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Driving Bison and Blackfoot Science

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Archaeological and ethnohistorical evidence of “buffalo jumping” is concentrated in Blackfoot (Nitsitapi) territory. Although the “hardware” of buffalo jumps has been documented extensively, little is known of the “software,” in particular the skills required to drive stampeding herds of bison over long distances to the deadfall, on foot, and often for days. The origins and nature of bison driving knowledge is explored on the basis of ethnohistory as well as Blackfoot chronicles, philosophy, and linguistics, and compared with the findings of recent field studies on the relationships between bison and wolves in the northern Great Plains. Blackfoot explanations of bison driving as knowledge learned from wolves are entirely plausible, and shed light on Blackfoot ecological methodology, as well as the development of human–canid hunting relationships generally.

KEY WORDS: traditional knowledge; Blackfoot; bison; buffalo jumps; wolves; canids; hunting tactics.

INTRODUCTION

Designers of the interpretive center for Head-Smashed-In Buffalo Jump, a World Heritage site in southern Alberta, asked Blackfoot elders for information on bison hunting (Brink, 1992). The elders told a number of Napi stories in which Napi makes a fool of himself while trying to become human. Napi gets into trouble because he never listens. The Old Man (Sun) and the animals try to give Napi advice, but he is preoccupied with his own impulses and desires. Parks personnel missed the significance of the stories

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elders chose to tell them. Like Napi, the elders were hinting, Park scientists were not prepared to listen carefully or take Blackfoot knowledge seriously as empirical science (compare Barsh, 1999; Maffi, 2001).

By 2000 B.P., Blackfoot and their neighbors learned how to drive bison over long distances to elaborately modified deadfall jumps like Head-Smashed-In. The knowledge and skill required to make such devices consistently useful despite annual fluctuations in bison movements is impressive. We will show that Blackfoot could have acquired that knowledge through an older hunting collaboration with wolves, as Blackfoot traditions assert. Although Blackfoot have lost their detailed technical knowledge of managing bison after more than a century of disuse, contemporary wildlife biologists can rediscover useful insights about bison behavior by the same means: studying and emulating wolves.

THE PROBLEM

As modern-day bison ranchers will attest, driving a buffalo herd is extremely difficult. "You can usually bluff longhorns [cattle] by standing up to them, but not buffalo," a pioneer bison-rancher once observed. "There is always some cow in the herd that will come bounding out of the bunch toward the rider as if she would like to swallow both him and his horse." His advice to fellow ranchers: "You can drive buffalo anywhere buffalo want to go" (Williams, 1957, p. 686). Our observations of southern Alberta captive bison attest to the truth of this statement.

We do not know when our ancestors began to kill large mammals, instead of scavenging the kills of other predators (Blumenschine, 1991; Lewis, 1997; O'Connell *et al.*, 1999; Potts, 1988; Stopp, 1997). Even during the last glaciation, it is debatable whether humans were yet capable of confronting and killing prey as large as a mammoth, although humans appear to have sometimes eaten them (Fisher 1992, p. 76; Shea, 1998). By 10,000 B.P., however, the human hunters of the Great Plains were not only killing bison regularly, but increasing their efficiency by driving small groups of bison on foot into various kinds of natural and artificial traps (Frison, 1998; Reeves, 1978a; Stanford, 1978). A thousand years before European traders arrived, the ancestors of northern Plains Indians were routinely driving herds of hundreds of bison for days to natural deadfalls: "buffalo jumps" (Reeves, 1978b; compare Kenyon, 1997, for caribou).

How did Plains hunters guide bison movements over such long distances, and how did they learn how to do it? Schaefer (1978, p. 243) was convinced that bison drivers must have possessed an intimate knowledge of "bison psychology" as well as extraordinary physical endurance. Frison

(1978, p. 218) expressed his respect for the skills of indigenous Plains bison drivers in these terms:

The bison is a large animal that appears to move awkwardly and think slowly, but a few minutes in a corral with one will rapidly dispel this kind of thinking. Although large, they are anything but awkward. And although their reactions to the same stimuli used in handling domestic cattle are similar, they react much faster. . . . They have to be pursued in exactly the right way and prodded at exactly the right moment from exactly the right position. Any other action will bring on the wrong reaction from the animal and the whole effort will be wasted.

Archaeology confirms the great antiquity of bison-driving knowledge, but does not tell us how it was done. Eyewitness accounts by European traders and explorers extend back only to the late 1700s, when horses and firearms were already in widespread use, and bison jumps and pounds were declining in popularity. More importantly, early European observers did not go out to watch long-distance bison driving, nor did they ask very much about how it was done. Some sons and grandsons of bison hunters were interviewed in the late nineteenth and early twentieth centuries (e.g., McClintock, 1910; Schultz, 1907, 1962), but their memories were of the actual slaughter of the bison at the jump, and stories they had been told about the spiritual significance of bison. Schaefer (1978, p. 246) was unable to learn from Blackfoot how they got a herd moving and kept it moving; he suggested that this knowledge had been a “trade secret” of a small group of specialists.

Communal bison hunting on the northern Great Plains came to an end more than a century ago, and contemporary Plains Indian ideas about bison behavior are largely historical, rather than acquired and tested through direct personal experience. However, our Blackfoot (Nitsitapi) elders and colleagues gave us intriguing clues about bison driving in linguistics, geography, cosmology, and the Blackfoot approach to studying the ecosystems surrounding them. These clues are consistent with the suggestion elsewhere that observing and imitating the animal behavior played a major role in the development and intergenerational transmission of indigenous peoples’ technologies (Barsh, 1999; Huffman, 1997).

THE ARCHAEOLOGICAL RECORD

Archaeologists have devoted considerable attention to large bison kill sites. Thick bone beds are visually obvious, and easily found with the help of local farmers and ranchers. Indeed, the visibility and artifact richness of large kill sites has arguably exaggerated the contribution of jumps and pounds to pre-Columbian Great Plains diets (Nicholson, 1988). On the other hand, widespread destruction of large kill sites by “bone miners” in the early

twentieth century has deprived us of many of the largest and most recent sites (Davis, 1978; Frison, 1978, p. 178), including some of the sites described in Blackfoot oral history.

The earliest documented group kills (11,000–5000 B.P.) utilized small natural traps such as arroyos, mud, or sand as well as “pounds” of timber and brush to corner a dozen or more bison (Chatters *et al.*, 1995; Dyck, 1977; Frison 1978, pp. 150–187; Reeves, 1978a; Stanford, 1978). Larger kills using drives over jumps appear by 5500 B.P., representing coordinated community hunting projects that used the same sites repeatedly for generations (Frison, 1978, pp. 208–211).⁴ The number of jump sites and size of kills grew markedly after 2000 B.P., implying a growing human population, heavier reliance on jerky and pemmican, and trade in pemmican and hides with the agricultural towns of the Mississippi basin (Brink, 1992, pp. 176–182; Kehoe, 1978). Plains bison herds flourished during the moist interval of the Little Ice Age (400–200 B.P.), supporting an even greater intensification of bison jumping. Use of the Vore jump increased from roughly once every 25 years to yearly during this period (Reher & Frison, 1980, pp. 40–42; Reeves, 1978b).

Most known bison jumps are located in the eastern foothills of the Rocky Mountains in Alberta, Montana, and Wyoming, roughly half of them in territory that was controlled by Blackfoot in the late 1700s when first described by European visitors (Harris, 1987, Plate 10).⁵ Jumps have been found in settings ranging from parkland forests in the Rocky Mountain foothills to rolling grasslands, and were used in spring and early summer as well as fall and early winter (Malainey and Sherriff, 1996). This suggests that sites were chosen strategically along seasonal bison migration routes and utilized somewhat opportunistically (compare Medicine Crow, 1978, on Crow bison jumping). Significantly, large-scale bison kills have not been found on the *southern* Great Plains (Bemant and Buehler, 1994; Wedel, 1986, pp. 123–126), despite similarities in ecology and topography. This regional difference in hunting tactics has not been explained, but it is conceivable that it reflected a dif-

⁴The Head-Smashed-In jump was used periodically, in winter and summer, for more than 5000 years (Brink, 1992), while the Vore jump at Sundance, Wyoming, was repeatedly used from roughly 500 B.P. until the nineteenth century, and may contain the remains of more than 20,000 bison (Frison, 1978, p. 242).

⁵For an introduction to Blackfoot ethnology, we suggest Ewers (1958) and Thomas (1986); for modern Blackfoot history, we suggest Hanks and Hanks (1950), Rosier (2001), and Samek (1987). It is possible that Blackfoot emerged as a distinct people elsewhere and later migrated to their present location, where they have been at least since the 1700s (Thomas, 1986, pp. 15–17). Historical Blackfoot territory falls at the western edge of the distribution of the Algonquian language family, which has led Algonquian speaking scholars to speculate that the Blackfoot were the *original* Algonquians. Blackfoot traditions refer to the Sand Hills of northern Alberta as both the origin and destination of human souls, which some scholars in the past interpreted as evidence of relatively recent southward migrations. No reliable material evidence exists to dispute either of these propositions.

ference in *technology* rather than opportunity or belief systems: perhaps a difference in *soft* technology, such as knowledge of bison behavior that made group hunting more reliable and economical, rather than tools or constructions that leave an archeological record.

Long-distance bison driving is indispensable to the use of jumps, and drives of 25–30 km are “not unthinkable” on the basis of the topography of known jump sites (Reher & Frison, 1980, p. 46; Reeves, 1978a). Jumping bison required large stampedes to produce sufficient momentum to prevent lead cows from turning away as they approached the deadfall, perhaps as many as 500–1000 animals (Frison, 1978, pp. 229–230; Reher and Frison, 1980, pp. 45–46). Managing a stampede of such size would be a formidable task for a small party of humans on foot—and a precious “trade secret,” to use Schaefer’s term (Schaefer, 1978).

HISTORICAL OBSERVATIONS

Verbicky-Todd (1984) has reviewed firsthand observations of the use of bison jumps and pounds, which extend from the 1790s to the 1870s.⁶ Drive lanes designed to funnel the stampeding animals into the trap or deadfall were defined by cairn-like markers constructed of rocks, brush, tipi lodge poles, blankets, snow, bison dung (often lit and smoldering), and people—mainly purely visual barriers which bison could breach but nevertheless tended to avoid (Verbicky-Todd, 1984, pp. 37–43). Considerable effort was required for their construction. The drive lanes at the Head-Smashed-In jump in southern Alberta are more than 12 km long and consist of more than 500-m-high rock cairns (Reeves, 1978b). The Five Fingers jump in Idaho has five drive lanes marked by 680-m high rock cairns, as well as several stone fences and breastworks (Agenbroad, 1978). These jumps were used for thousands of years, and they were undoubtedly enlarged and rebuilt in stages. Their construction nevertheless represented a very large, long-term community investment in a particular strategic location.

European trappers and explorers reported that people went to particular sites at different times of year to wait for bison herds to approach within a few days’ travel (Verbicky-Todd, 1984, pp. 6–7). This suggests reliable forecasting of herd movements. The nineteenth-century trader Schultz (1962, p. 313) heard that Blackfoot “bison-callers” would tell the chiefs when to move camp near a particular jump, then pray to bring a herd within its

⁶A surviving Blackfoot Winter Count refers to 1879 as “no more buffalo” (Dempsey, 1965). According to one Blackfoot tradition, the bison-caller Many Tail Feathers put an end to their use of pounds and jumps in the late nineteenth century after dreaming that the use of horses for driving had made these devices too destructive (Schultz, 1962, pp. 317–318; see also Wedel, 1986, p. 64).

vicinity. Other European observers described the use of runners to locate the herds and launch a stampede, decoyers to lead an approaching herd down the drive lanes towards the jump or into a pound, and frighteners to prevent the herd from turning away at the last moment (Verbicky-Todd, 1984, pp. 46–49). Bison runners reportedly used songs, shouts, animal calls, noise-makers, and grass fires to start a herd, aided in the 1800s by their horses.⁷ Decoyers often dressed as bison, and imitated the movements of bulls or the bleating of terrified calves (Schultz, 1916, pp. 56–99, 206–207). After observing Blackfoot bison hunts in 1792, the English trader Peter Fidler concluded that there was “a deal of art in this driving them [the bison] as they wish,” often for several days before reaching the jump or pound (Verbicky-Todd, 1984, p. 66).

In 1772, fur trader Alexander Cocking watched his Assiniboiné and Cree companions repeatedly try to draw bison into an abandoned Blackfoot pound that had apparently had been used within the past year, without success (Verbicky-Todd, 1984, p. 61). Although many Great Plains peoples used the same hardware to trap bison, knowledge of attracting and driving bison over particular terrain was probably localized, perhaps site-specific. Among Blackfoot, at least, *piisskan* were associated with specific clans (Shaeffer, 1978), and operating knowledge was embedded in clan-specific traditions. Like musical and artistic skills, however, the ability to call, drive, or decoy bison also required individual talents or gifts that could only be rediscovered by each generation of children (as suggested by Schultz, 1916).

BLACKFOOT ETYMOLOGIES

In the Blackfoot language, related concepts share the same roots, or form sets of alliterative words. An example of this is *iinii* (bison), which is phonemically embedded in terms such as *iinii'im* and *iinii'tsawa* (holding someone in special regard or favor).⁸ Thus a special human relationship is “just like bison to me,” and bison are “my special relations.”

The terms *piisskan* (a bison jump or a pound) and *iinisskimm* (buffalo stones used by bison-callers)⁹ build etymologically on the root *issk* which

⁷There is evidence of fires at Head-Smashed-In and Boarding School (Kehoe, 1967; Reeves, 1978b), although it is uncertain whether it was part of a drive or simply to renew prairie vegetation to maintain large bison populations (compare Barsh, 1997a).

⁸This analysis was developed with Duane Mistaken Chief, informed by Frantz and Russell (1989) and our discussions with other knowledgeable Blackfoot speakers.

⁹The *iinisskimm* described by ethnographers, and those which continue to be collected today, tend to be fossil ammonites such as *Baculites*. All *iinisskimm* are not ammonites nor are all ammonites *iinisskimm*, however. Other vertebrate and invertebrate fossils and inorganic concretions may be *iinisskimm*. The shared feature of all *iinisskimm* is that they must be *found* under circumstances that signify the finders' tendency to attract, manipulate, or “call” bison.

implies containing or holding, and is used today to refer to a pail. *Pisskan* can refer to an animal corral, and *niistsiiipisskan* (“people *pisskan*”) can signify a fence around land. As *iinii* are bison, an *iinisskimm* is something that contains or holds bison in its power. *Iinisskimm* songs recorded by Wissler and Duvall (1908, pp. 85–89) include phrases such as “a hundred I shall lead over [the jump]” and “good running of buffalo, the driver is coming with them,” suggesting that buffalo stones were originally associated with running bison rather than “calling” them. The root *issk* also appears in *ksisskstaki* (beaver) because beavers are builders of enclosures. This explains the association of *iinisskim* with the Blackfoot beaver bundle, as described by Wissler (1912, pp. 242–245) and McClintock (1923, p. 66), and by contemporary Blackfoot.

The Blackfoot names of individual *pisskan* also contain important clues. The story behind Head-Smashed-In suggests the risks of a communal bison hunt (Reeves, 1983). Two Medicine *pisskan*, on Lee’s Creek near Browning, Montana, is known in Blackfoot as “banks-roped-together” (McClintock, 1910, p. 438), a reference to the number of bison once taken there, and the great length of bison-hide rope that was made from them. Old Woman’s *pisskan* near Cayley, Alberta, takes its name from the story of how men and women first got together to hunt bison cooperatively, and Wolf-Also-Jumped *pisskan* is a reminder than humans and wolves hunted bison alongside each other.

It is more difficult to interpret the terms recorded by Schultz (1962, p. 313) and others for decoyers (*aahwa’waki*, *awah-kee*, and *auki*). In contemporary Blackfoot, *aawowaaki* connotes a male homosexual, drawing on the root *waawo* (reversed or backward), but it could easily have once implied a disguise, or something that is not what it appears to be. It is also conceivable that nineteenth-century Blackfoot were making an alliteration on *awakaasi* (antelope or deer) for the runners and decoyers who brought bison herds into the *pisskan* on foot.

BLACKFOOT CHRONICLES

There are many historical and contemporary versions of the origins of *iinisskimm* and *pisskan* (e.g., Verbicky-Todd, 1984, pp. 220–225; Wissler & Duvall, 1908, pp. 85–89). In all versions of the *innisskimm* story that we have read and heard, the people in camp are starving because the bison have moved away. This may refer to the severe Altithermal drought of 7500–8000 B.P., which preceded the appearance of large-scale bison kills in the archaeological record (Reher & Frison, 1980, p. 46). A young woman stumbles upon one or several *iinisskimm*, which appear as small stones or tiny bison and are dancing and singing. The *iinisskimm* explain that repeating their

ceremony will always ensure an ample supply of bison, which eventually comes to pass after the woman shares her gift with a man (son or husband). Historical accounts identify all bison callers, runners, and decoyers as men; in recent years, women have reportedly found *iinisskimm* for men.

Blackfoot maintain a men's ceremonial society, the *Iitskinaiksi* or Horns, and a women's society, the *Maoto'kiiksi*, both traditionally associated with bison. The key root in *Iitskinaiksi* is *mootskina'yi* (an animal horn) and in *Maoto'kiiksi* it is *mao* (red color or red ochre). Ochre was frequently rubbed on the *iinisskimm* to enhance its power. The bison dances of the Horn Society and *Maoto'kiiksi* society reportedly portrayed a *pisskan* drive (Wissler & Duvall, 1908, p. 405; McClintock, 1910, pp. 440, 450; Wissler, 1913, pp. 404–408). Broadly speaking, Algonquin societies tend to embrace this kind of gender complementarity, in which functions are divided between men's and women's institutions (Barsh, 1986). Gender complementarity is visible at the annual Sun Dance, where the *Maoto'kiiksi* must ritually prepare the arbor site for the Horns, and at ceremonies such as all-smokes (*kano'tsisissin*) that include ritual meals of berries and meat (traditionally bison tongues), representing the contributions of women and men, respectively.¹⁰

According to a contemporary version of the story behind Old Woman's *pisskan*, men and women used to live in separate camps, and both hunted buffalo. The men are described as *aawowaaki*, implying an ignorance of their heterosexuality. The men were strong, had obsidian knives, and used *aki* (piles of dung) to mark the drive lanes of their *pisskan*. The women had spears, were skilled butchers and tanners, and could make beautiful robes from tanned hides. Napi—the son of the Old Man (the Sun or Creator), who had come to live in the men's camp—suggested that the men and women should live together and reproduce together. Men and women should share their skills and technology, Napi explained, because cooperation would enable them to achieve *moguksin*: knowledge of “how to put everything together,” or true wisdom.

Blackfoot relate their understanding of ecological processes to specific places rather than to general laws (compare Basso, 1996). A thick layer of bones in Pine Coulee near Stavely, Alberta, marks the base of a bison jump. Above the precipice rests a massive pictographic boulder known to the Apikuni (or Peigan) branch of the Blackfoot as *Iikisstonopata*, which has been translated as “all listen when she talks.” Three small human figures appear beneath a larger figure, symbolically consistent with the name of this landmark. *Iikisstonopata* has been a vision-seeking site since the days when

¹⁰Our colleague Duane Mistaken Chief believes *kano'tsisissin* was originally the blessing ceremony for the bison-runners, but has now taken on a broader role as a blessing of any important venture.

Pine Coulee was the principal wintering campsite of the *Puk'ni* (Padded Saddles or Hairy Noses) clan, and offerings continue to be left there. It is also associated with the Beaver Bundle. *Iinisskimm* are sought here, and at only a half-dozen other sites in historical Blackfoot territory. According to the traditions of *Puk'ni* families, *iinisskimm* taught them how to jump bison at *Iikisstonopata*. Pine Coulee has also been identified as a bison gate that connected wintering valleys in the foothills with the Alberta prairie.¹¹

KNOWLEDGE AND SURVIVAL

European explorers encountered bison herds extending for 25 miles or more and containing millions of individuals, but the herds were separated by several days' journey (Shaw, 1997).¹² It is unlikely that people kept pace with long-distance bison migrations, especially in winter when human mobility was limited by the need for shelter and firewood (Epp, 1988). Plains hunters must have had some ability to forecast the movements of herds, and to intercept them, as Bamforth (1987) has argued. Contemporary field studies of bison offer some further clues to the knowledge and skills of pre-Columbian bison hunters, although we must bear in mind that the vast bison herds of the eighteenth century did not necessarily behave exactly like the small refuge-based bison populations of the twentieth century.

Bison herds follow long-established trails (Carbyn *et al.*, 1993). The timing and direction of their movements are not fixed, however, and even the membership of herds and smaller "pods" is continually in flux (Larter and Gates, 1994). Bison will travel considerable distances in search of nutritionally high-quality grasses (Tieszen *et al.*, 1998).¹³ Their movements therefore depend on many factors affecting the annual growth pattern of grasses, such as topography, hydrology, fire history, and the location of prairie dog towns (Barsh, 1990; Epp, 1988; Knapp *et al.*, 1999; Shaw, 1997). In Yellowstone National Park, bison tend to overwinter in sheltered valleys, then pursue the edge of spring green-up to higher altitudes, but the seasonal routes they

¹¹In 1999, over the strenuous objections of the Peigan Nation, the Province of Alberta completed a concrete barrier dam near *Iikisstonopata* and turned Pine Coulee into an irrigation reservoir.

¹²Martin and Szuter (1999) argue that the wide separation of bison herds in historical times was due to intense warfare among Plains Indian nations; bison could only thrive in the unexploited, game-rich no-man's-lands that lay between combatants' territories. While plausible for the historical period, when the fur trade, firearms, and displacement of Indian populations by settlers intensified conflict over land and wildlife, it is less convincing for the dog days.

¹³Contemporary bison appear less density-dependent than other large herbivores (Knapp *et al.*, 1999; Singer *et al.*, 1998); that is, the number of bison can increase considerably without affecting the structure or stability of plant communities. This suggests that bison are particularly well adapted to sustaining large numbers over large geographical areas.

choose can change dramatically in response to severe weather (Meagher, 1997).

During the dog days,¹⁴ Blackfoot had to plan their annual movements so as to take advantage of seasonal food sources such as berries, and minimize the risk of long periods of want. At each stopping point in their annual rounds, Blackfoot probably reassessed their travel plans on the basis of their knowledge of the effects of unfolding weather patterns on the animals and plants they sought for food. The climate is highly volatile today in Blackfoot territory, with conditions between May and September fluctuating from desert-like aridity to cool rains, hail, and snowstorms at 10°C or lower. A promising spring may quickly become a famine summer. Important forage foods, such as prickly pears and saskatoon berries, vary considerably in their local abundance from year to year, and do not appear at all in some years. Blackfoot had to reduce the uncertainties of intercepting bison as much as possible; if a band visited a *pisskan* too early or too late, they would have to rely on transported supplies of dry meat and pemmican and whatever small game was locally available.

One finding of recent research is the tendency of bison to prefer recently burned patches of prairie grass for foraging, especially in the early spring (Carbyn *et al.*, 1992; Coppedge & Shaw, 1998; Knapp *et al.*, 1999; Vinton *et al.*, 1993). There are historical references to the firing of the prairie to attract bison to the vicinity of a *pisskan*, and to drive bison towards it (Arthur, 1975, pp. 24–25; compare Barsh, 1997a). Blackfoot may have moved their camps near certain *pisskan* in the early spring and then fired the surrounding prairies so that bison would be drawn to the fresh growth of grass. The location of springs and streams may have been a more important limiting factor on bison numbers and movements than forage, moreover, especially during periods of relative aridity. Old bison trails still visible in the Alberta prairies follow watercourses as well as ridgelines.

Iinisskimm were reportedly part of the original Beaver bundle, associated with rivers and reputedly the oldest Blackfoot ceremonial bundle. As architects of the waters, beavers controlled a key landscape condition for bison. Beaver-bundle holders would probably have understood how the distribution of surface waters influenced the movements of bison, and also how the movements of bison might change in response to changes in surface waters due to weather and climate conditions. *Iinisskimm* were also contained in other bundles and in their own bundles, however, and no two historical observers recorded the same *iinisskimm* ceremonies or songs (Verbicky-Todd,

¹⁴Blackfoot divide history into the ancient times of the wolf people (when there were still horses, hence the interglacial); the dog days when dogs were the main beast of burden; and the horse days—the past 250 years or so.

1984, pp. 12–22; Wissler, 1912, pp. 204–208).¹⁵ We believe that this indicates that *iinisskimm* were originally associated with forecasting bison migrations, but later became associated with bison driving as well. It also suggests that methods of use varied with the user; the common element of all *iinisskimm* was the holder's demonstrated knowledge of bison behavior, rather than a traditional ritual.

Of course, it is possible that *pisskan* were deliberately situated near good deer, elk, and antelope hunting areas, such as riparian cottonwood forests, to minimize the risk of famine, and reduce the need for highly reliable bison forecasting. It is also clear from historical accounts that bison were ordinarily driven from considerable distances to *pisskan*. Longer drives would have increased the catchment area of each *pisskan*, and reduced the need for precise forecasting. How did Blackfoot manage bison behavior to increase the drive-length of their *pisskan*?

WHAT WOLVES TEACH

In Blackfoot cosmology, beavers constructed the world in which we now live, but wolves were the first to learn how to utilize the most precious food resource in the world that beavers built: bison. Blackfoot learned to live together and hunt bison in social groups from wolves, and refer to their ancestors as “the wolf people.” Blackfoot reportedly called wolves their brothers and protected them (McClintock, 1910, pp. 434, 476). Wolves were associated with cunning and traveling long distances, and wolf-songs were used in hunting and in war (McClintock, 1923, pp. 210, 281).¹⁶ These stories coexist with *iinisskimm* stories, and draw attention to an important ecological fact: wolves drive bison.

Wolves prefer large prey such as moose, musk-oxen, caribou, bison, and in the Old World, horses. Prey selection varies regionally, not only in response to the relative abundance of different large herbivores, and topographical conditions affecting the ease with which wolves can capture them, but also as a function of social learning and individual variation within and between wolf packs (Carbyn, 1992; Hayes and Harestad, 2000; Hovens *et al.*, 2000; Kunkel *et al.*, 1999; Okarma, 1995; Vos, 2000). Wolves' hunting tactics vary locally, as do the defensive tactics of their prey, which also appear to be

¹⁵In pursuing our research, we have respected the confidentiality of songs and associated ceremonies, which constitute forms of knowledge that must be “paid for” through initiation into sacred societies, or through the transfer of a bundle. We have not sought direct access ourselves to these texts, but rather discussed their significance with initiated people.

¹⁶The root term for coyotes and wolves is *aapi'si*, which alliterates with *aapii* (white- or light-colored) and *a'pis* (rope), two concepts that are frequently alliterated in words associated with medicine or power such as *aapiinima'tsis* (medicinal plants).

learned (Berger *et al.*, 2001; Laundre *et al.*, 2001; Smith *et al.*, 2000). Moose frequently confront wolves, often successfully (Mech, 1981, pp. 208–210; Mech, 1988). Ungulates that form herds can employ defensive tactics such as circling, and collective flight.

Bison are large and they form large herds, posing a formidable challenge to predators that are a mere fraction of their weight. Bison nonetheless appear to have been the preferred target of Great Plains wolves. Wolves must utilize intelligence and cooperation to engage in big-game hunting without unacceptably high losses. Fox (1992, p. 35), a veterinarian who has done comparative work on the behavior of wolves and other canids, and wildlife biologist Roger Peters (1978), contend that wolves necessarily share humans' capacity for mentally mapping landscapes and forecasting the movements of other species, given the size of wolves' territories and the mobility of their preferred prey.

As British zoologist John Richardson observed in the 1820s (Dyck, 1977, p. 63), wolves shadow bison herds, observing them from convenient vantage points, occasionally harassing them, and mixing casually with them for days without attacking (Carbyn & Trottier, 1987, 1988; Mech, 1981, p. 241). Wolves' hunting success increases the longer they follow a herd, perhaps because they use this opportunity to study and test the weaker animals (Carbyn *et al.*, 1993). Once wolves isolate and attack an individual animal, the chase is very short and the outcome is usually decided within a few seconds (Mech, 1981, pp. 202, 209, 225).¹⁷ After a wolf attack, bison may run for days to escape the pack's territory entirely (Carbyn, 1992; Mech, 1981, p. 203).¹⁸ Like human hunters, wolves must achieve high success rates each time they attack.

Bison initially defend themselves from a wolf attack by gathering closer, shielding calves, and charging individual wolves that approach them too closely. Under persistent harassment the herd runs, with the vulnerable calves in front (Carbyn & Trottier, 1987, 1988). Whether the herd makes a stand or runs, the challenge for the attackers is cutting some of the calves or weaker adults away from the rest of the herd. Stampeding the bison, usually by means of a coordinated rush, appears to give attackers an edge by splitting the herd into smaller groups (Carbyn *et al.*, 1993). Wolves also engage in coordinated teamwork to "ambush" bison. While some members of the pack attack and stampede the herd, others circle around far ahead and cut off possible escape routes (Carbyn and Trottier, 1988). Wolves have been

¹⁷Wolves in circumpolar North America and Russia follow caribou herds year-round, and appear to be so familiar to caribou that they cause no alarm and mingle with the herd, except when they actually attack (Mech, 1981, pp. 161–162, 229–230).

¹⁸Packs' territories appear to range from about 100 km² in temperate forests to 20 times that size in tundra (Mech, 1981, p. 165).

observed using similar tactics to hunt caribou, deer, and musk-ox (Mech, 1981, p. 226, 1988, pp. 69–71; Kelsall, 1968, p. 252; Pimlott *et al.*, 1969, pp. 46–49), and juvenile wolves, like dogs, routinely play ambush games with each other (Fox, 1971; Pimlott *et al.*, 1969, p. 48). Repeatedly ambushing a fleeing herd can accelerate the stampede and manipulate its trajectory.

Wolves have been observed taking advantage of the familiar topography of their home range to set up repeated ambushes. Carbyn *et al.*, (1993, p. 218) described the hunting tactics of a pack on Lousy Creek in Wood Buffalo National Park:

This pack specialized in multiple kills by first chasing herds with calves along a trail leading to a water crossing. After plunging through the water crossing, the herds would remain in a tight formation along a trail leading through an aspen forest for another 250 m[eters]. The trail led out into an open meadow, but one branch of the trail paralleled the meadow. This physical feature was used to an advantage by the wolves. In full flights, a large portion of the herd would continue running along the trail, while some adults with calves would be pushed out straight ahead and into the open. The pack had perfected its hunting technique by quickly rushing out into the open and killing in multiples those calves that were together in close proximity.

These wolves used their familiarity with game trails, topography, and bison behavior not only to drive and cut bison herds, but also to drive bison into terrain where they were more vulnerable. Bison jumps worked on the same principle.

COLLABORATING WITH CANIDS

There is an 1857 report of Dakota Sioux following a bison herd like wolves (Wedel, 1986, p. 201). One *pisskan* is known as “wolf-also-jumped” because a wolf had been shadowing the same herd as Blackfoot runners, and went over the precipice with the stampede (Schultz, 1962, p. 318).¹⁹ If humans followed wolves to scavenge wolf kills (compare McNulty *et al.*, 2001) or locate prey, they would have observed wolves’ forecasting skills (Olsen, 1985, p. 18; Sharp, 1978) and wolves’ hunting tactics. When Schultz (1962, pp. 166–167) went hunting with Blackfoot more than a century ago, and Catlin (1973, pp. 386–387) went hunting with the Sioux, they observed the collective ambush tactics of wolves much as the “wolf people” may have done many generations earlier.

Human hunters on foot wielding spears would be very vulnerable in a confrontation with a group of bison. Humans are slower than wolves, and lack wolves’ formidable dentition. Like wolves, humans would try to minimize

¹⁹Canid bones have been found in several bison kill sites, but whether these individuals were involved in the chase, or simply scavenged the kill, is uncertain (e.g., Dyck, 1977, pp. 44–49; Kehoe, 1967; Stanford, 1978).

their own losses; harassing, tiring, and unnerving bison, then cutting out weaker individuals such as calves would have been safer than a direct assault. Such a strategy benefits from numbers and from teamwork, which humans would have initially observed in wolves.²⁰ Early bison traps would probably have involved a small group of hunters working like wolves to harass a herd and cut out a small number of animals before cornering and killing them. As humans improved their knowledge of bison behavior, they were able to drive larger groups of bison over greater distances to large artificial traps or precipices.

Initially competitors, wolves and humans, may eventually have become collaborators (Fox, 1978). Wolves and humans have complementary advantages. Wolves are faster and have a superior ability to track by scents and sounds. Handheld weapons such as spears may have offered some improvement over the dentition of wolves at close range,²¹ and fire can be a powerful albeit dangerous tool for harassing bison. Wolves are naturally insulated for winter hunting but tend to get stuck in snowdrifts, while humans wearing snowshoes can use their relative mobility to get heavy prey such as bison stuck in deep snow (Catlin, 1973, p. 384; Mech, 1981, p. 223). Neither wolves nor humans enjoyed a significant net advantage (Sharp, 1978), but the combination of wolves' senses and mobility with humans' tools was probably mutually beneficial.

Humans began to intervene in the reproduction of wolves at least 100,000 years ago, and continued to draw on wolf populations to breed domestic dogs (Vila *et al.*, 1997). John Richardson had difficulty distinguishing Indian dogs from wolves when he visited the upper Missouri 180 years ago (Dyck, 1977, pp. 75, 80). Living with dogs would have helped humans understand wolves and maintain relationships with them (Fox, 1971). Olsen (1985, p. 18) speculated that humans originally shadowed wolves to locate prey, and began a special social relationship with wolves by letting the pack share human kills. Wolves and foxes reportedly "cleaned up" bison traps and pounds after each use. Did humans simply abandon the *pisskan* to waiting predators after taking what they wanted, or did they make a conscious effort to establish social relationships by throwing meat to the wolves gathered at a short distance from the carcasses?²² Wolves may simply have shadowed the

²⁰It is also quite plausible that humans adopted wolves' strategy of wounding a large prey animal, then returning to finish it off after a day or two when it has weakened (see Mech, 1981, p. 241).

²¹Frison's experiments persuaded him that heavy spears would have been effective for prodding, containing, and killing stuck or cornered bison (Frison, 1978, p. 173). Wolves have the advantage on the run.

²²We have observed Pacific Northwest and Alaskan Native fishermen sharing salmon with eagles as a way of establishing relationships.

human hunters driving bison towards a trap, in anticipation of sharing some of the kill; but even this passive form of collaboration would have increased the terror of bison in full flight.

Aboriginal Australians often raised dingo pups, returning most of them to free-ranging dingo social groups. Hunters then shadowed feral dingoes, or used relatively tamer dingoes to locate, chase, harass, and tire large prey (Corbett, 1995, pp. 18–21; Meggitt, 1965). Medicine Crow (1978) reports that the Crows used their dogs to help haze bison, and while there are historical reports that Blackfoot kept their dogs tied and muzzled in camp during a bison hunt (Schaefer, 1978), this may have been a consequence of the adoption of horses as hazers. Canids' usefulness as hunting partners declined considerably in the eighteenth century, and dogs were used mainly for transportation and camp security (Wilson, 1924). By the late nineteenth century, Blackfoot even reportedly began trapping canids for their fur (Ewers, 1958, pp. 32, 85).

ACQUIRING WOLF KNOWLEDGE

Blackfoot could have learned to drive bison by trial and error. They could have observed bison over time, made systematic inferences about the nature of bison perception and cognition, and derived theories about manipulating bison behavior from models of bison psychology—a deductive, “scientific” approach. Or they could have observed wolves, recognized the usefulness of wolves' knowledge, and then imitated wolves' behavior to insert themselves into the existing bison–wolf relationship without significantly changing it. Blackfoot today report that they followed this “empathetic” (Barsh, 1997b) approach.²³

Instead of collecting data on bison, Blackfoot *performed wolves*. They tried to look like wolves and to move like wolves (compare the Mandan bison dance; Catlin, 1973, pp. 207–210). They *became* wolves in ceremonies at home in camp, and in the presence of bison herds on the prairie. Blackfoot would have observed that bison reacted to the human performance much as they reacted to wolves. By becoming brothers to the wolf in a symbolic and ceremonial manner, Blackfoot could quickly discover effective means of manipulating bison, without studying bison “objectively” at arm's length. They would have absorbed wolf knowledge, effectively but nonverbally, through performances that could easily be mistaken for purely “cultural” activities by an outside observer.

²³A third possibility, suggested by Schultz (1916, pp. 206–207), is that humans captured and observed bison calves, as Catlin (1855, p. 388) reported it surprisingly easy to do. This might help explain “calling” bison, by imitating calves' distress cries, but not cutting herds and “driving” bison.

Bison have relatively poor vision, but keen senses of hearing and smell (Arthur, 1975, pp. 35–36; Schaefer, 1978, p. 244). At a distance, bison perceive motion but little detail. They apparently can detect the presence of wolves by scent at distances of hundreds of meters, and distinguish wolves from harmless coyotes by their scent or motion. Moving and smelling like a wolf, a human hunter would frighten bison from a distance. Moving and smelling like a coyote, a human hunter would probably be able to approach a herd easily and safely, until becoming recognizably human to the near-sighted bison. Knowing that bison are particularly sensitive to certain scents or movements can help a hunter stampede bison, or approach within range of an easy shot or spear-throw.

Blackfoot stories of buffalo hunting frequently refer to wolf or coyote disguises.²⁴ There are many historical accounts of men wearing coyote skins to stalk bison or bison-calf skins to attract bison; sometimes a pair of hunters stalked bison on foot, one dressed like a wolf and the other a bison calf (Verbicky-Todd, 1984, pp. 159–161; see also Catlin, 1973, pp. 385–386; Mallery, 1893, p. 534, Fig. 747). Since coyotes are solitary small-game hunters, bison respond differently to coyotes than to wolves. It would be easy to take advantage of this difference by wearing different skins to produce different bison responses—flight or indifference.²⁵

Using a *pisskan*, humans were able to kill bison of all ages and conditions, while wolves culled out young calves and the feeble. Healthy adults could *escape* a wolf drive, but not a *human* drive. Perhaps this is another reason why humans used wolf disguises. After observing caribou grow anxious whenever he wore the fur-edged hood of his parka, Pruitt (1965) opined that caribou had learned that wolves raise their manes when they are stalking and about to attack. Humans disguised as wolves could have used their movements to send deceptive signals to caribou, and presumably to bison as well.

THE HUMAN-BISON RELATIONSHIP

To guide a stampede, humans could think of the “flow” of a herd as a kind of river of animals. Blackfoot today characterize a bison herd as a

²⁴Wolves became nearly extinct in Blackfoot territory at the same time as bison, but coyotes remain abundant. In Blackfoot, the root can be used to connote a family of animals (e.g., *aapi'si* for all canids). It has now been more than a century since the local disappearance of wolves, and present-day Blackfoot speakers may be repeating old stories using *aapi'si* rather than the more precise terms that distinguish between wolves and coyotes—meanwhile assuming that *aapi'si* refers to the surviving species.

²⁵Collaboration of a wolf and coyotes in subduing a bison calf was recently observed, but was perhaps an exceptional event (Smith *et al.*, 2001).

single organism or energy force, rather than as a collection of individual animals. The means by which individual bison remain aware of the speed and direction of their herd and remain aggregated is a matter of some speculation even among our Blackfoot colleagues. It is generally agreed that the aggregative force is an inverse function of the size of the herd, however. Blackfoot reasoning about managing bison employs logical models similar to mathematical models of fluid systems (hydraulics). We believe that such models could have been discovered through observing and participating in wolf–bison encounters. By comparison, contemporary “scientific” studies of bison attempt to predict herd behavior from the behavior of the herd’s individual members.

People often exhibit an affinity for particular kinds of animals. Blackfoot accept the affinity of particular humans for particular animals as an important and useful form of power, as do many other hunting and pastoral peoples. Dreams and visions reveal this power; ceremonies may acknowledge its possession and legitimize its use; and traditions may give it a social context and ethical framework; but the power itself is an individual skill that is learned through experience, nonverbally and unconsciously, like the ability to play the violin or to become a champion at ice hockey. Some Blackfoot have had an exceptional affinity for bison, which they confirmed by discovering *iinisskimm*.

Children necessarily build predictive models of the thinking, motives, and moods of their parents and siblings as part of socialization. Children who play with animals presumably learn animal behavior. Like many other hunting peoples, Blackfoot captured and raised “pets” (Ingold, 1994; Morris, 1998, p. 3; Olson, 1936, p. 137). A child’s learned ability to predict and manage the behavior of dogs or horses may be difficult to explain verbally and may seem “innate,” or a “knack,” but it is no more mysterious than a child’s ability to get along well with other humans (a skill that some people never master fully). Some children may have exceptional visual, auditory, or olfactory acuity, rendering them more sensitive to the sights, sounds, or smells detected by animals and consequently better able to appreciate animal behavior. Similarly, it is likely that animals respond to the smells or vocal pitch of particular humans (Fox, 1992). Individual Blackfoot probably possessed bison affinity of this nature, and as such would have played an important economic role in collective hunting, symbolically expressed through *iinisskimm*.

Since Blackfoot bison hunting came to an end more than a century ago, *iinisskimm* would appear to have no remaining function, yet there are still many *iinisskimm* in use, and many young Blackfoot are seeking them. Although a whole world disappeared with the last *pisskan* drive, it has been

replaced by a new world,²⁶ inhabited by what Blackfoot elders describe as “new people,” and in which *iinisskimm* play an important and functionally equivalent role. In the last world, bison meant wealth. In the new world, money and employment have replaced bison. Today, *iinisskimm* are said to attract wealth to men and women who use their wealth in the service of others.

CONCLUSIONS

The oral literatures of tribal peoples contain a great deal of technical knowledge as well as moral examples (Sugiyama, 2001). It is important to recognize that the technical content of stories may not be a literal expression of the underlying knowledge, but a direction for making observations and experiments. A story can be a model or plan for making a discovery; just as an engineer’s diagram of a machine, or a biochemist’s formula of a molecule, is a model for making a thing. When Blackfoot stories about bison refer to wolves, it may indeed be a clue that people first learned to drive bison from wolves, but it has an alternative reading that may have been far more relevant to Blackfoot listeners: wolves and humans hunt bison the same way; therefore watch wolves—*become a wolf*—to be a good hunter. Historical cause and behavioral ecology are confounded in a single assertion, which is highly problematic for Western trained scholars. For Blackfoot, the ecological side of the assertion was empirically tested every generation and was demonstrably true. The historical or causal side of the assertion was another way of saying the same thing, for Blackfoot, rather than a distinct proposition requiring separate empirical proof.

We have rationalized our conclusions within a Western epistemological framework by showing that there are plausible biophysical explanations for the extraordinary bison-driving abilities of Blackfoot in the “dog days.” To our Blackfoot colleagues, however, bison driving and *iinisskimm* are inseparable from a web of social relationships among animals that include prayers, ceremonies, and ethics. Without full respect for all of these relationships the web cannot exist, and the bison will not come. This is a fact in the same way that “the Sun is the creator of all things” is a fact. Remove the sun, and all life will end. What Western listeners understand as a statement about the past is for Blackfoot a forecast of the future. In this regard, Blackfoot knowledge focuses on “timeless” dynamic relationships rather than first causes within a unidirectional time line (compare Fabian, 1992). Some things necessarily

²⁶We use the term “world” in the Blackfoot sense of a world system, worldview, or universe of social relationships, rather than in the purely physical sense of astronomers (for a parallel conceptualization in the Aboriginal Australian context, see Mudrooroo, 1983).

belong together, like humans, bison, and wolves; and this is what Blackfoot generally render into English as “natural law.”

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