5

Native American Systems of Knowledge

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In American historical consciousness, Indians are often imagined as children of nature, hunters roaming over vast areas from which they took only what they needed to survive and no more. The popular image belies the remarkably sophisticated techniques that native peoples used to control their environments. New work in archaeology and ethnohistory has revealed much about the intellectual sophistication of American Indians in North America and the ways in which they observed, understood, and sought to control their environments. Recent scholarship suggests that native agricultural practices, for instance, were much more diverse and subtle than the image allows. Native systems of knowledge are difficult to describe, for while they often reflect familiar Western processes – observation, deduction, hypothesis, experimentation – they also rest upon fundamentally different understandings of a world that can be alive with intent and will. Recent scholarship has sought to describe native knowledges as they existed prior to contact and as they changed in relation to European introductions. In terms of contact, that scholarship has focused on processes of adaptation rather than acculturation. The result is a richer understanding of the ways in which the worldviews of different cultures converge and diverge over time. This essay will reflect briefly on the relation between native and non-native systems of knowledge, examine some of the most important areas of Indian knowledge, and consider the nature of native adaptation.

Native American and European Systems of Knowledge

The image of Peter Minuet purchasing the island of Manhattan from the Indians for $24 worth of beads and trinkets is part of the mythology of American culture. The commonly held belief that wampum – easily seen as just another bead – was the Indians' form of money is part of that mythology. Both ideas reflect a peculiarly Western notion that objects can be assigned a specific value and used as money.

Minuet's exchange reinforces the idea that the Indians had no concept of the value of land and were merely intrigued by gaudy baubles. The use of wampum strings and belts woven of wampum beads is understood in the Western terms of buying and selling, rather than what it actually was – a signifier of a contractual relationship.

The idealized bead, then, becomes a way of viewing different cultural understandings of the world and of human relationships. It can also be used to explore a historical assumption – that a technologically superior Western civilization, with its metal tools, weapons, and modes of mass production, overwhelmed native peoples and native systems of knowledge. It gives us a way of understanding that exchange of objects can introduce new knowledge and information that cause historical change in culturally specific ways. And if we find a bead "good to think with," so too can we apply its insights to kettles, guns, horses, and the myriad other objects that lie at the nexus of intercultural trade and imagination.

Native American systems of knowledge are often characterized as religious or magical. Native people explained their environments in terms of immanent power manifest in physical reality, a power that aroused feelings of awe. *Manido* in Algonquian languages, *Orenda* in Iroquoian languages, and *Wakan* in Siouan languages – these are all terms for this immanent power (Williams, 1973: 190–1; DeMallie, 1987: 28–35; Hewitt, 1902: 33–46). These terms designate things that are out of the ordinary, that have unusual characteristics, or that behave differently. The capacity to act or to express difference is seen as evidence that the forces of nature have will and volition. The natural world is thus an intentional one, filled with beings, human and other, who exercise will and choice.

At one point in his fieldwork among the Ojibwa, A. Irving Hallowell asked an old man: "Are *all* the stones we see about us here alive?" The man reflected a while and answered, "No! But *some* are." The question and the answer epitomize a crucial distinction between native and Western systems of knowledge. Hallowell was trying to establish a linguistic category, a place for a word in a descriptive and analytical hierarchy. For the old man, *some* stones were important, for they had the potential to *act* (Hallowell, 1976: 362–3).

Western science presupposes a nature composed of physical forces acting according to laws. Those forces have no personal aspect. They can be understood rationally because their behavior is lawful, rather than willful. Laws are based on systematic observation of the natural environment and the ability to predict the outcome of events based on perceived natural patterns. As we know, however, Europeans also had traditions of knowledge that admitted the possibility of an active will in nature. Enlightenment rationality was not Europe's only mode of thought.

At the time of initial contacts between native peoples and European colonizers, for example, the European world was still alive with Aristotelean doctrines of natural place, which decreed that objects fell because they sought to reach the center of the earth. More important, the Christian idea of God's will and natural order was lodged equally firmly in place. God might intervene in human and non-human affairs, but always on the side of his Christian believers. Colonizers attributed the diseases that struck Indian populations after contact, for example, to God's divine intervention on their behalf. John Winthrop in 1634 wrote that the natives around Boston "…are neere all dead of the small Poxe, so as the Lord hathe cleared our title to what we possess…" (Pearce, 1965: 19). Colonization and enlightenment, however, went hand in hand, and scientific rationalism gained in epistemological power as the colonial drama unfolded.

European science was based in concepts of lawful behavior of natural forces. Native American beliefs were based on the willful behavior of those forces. The one presupposed fixed and rational ways of understanding those laws. The other looked toward intimate interaction with the forces of nature through dreams, visions, ceremonies, and through intuitive and personal ways of comprehending and controlling those forces. Europeans observed in the world the work of God and marveled at its order. Native people in the Americas saw themselves as active agents in bringing events about because of their ability to establish relationships with the beings who populated the world.

The "beads and trinkets" that so fascinated Indians may not have been exotic so much as they were similar to objects that had spiritual powers in Indian cultures. Crystals, for example, were used in divining because they projected light and shifted the perspective of things viewed through them. Glass beads were similar to crystals (Miller and Hammell, 1986: 315–18). Wampum beads, laboriously cut and shaped from the coahoag shells found on beaches along the New England coast, had sacred significance. Wampum belts carried in a physical sense the sacred words that were spoken into them, and they thus became records of understandings and agreements (Salisbury, 1982: 149).

Confronted with the unfamiliar, Indians found ways to put European technology into their own systems of thought. They often reasoned by analogy, adopting new goods when they recognized similarities to things that they already used. The Tsimshian on the Pacific Coast in the nineteenth century replaced deer hooves with brass thimbles on the fringes of dance aprons. The analogy of hooves and thimbles lay in the rhythmic sound that accompanied the dance. The basic Tsimshian understanding of the dance remained the same (Barnett, 1942: 23–6).

Within their own systems of thought, Indians also reasoned by metaphor, organizing categories of beings by their relationships to the physical world around them and seeing physical phenomena as manifestations of spiritual power. Where analogies are based on similarities of form or function, metaphors establish a sense of identity between two objects. Analogies make the unknown familiar because of its resemblance to something that is known. A metaphor, however, is deeply embedded in culture because it depends on existing, shared assumptions about the nature of relationships between objects. In contact situations, one might link the two. A European bead is like a wampum bead; the wampum bead is both physical object and metaphorical embodiment of human thought, speech, and action.

Copper kettles have similar significance as analogy and metaphor. Many native peoples used clay cooking pots, but the French in Canada introduced literally thousands of copper and brass kettles into the trade. The Mi'kmaq in Nova Scotia began to use them not only for cooking (analogy) but also in their burial practices (metaphor). In some cases kettles were flattened to line the floor of a grave, and in some graves they were used to hold offerings. In some, kettles were found broken or slashed with an axe to ceremonially kill them so they could accompany the spirit of the deceased. The idea that kettles had souls vastly amused early French traders, but their use as grave goods indicates their cultural significance to the Mi'kmaq (Martin, 1975: 114–15; Turgeon, 1997: 11–15). A copper kettle may replace a clay pot as a container for a soul. It may be "killed," i.e., broken, so it can accompany the soul of the deceased to another world. The killing assures that it will not be put to further use in the land of the living. The kettle thus takes its place in a cultural system of knowledge.

Subsistence

Corn is often synonymous with American Indian cultures in grade school textbooks, and indeed corn, beans, and squash were, and in some areas still are, the agricultural staples of historic Indian villages. But agriculture in North America began not with corn but with the domestication of sunflowers in the Midwest and Northeast by about 4000–1000 BC. Jerusalem artichokes, another widely used food source, are actually tuberous roots of a species of sunflower. The appearance of domesticated squash in central Missouri as early as 2300–2000 BC indicates the development of an independent agricultural hearth in the Eastern Woodlands. Native people cultivated marsh elder, knotweed, maygrass, and goosefoot, plants that would be considered weeds in modern society, for their oil and protein-rich seeds (Cowan, 1985: 207–17).

Although corn was domesticated in northern Mexico about 4000 BC, and introduced into the American Southwest in about 1300 BC, it did not appear in the Northeast until about 200 BC, and it remained a relatively minor crop in the agricultural complex until about the beginning of the Mississippian period around AD 750 (Yarnell, 1993: 17, 22–3). Bottle gourds and Devil's Claw were also part of the agricultural complex in the Southwest, the former used for containers and the latter for fibers used to make baskets (Heiser, 1985: 63–7).

Domestication of plants entails systematic observation and use of the natural environment. It is thus the most basic form of science in human activity. It implies an understanding of the outcome of events, for example, that seeds will reproduce their own kind. It also involves systematic modification of the environment. Plants that flourished in the wild in flood-disturbed river bed environments moved easily into human-disturbed environments around villages. Wild plants produced large numbers of small seeds and fruits that dropped easily from the plant so they could propagate themselves. Women, the primary gatherers in Indian societies, favored plants with larger and tighter seed and fruit clusters that did not scatter easily. Because of selection, plants lost the ability to spread their own seeds, and humans had to take responsibility for propagation by deliberately harvesting and planting seeds. Morphologically, domesticated plants have larger and thinner-coated seeds than wild plants.

If the domestication of corn is a result of systematic human activity, native stories about the origin of corn demonstrate the metaphorical nature of Indian understandings of their relationship with the natural world. In the Cherokee story, Selu, the mother, and her husband, the hunter Kintuah, have two sons. Selu provides a delicious food (corn) but will not reveal its source. Her sons follow her one day and find her rubbing skin from her body into a basket, where it becomes grains of corn. They then fear her as a witch, and when she discovers that they know her secret, she tells them that they must clear the ground in front of the cabin, kill her, and drag her body seven times around the ground. The brothers kill her, but they clear only seven small spaces, and they drag her body around them only twice. Thus, corn grows only in some places, and Cherokees work their fields only twice (Mooney, 1982: 242–5).

The story identifies Selu as mother, as source of food, as earth, and her death is necessary to bring forth the life of corn, identifying her with the seasonal cycles of planting and harvesting and the alternation of seasons. The fact that her blood must touch the earth associates the female menstrual cycle and power to give birth with the growth of the corn, and women's work as farmers is further association of female fertility with the fertility of the earth. The knowledge associated with corn and other domesticated plants rested on observation and experimentation *and* upon a metaphorical, spiritual understanding of the world. The fact that corn was widely used throughout North America attests to a ready acceptance by native people of a food source analogous to others that had already been independently domesticated.

Time and History

The cycles of the natural environment oriented native people to the repetition of events rather than to the linear progression that preoccupied Europeans. The Christian worldview pointed toward the ultimate end of salvation. Native worldviews were more often concerned with events that repeated themselves on a regular basis – the growth and harvest of crops, the mating and migration of animals, the movements of stars and planets. Yet, if astronomy rests upon cycles, it is nonetheless a quintessentially historical discipline. Recognition of patterns in celestial events depends on accumulation of data over extended periods of time, usually greater than those of the lifetime of a single observer, and it requires some form of record-keeping.

Although the best known evidence for sophisticated astronomical knowledge in the Americas is from Mayan, Aztec, and Incan sources, Indian people in North America also left permanent records of their knowledge in medicine wheels and building alignments. Fajada Butte, near the Pueblo ruins in Chaco Canyon, New Mexico, is one such site. There, a spiral carved into a rock face is exactly bisected by a dagger of light on the day of the summer solstice. At the winter solstice, two daggers touch the edges of the spiral, enclosing it in a frame (Sofaer, Zinser, and Sinclair, 1979: 283–91). Medicine wheels in Saskatchewan indicate that the Blackfeet may have oriented their tipis on a north–south axis that allowed observation of eastern sunrise solstice sites; oral traditions tell of calendar men who observed the sun to predict certain ceremonies (Kehoe and Kehoe, 1977: 85–95). In the Big Horn Mountains of Wyoming, a circle of stones with spokes and cairns forms a medicine wheel. Sight lines across the cairns point to the rising of the sun at the summer solstice and possibly to the helical rising of Sirius, Rigel, and Aldebaran. It was constructed about AD 1500 (Eddy, 1974: 1035–43).

The sun, however, is not simply an inanimate body subject to observation. It is often the metaphor that embodies relations between humans and the world. Its passage from winter solstice point to summer solstice point is accomplished because people give it energy through their ceremonies. The Soyal, a nine-day Hopi ceremony conducted around the winter solstice, assures that the sun will be able to rise from his southern "house" and begin his journey back across the sky. Niman Kachina marks the summer solstice (McCluskey, 1982: 42; Fewkes, 1920: 496). The timing is determined by systematic observation of the sun's rising and setting points along the horizon for several days before the solstice (McCluskey, 1982: 39–40). The Hopi system is based on both empirical observation and cultural belief. The points along the horizon that sun watchers observe have been identified based on long periods of earlier observation. The basic assumption is that the sun is a spirit, but that he follows a regular path through the sky. Likewise a group of Lakota elders has explained how the path of the sun through the constellations corresponds with the geography of the Black Hills (*Paha Sapa*). And those correspondences exist in relation to certain Lakota rituals performed at specific times and places (Haile, 1947; Goodman, 1992).

The Pleiades are another important celestial marker of planting seasons. In the Northern Hemisphere they are a winter constellation. The dates of their first and last appearance in the night sky depend upon the latitude of the observer, and they generally correspond to the times of the first and last killing frosts. These dates for the Seneca communities in present-day New York state (approximately 42° north latitude) are generally between October 10–15 and May 15–19. Seneca corn requires approximately 120 days of frost-free weather to mature, a period well within the period of 153 to 163 days of the Pleiades' absence from the sky. The zenith passage of the Pleiades marks the mid-point of the frost season and traditionally has been the signal for the beginning of the traditional Seneca Midwinter Ceremony. The Seneca believed that the stars were spirits who danced above the longhouse (Ceci, 1978: 306–8).

Although major ceremonies may be timed by annual celestial events such as the appearance of the Pleiades directly overhead or by solstices, the more important calendric event for American Indian tribes was the waxing and waning of the moon. The combination of the appearance of the moon and the occurrence of events in nature served to give months names like "Moon of Ripe Choke Cherries" (Mandan – July). Astronomical knowledge continues to be used in the timing of elements of the Girls' Puberty Ceremony in the contemporary Mescalero Apache tribe. The main singer in the ceremony times the final song of the ceremony to end exactly at sunrise by watching the rotation of the stars of the Big Dipper through the smokehole of the tipi in which the ceremony is held. The song is responsible for "pulling the sun over the horizon" but its timing depends upon precise knowledge of celestial movements (Farrer, 1991: 38–59).

The importance of systematic observation of celestial bodies can be inferred from the appearance of a standardized unit of measure in the alignment of mounds. At the Toltec Mounds site in central Arkansas, this standard (called the Toltec module) is 47.5 meters, and the 18 mounds in the complex and their surrounding embankment are spaced at various extensions of this basic unit. Two mounds are the primary reference points for the module and are aligned to summer and winter solstices. Similar spacing and solstice alignments have been found for 28 mound sites in the lower Mississippi River valley. At Cahokia, the great mound complex across the Mississippi River from St. Louis, the module was "extended in magnitude out to 22 times and even 44 times."

Fully 75 percent of the Mississippian mound sites analyzed by scholars also feature one or more solar alignments, and some showed equinoctial and stellar sightings (most often of Vega and Sirius). Complex alignments of massive mounds with solar phenomena indicate that the builders were capable of mobilizing both long-term record-keeping of some form and the resources of a wide-spread population. From the mound tops they could announce times for planting and harvesting floodplain gardens (Rolingson, 1990: 27–50).

In Mesoamerica, the Mayans and Aztecs viewed a sky much different from that of their European conquerors. In the temperate latitudes of Europe, the movement of the sun along the horizon is much more dramatic than in the tropics, where the sun moves more directly overhead through a much narrower range of the horizon (Aveni, 1980: 40). The next brightest object in the sky after the sun and the moon and most dramatic in its complex movements across the sky, the planet Venus was both deity and focus of observation and record-keeping (Thompson, 1966: 262–3). The Dresden codex, a Mayan hieroglyphic text, described in mathematical notations the path of Venus in relation to the sun, its periods of appearance in the sky as the morning star and then the evening star, and gave a table of lunar eclipse predictions, another indication of the sophistication with which the Maya realized the relationship between the sun and moon in their passage through the night sky. The numerical values in the table are mathematically consistent in recording the pattern of the 584-day solar cycle of Venus, but the dates of actual appearance and disappearance of the planet did not coincide with the math, and corrections (roughly equivalent to the leap year in the Gregorian calendar) were inserted in the tables (Aveni, 1980: 189–90). Building alignments also served as permanent records of astronomical observations. At Caracol Tower at Chichen Itza, a Mayan site dating to about AD 800, windows aligned with the further northernmost and southernmost helical rising of Venus and the point of disappearance of the Pleiades from the sky on the date of the vernal equinox (Aveni, 1980: 261–2, 264–6).

The Mayan sense of history is connected to a calendar system that evolved over a long period of time, beginning probably with the Olmec culture that flourished from *ca*. 1500–600 BC, and that was capable of recording cycles of long duration (Lounsbury, 1970–80: vol. 15, p. 813). The calendar was a combination of two systems – a sacred calendar of 260 days (the *Tzolkin*), and a 365-day solar calendar referred to as the Vague Year – both of which allowed observation and metaphorical interpretation. The Sacred Year and the Vague Year created a 52-year cycle called the calendar round. The combination of day names in the *Tzolkin* and the Vague Year gave a unique identity to each day in the calendar round, which made it possible to record unique historical events. It took 18,980 days (or 52 years) to return to the same combination of named and numbered days that began this cycle (Lounsbury, p. 765).

The Aztecs who arrived in the valley of Mexico in the thirteenth century AD inherited the Mayan calendar system and marked the end of the 52-year cycle with a

ceremony called the "Binding of the Years," which involved the sacrifice of a captive to feed the sun with blood to sustain its strength for the next cycle. The timing of the ceremony was determined by the zenith passage of the Pleiades (Krupp, 1982: 9–13). The Mayans also had a day count, by which they reckoned the absolute number of days in their history. Although the day count might imply a linear sense of history, the cycle of the calendar round seems to have been the more important concept. Calendar notation included glyphs designated as day carriers, and crucial calendric conjunctions were occasions for changes in political leadership. The deaths of rulers and the accession of new rulers were memorialized in dates on stelae, and because these transitions had occurred and would occur, the Mayans and Aztecs essentially remembered the future based on what had happened in the past (Farriss, 1987: 577). Although the Mayan and Aztec cultures differed dramatically from Hopi culture, there is an underlying similarity in the concerns of their calendar systems. Human efforts maintained the cycles of the sun for both the Aztecs and the Hopi. The primary concern for all three cultures was the repetition of events in understandable ways – what had happened before must surely happen again.
Indian people were also generally aware that the lunar year did not correspond to the solar year. A Ho-Chunk (Winnebago) calendar stick dating from the nineteenth century recorded not only two precise, non-arithmetic records of observable lunar years of twelve months, but also notations that incorporated a thirteenth intercalary month every three years in order to bring the lunar calendar into phase with the solar tropical year (Marshack, 1985: 27–51).

Acculturation and Accommodation

Beads and trinkets (brass bells, mirrors, buttons) were only a small part of the complex of European trade goods introduced to native people. Indians replaced their own goods with metal utensils, trade cloth, and guns. They did not, however, automatically accept all the trade goods they were offered. Salisbury points out (1982: 52–3) that in the early sixteenth century, the Narragansetts accepted a wide variety of goods because trade was a way of establishing alliances, whereas the Abenaki, who had no interest in alliances with European explorers and fishermen, demanded only metal utilitarian goods that could be substituted for stone tools.

The anthropological paradigm of acculturation presupposes that cultures are characterized by discrete sets of traits and values, and in the historical experience of contact between cultures, those of the dominant society are accepted by and replace those of the subordinate society (Redfield, Linton, and Herskovits, 1936: 149–52). From the cultural presumption that European technology was superior to native technology, scholars have argued that trade goods led to the decline or transformation of Indian cultures. Stone Age culture must necessarily give way to European Iron Age culture (Quimby, 1966: 3).

The vast literature on the Indian trade generally stresses Indians' growing dependence on both European goods and alcohol as factors in the degradation of Indian cultures. Initially amazed at the uses of axes, knives, and guns, Indians very quickly recognized the superiority of these items to their own tools and put aside their traditional implements in favor of these trade goods. They soon became dependent upon them in ways that led to change in native economies. Jennings (1975: 86) summarizes the situation: "New commodities replaced old. Iron and steel implements made copper and stone obsolete. Instead of exchanging surpluses of their own products, the tribes abandoned their crafts in order to concentrate on obtaining surpluses of the goods desired by Europeans."

Indians were not, however, uncritical consumers or unwary buyers. Malone (1993: 37) concludes that Indians were selective in their adoption of foreign products. "Favored goods usually satisfied functional or symbolic needs already existing in the aboriginal culture." Although Indians were generally terrified by guns in their first encounters, they soon learned their usefulness in hunting and warfare. Indians in New England also learned quickly to mold bullets and sharpen the flints of their weapons. They could replace broken stocks and salvage parts from damaged weapons, but repairing mechanisms and metal parts of guns was generally beyond their skill, and for those purposes they relied on blacksmiths (Malone, 1993: 45, 95). Guns also took their place in some native systems of thought. The report of the gun was analogous to the sound of thunder, which was in turn associated with rain, fertility, crops, and renewal. The Cherokee integrated guns into their Green Corn Ceremony. Frank Speck reported that in the 1930s, men carried guns during the ceremony and fired them at periodic intervals. Gunshot became the source of the spiritual power of thunder and rain (Speck and Broom, 1983: 47).

In contemporary Yuchi culture in Oklahoma, guns are still used in the Lizard Dance. They continue to represent thunder, but their firing replaces lost elements of songs whose words formerly summoned thunder (White Deer, 1995: 11). The Cheyenne, on the other hand, believed that thunder and lightning were malevolent beings and fired guns to drive them off. Mandan ceremonial leaders consecrated guns in a ritual closely resembling other purification rites. The Blackfeet attempted to cure illnesses in horses by loading a gun with powder and firing it at the horse's side. The shock might cure the horse (Ewers, 1997: 49–50). For the Heiltsuk on the Northwest Coast, Harkin (1997: 86) maintains that "The rifle is iconic of the Heiltsuk notion of corporeal causality." Its bullets penetrate the human body in the same way that objects can be injected into a person's body by witchcraft. This action at a distance appears as a form of power; guns might easily be seen as part of witchcraft. In sum, the gun entered native systems of knowledge as metaphor, analogy, substitute, and wholly new practice.

Guns also allowed Indians to alter their environments through more efficient hunting. Guns and metal traps could more easily kill animals, and they led to the depletion of animal populations, especially the deer and beaver whose skins were important in the trade. Calvin Martin (1978) has argued, however, that even the rapid disappearance of beavers in northeastern hunting territories can be explained by looking at native worldviews. Indians, according to Martin, believed that the beavers were angered by their adoption of elements of the white man's culture and were withdrawing deliberately from contact with Indian hunters. Disappearance of animals from traditional hunting grounds and large-scale animal deaths from disease were seen as animals "making war" on humans, and Indian hunters felt justified in retaliating by making war on the animals. Martin's provocative thesis presented a classic "systems of knowledge" problem – how did Indian people understand ecology, technology, and the fur trade? His work was challenged almost immediately by Indian people and anthropologists alike (Krech, 1981). The thesis was based on flimsy evidence and, despite Martin's attempt to construct a native perspective, his argument adopted non-Indian assumptions about war and spiritual belief.

Yet Martin was right in thinking that the complex interplay of human beings and spiritual powers operating in the natural environment could help explain the adoption of European technology by Indian tribes. The Chippewa integrated the term "Manitou," their word for transcendent spiritual power, into their name for glass beads, *manitôminens*, *min* (berries), *ens* (a diminutive), roughly translated as "small sacred berries." Steel was *manitobiwâbik*, sacred iron. The Dakota word for power is *Wakan*, which can be translated as something that is difficult to understand, and *maza wakan* (sacred iron, a gun) demonstrated its power to act in mysterious ways (White, 1994: 369). Bradley (1987: 110) argues that the Iroquois acquired trade goods which, because of their mysteriousness, represented power. As evidence he cites the sudden appearance of grave offerings after European contact, a custom rarely practiced before, and the vast quantity of trade items among those offerings, along with shells, crystal, and copper, indigenous materials denoting power. European goods were fully adopted into the potlatch ceremony on the Northwest Coast. Daniel Cramner, who hosted a great Kwakiutl potlatch in 1921, gave cash, gas boats, and pool tables to two chiefs, commenting "It hurt them." The sentiment is totally in keeping with the intent to shame or humiliate high-ranking guests in order to establish one's own social privileges (Codere, 1966: 117). As products of European systems of knowledge, the trade goods that made their way into native knowledge systems offer difficult but suggestive opportunities for thinking about cultural interaction and exchange.

Science and Ethnoscience

The seventeenth and eighteenth centuries in Europe saw the rise of the scientific revolution. Nicholas Copernicus proposed a sun-centered mathematical model of the universe. Galileo Galilei established laws describing the acceleration of falling bodies and asserted the physical reality of planetary motion. Using observational data from the Danish astronomer Tycho Brahe, Johann Kepler determined the elliptical shape of planetary orbits. Isaac Newton promulgated the law of gravity, and Carl van Linne established his great classification system for plants and animals. The intellectual achievements of the scientific revolution codified and classified the cycles and patterns of nature into immutable laws.

Native people, as we have seen, recognized cycles and patterns too, but they saw them in terms of relationships between humans and the environment. The Linnean system proposed that sexual organs were the main factors in the classification of plants. The Navajo classified plants as male and female, based on qualities associated with gender rather than sex. Woody plants are male, while slender, flexible plants are female. External form determines. Ethnoscience, then, involves understandings of Native systems of classification which, like European systems, operate within their own cultural logics. Plants may be classified together because they grow in proximity with each other. Appearance, history, spiritual position – these and other factors helped define classificatory position. Many plants may be broadly classified as medicinal because of the effects they have upon the human body.

Such effects constituted the basis for healing in Native societies, and they also mark the point at which European and Native practices converged. The European medical doctrine of simples was based on similarities between physical characteristics of plants and aspects of the human body. Indian uses of plants were based on the belief that plants as living beings had powers that affected the well-being of human beings. Physical similarity between plants and the human body was an indication of a special relationship. The juice of milkweed (*Asclepius sp.*), for example, was used among the Ojibwa for female complaints. Bloodroot (*Sanguinaria canadensis*) was widely used in a variety of ways, from a dye to a strong emetic. When a Chippewa woman in Minnesota today digs roots, leaves a pinch of tobacco in the hole, and ends her prayer to the plant with *Megwich* ("Thanks"), she still expresses this belief in the spiritual nature of the plant.

Many white settlers in America adopted Indian herbal medicines. White trillium, for example, was called "squaw flower" by whites who put it to the same use as Indians, an aid in childbirth. A number of plants used by American Indians have been listed in the United States *Pharmacopeia* (Vogel, 1970: 267, 336–7, 354–6, 384–5). Although ethnographers scoffed at Indian curing ceremonies as mere superstition, patent medicines based on supposed Indian formulas became popular during the nineteenth century, and books on Indian herbal medicines were widely used (Gibson, 1967: 34–9, 74–9; Hallowell, 1965: 239–41). Ironically, the failure of native healers to deal with European-introduced epidemic diseases such as smallpox, measles, and cholera often served to discredit them and promoted acceptance of Christian missionaries (Axtell, 1985: 97–8).

Orality and Literacy

Writing was one of the most amazing skills that Europeans brought to North America. Indeed, Axtell (1985: 102–3) maintains that the Hurons were awed by the ability of French Jesuits to read and write, activities that they took as a sign of mysterious power. For people who believed that human thought was a causal element in the processes of the natural world and influenced things at a distance, the ability of Europeans to know about distant events by reading messages was a sign of spiritual power. Europeans, of course, had their own belief in the power of the word of God to transform Indians into Christians. Christian hymns could counter native songs, which missionaries sometimes considered incantations to the devil (Calloway, 1991: 48). Priests and ministers labored to reduce Indian languages to written form so that native people could read the word of God and be transformed by it.

The introduction of literacy to Indian people was done with the main intent of converting them to Christianity, which was as important as technology in changing native knowledges. Christianity, for example, introduced a linear concept of time to people whose oral traditions were based in cyclical memories of past events (Todorov, 1992: 80–1). The repetition of the past was less important than a striving toward the future, and the printed page itself forced linearity upon meaning (Ong, 1982: 121).

The association of writing and Christianity discouraged many adult Indians from adopting literacy, although mission schools made an impact on their Indian students. It was not until 1821 that Sequoyah, a Cherokee who knew no English, devised a syllabic form of writing for the Cherokee language. The *Cherokee Phoenix*, the tribal newspaper, published articles in English and Cherokee beginning in 1828. It became a major vehicle for expressions of sentiments in favor of and opposed to the proposed government policy of Indian removal (McLoughlin, 1984: 183–5, 233). The publication of constitutions and laws in the Cherokee and Choctaw languages during the late 1820s is striking evidence of the changing circumstances wrought by technology and literacy. Indian nations sought to prove that they had become civilized and capable of living with their white neighbors while inexorable forces of American expansion pushed them to the west.

Continuity and Change

The major divergence between American Indian and European systems of knowledge lies in the perception of the role of human beings in the processes of nature. In European science, humans manipulate circumstances to test the validity of laws through experiments. In Indian cultures, human action in reciprocal relationship with spiritual action brings about the cycles of the environment. The Hopi, for example, would not think of not performing their ceremonies to see if the sun would remain at rest. To do so would risk the continuation of their world. Human beings are an integral part of the processes of the natural world, not observers who stand outside those processes.

Columbus's world in 1492 was still alive with mysterious forces. Alchemists sought the Philosopher's Stone, which had the power to transmute base metals into gold. Magnetism was understood as an invisible fluid that acted between objects. In many respects, will in natural objects was part of the European world as well as the American Indian world. Columbus charted his voyage to the New World with crude instruments – an hourglass to tell time, the mariner's compass for direction, and a simple quadrant to shoot the angles of stars above the horizon. Dead reckoning and a good deal of luck got him to the Americas. His religion convinced him in his later years that he had actually discovered Eden on earth (Morrison, 1942: 183–96). But the urge that drove Europeans to explore and to seek material wealth in unknown regions was also part of the intellectual renaissance that led to the development of modern science. Greek philosophers knew theoretically that the world was round, but Columbus's and Magellan's voyages gave physical proof of the fact.

Europeans brought to the native people of these newly discovered lands new systems of knowledge – a belief in the absolute power of the Christian God and a technology based on metal, mechanical energy, and domesticated animals. Where Indian goods were handmade, unique objects, European-manufactured trade goods could be produced uniformly in large quantities. The sheer abundance of strings of beads may have amazed Indians who laboriously drilled each shell bead of a wampum belt by hand. Even as it connects different peoples, then, a bead also reflects different systems of cultural knowledge.

Indian people became increasingly dependent on European goods as their traditional subsistence patterns changed under the impact of European settlement, the effects of European diseases, and the introduction of domesticated livestock. The intellectual change in worldview was less dramatic, however, as Indian people found ways to integrate new ideas into their own systems of knowledge. Though they might adopt metal hoes to work their fields, Cherokee women could still understand that the story of Selu, the corn mother, encompassed many layers of meaning and association between corn and human life. The story showed the essential importance of natural cycles in human life.

Guns made hunting more efficient, and they exacerbated intertribal warfare, both conditions that led to cultural change. They were also, however, a new form of thunder that fit into older ceremonies that renewed human relationships with the spiritual world. Anthropologist Marshall Sahlins argues that new influences change a culture even when they are adopted into seemingly traditional forms (Sahlins, 1985: 138–9). But perhaps the truest sign of cultural change was not dependence on guns in hunting, war, and ritual, but the more dramatic moments when Indian leaders agreed to support schools to expose their citizens to "the benefits of instruction in the mechanic and ordinary arts of life" (Treaty with the Choctaw, 1825, cited in Kappler, 1904–41: vol. 1, p. 212). Missionaries measured the progress of civilization among the Choctaws in the number of cards, spinning wheels, and looms used by women in the Nation (Schermerhorn, 1814/1846: 20–1). When Indians expressed an interest in learning new skills to replace the old, the process of cultural adaptation and change was well underway.

Yet, in varying degrees, Indian people have continued to pursue traditional ceremonies that keep them grounded in the cycles of nature. The Yuchi Lizard Dance and variations of the traditional southeastern Green Corn Ceremony are still performed in parts of Oklahoma. The Hopi ceremonial cycle is maintained on the mesas in central Arizona. The Makah tribe of Neah Bay, Washington has regained the right to hunt whales for subsistence, now using gasoline-powered boats and explosive powered harpoons, rather than the traditional cedar canoes and yew wood harpoons. Although Sahlins maintains that the more things remain the same, the more they change, in many cases systems of knowledge based on seasonal and religious cycles coexist with modern and changing technology.

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