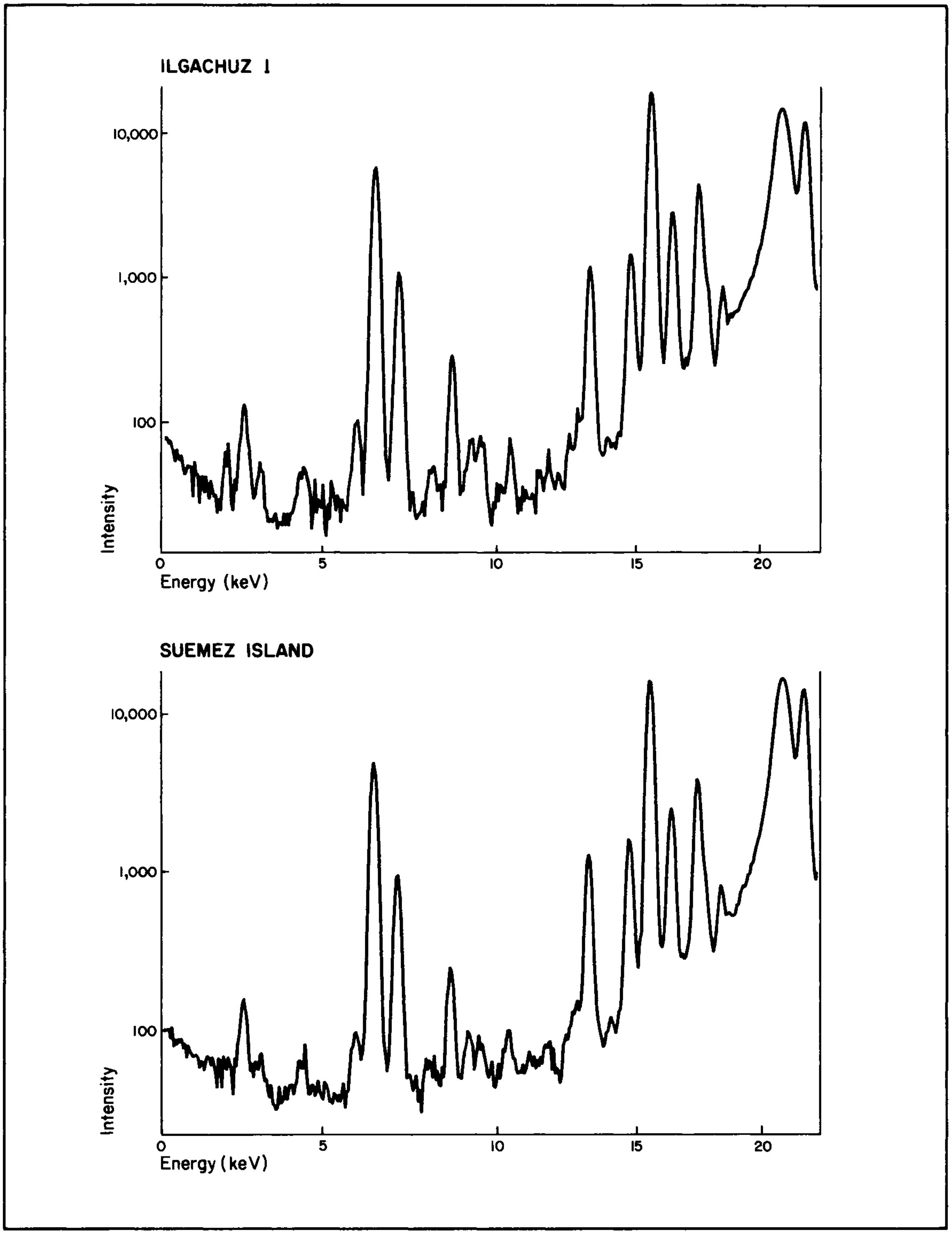

Figure 66. ED-XRF spectra of obsidian from the Suemez Island and Ilgachuz 1 source localities.

Table 22. A comparison of relative peak areas in two unrelated obsidian sources which show very similar XRF spectra.

	SUEMEZ I.		ILGACHUZ 1	
	Mean	Std.	Mean	Std.
Fe	270.9	11.7	325.5	21.1
Zn	9.7	0.4	10.6	0.6
Rb	73.4	5.5	57.8	1.4
Sr	0.0	0.0	0.0	0.0
Y	85.1	1.6	68.4	2.3
Zr	938.5	20.7	880.6	32.8
Nb	134.3	2.3	143.0	3.2
Rayleigh	770.7	4.1	714.6	41.4

All peaks are normalized to the Compton scatter peak.
Mean = mean peak area
Std. = standard deviation in the mean

In cases where obsidian source materials from different areas have similar spectra, it is easy to attribute an artifact to the wrong source or to the wrong flow of a source on the basis of a graph alone. However, it is sometime possible to identify an obsidian source on the basis of a spectrum alone, if the source has been well-studied and has a spectrum which is clearly distinct from the spectra of all other sources. In any case, a proper numerical analysis is required to confirm or reject a preliminary visual interpretation and should therefore be included in all reports dealing with the source characterization of artifacts. Deletion of tables of numerical data in the interest of brevity in reports is not a sound practice.

(4) In view of the above discussion, it cannot be concluded that both artifacts from FfQm-26 represent the same obsidian source since a number of source flows in central and northern British Columbia and Alaska have very similar spectra. The spectra shown exhibit several differences in the relative heights of the peaks labeled Sr, Y and Zr (actually Y, Zr and Nb) that may, in numerical analysis, have resulted in different source attributions. However, the artifacts attributed to the Anahim 1 and Yellowstone sources are probably

identified correctly, since both sources have spectra which are distinct from those of other sources.

(5) The source in Yellowstone National Park is not only known, but it is the best known one on the entire North American continent. This obsidian type is found at Obsidian Cliff in Yellowstone Park, with clasts of the material also occurring in nearby Obsidian and Crystal creeks (Anderson et al. 1986). The source is often referred to as Obsidian Cliff, Yellowstone Park. Other obsidian occurrences in Yellowstone Park, more distant from Obsidian Cliff and representing different flows, yield different spectra.

In summary, it is useful to reiterate that semi-quantitative ED-XRF is a powerful technique for the identification of the sources of obsidian artifacts, since it is both fast and non-destructive. The ease with which it is applied, however, should not lead to an oversimplification of the analytical procedures which follow measurement. In all manner of scientific endeavour, data collection procedures can be easily learned, but the meaningful interpretation of data is the result of both sufficient theoretical knowledge and experience.

ACKNOWLEDGEMENTS

The work discussed above was performed at the XRF laboratory in the Chemistry Department, Simon Fraser University and was partly supported by the Natural Sciences and Engineering Research Council. Many thanks to C. Campbell of Anchorage, Alaska for submission of obsidian source material from Suemez Island; to D.E. Nelson for his permission to use the obsidian source collection at SFU; to Malcolm James for discussions on the preliminary form of this report; and to D.J. Huntley for his comments. The computer program for data analysis was provided by M. Cackette.

ABSTRACTS FOR 1986 PERMITS

Compiled by
Martina Purdon

The following abstracts represent those for 1986 permits available at the time of publication. We thank all those permit holders who submitted abstracts by our publication deadline.

86-1

Rebecca J. Balcom
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Alberta Transportation
Cranford Gravel Pit

PROJECT TYPE: Reconnaissance and mapping at DlPb-2

LOCATION/SETTING: Native prairie on the south upper terrace of the Oldman River, about 13 km northwest of Taber. About 13 of the 69 hectares have been disturbed by gravel pit operations.

METHODOLOGY: The entire lease area was examined by means of several narrowly spaced foot traverses. Exposures, such as road cuts and those made by the pit excavations, were examined. The site was mapped by compass and chain, and site features were staked and flagged. Bearings and distances were taken from the gravel test pits which have been surveyed by Alberta Transportation. Notes were taken on all site features.

RESULTS: Eighty rings, five cairns, one rock alignment and several lithic concentrations were recorded. Most of these features are in danger of impact.

SITE TYPE: Prehistoric encampment

REPORT: Complete, entitled "Historical Resources Reconnaissance and Mapping Program Cranford Gravel Pit Final Report, Permit 86-1," by Rebecca J. Balcom

86-2

John Brumley
Ethos Consultants Ltd.
Group Box 20, Veinerville
Medicine Hat, Alberta

Lacana Petroleum Ltd.
Natural Gas Developments
near Matziwin

PROJECT TYPE: HRIA

LOCATION/SETTING: Matziwin area of south-central Alberta. The project area includes portions of the Red Deer River valley and the prairie surface adjoining it.

METHODOLOGY: Foot traverse of all development locations

RESULTS: Three previously recorded sites (EgOx-30, 31 and 64) were examined and evaluated in terms of the proposed development. As well, a previously unrecorded site (EgOx-65) was located, recorded and evaluated.

SITE TYPES: Historic farmstead and stone circles

REPORT: Complete, entitled "An Historical Resources Impact Assessment of Natural Gas Development Locations in the Matziwin Area of South Central Alberta - Final Report," by John H. Brumley

86-3C	**Barry J. Dau** **Ethos Consultants Ltd.** **Group Box 20, Veinerville** **Medicine Hat, Alberta**	**Alberta Environment** **Oldman River Dam Project**

PROJECT TYPE: HRIA

LOCATION/SETTING: The project area is located north of Pincher Creek, on both sides of the Oldman River, immediately downstream from the proposed Oldman River Dam.

METHODOLOGY: The projected consisted of foot traverse surveys of two proposed borrow source locales on the north and south sides of the river, a proposed construction camp locale, a proposed access road and a proposed stockpile area on the north side of the river; a backhoe testing program on the observed terraces within the borrow source locale; and an auger testing program at those sites threatened with immediate disturbance due to construction camp development.

RESULTS: During the course of the project, two historic sites (a stone foundation and a bridge or ferry crossing) and eight prehistoric sites (DjPl-28, 29, 58, 78, 100, 121, 132, 133) were assessed. All but two of the prehistoric sites had been previously recorded. Auger testing was completed at sites DjPl-28, 100, 121, 132 and 133. Sites DjPl-78 and 100 were fenced off to protect them from current development.

SITE TYPES: Historic sites (2), stone circles (6), stone circle/cairn, stone circle/buried camp

REPORT: Complete, entitled "An Historic Resource Impact Assessment of a Series of Proposed Developments at the Oldman River Dam, Southwestern Alberta - A.S.A. Permit 86-3," by Barry J. Dau

86-4	**Rebecca J. Balcom** **ARESCO Ltd.** **2912 - 18 Street N.E.** **Calgary, Alberta**	**City of Medicine Hat** **East Glen In-fill** **East of Carry Drive** **Highway 1 Upgrading**

PROJECT TYPE: HRIA

LOCATION/SETTING: Located within the city of Medicine Hat, the subdivision is 7.8 ha in size and lies in an area of native prairie overlooking Ross Creek. The portion of Highway 1 to be upgraded is 2.8 km in length and traverses lands which have been disturbed by ploughing, topsoil stripping or previous road construction.

METHODOLOGY: The development areas were walked and shovel tested where necessary. EaOp-37, located in the proposed subdivision, was later mitigated by means of a 2,000 square metre controlled surface collection and excavation of twenty 0.5 x 0.5 m test units.

RESULTS: Two sites (EaOp-37 and 38) were located at the proposed subdivision and three sites (EaOp-39, DlOp-17 and 18) were located within the proposed highway upgrading. Only small amounts of debitage were collected from the sites, except at EaOp-37 where 438 pieces of material were recovered. No diagnostics were found at any of the sites.

SITE TYPES: Campsites and small lithic scatters

REPORT: Complete, entitled "Historical Resources Impact Assessment and Mitigation East Glen In-fill East of Carry Drive and City of Medicine Hat Highway Upgrading, Final Report, Permit 86-4," by Rebecca J. Balcom

86-5

Barry J. Dau
Ethos Consultants Ltd.
Group Box 20, Veinerville
Medicine Hat, Alberta

NovaCorp International
Consulting Ltd.
Medicine Hat -
Manyberries Pipeline

PROJECT TYPE: HRIA

LOCATION/SETTING: The project area extended southward from Medicine Hat to the vicinity of the village of Manyberries.

METHODOLOGY: The 81 km proposed pipeline route was surveyed by foot and vehicle traverse. Uncultivated portions (40 km) of the right-of-way were examined more closely. These were situated within and adjacent to stream drainage channels or on open prairie.

RESULTS: Five new stone circle sites (DjOq-1 to 5) and two new surface scatter/lithic quarry sites (DkOq-9 and 10) were recorded. No diagnostic cultural materials were noted in any of the sites.

SITE TYPES: Stone circles (5) and surface scatters/lithic quarries (2)

REPORT: Complete, entitled "An Historic Resources Impact Assessment of a Proposed Pipeline between Medicine Hat and Manyberries, Southeastern Alberta," by Barry J. Dau

86-6 **Edward J. McCullough** **Nova, An Alberta Corporation Milo Pipeline Project**
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed project consisted of a realignment of a portion of the pipeline right-of-way discussed in the results of investigations conducted under permit 85-93. The project area is directly north of Badger Lake in the grasslands of southern Alberta.

METHODOLOGY: Fortuitous natural exposures and visual inspection for surface features were used to identify the existence of prehistoric remains.

RESULTS: Three prehistoric sites (EcPc-73, EdPc-67 and 68) were newly recorded, and one previously recorded site (EdPd-16) was reassessed relative to the new alignment.

SITE TYPES: Isolated find and stone feature sites

DATES: Unknown

REPORT: Complete, entitled "Historical Resources Impact Assessment Nova, An Alberta Corporation Milo Pipeline Project," by Edward J. McCullough

86-7 **Rebecca J. Balcom** **Canadian Western Natural Gas Taber to Bow Island Pipeline**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed pipeline extends from east of Taber to north of Bow Island. It is approximately 50 km in length and runs more or less parallel to the Oldman and South Saskatchewan rivers. Approximately 14 km of pipeline was selected by the Archaeological Survey of Alberta to be examined. These areas exhibited higher potential than the remainder of the route. About 7.4 km of the route inspected crossed ploughed fields and about 6.6 km crossed native prairie.

METHODOLOGY: The entire pipeline was spot checked to ensure that there were no areas of native prairie that had not been defined on the basis of the map study. Shovel tests were excavated in areas exhibiting moderate to high potential for historical resources but lacking in exposures, where the possibility of buried cultural material existed, and at sites. Sites located during the impact assessment were recorded, photographed and sketched. The sites were shovel tested to aid in the evaluation of their significance.

RESULTS: Six sites were recorded on or near the pipeline. Three were located in the native prairie on the upper south terrace of the Oldman River and three were located in ploughed fields.

SITE TYPES: Tipi rings, tipi ring and lithic scatter and isolated finds

REPORT: Complete, entitled "Historical Resources Impact Assessment Taber to Bow Island Pipeline Final Report, Permit 86-7," by Rebecca J. Balcom

86-8 **John Pollock**
Settlement Surveys Ltd.
P.O. Box 2529
New Liskeard, Ontario

Meridian Surveys Ltd.
Lac La Biche Subdivision

PROJECT TYPE: HRIA

LOCATION/SETTING: Lot B, part of Lot 47, Lac La Biche Settlement

METHODOLOGY: Judgemental foot traverses with surface and subsurface testing

RESULTS: One prehistoric site (GePa-48) was located on the second terrace up from Lac La Biche.

SITE TYPE: Isolated find (quartzite flake)

REPORT: Complete, entitled "Historical Resources Impact Assessment Lot B, Part of Lot 47, Lac La Biche Settlement," by Settlement Surveys Ltd.

86-9 **John Pollock**
Settlement Surveys Ltd.
P.O. Box 2529
New Liskeard, Ontario

Meridian Surveys Ltd.
Lac La Biche Subdivision

PROJECT TYPE: HRIA

LOCATION/SETTING: Lot A, Part of Riverlot 68, Lac La Biche Settlement. The area has been severely disturbed by previous tree clearing operations undertaken by the former owner.

METHODOLOGY: Intensive subsurface and surface inspection

RESULTS: One site (GeOx-56) was located on a high bluff near the shore of Lac La Biche.

SITE TYPES: Scattered buried campsite consisting of quartzite flakes

REPORT: Complete, entitled "Historical Resources Impact Assessment Part of Lot A, Riverlot 68 Lac La Biche Settlement," by John Pollock

86-10	**Richard Callaghan** ARESCO Ltd. **2912 - 18 Street N.E.** **Calgary, Alberta**	**Genstar Development Co.** **Sundance Storm Trunk** Line

PROJECT TYPE: HRIA

LOCATION/SETTING: South Calgary, west of the Bow River. The line runs from the river westward across the valley floor, up the valley wall, and for a short distance over prairie level. The total length of the line is 1.2 km.

METHODOLOGY: The entire line was inspected on foot. Extensive vertical and horizontal exposures existed where surface disturbance and ditching had occurred; these were closely examined. In localities of limited visibility, test holes were excavated by hand.

RESULTS: No cultural material was found; however, considerably more deposition than expected was observed running back from the valley rim.

REPORT: Complete, entitled "Historical Resources Impact Assessment Fish Creek Area Development Sundance Storm Trunk Line, Final Report, Permit 86-10," by Richard Callaghan

86-11	**Peter T. Bobrowsky** **P.T.B. Consulting** **4604 - 119 Avenue** **Edmonton, Alberta**	**Daltam Consulting Ltd.** **Residential Subdivision**

PROJECT TYPE: HRIA

LOCATION/SETTING: East of Elk Point, north side of the North Saskatchewan River, east side of Laurier Lake

METHODOLOGY: Systematic foot traverse of the shoreline area encompassing 34 ha. A total of 35 shovel test holes was excavated in areas judgementally deemed to be of high potential. Sediment was not screened.

RESULTS: Known prehistoric site FlOp-5 was relocated. No additional historical, archaeological or palaeontological sites were found in the study area.

SITE TYPE: Isolated find

REPORT: Incomplete

86-12 | **B.O.K. Reeves**
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Canuck GIE Engineering
Joffre Nitrogen Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The study area is situated in the parklands ecotone of south central Alberta, east of Red Deer and north of the Red Deer River.

METHODOLOGY: Surface inspection, supplemented by subsurface shovel prospecting, was made of 37.7 km of pipeline rights-of-way. FbPj-14 was assessed utilizing both backhoe and hand excavations.

RESULTS: One prehistoric site (FbPj-14) was located on the Red Deer River. During assessment of FbPj-14, a variety of artifacts (knives, wedges, choppers and retouched flakes), other cultural materials (fire-cracked rock and bone) and features (rock-filled hearths and surface and buried ring rocks) were noted and recorded.

SITE TYPE: Prehistoric campsite

RESULTS: Complete, entitled "Historical Resources Impact Assessment Alberta Energy Company Ltd. Joffre Nitrogen Project," by B.O.K. Reeves

86-14 | **Barry J. Dau**
Ethos Consultants Ltd.
Group Box 20, Veinerville
Medicine Hat, Alberta

Alberta Environment
Construction Camp,
Oldman River Dam Project

PROJECT TYPE: Mitigation

LOCATION/SETTING: The project area is located on the north side of the Oldman River, north of Pincher Creek, immediately downstream from the proposed Oldman River Dam.

METHODOLOGY: The project consisted of the detailed mapping of the stone circles in three sites (DlPd-28, 121 and 132) and a detailed surface collection at one stone circle at site DjPl-132. All three sites were threatened with disturbance due to the construction of the main construction camp associated with the Oldman River Dam.

RESULTS: Seven stone circles and a single cairn were mapped at the three sites in question. In addition, 17 pieces of cultural material were recovered from the surface within and adjacent to stone circle 1 at site DjPl-132. No cultural diagnostics were found during surface collection.

SITE TYPES: Stone circles

REPORT: Complete, entitled "An Historic Resources Mitigation Project at the Oldman River Dam, Southwestern Alberta - A.S.A. Permit 86-14," by Barry J. Dau

86-15

John Pollock
Settlement Surveys Ltd.
P.O. Box 2529
New Liskeard, Ontario

Alberta Transportation
Seven Aggregate Pits in Southern Alberta

PROJECT TYPE: HRIA

LOCATION/SETTING: Various locations throughout southern Alberta

METHODOLOGY: Surface and subsurface testing

RESULTS: Eight new sites (EaPd-1 to 3, EfPo-7, EgPo-47, 48, EhOq-8 and 9) were recorded. Four previously recorded sites (EgPo-45, EhPo-35, 47 and EhOq-1) were also examined.

SITE TYPES: Medicine wheel/cairn, surface scatter/surface campsite, tipi rings

REPORT: Complete, entitled "Historical Resources Impact Assessment of Seven Aggregate Pits in Southern Alberta," by John Pollock

86-16

Bea Loveseth
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Scion Petroleum Engineering Ltd.
Ponoka Pipeline Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The study area is located in the central Alberta plains/parklands near the hamlet of Morningside. The area is characterized by hummocky ground moraine with approximately 80 percent under cultivation.

METHODOLOGY: The 45 km of pipeline rights-of-way were examined utilizing a series of zig-zag foot traverses approximately 15 m apart with examination of fortuitous exposures. Shovel testing was undertaken where natural subsurface exposures were lacking and to delineate archaeological sites content and size.

RESULTS: Three prehistoric sites (FdPj-5, FdPi-2 and FdPl-10) were recorded. All three were observed on the surface of ploughed fields, contained minimal amounts of cultural material and represent temporary occupations. FdPj-5 contained a Middle Prehistoric Hanna projectile point.

SITE TYPES: Temporary campsite and lithic scatters

CULTURAL AFFILIATION: FdPj-5 - McKean Phase

REPORT: Complete, entitled "Historical Resources Impact Assessment Morgan Hydrocarbons Ponoka Pipeline Project," by B.A. Loveseth

86-17 **Peter T. Bobrowsky** **Associated Engineering Ltd.**
P.T.B. Consulting **Residential Subdivision**
4604 - 119 Avenue
Edmonton, Alberta

PROJECT TYPE: HRIA

LOCATION/SETTING: East of Canyon Creek and west of Widewater, along the south shore of Lesser Slave Lake

METHODOLOGY: Systematic foot traverse of the shoreline area encompassing 16 ha. A total of 14 shovel test holes was excavated in areas judgementally deemed to be of high potential. Sediment was not screened.

RESULTS: No historical, archaeological or palaeontological sites were found in the study area.

REPORT: Complete, entitled "Historical Resources Impact Assessment for the Proposed Canyon Creek Subdivision on Behalf of Associated Engineering Ltd. Final Report," by Peter T. Bobrowsky

86-18 | **James A. Light** | **Alberta Transportation**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Hwy. 22:16 Cochrane, Hwy. 22X:20 Sundre, SR 766:10 Spruceview, SR 835:02 Ewing Lake, Tolman Bridge Recreation Area

PROJECT TYPE: HRIA

LOCATION/SETTING: Highway 22:16 is west and north of Cochrane in partly disturbed rolling prairie. Highway 22X:20 is north of Sundre in largely disturbed rolling boreal foothills. It crosses the James River at the north end. SR 766:10 near Spruceview is in slightly rolling aspen parkland which is largely disturbed by agriculture. SR 835:02, near Ewing Lake, is in rolling prairie-aspen parkland. The Tolman Bridge Recreation Area is on the flood plain of the Red Deer River east of Trochu.

METHODOLOGY: All highway construction was visually examined. New highway construction was walked and shovel tested where necessary. Areas where the right-of-way expansion was less than 1 m were visually examined. Areas where new construction did not affect areas undisturbed by previous construction were not walked. The Tolman Bridge Recreation Area was walked and shovel tested as necessary.

RESULTS: Six sites (EhPo-61, ElPg-11, FaPo-21, FbPo-2, FbPf-2 and 3) were recorded. No sites contained diagnostic artifacts.

SITE TYPES: Lithic and fire-broken rock scatter and isolated finds

REPORT: Complete, entitled "Historical Resource Impact Assessments of Highway 22:16, Highway 22X:20, SR 766:10, SR 835:02, and the Tolman Bridge Recreation Area, Final Report, Permit 86-18," by James A. Light

86-19C | **Rebecca J. Balcom** | **Alberta Transportation**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Cranford Gravel Pit

PROJECT TYPE: Mitigation of site DlPd-2

LOCATION/SETTING: The site is at prairie level on the south side of the Oldman River. The gravel lease encompasses an area of about 70 ha. The site has been impacted by two gravel pits covering 13 ha. Vegetation is native prairie.

METHODOLOGY: A total of 29 tipi rings was tested by 256 square metres of excavation. At least one 2 x 2 m unit was excavated in the centre of each ring. A rock alignment was tested with seven 1 x 1 m units. A shovel testing program consisting of 120 0.5 x 0.5 m units was undertaken. Excavation in other areas consisted of five 1 x 1 m units. The depth of excavations ranged from 10 to 100 cm below surface.

RESULTS: Totals of 4,739 lithic artifacts, 319 ceramics, and 13,780 bones and bone fragments were recovered from the excavations at DlPb-2. Deposition was shallow in the east area of the site but much deeper in the west where several components were buried under the rings. Buried rings and hearths were found.

DATES: Based on ceramics and projectile point types, the site dates from Early Prehistoric through to the Lake Prehistoric Period. Point types identified at the site include Plains Triangular, Plains Side-notched, Prairie Side-notched, Avonlea, Besant, Pelican Lake, Hanna, McKean and Boss Hill. Radiocarbon dates range from 620 $\pm$ 100 years B.P. to 1890 $\pm$ 80 years B.P.

REPORT: Complete, entitled "Historical Resources Impact Mitigation, Site DlPd-2, Cranford Gravel Pit, Phase 1, Final Report, Permit 86-19C," by Rebecca J. Balcom

86-20C

Barry J. Dau
Ethos Consultants Ltd.
Group Box 20, Veinerville
Medicine Hat, Alberta

Alberta Environment
Forty Mile Coulee
Irrigation Dam

PROJECT TYPE: Assessment/mitigation

LOCATION/SETTING: The project area is located approximately 35 km south of Bow Island within the portion of Forty Mile Coulee intended for the Forty Mile Coulee irrigation dam.

METHODOLOGY: The 1986 Forty Mile Coulee archaeological project served as the culmination of a multi-year assessment/ mitigation project begun in 1981. During 1986, limited feature mapping and auger testing were conducted at 85 stone circles in 17 sites. Excavation of 506.54 square metres was completed at 41 stone circles, 12 cairns and two buried camps.

RESULTS: A total of 14,727 pieces of cultural material was recovered. The majority of this consisted of butchered bison bone. Full analysis of the recovered data is currently in progress.

CULTURAL
AFFILIATION: Preliminary examinations of the data show that the majority of the surface stone feature sites excavated in 1986 belong to the Late Prehistoric or historic periods. Diagnostics recovered from the surface sites consist of Old Women's Phase projectile points, Saskatchewan Basin Complex ceramics and Euro-Canadian goods of the pre-homestead period. Diagnostics from the buried camps consist of projectile points belonging to the Avonlea, Besant and Pelican Lake phases.

REPORT: Complete, entitled "Historical Resource Investigations within the Forty Mile Coulee Reservoir," by Barry J. Dau and John Brumley

86-21C

Gloria J. Fedirchuk
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Alberta Culture
Alberta Transportation
Site Excavation

PROJECT TYPE: Mitigation

LOCATION/SETTING: The Missinglink site, EdPq-16, is situated in the eastern slopes of southern Alberta, approximately 2 km north of the Sheep Sanctuary/Ranger Station on North Fork Road, Kananaskis Country, Alberta.

METHODOLOGY: Thirty 1 x 1 m units were excavated: ten in the locality which, based on Pollock's (1984) interpretation, contained Avonlea materials; ten in the locality associated with Besant materials; and ten in the area from which bones had been previously obtained.

RESULTS: Nearly 1200 artifacts were recovered in 1986 including projectile points, bifaces, scrapers, retouched flakes, flakes, cores, fire-broken rock and bone.

SITE TYPE: Campsite

CULTURAL
AFFILIATION: Of the 21 projectile points recovered from the site, one is a large lanceolate, possibly Lusk; three are Besant; five are large, side-notched points consistent with the Bitterroot series; and three possibly fit into the Pelican Lake series. Four are unidentifiable, small, side-notched points, and one is an unidentified "waisted" and "eared," possibly Oxbow form. The remaining points are unidentifiable fragments.

DATES: No absolute dates are available; however, accepting the above typological identifications, the site could reflect occupations from 6,000 B.C. to A.D. 1000.

REPORT: Complete, entitled "The Missinglink Site, Kananansk is Country," by Gloria J. Fedirchuk

86-22 — **Bea Loveseth**
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Marquis Scenic Acres
Development Corporation
Scenic Acres Subdivision

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed subdivision is located in northwest Calgary in grasslands - natural and pasture - of hummocky disintegration moraine.

METHODOLOGY: The 200.5 ha of lands were inspected by foot traverses. All visible exposures were examined and shovel tested. Backhoe tests were dug in swales and glacial stream channels.

RESULTS: Fourteen prehistoric sites (EgPn-304 to 317) were recorded.

SITE TYPES: Tipi rings, buried campsite and lithic scatters

REPORT: Complete, entitled "Historical Resources Impact Assessment Scenic Acres Undeveloped Lands 1986," by B.A. Loveseth

86-23C — **Brian Kooyman**
Department of Archaeology
University of Calgary
Calgary, Alberta

Alberta Culture
Strathcona Site

PROJECT TYPE: Research/archaeology field school

LOCATION/SETTING: The site is located on the east side of the North Saskatchewan River, in the county of Strathcona, near the eastern limits of the city of Edmonton.

METHODOLOGY: A 26-square-metre block excavation was undertaken in a portion of the site suspected of being a habitation area based on a previous test unit. Excavation was by trowel; all material was sieved through 1/4 inch screens; and a 1 percent sample was processed through 1 mm screens. Three 1 x 1 m units were excavated to allow excavation of a sump pit on the site. These units were excavated by shovel shaving and sieved through 1/4 inch screen.

RESULTS: Several thousand pieces of cultural material were recovered, most of it being lithic debitage and small bone fragments. Besant and Oxbow projectile points were included in the assemblage, and a possible stone boiling pit was located.

SITE TYPE: Habitation site, possible lithic workshop

CULTURAL AFFILIATION: Middle and Late Prehistoric

DATES: From contact through to ca. 4,000 or 5,000 years B.P., based on radiocarbon dates and projectile point typology

REPORT: Complete, entitled "Final Report of the 1986 University of Calgary Archaeology Field School at the Strathcona Site (FjPi-29)," by Brian Kooyman, Tom Arnold, Don Boras and Maria Teresa Garcia

86-24 **Laurie Milne** **Alberta Culture**
Department of Archaeology **Larson Site**
Simon Fraser University
Burnaby, B.C.

PROJECT TYPE: Research

LOCATION/SETTING: County of Cypress, near Irvine

METHODOLOGY: A 12-square-metre area was excavated to delineate specific activity areas, enlarge the artifact sample, secure additional bone and/or charcoal for radiocarbon dating, and enlarge the faunal assemblage.

RESULTS: Four features were recorded, including several roasting pits and a stone boiling pit. The sample of ten artifact classes was substantially enlarged with the recovery of more projectile points, endscrapers, bifaces, perforating tools, pièces esquillées, cores, marginally retouched flake tools, heavy stone tools, ceramics and bone tools. The most unusual find was a segment of dentalia. The late winter seasonality of site occupation suggested by the foetal bison bone recovered in the 1982 excavations was reconfirmed.

SITE TYPE: Campsite

DATES: Three additional radiocarbon dates were obtained from the Avonlea cultural level: A.D. 760 ± 80 years

(AECV-298C), A.D. 740 ± 80 years (AECV-299C) and A.D. 810 ± 90 years (AECV-300C).

REPORT: Complete, entitled "The 1986 Excavations at the Larson Site (DlOn-3): Description, Interpretation and Speculation," by Laurie Milne

86-25 — **John Pollock**, **Settlement Surveys Ltd.**, **P.O. Box 2529**, **New Liskeard, Ontario** — **Dirham Construction Ltd. Grande Prairie Subdivision**

PROJECT TYPE: HRIA

LOCATION/SETTING: Grande Prairie, Alberta

METHODOLOGY: Systematic judgemental surface and subsurface inspection

RESULTS: One prehistoric site (GgQq-5) was located.

SITE TYPES: Surface scatter of lithic specimens, no buried components

REPORT: Complete, entitled "Historical Resources Impact Assessment Sand Ridge Estates SW 1/4 Section 17-71-5-W6M," by John Pollock

86-26 — **John Brumley**, **Ethos Consultants Ltd.**, **Group Box 20, Veinerville**, **Medicine Hat, Alberta** — **Canadian Western Natural Gas Co. Pipeline Across Chin Coulee and Reservoir**

PROJECT TYPE: HRIA

LOCATION/SETTING: Chin Coulee, south of Taber. The region consists largely of level to undulating prairie which is characterized by surficial deposits of glacial till.

METHODOLOGY: Foot traverse. Sites discovered were recorded and mapped. Mitigative needs and options were formulated on a site by site basis.

RESULTS: Three sites (DjPa-4 to 6) were located.

SITE TYPES: Stone circles/tipi rings

CULTURAL AFFILIATION: Unknown, probably reflect prehistoric native campsites

REPORT: Complete, entitled "An Historical Resource Impact Assessment of a Proposed Pipeline across Chin Coulee and Reservoir," by John H. Brumley

86-27	**Margaret Kennedy**	**Alberta Culture**
	Department of Archaeology	**High River Area**
	University of Calgary	**Whiskey Post Site**
	Calgary, Alberta

PROJECT TYPE: Research

LOCATION/SETTING: The site (EdPl-12) is situated on private property, 3.5 km west of the town of High River, on former Highwood River floodplain marked by cottonwood and willow thickets.

METHODOLOGY: Initial excavations at the site began in the fall of 1985 (ASA Permit 85-80) but were discontinued due to bad weather. When continued in 1986, excavations were expanded to expose the entire camp foundation, as well as an additional area to the southeast which was characterized by considerable quantities of sheet refuse, FBR, ash and burnt wood. All ash deposits were passed through fine nesting screens for enhanced recovery of minute artifactual and faunal remains.

RESULTS: The exposed cabin foundation measured 10.5 x 5 m. No internal divisions could be discerned. Deposits of refuse and bone scrap littered the cabin interior on the south side near the presumed doorway and continued outside the cabin to the southeast. In total, 2,894 artifacts and 9,596 bones and bone fragments were collected. Identifiable commercial products indicated St. Louis, Missouri as the source of manufacture, a conclusion totally in keeping with known whiskey trade supply patterns.

SITE TYPE: Archaeological remains of historic whiskey trade era structure

DATES: Likely early 1870s

REPORT: Complete, entitled "Final Report, Research Excavations at EdPl-12; A Whiskey Trade Era Structure, High River," by Margaret Kennedy

86-28	**Jack Brink**	**Alberta Culture**
	Archaeological Survey of Alberta	**Head-Smashed-In Buffalo Jump**

PROJECT TYPE: Research

LOCATION/SETTING: In southwestern Alberta, on the eastern flank of the Porcupine Hills, about 16 km west of Fort Macleod

METHODOLOGY: Research excavations were conducted in the processing site using 2 x 2 m units with provenience recorded to the 50 x 50 cm subquad in arbitrary 10 cm levels. All identifiable bone, features and fire-broken rock were mapped in place. Lithic remains from selected units were piece plotted using horizontal and vertical provenience controls. All excavated material was screened using 1/4 inch (6.3 mm) mesh.

RESULTS: A total of 8 square metres of contiguous excavation was completed. The cultural deposits ranged in depth from near surface to 50 cm below the surface and revealed some evidence of stratification in the lowest level. The stratification is the result of slope wash, and samples of bone have been submitted to determine the timing of this event.

SITE TYPE: Buffalo jump and associated camp and processing site

REPORT: Incomplete

86-29 | **J. Rod Vickers, Archaeological Survey of Alberta** | **Alberta Culture, Majorville Cairn Area Inventory**

PROJECT TYPE: Research, inventory

LOCATION/SETTING: About 22 km south of Bassano, on lands adjacent to Majorville Cairn (EdPc-1)

METHODOLOGY: Foot traverse, site recording and sketch mapping. No subsurface testing or artifact collection

RESULTS: About 1.5 sections were examined in an irregular block of land within about 1-1.5 km of EdPc-1. Three previously recorded and 30 new sites were examined. Twenty-two cairns and 143 stone circles were noted. Four circles were bisected by cobble rows. Larger sites were located near the valley rim. Milky white quartzite was common, and Knife River Flint was observed. No diagnotics were seen.

SITE TYPES: Tipi rings, cairns, medicine wheel and historic site

REPORT: Incomplete, to be entitled "1986 Majorville Cairn Inventory Project," by J. Roderick Vickers

86-30	**Don Steer** **DS Consulting** **723 Woodpark Blvd. S.W.** **Calgary, Alberta**	**Don Kelly** **Bearspaw Village** **Subdivision, Phase I**

PROJECT TYPE: HRIA

LOCATION/SETTING: The project area is situated immediately west of the city of Calgary, approximately 500 m from an upper terrace escarpment of the Bow River valley.

METHODOLOGY: Surface examination and subsurface testing

RESULTS: One prehistoric site, consisting of a single small retouched brown-black vitreous chert flake, was discovered. The archaeological specimen was recovered from a context 10 to 15 cm below ground surface.

SITE TYPES: Isolated find

REPORT: Complete, entitled "Historical Resources Impact Assessment Bearspaw Village Subdivision Phase I," by Don Steer and Malcom James

86-31C	**Gloria J. Fedirchuk** **Fedirchuk McCullough &** **Associates Ltd.** **304, 1725 - 10 Avenue S.W.** **Calgary, Alberta**	**Alberta Culture** **Alberta Transportation** **Highway Projects**

PROJECT TYPE: HRIA

LOCATION/SETTING: Four highway projects were examined: Highway 54:06 curve revision west of Innisfail, SR 851:04 upgrading south of Delia; SR 845:06 new crossing of Little Bow River; and Highway 3:06 new climbing lane west of Brockett.

METHODOLOGY: All rights-of-way were traversed on foot; natural exposures were examined; surficial cultural materials and features were noted; and subsurface tests were excavated where visibility was impeded by vegetation. Identified sites were shovel tested and documented. Palaeontological survey of both banks and monitoring of construction cut on north side of Little Bow were also carried out on SR 845:06.

RESULTS: Highway 54:06 - three surficial sites (FaPo-18 to 20) were located off proposed right-of-way. SR 851:04 - six surficial sites (EjPb-2 and EjPc-6 to 10) were located. SR 845:06 - three sites (DlPd-22, EaPd-4 and 5), all surficial indications, and one palaeontological site containing a molar of *Mammuthus* sp. were identified during monitoring of gravel crushing operations. Highway 3:06 - no new sites were recorded.

SITE TYPES: Isolated finds, campsites and stone circle sites

DATES: No absolute dates are available. Although two sites contained temporally diagnostic material (FaPo-18 - tip of large unidentifiable projectile point and EaPd-4 - Late Prehistoric Period small side-notched point), it was possible to relate only the latter of a specific period.

REPORT: Complete, entitled "Historical Resources Impact Assessment Alberta Transportation Projects," by Gloria J. Fedirchuk

86-32 **Susan Marshall, Department of Anthropology, Trent University, Peterborough, Ontario** — **Alberta Culture, Calderwood Buffalo Jump**

PROJECT TYPE: Research

LOCATION/SETTING: On the eastern slope of the Porcupine Hills in southwestern Alberta, approximately 16 km west of Fort Macleod and 1 km north of Head-Smashed-In Buffalo Jump

METHODOLOGY: Research was undertaken at kill area using 1 x 1 m units. The horizontal provenience of recovered cultural material was recorded to the 1 m square, employing arbitrary levels of 10 cm. All identifiable bone, fire-broken rock and features were mapped in situ. Excavated matrix was passed through a 1/4 inch (6.3 mm) screen. Bone, lithic remains and FBR were bagged separately for each excavation unit and level.

RESULTS: A total of 21 square metres was excavated in the kill area, 15 square metres being a contiguous excavation area. Preliminary testing in 1985 and investigations in 1986 recovered cultural deposits ranging from approximately 10 to 120 cm below surface, representing at least four stratigraphically separated deposits.

SITE TYPE: Buffalo jump and associated drive lane cairns

DATES: Middle Prehistoric Period, based on radiocarbon dates and projectile point typology

REPORT: Complete, entitled "The Calderwood Buffalo Jump DkPj-27," by Susan E. Marshall

86-33 — **Theresa A. Ferguson**, **Department of Anthropology**, **University of Alberta**, **Edmonton, Alberta** — **Alberta Culture**, **Salt River, Hay Meadows Survey**

PROJECT TYPE: Research

LOCATION/SETTING: Project area is located in the Mission Farm area in northeastern Alberta, just southwest of Ft. Smith. This is an area of extensive meadow, both wet and dry, with spruce and aspen forest invading.

METHODOLOGY: The survey technique involved visual survey for contemporary/twentieth century sites and cutbank survey and testing on the Salt River where possible for prehistoric sites. Informants were interviewed as to site locations and uses.

RESULTS: Twenty-six sites were found, all of which were contemporary or twentieth century. Ethnographic sources did not prove useful in locating older sites in this area, but they did provide information on the location and use of contemporary sites.

SITE TYPES: Campsites, trapping sites, a "caboose," a barn and isolated fireplaces

REPORT: Complete, entitled "Salt River Hay Meadow Survey (Permit 86-33): Final Report," by Theresa A. Ferguson

86-34 — **Edward J. McCullough**, **Fedirchuk McCullough & Associates Ltd.**, **304, 1725 - 10 Avenue S.W.**, **Calgary, Alberta** — **Esso Resources Canada Limited**, **Public Archaeology, Duckett Site**

PROJECT TYPE: Public archaeology/research

LOCATION/SETTING: The public archaeology program, sponsored by Esso Resources Canada Limited, was conducted at the Duckett site (GdOo-16) on Ethel Lake in northeastern Alberta. The Duckett site lies within the lakeland district of the southern boreal forest of Alberta.

METHODOLOGY: The public archaeology program consisted of a training program for full time volunteers (two weeks), for visiting volunteers (one week), and for one grade six class (one day). One hour public lectures (five per day for one week) on the nature of archaeological data, artifact identification, Duckett site chronology and excavations were given to students from a variety of local schools.

RESULTS: The range of temporal indicators recovered from the Duckett site has been extended and now includes Clovis, Agate Basin, Plainview, Scottsbluff, Oxbow, McKean, Pelican Lake, and Late Prehistoric small side-notched. Cord marked and neck punctate ceramics were also recovered.

SITE TYPE: Campsite

REPORT: Incomplete, to be entitled "The Duckett Site, 10,000 Years of Prehistory on the Shores of Ethel Lake, Alberta," by G.J. Fedirchuk and E.J. McCullough

86-35

Edward J. McCullough
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Singleton Associated Engineering/BP Resources Chauvin Pipeline Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Chauvin Pipeline System, Section 1 Edgerton Lateral pipeline project is situated southeast of Wainwright in the parkland of central Alberta.

METHODOLOGY: Fortuitous natural exposures and ploughed fields were visually inspected for identification of prehistoric remains.

RESULTS: Seven prehistoric sites (FdOp-1 to 5, FeOp-1 and 2) were newly recorded.

SITE TYPES: Isolated finds (5) and artifact scatters (2)

REPORT: Complete, entitled "Historical Resources Impact Assessment Singleton Engineering Ltd. BP Resources Canada Limited Chauvin Pipeline System Section I Edgerton Lateral," by E.J. McCullough

86-36

Gloria J. Fedirchuk
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

American Trading and Production Corporation Shannon-Kirkwall Pipeline

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Shannon-Kirkwall area pipeline project is situated south of Cereal within the grasslands of southern Alberta.

METHODOLOGY: Examination of fortuitous exposures, ploughed fields and shovel tests were used to identify the presence of prehistoric cultural materials.

RESULTS: Eleven newly identified prehistoric sites (EhOq-10 to 19 and EhOr-3) were recorded, and two previously recorded sites (EhOq-8 and 9) were assessed relative to the proposed project.

SITE TYPES: Cairns (6), stone circles (4) and cairns and stone circles (3)

REPORT: Complete, entitled "Historical Resources Impact Assessment American Trading and Production Corporation Shannon-Kirkwall Area Pipeline," by Fedirchuk McCullough and Associates

86-37 | **Bruce F. Ball**
Archaeological Survey of Alberta | **Alberta Culture**
Pincher Creek Buffalo Jump (DjPl-1)

PROJECT TYPE: Mapping and assessment

LOCATION/SETTING: Located in southwestern Alberta, on the southern edge of the Porcupine Hills, approximately 4 km north of the town of Pincher Creek

METHODOLOGY: The site area and its surroundings were surveyed, and areas of cultural activity were mapped. The kill site area was tested using shovel tests, a power auger and two 2 x 2 m excavations. Test excavations of ring features located near the kill site were carried out as well.

RESULTS: Three undisturbed layers of bone were identified in the kill site deposits.

SITE TYPE: Buffalo jump with associated camp and processing areas

CULTURAL AFFILIATION: Projectile points (Prairie and Plains Side-notched) from the tests date the site to Late Prehistoric times.

REPORT: Complete, entitled "Archaeological Investigation of the Pincher Creek Buffalo Jump (DjPl-1)," by Bruce F. Ball

86-39 | **Brian Ronaghan**
Archaeological Survey of Alberta | **Alberta Culture**
Porcupine Hills Inventory

PROJECT TYPE: Research inventory was conducted in a high elevation, spring fed drainage basin in order to identify new sites, as well as to assess the terrain for the possibility of containing early occupations in near surface situations.

LOCATION/SETTING: Honey Coulee is the head of the Trout Creek drainage and is located in the north Porcupine Hills in southwestern Alberta.

METHODOLOGY: Due to time and manpower restrictions, survey was judgemental and extensive rather than intensive in character. Shovel and, in some cases, auger testing were employed when prehistoric materials were encountered.

RESULTS: Nine possible sites (EaPm-5 to 13) were identified. Four (EaPm-10 to 13) consisted only of large ungulate bone fragments exposed in small erosional cuts or rodent holes. Shovel and auger tests failed to produce clear-cut evidence of human origin. Five sites (EaPm-5 to 9) produced lithic remains, either singularly or in association with large ungulate bone fragments. All appear to be small, near surface concentrations believed representative of short-term hunting forays into these high elevation grazing areas.

SITE TYPES: Artifact scatters and small campsites

CULTURAL AFFILIATION: Based on projectile point morphology, EaPm-8 - Late Plains, EaPm-9 - Scottsbluff/Eden

REPORT: Incomplete

ADDITIONAL INFORMATION: Although several potential rock shelter locations were examined, no evidence of prehistoric occupation was identified. The wide dispersal of prehistoric materials, both in time and space, suggest that this area has seen frequent use throughout the bulk of the prehistoric record. Systematic deep testing would be necessary to adequately assess depositional characteristics and the potential for very early occupations.

86-40 **Michael Forsman** **Alberta Culture**
Archaeological Survey of Alberta **Northeastern Alberta**

PROJECT TYPE: Continuation of research and resource management study

LOCATION/SETTING: Athabasca River, Fort Chipewyan area

METHODOLOGY: Review of archival records and in-field search for site locations and preliminary assessment

RESULTS: Several sites were located and surveyed, including HeOu-1 (at the confluence of the Clearwater and Athabasca rivers), Pierre au Columet (on the Athabasca River), and Fort Wedderburn and Fort Chipewyan on Lake Athabasca.

REPORT: Part of a continuing study to be prepared later

86-41 **James A. Light**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Manalta Coal Ltd.
Montgomery Mine Expansion

PROJECT TYPE: Mitigation in advance of strip mining, inventory and recording of historic period coal mines in the mine lease and preparation of a general history of coal mining in the Sheerness area

LOCATION/SETTING: The study area is largely mixed grass prairie. The mitigated sites were situated in cultivated fields.

METHODOLOGY: EiOw-73 was surface collected without provenience controls. EiOw-132 and 133 were collected as one site using a 5 m collection grid. Historic period sites were mapped, photographed and recorded.

SITE TYPES: Lithic scatters (3), coal mining sites (3) and related habitation sites (2)

REPORT: Complete, entitled "Historical Resources Impact Mitigation at EiOw-72, EiOw-132, and EiOw-133, Inventory and Recording of Historic Period Mining Sites, Montgomery Mine Expansion Project, Final Report, Permit 86-41," by James A. Light

86-42C **Stanley Van Dyke**
Bison Historical Services
236 - 11A Street N.W.
Calgary, Alberta

Alberta Transportation
Summerfield, Thurn and Ouellette borrow pits and Highway 2:10 twinning Stavely to Nanton

PROJECT TYPE: HRIA

LOCATION/SETTING: Various locations in parklands and prairie, including vicinity of Big Hills Springs, North Saskatchewan River and Stavely area

METHODOLOGY: Foot traverse of study areas with examination of backhoe tests excavated in conjunction with pit testing and shovel tests of moderate and high potential areas where no pit tests were present

RESULTS: Four prehistoric sites (EbPj-1, EbPk-14, EhPo-62 and 63) were identified. Sites were determined to be not significant.

SITE TYPES: Isolated ring sites (2) and lithic scatters (2)

REPORT: Complete, entitled "Final Report, Historical Resources Impact Assessment, Summerfield, Ouellette and Thurn Borrow Pits, and Highway 2:10 Twinning, ASA Permit Number 86-42-C," by Stanley Van Dyke

86-43 **John Pollock**
Settlement Surveys Ltd.
P.O. Box 2529
New Liskeard, Ontario

Lehndorff Development Corp.
Pineview Subdivision Phase 2

PROJECT TYPE: HRIA

LOCATION/SETTING: Lehndorff Lands Pineview Neighbourhood, city of St. Albert

METHODOLOGY: Systematic foot traverses and surface inspection along with judgemental subsurface testing

RESULTS: Three prehistoric sites (FjPj-41 to 43) were located.

SITE TYPES: Surface campsites

REPORT: Complete, entitled "Historical Resources Impact Assessment Lehndorff Development Corp. Lands City of St. Albert," by John Pollock

86-44 **B.O.K. Reeves**
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Magnesium Company of Canada Limited
Magnesium Plant

PROJECT TYPE: HRIA

LOCATION/SETTING: Flat, glacial fluvial plain in a meander of the Highwood River south of Aldersyde

METHODOLOGY: Foot traverses of the entire area complemented by shovel and backhoe testing where potential for buried soils and cultural remains existed

RESULTS: One prehistoric site (EdPl-16) was located in the development area.

SITE TYPE: Scattered campsite (tipi ring)

REPORT: Complete, entitled "Historical Resources Impact Assessment Magnesium Company of Canada Limited Magnesium Plant Aldersyde, Alberta," by Brian O.K. Reeves

86-45 **James A. Light**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta **Bow River Pipe Lines Ltd.**
1986 Stanmore Mainline Loop

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed pipeline is about 40 km in length with a 10 m wide right-of-way. The line begins north and east of the town of Stanmore near Kirkpatrick Lake, passes within 3 km of Stanmore and terminates west of the town of Rose Lynn. The area is predominantly native prairie with slight relief. The line crosses Berry Creek near its southern terminus.

METHODOLOGY: The entire right-of-way was walked and shovel tested where there was potential for buried sites.

RESULTS: One site (EjOu-3) was located on a hilltop near the right-of-way. Four flakes were collected from surface exposures. The site will not be directly affected by pipeline construction.

SITE TYPE: Lithic scatter

REPORT: Complete, entitled "Historical Resources Impact Assessment of Bow River Pipe Lines Ltd.'s Proposed, 1986 Stanmore Mainline Loop, Final Report, Permit 86-45," by James A. Light

86-47 **Alan Bryan and Ruth Gruhn**
Department of Anthropology
University of Alberta
Edmonton, Alberta **Alberta Culture**
Caribou Island Site

PROJECT TYPE: To clarify stratigraphy and dating at Caribou Island site (GbOs-1)

LOCATION/SETTING: West of Moose Lake, west of Bonnyville, north of Rife Church

RESULTS: Excavated two superimposed charcoal concentrations (probably hearths) and took sand samples for TL dating. Quarry workshop detritus (flakes and bulbless spalls, battered pebbles, anvil stones) indicate block on anvil splitting of quartzite pebbles. Little evidence was noted for hand-held flaking or bifacial thinning. Glacially split pebbles were excavated from underlying kame deposits.

SITE TYPE: Quartzite pebble quarry/workshop

REPORT: Complete, entitled "Final Report of a Text Excavation at the Caribou Island Site (GbOs-1), East Central Alberta," by Alan Bryan

86-48

James A. Light
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

BHP Petroleum Ltd.
Turin Area Pipeline

PROJECT TYPE: Inventory and assessment

LOCATION/SETTING: The proposed development is in an area of native short grass prairie on the valley rim and terraces of the Oldman River north of the town of Chin.

METHODOLOGY: The entire 2 km right-of-way was walked and shovel tested where appropriate. Two areas with tipi rings, previously noted by the land surveyors, were examined in detail.

RESULTS: Two archaeological sites (DlPc-11 and 12) were recorded. Neither are on the right-of-way of the proposed developments.

SITE TYPES: Tipi rings

REPORT: Complete, entitled "Historical Resources Impact Assessment BHP Petroleum Ltd.'s Turin Pipeline in Sections 19 and 30, T10-R18-W4M Final Report, Permit 86-48," by Rebecca J. Balcom

86-49

James A. Light
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Fording Coal Ltd.
Bow City Mine
Brooks Coal Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed development is a strip mine which would affect about 325 ha of previously undisturbed land.

It is located on the north side of the Bow River, west of Bow City. The area is mostly native short grass prairie, although some areas have been cultivated or mined for gravel. The development straddles Coal Creek which flows into the Bow River.

METHODOLOGY: The development area was walked in narrowly spaced transects and shovel tested where there was moderate to high potential for buried archaeological material.

RESULTS: Fourteen sites (EcPb-19 to 32) were recorded.

SITE TYPES: Isolated finds (2), lithic scatters (3), cairns (2), single ring sites (2) and multiple feature sites (5)

CULTURAL AFFILIATION: One site, EcPb-21, produced a Besant type projectile point.

REPORT: Complete, entitled "Historical Resources Impact Assessment, Fording Coal Ltd. Bow City Mine, Brooks Coal Project, Final Report, Permit 86-49," by James A. Light

86-51 **B.O.K. Reeves** **Town of Taber**
Lifeways of Canada Ltd. **Sewage System**
317 - 37 Avenue N.E.
Calgary, Alberta

PROJECT TYPE: HRIA

LOCATION/SETTING: The project area is located on the north side of the Oldman River north of Taber.

METHODOLOGY: The proposed pipeline rights-of-way and the sewage lagoon location were covered by foot traverse with all exposures examined. Subsurface shovel testing was undertaken in areas with poor ground visibility.

RESULTS: No significant historical resource sites were observed.

REPORT: Complete, entitled "Historical Resources Impact Assessment Town of Taber Sewage System Improvements," by Brian O.K. Reeves

86-53 **Eugene M. Gryba** **Alberta Transportation**
3, 346 - 4th Avenue N.E. **Sorgaard and Kenney**
Calgary, Alberta **Gravel Pits**

PROJECT TYPE: Mitigation of tipi ring sites EaPd-2 and EhOq-8 and mapping of a medicine wheel (EhOq-1)

LOCATION/SETTING: Little Bow River valley near Picture Butte in southwestern Alberta and the Cereal district in the east-central part of the province. Local environment in both areas consists of natural shortgrass prairie.

METHODOLOGY: Units (2 x 2 m) were excavated within two rings at EaPd-2 and in 11 rings at EhOq-8. Horizontal provenience was maintained for each square metre. Units were taken down in 5 cm levels to top of gravel deposits, which occurred from 7.5 to 15 cm below surface. Matrix was sifted through a screen having a 6.0 x 2.9 mm diamond-shaped mesh. Detailed feature and site maps were made of all three sites.

RESULTS: The stone circles at EaPd-2 and EhOq-8 yielded a disappointing return of cultural material. Two end scrapers from EhOq-8 comprised the only diagnostic tools recovered during this project. These results confirmed the observations of very sparse surface occurrences of material at the two sites. The central rock cairn at EhOq-1 had been vandalized; however, much of the ring and at least six spokes radiating from it were still intact. The fact that three spokes terminated at large boulders tentatively negates an astronomical interpretation of this medicine wheel.

REPORT: Complete, entitled "Test Excavations at Tipi Ring Sites EaPd-2 and EhOq-8, and Mapping of the Sutherland Wheel (EhOq-1): Sorgaard and Kenney Gravel Pits Mitigations, Permit 86-53," by Eugene M. Gryba

86-54

James A. Light
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Gulf Canada Corporation
Millarville Pipeline

PROJECT TYPE: HRIA

LOCATION/SETTING: The pipeline is 20 km long with a 20 m right-of-way, located in the foothills west of Calgary between Bragg Creek and Millarville.

METHODOLOGY: The entire right-of-way was walked and shovel tested in areas of medium and high potential.

RESULTS: No historical resource sites were discovered.

REPORT: Complete, entitled "Historical Resources Impact Assessment of the Gulf Canada Resources Ltd. Millarville Gas Pipeline, Final Report, Permit 86-54," by James A. Light

86-55 | **B.O.K. Reeves** | **Municipal District of Cardston Subdivision**

B.O.K. Reeves
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Municipal District of
Cardston
Subdivision

PROJECT TYPE: HRIA

LOCATION/SETTING: Meandering flood plain of Crooked Creek in the Municipal District of Cardston, north of Waterton Lakes National Park

METHODOLOGY: Foot traverse with inspection of natural and man-made exposures

RESULTS: No archeological sites were noted.

REPORT: Complete, entitled "Historical Resources Impact Assessment Proposed Subdivision Development in the Municipal District of Cardston SW-22-2-29-4," by Brian O.K. Reeves

86-56

Gloria J. Fedirchuk
Fedirchuk McCullough &
Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

TransAlta Utilities
Corporation
Deerland Substation

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Deerland substation project is situated north of Bruderheim within the parkland region of central Alberta.

METHODOLOGY: Examination of fortuitous exposures and shovel tests were used to identify the presence of prehistoric cultural materials.

RESULTS: One prehistoric site (FlPf-25) was recorded.

SITE TYPE: Isolated find

REPORT: Complete, entitled "Historical Resources Impact Assessment TransAlta Utilities Corporation Deerland Substation," by G.J. Fedirchuk

86-57

Bruce F. Ball
Archaeological Survey of
Alberta

Alberta Culture
Folkin Lake Burial
FeOm-1

PROJECT TYPE: Mitigation

LOCATION/SETTING: Located on the bank of an unnamed lake, east of Chauvin in east central Alberta

METHODOLOGY: Human bone remains were removed from an eroding section of lake shore using archaeological excavation techniques. The overburden was removed by trowel, and the bone elements were exposed, photographed and removed for laboratory analysis. All recovered material was described and analyzed.

RESULTS: Osteological analysis is not yet complete. Remains are that of an older, male individual. Four lithic artifacts were recovered from the surrounding deposits; unfortunately, none are indicative of known culture historical associations

SITE TYPE: Human burial

REPORT: Incomplete

86-58

Stanley Van Dyke
Bison Historical Services
236 - 11A Street N.W.
Calgary, Alberta

Alberta Environment
Milk River Dam and Reservoir

PROJECT TYPE: HRIA

LOCATION/SETTING: Located 18 km upstream from the town of Milk River, the study area includes portions of the North Milk and Milk river valleys above the dam site located 4 km below the confluence. The area of the study was 2,590 ha in size and consisted of short grass prairie with few areas of past disturbance.

METHODOLOGY: The study area was traversed on foot. Shovel testing was carried out on areas of moderate and high potential in areas of limited deposition. Backhoe testing was carried out in areas with deep deposition. Test excavations were carried out on selected sites with moderate and high values.

RESULTS: Two hundred and ten sites were recorded. A high percentage of the sites yielded preserved organic materials.

SITE TYPES: Isolated finds (4), lithic scatters (22), buried bone occurrence, campsites (13), medicine wheel, stone circle sites (115) isolated cairns (8), buried hearths (2), buried bone in association with FBR (11), buried bone in association with lithics (2), stratified campsites (21), surface hearth, kill sites (6), historic aged sites (3)

CULTURAL AFFILIATION: Besant, Pelican Lake, Avonlea and Old Women's

REPORT: Complete, entitled "Final Report Historical Resources Impact Assessment Milk River Dam and Reservoir, ASA Permit Number 86-58," by Stanley Van Dyke and Thomas H. Head

86-59

B.O.K. Reeves
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Shell Canada Resources Ltd.
Waterton Field Wellsites and Access Road

PROJECT TYPE: HRIA

LOCATION/SETTING: The project area is located southwest of Pincher Creek on the top of Prairie Bluff Mountain.

METHODOLOGY: The proposed well site locations and access road right-of-way were foot traversed.

RESULTS: No historical resources sites were located in the study area. DiPm-11 is outside the study area.

SITE TYPE: Spiritual circle/cairn

REPORT: Complete, entitled "Historical Resources Impact Assessment Shell Canada Resources Ltd. Shell Waterton Field Prairie Bluff Development," by Brian O.K. Reeves

86-60

John Pollock
Settlement Surveys Ltd.
P.O. Box 2529
New Liskeard, Ontario

Nova, An Alberta Corporation
Joffre Sales Pipeline

PROJECT TYPE: HRIA

LOCATION/SETTING: The 25.2 km pipeline begins at the 48 inch main line southwest of Red Deer and proceeds northeasterly across relatively flat terrain, crosses Piper Creek, passes through an area of very high hills and then crosses the Red Deer River.

METHODOLOGY: Complete foot traverse and subsurface testing of areas lacking surface exposures

RESULTS: Four prehistoric archaeological sites (FbPj-15 to 17 and FbPk-12) were located.

SITE TYPES: Surface camps, isolated finds and a buried campsite

REPORT: Complete, entitled "Historical Resources Impact Assessment Proposed Joffre Sales Pipeline," by John Pollock

ADDITIONAL INFORMATION: One site, FbPj-17, with buried components, produced projectile points relating to the middle prehistoric era including an Oxbow point and faunal remains. Further mitigative work was recommended for this site.

86-61C | **Rebecca J. Balcom**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta | **Alberta Culture**
Sir Winston Churchill
Provincial Park Upgrading

PROJECT TYPE: Site assessment

LOCATION/SETTING: Sir Winston Churchill Provincial Park is located on Big Island in Lac La Biche, Alberta.

METHODOLOGY: Sites were relocated and visually assessed to aid in defining impacts. Sites were mapped and tested with 0.5 x 0.5 m or 1 x 1 m tests.

RESULTS: In all, 22.5 square metres were excavated. A total of 154 artifacts and bones was recovered from the five prehistoric sites (GfOx-2, 3, 44, GfPa-1 and 57), while a nail and a bottle were recovered from the historic site (GfOx-1).

SITE TYPES: Historic cabin, lithic scatters (3) and buried campsites (2)

DATES: Based on projectile point typology, GfPa-1 is Middle Prehistoric, about 5,500 to 3,500 years B.P.

REPORT: Complete, entitled "Historical Resources Assessment Program, Sir Winston Churchill Provincial Park, Lac La Biche, Final Report, Permit 86-61C," by Rebecca J. Balcom

86-62 and
86-74 | **John Brumley**
Glenn Stuart
Ethos Consultants Ltd.
Group Box 20, Veinerville
Medicine Hat, Alberta | **Alberta Environment**
Oldman River Dam
Project

PROJECT TYPE: Assessment of site DjPl-15, 60, 61, 63, 78, 100, 113 to 115, 134, 135

LOCATION/SETTING: Oldman River, southwestern Alberta, northeast of Pincher Creek. The topography ranges from moderately rolling in the open prairie areas, through rough broken terrain of the valley walls, to flat on the valley bottom.

METHODOLOGY: All sites, except DjPl-60 and 63, were recorded by aerial photography. All excavated features were mapped using the photoboom. At DjPl-15, 19 stone circles were auger tested; seven stone circles were test excavated with centrally located 1 x 2 m units; and four stone circles were excavated with a total of 49 square metres. And additional 15 square metres were excavated over the historic component. DjPl-60 and 63 were flagged for avoidance from impending construction activity. DjPl-61 and 113 were auger tested. DjPl-78 was auger tested, and 18 square metres were excavated at one stone circle. DjPl-100 was test excavated with 5 square metres. Backhoe testing was also conducted. DjPl-114 was auger tested and one stone circle was test excavated with an internally placed 2 x 2 m unit. At DjPl-115, eight stone circles were auger tested, and two stone circles were test excavated with centrally located 1 x 2 m units. An additional 5 square metres were excavated over the historic component. Backhoe testing was also conducted. DjPl-134 was test excavated with a 2 x 2 m unit. DjPl-135 was auger tested and one stone circle was test excavated with a centrally located 1 x 2 m unit.

RESULTS: This project recovered a total of 5,801 cultural items. Investigation of the prehistoric sites and prehistoric components at DjPl-15 and 115 yielded 86 artifacts, 38 FBR and 152 faunal remains. Investigation of the historic components yielded 4,903 artifacts and 622 faunal remains, all from DjPl-15. Of the prehistoric sites only, DjPl-100 displayed a relatively high density of artifacts at 4.43 items/square metre (28.96 items/square metre including faunal remains). This site also contains cultural material to depth of 70+ cm B.S. The remaining prehistoric sites were quite shallow and contained relatively low quantities of cultural material. Analysis of material recovered had not been completed at the time of abstract preparation.

SITE TYPES: Stone circles, cairns, possible rock shelter, historic house foundation, privy and barn

CULTURAL AFFILIATION: DjPl-15 - Historic, Old Women's, DjPl-100 - Historic/Protohistoric, Old Women's, DjPl-115 - Historic, unknown

REPORT: Complete, entitled "Archaeological Survey, Assessment and Excavation Activities at the Oldman Dam Conducted Under the Auspices of ASA Permits 86-62 and 86-74," by Glenn Stuart and John H. Brumley

86-63C **Eugene M. Gryba**
3, 346 - 4th Avenue N.E.
Calgary, Alberta **Alberta Transportation**
Haig Lake Road

PROJECT TYPE: HRIA

LOCATION/SETTING: Project is located in northwestern Alberta in low, rolling terrain south of Haig Lake. Project crosses mixed forest uplands and shagnum and black spruce bogs.

METHODOLOGY: Foot traverse and visual inspection, supplemented by shovel testing. The western half of the alignment had been winter cleared, while a recent cutline of two bulldozer widths marked the remainder of the route. Construction was already in progress when the impact assessment was made. About one third of the road had already been built. There was an abundance of excellent exposures of mineral soil throughout the length of the new alignment. Exposures where the Roxy Petroleum road skirted the southeast side of Haig Lake and along the edge of a large meltwater channel south of Sawn Lake were also checked.

RESULTS: No archaeological material was encountered along the proposed alignment. Two small occurrences of lithic material (HfQa-1 and 2), discovered where the Roxy Petroleum road cut through an abandoned beach in the southeast side of Haig Lake, suggest that prehistoric settlement was focussed locally around the larger water bodies. The material consisted of debitage, a broken biface and two retouched pieces. The lithic material is represented by quartz, quartzite and a grey-black chert.

SITE TYPES: Lithic scatters

REPORT: Complete, entitled "Final Report of a Historical Resources Impact Assessment of the Haig Lake Road in Northern Alberta," by Eugene M. Gryba

86-64 **Brian Ronaghan** **Alberta Culture**
Archaeological Survey of Alberta **Jean D'Or Prairie Inventory**

PROJECT TYPE: Management-oriented pilot inventory

LOCATION/SETTING: Lands on both sides of the Peace River in the Fort Vermilion/Jean D'Or Prairie area. The terrain is generally flat to low lying glacial lake bed shallowly cut by the Peace River and several small tributaries. Lands are largely agricultural with treed ridges representing stabilized aeolian dunes.

METHODOLOGY: Airphoto interpretation to identify areas of high to moderate potential. Foot traverse of these areas with visual examination and judgemental shovel testing in an attempt to identify sites. Helicopter assisted access to more remote areas.

RESULTS: Despite examination of a number high potential areas, only three sites were identified. IcPx-5 consists of a widespread scatter of bone with some lithic materials located on the ploughed south valley rim of the Peace River. IcPu-1 is a small find of two lithic items recovered in undisturbed context on the north rim of the valley near the confluence with Beaver Ranch Creek. IcPu-2 is a lithic scatter exposed by road construction upstream along Beaver Ranch Creek.

SITE TYPES: Campsite, small find and lithic scatter

REPORT: Incomplete

ADDITIONAL INFORMATION: The limited results obtained suggest that this section of the Peace River was not densely occupied and/or settlement patterns are not completely understood.

86-65 **Rebecca J. Balcom** **Westmin Resources Ltd.**
ARESCO Ltd. **Wintering Hills Gas Pipeline**
2912 - 18 Street N.E.
Calgary, Alberta

PROJECT TYPE: HRIA

LOCATION/SETTING: In the Wintering Hills area, on both the north and south sides of the Red Deer River

METHODOLOGY: The 19.2 ha of pipeline were examined on foot and visually assessed. Shovel tests were excavated as deemed appropriate.

RESULTS: Seven prehistoric sites (EgPb-3, EhPa-24 to 26, EhPc-117 to 119) were found.

SITE TYPES: Tipi rings (3), isolated find, lithic scatters (2) and a buried campsite

REPORT: Complete, entitled "Historical Resources Impact Assessment Westmin Resources Limited Wintering Hills Gas Pipeline," by Rebecca J. Balcom

86-66C Thomas H. Head
Bison Historical Services
236 - 11A Street N.W.
Calgary, Alberta

Alberta Transportation
SR 845:06, Sites DlPd-22 and EaPd-4

PROJECT TYPE: Mitigation

LOCATION/SETTING: DlPd-22 is located on the south side of the Little Bow River on the first terrace above the river, while EaPd-4 is located in an area of mixed prairie.

METHODOLOGY: Excavation of 34 square metres at DlPd-22 and 16 square metres at EaPd-4; site and feature mapping at both sites

RESULTS: DlPd-22 contained only limited cultural materials (lithic remains, FBR and bone) associated with internal and external areas of two stone circles. Most of the material recovered was associated with one of the stone circles, which contains a hearth and at least two activity areas. EaPd-4 contains at least two cultural occupations. The occupation associated with two stone circles contained only limited materials, while a buried occupation beneath one of the features was a small quartzite reduction area.

SITE TYPES: Stone circles

DATES: EaPd-4 - Late Prehistoric point collected during HRIA

REPORT: Complete, entitled "Historical Resources Mitigation SR 845:06 Prehistoric Sites EaPd-4 and DlPd-22 ASA Permit No. 86-66-C," by Thomas H. Head

86-67 Edward J. McCullough
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Tera Environmental Consultants (Alta.) Ltd./ BP Resources
Amisk Pipeline Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Amisk pipeline project is situated north of the Neutral Hills in the parkland of central Alberta.

METHODOLOGY: Fortuitous natural exposures and ploughed fields were examined for the presence of prehistoric cultural materials.

RESULTS: Eight prehistoric sites (FaOr-7, 8, FbOr-53, 70 to 72, FcOr-4 and FcOs-1) and two historic sites were recorded.

SITE TYPES: Isolated finds (4), artifact scatter, quarry, campsites, stone circle, historic rock structure and homestead remains

DATES: Historic rock structure - 1932

REPORT: Complete, entitled "Historical Resources Impact Assessment Tera Environmental Consultants (Alta) Ltd. BP Resources Canada Limited Amisk Pipeline Project," by E.J. McCullough and G.J. Fedirchuk

86-68 **Edward J. McCullough**
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Singleton Associated Engineering Ltd./BP Resources Canada Ltd. Chauvin Pipeline Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Chauvin Pipeline System Hayter Extension is situated south of Chauvin in the parkland of central Alberta.

METHODOLOGY: Fortuitous natural exposures and ploughed fields were examined. Shovel tests were excavated in the undisturbed area adjacent to an unnamed stream draining into Killarney Lake.

RESULTS: Three prehistoric sites (FdOm-16, 17 and FdOn-4) were recorded.

SITE TYPES: Isolated finds

REPORT: Complete, entitled "Historical Resources Impact Assessment Singleton Associated Engineering Ltd. BP Resources Canada Limited Chauvin Pipeline System Hayter Extension," by E.J. McCullough

86-69

Gloria J. Fedirchuk
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Chevron Canada Resources Limited
Calais Well Site/Access Road

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Calais well site and access road are situated east of Peace River within the boreal forest region of northwestern Alberta.

METHODOLOGY: Examination of fortuitous exposures and shovel tests were used to identify the presence of prehistoric cultural materials.

RESULTS: No prehistoric sites were recorded.

REPORT: Complete, entitled "Historical Resources Impact Assessment Chevron Canada Resources Limited Calais Well Site and Access Road, by G.J. Fedirchuk

86-70

Rebecca J. Balcom
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Tripet Resources Ltd.
Nevis Wellsite and Access Road

PROJECT TYPE: HRIA

LOCATION/SETTING: Alix area, south of the Red Deer River. The well site is on the lower terrace, while the access road begins on the upper terrace. Most of the area is cultivated.

METHODOLOGY: Foot traverses and subsurface testing as necessary

RESULTS: No sites were located.

REPORT: Complete, entitled "Historical Resources Impact Assessment Wellsite and Access Road Near Nevis," by Rebecca J. Balcom

86-71

Bea Loveseth
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Alberta Power Limited
240 kV Transmission Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed project is located in east central Alberta, south of Deerland and extending northeast to just north of Vilna.

METHODOLOGY: Thirty-nine kilometres considered to have high potential for the occurrence of historical resource sites were foot traversed. Shovel testing was utilized to complement surficial examination.

RESULTS: One historic and three prehistoric sites (GaPa-2, GaPb-18 and 19) were recorded. Only GaPb-18 was judged to be significant. Twenty-two sites reported by the Historic Sites Service were visited and found to be well outside the impact zone.

SITE TYPES: Historic farmstead and prehistoric campsites

REPORT: Complete, entitled "Historical Resources Impact Assessment Deerland to 7L41 240 kV Transmission Project," by B. Loveseth

86-72

Bea Loveseth
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Alberta Transportation Extraction Areas and Highway Rights-of-way

PROJECT TYPE: HRIA and site assessment

LOCATION/SETTING: The projects in central and southern Alberta included SR 620:02 near Drayton Valley, Local Road County 23 near Ponoka, Highway 37 near Onoway, Highway 23 at the Little Bow River crossing at Carmangay, and Mueller Sand Pit near Ponoka.

METHODOLOGY: The area of 1 ha of extraction and 15 km of highway right-of-way was examined by systematic foot transects, visual examination of available exposures and subsurface testing in medium to high potential areas and to delimit the site area.

RESULTS: No sites were recorded for SR 620, as the passing lane had already been constructed, or for the local road widening and realignment near Penhold. The historic site (FkPn-6), a log barn and house foundation recorded in 1977, was to be photographed and mapped but could not be relocated with the legal and UTM descriptions given. A temporary campsite (FdPj-6) was recorded in the Mueller Sand Pit extraction area. EaPg-3, a tipi ring site near Carmangay, is outside the new Highway 23 alignment, but shovel testing in the proposed right-of-way uncovered cultural material at 15 to 20 cm below surface.

SITE TYPES: Temporary surface campsite and buried campsite

CULTURAL AFFILIATION: EaPg-3 - early Late Prehistoric Period based on the recovery of an Avonlea triangular projectile point fragment

REPORT: Complete, entitled "Final Report HRIA and Impact Assessment Alberta Transportation Highway Construction Program in Central and Southern Alberta (ASA Permit No. 86-72)," by B. Loveseth

86-73

Bea Loveseth
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Shell Canada Limited
Enhanced Oil Recovery Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The project is located in gently rolling grassland in southeastern Alberta near the hamlet of Manyberries.

METHODOLOGY: Surface examination was undertaken of ten proposed well sites, 2.5 km of access roads and a central treatment facility. All facilities were foot traversed with natural exposures examined in detail and complemented by subsurface shovel tests. Bedrock exposures were identified as possible locales for significant palaeontological remains.

RESULTS: Twenty prehistoric sites (DiOp-24 to 43) were identified.

SITE TYPES: Tipi rings, workshops, lithic scatters and isolated finds

REPORT: Complete, entitled "Manyberries Enhanced Oil Recovery Project," by B. Loveseth

86-75C

Terrance H. Gibson
9932 - 112 Street
Edmonton, Alberta

Alberta Transportation
Alberta Forestry Service
Fort MacKay - Fort Chipewyan Winter Road, Forestry Station and Water Pipeline

PROJECT TYPE: HRIA

LOCATION/SETTING: Fort MacKay locality and winter road north of Athabasca River to Richardson Lake. Setting is spruce forest, bog and pine forest on stabilized sand dunes.

METHODOLOGY: Shovel testing of a cleared 4.25 ha area to be impacted by construction of an Alberta Forestry Service station. Shovel testing and backhoe monitoring the transect of a proposed 2 km water pipeline which will service the station. Shovel testing and surface inspection of selected localities along the route of the Fort MacKay-Fort Chipewyan Winter Road, which was to be widened by Alberta Transportation. Areas of ground inspection included the Firebag and Richardson river crossings and seven localities in the Richardson Hills area. The road route paralleling the Maybelle River was also inspected from the air for potential archaeological resources.

RESULTS: No cultural remains were encountered n the vicinity of the forestry station or the associated water pipeline. Three prehistoric sites were discovered in the Richardson Hills locality. Two sites (HlOs-1 and 3) consisted of spot finds of two lithic items each on the exiting road surface. The third site (HlOs-2) consisted of 18 pieces of lithic shatter found on the ground surface of a high hill of the projected route of the winter road improvement. No sites required further mitigation, although avoidance of HlOs-2 was recommended if further work is planned in the area.

SITE TYPES: Surface scatters

REPORT: Complete, entitled "Project 86-75C; Fort MacKay Ranger Station and Water Pipeline and Fort MacKay - Fort Chipewyan Winter Road Historical Resources Impact Assessment," by Terrance H. Gibson and Eric Damkjar

86-76 **Terrance H. Gibson**
9932 - 112 Street
Edmonton, Alberta

City of Edmonton
Edmonton Ring Road

PROJECT TYPE: HRIA

LOCATION/SETTING: West side of municipal boundary of the city of Edmonton. Setting is parkland under cultivation, spruce forest and bog.

METHODOLOGY: Shovel testing and surface inspection of portions of the 24 quarters of land associated with the planned construction of the Edmonton Ring Road (West Leg) by the City of Edmonton

RESULTS: Twenty-five archaeological sites were located within the assessment corridor defined by the proponent. All sites consisted of prehistoric artifact surface scatters or find spots. Seven sites yielded historic artifacts as well. Detailed subsurface testing demonstrated that all archaeological stratigraphy associated with the sites had been destroyed, either by agricultural activities or construction. No significant historic features were noted. No further mitigation is recommended for these sites.

SITE TYPES: Surface scatters and find spots

REPORT: Complete, entitled "Project 86-76; Historical Resources Impact Assessment of the West Leg of the Edmonton Ring Road," by Terrance H. Gibson

86-77C

B.O.K. Reeves
Lifeways of Canada Ltd.
317 - 37 Avenue N.E.
Calgary, Alberta

Alberta Transportation
Upgrading Hwy. 1A

PROJECT TYPE: HRIA

LOCATION/SETTING: West of Cochrane, on a high terrace of the Bow River

METHODOLOGY: Surface inspection of the entire alignment. Shovel tests were conducted along a major curve revision east of the Ghost River.

RESULTS: Five sites were previously reported in the development area. Surface inspection determined that sites EhPp-1 and 4 and EhPq-1 would not be impacted by the development. Casual reinspection of site EhPp-6 failed to reveal any new cultural materials. Minimal impacts occurred at this site as a result of the development. Access could not be gained to site EhPp-5. Part of the site area was subsequently taken as borrow in the 1987 highway construction program. No new sites were located.

SITE TYPES: Tipi rings, isolated find, historic coal mine complex

REPORT: Complete, entitled "Final Report Historical Resources Impact Assessment Upgrading Highway 1A from Ghost River to Horse Creek," by B.O.K. Reeves

86-79

Alan Bryan
Ruth Gruhn
Department of Anthropology
University of Alberta
Edmonton, Alberta

Alberta Culture
Mitigation of Bison Skeleton

PROJECT TYPE: Research

LOCATION/SETTING: Near mouth of Aux Pines Creek north of Sherwood Park

METHODOLOGY: Excavation bison skeleton from eroding cutbank

RESULTS: Excavated six articulated bison cervical vertebrae. Discoverer of the site, Mr. Kon Bonderenko, reported a small chunk of hematite in association, and charcoal is also associated. Vertebral spines are possibly deliberately flaked off. Bones were given to Jim Burns, palaeontologist at the Provincial Museum, who will complete the excavation and determine if there is any cultural evidence present.

RESULTS: Site form, profile and abstract on file

86-80

James A. Light
D.S. Consulting
2912 - 18 Street N.E.
Calgary, Alberta

Novacorp International
Porcupine Hills Liquid
Pipeline Corridor

PROJECT TYPE: HRIA and mitigative research

LOCATION/SETTING: Porcupine Hills, Turner Valley, Pincher Creek, Lundbreck

METHODOLOGY: Relocating 25 known sites, surface observation, subsurface testing and mapping of sites in the development area

RESULTS: Incomplete, project extended to 1987

REPORT: Complete, entitled "Historical Resources Impact Assessment Porcupine Hills Pipeline Final Report," by D.S. Consulting

86-81

Peter T. Bobrowsky
P.T.B. Consulting
4604 - 119 Avenue
Edmonton, Alberta

Stanley Associates
Engineering Ltd.
Residential Subdivision

PROJECT TYPE: HRIA

LOCATION/SETTING: South of Edmonton, south side of Black Mud Creek on ploughed field

METHODOLOGY: Systematic foot traverse of the terraced area encompassing 11 ha. Ten shovel test holes were excavated in areas judgementally deemed to be high potential. Sediment was not screened.

RESULTS: No historical, archaeological or palaeontological sites were found in the study area. Previously recorded sites FiPj-64 and 65 could not be relocated.

REPORT: Complete, entitled "Historical Resources Impact Assessment for the Proposed Running Creek Subdivision on Behalf of Stanley Associates Ltd. and Georgy Wimpey Canada Ltd. Final Report," by Peter T. Bobrowsky

86-82C

Gloria J. Fedirchuk
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Alberta Culture
Alberta Transportation
Highway 41:24 Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed right-of-way for upgrading and widening of Highway 41:24, Beaver River crossing is located in a predominantly cultivated area of the boreal forest. The new bridge approach at the Beaver River which had already been constructed is located in uncultivated lands. Except for the deeply incised Beaver River, the route is located on flat upland terrain.

METHODOLOGY: The entire right-of-way was traversed on foot. Natural exposures, cultivated fields and the cut and graded portion of the bridge approaches were examined. Subsurface tests were excavated where visibility was impeded by vegetation.

RESULTS: No new historical resource sites were identified.

REPORT: Complete, entitled "Historical Resources Impact Assessment, Highway 41:24, Beaver River Crossing," by Gloria J. Fedirchuk

86-83

Edward J. McCullough
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Esso Resources Canada Limited
Obed Kaybob/Pine Creek Pipeline Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Obed Kaybob/Pine Creek pipeline is situated northeast of Hinton. It crosses the Athabasca River in the Boreal-Cordilleran Transition Zone of western Alberta.

METHODOLOGY: Shovel tests were used to determine the presence of prehistoric cultural materials.

RESULTS: No sites were recorded.

RESULTS: Complete, entitled "Historical Resources Impact Assessment Esso Resources Canada Limited Obed Kaybob/Pine Creek Pipeline Project," by E.J. McCullough

86-84 **Rebecca J. Balcom**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Alberta Environment
Hutch Lake Reservoir

PROJECT TYPE: HRIA

LOCATION/SETTING: Hutch Lake is located in northwestern Alberta, 32 km north of High Level. The lake and Meander River, which flows into the lake, will be impounded.

METHODOLOGY: The Archaeological Survey of Alberta identified portions of the impact zone at the northern and southern ends of the lake and along the river to be examined. These areas were modified to reflect current conditions. The areas were examined by means of foot traverses, shovel tests and inspection of fortuitous exposures.

RESULTS: No historical resources were found.

RESULTS: Complete, entitled "Historical Resources Impact Assessment, Hutch Lake Reservoir," by Rebecca J. Balcom

86-85 **Rebecca J. Balcom**
ARESCO Ltd.
2912 - 18 Street N.E.
Calgary, Alberta

Alberta Transportation
Site EaPg-3 on Highway 23

PROJECT TYPE: Mitigation

LOCATION/SETTING: EaPg-3 is located on the north terrace of the Little Bow River at the Carmangay Recreation Area. Portions of the site have been disturbed by grading, road construction and development of park facilities.

METHODOLOGY: Ten 1 x 2 m units were excavated within the proposed right-of-way for a distance of about 150 m. Excavation proceeded in the 10 cm levels until sterile soils were encountered. All matrix was screened. Shovel tests were excavated to depths ranging from 40 to 75 cm below surface in five units. Horizontal provenience was maintained to 1 x 1 m quadrants. All tests were located outside of the tipi rings.

RESULTS: The excavation resulted in the collection of 29 pieces of debitage (primarily quartzite) and several unidentifiable bone and burnt bone fragments and the recording of 11 pieces of fire-broken rock. The assemblage is distributed from 5 to 25 cm below surface. There are no clear stratigraphic changes.

SITE TYPES: Multiple tipi ring site/buried campsite

REPORT: Complete, entitled "Historical Resources Impact Mitigation Site EaPg-3, Carmangay," by Rebecca J. Balcom

86-86 — **Edward J. McCullough, Fedirchuk McCullough & Associates Ltd., 304, 1725 - 10 Avenue S.W., Calgary, Alberta** — **TransAlta Utilities Corporation Transmission Line**

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed 240 kV 942L/943L transmission line is situated northeast of Bruderheim within the parkland region of central Alberta.

METHODOLOGY: Examination of fortuitous exposures and ploughed fields and shovel tests were used to identify the presence of prehistoric cultural materials.

RESULTS: No prehistoric sites were recorded.

REPORT: Complete, entitled "Historical Resources Impact Assessment TransAlta Utilities Corporation 240kV 942L/943L Transmission Line," by E.J. McCullough

86-87 — **Edward J. McCullough, Fedirchuk McCullough & Associates Ltd., 304, 1725 - 10 Avenue S.W., Calgary, Alberta** — **TransAlta Utilities Corporation Burdett Westfield Transmission Line**

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed Burdett Westfield transmission line is situated adjacent to Yellow Lake, north of Forty Mile Coulee, within the grasslands of southern Alberta.

METHODOLOGY: Examination of fortuitous exposures, ploughed fields, and shovel tests were used to identify the presence of prehistoric cultural materials.

RESULTS: Nine sites (DkOu-51 to 59) were recorded.

SITE TYPES: Stone feature sites and historic cellar remains

RESULTS: Complete, entitled "Historical Resources Impact Assessment TransAlta Utilities Corporation Project 730, 138kV Transmission Line Burdett Substation to Westfield Substation," by E.J. McCullough

86-88

Edward J. McCullough
Fedirchuk McCullough & Associates Ltd.
304, 1725 - 10 Avenue S.W.
Calgary, Alberta

Amoco Canada Petroleum Company Limited
Elk Point Heavy Oil Project

PROJECT TYPE: HRIA

LOCATION/SETTING: The proposed heavy oil project is situated south of Elk Point within the boreal forest of central Alberta.

METHODOLOGY: Examination of fortuitous exposures, ploughed fields, and shovel tests were used to identify the presence of prehistoric cultural materials.

RESULTS: Twenty-seven newly identified sites (FkOq-48 to 68 and FkOr-27 to 32) were recorded, and two previously recorded sites (FkOq-2 and 3) were reassessed relative to the proposed project.

SITE TYPES: Artifact scatters (10), isolated finds (16) and campsites (3)

RESULTS: Complete, entitled "Historical Resources Impact Assessment Amoco Canada Petroleum Company Ltd. Elk Point Project," by E.J. McCullough

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