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Strangely Estranged: Native Studies and the Problem of Science

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Native people are noticeably absent from science classes at universities and colleges, and they have only a minor presence in careers that flow from scientific knowledge. One reason may be the lack of positive experiences with a discipline that has often been viewed as hostile to Native people. This article looks at the scientific method for its potential in conducting Native Studies research. Specifically, it examines topics like Native astronomy for evidence of scientific thought among Aboriginal peoples. It reports on the impact of modern technologies in expanding the horizons of cognitive geography to more fully explore the complexities of traditional landscapes. Employing the scientific method may enhance the value of Native traditional knowledge of the environment. This article reviews the literature to report on recent scientific research focused on Aboriginal subjects.

Les Autochtones sont visiblement absents dans les cours de science des universités et des collèges et ils sont peu présents dans les carrières qui découlent des connaissances scientifiques. Une raison à cela est peut-être le manque d'expériences positives avec cette discipline souvent considérée comme hostile envers les Autochtones. Cet article examine la méthode scientifique pour voir son potentiel pour effectuer des recherches en études autochtones. En particulier, il examine les sujets comme l'astronomie autochtone comme témoignage de la pensée scientifique chez les peuples autochtones. Il fait état de l'impact des technologies modernes pour développer les horizons de la géographie cognitive pour explorer encore plus les complexités des paysages traditionnels. Employer la méthode scientifique pourrait peut-être améliorer la valeur des connaissances autochtones traditionnelles sur l'environnement. Cet article présente une analyse bibliographique pour faire état des recherches scientifiques récentes axées sur des sujets autochtones.

Introduction

The absence of a methodology unique to Native Studies means that methods are often borrowed from other disciplines in order to accrue new knowledge. The primary objective of this essay is to examine the scientific

method for its potential in contributing to Native Studies research. Indian students are conspicuously absent in occupations that flow from the sciences, and what may be needed is a medium to connect Native Studies with sciences. The point here then will be to examine the role of the scientific method in constructing knowledge in traditional societies and the way it operated as a foundation for traditional knowledge. For tribal people, amassing knowledge about the natural world is not randomly collecting trivia; instead, knowledge is derived through systematic analysis of natural phenomena that requires a particular thought process.

The areas of science promoted include geography, the natural sciences, earth sciences, astronomy and medicine. Typically these subjects appear in the form of Indian lore, but that can obscure knowledge that may end up having a direct beneficial impact on Indians, for example in medical research that reports on the health of Indians, or in ethnobotanical searches for new medicines. In addition, adopting new technologies can have potential benefits because of their practical applications in such areas as land management, wildlife management and ecological assessment. Scientific literacy will be necessary for managers of Indian lands because the complex decisions they make will affect the future well-being of their communities, so it is important that they be aware of current research.

Prologue: Studying Natives from a Scientific Perspective

Prior to the advent of Native Studies, Native people were not absent from the text of scholarly discourse; far from it, studying Natives and their cultures was a lively venture that filled volumes of ethnographic reports. Initially it was to determine their place in creation, and later to ascertain their traits, linkages and languages (Dickason, 1992). The enigmatic presence of so many Native societies in the Americas was the stimulus for scrutinizing their inherent "otherness" and for speculating on the conundrum of variety in culture. It generated enough interest to support societies of like-minded scholars dedicated to examining and describing Indian cultures (Hilder, 1899; Fletcher, 1913) and amassing anthropological data as evidence for researchers formulating their theories of cultural change (Powell, 1888; Holmes, 1902).

By the 20th century, anthropology was enjoying official status in universities and museums, although the methodology and theoretical constructs reflected self-directed studies in cultural diversity (MacCurdy, 1903; Boas, 1920; Meggers, 1946; Lowie, 1956). As cultural institutions, they espoused a mandate to collect and curate the material culture of Indians, the success of which soon resulted in an undifferentiated mass of artifacts. Devising a classification system to allow museums to organize

their collections of Indigenous manufacture, by uniting material culture with spatial parameters, also meant anthropology achieved its equivalent of the Linneaen system employed in biology (Wissler, 1922). When this culture area taxonomy was extended to real space it assumed homogeneity where none existed, and imposed static categories on cultures that were undergoing change. Subsequent criticism of this classificatory device pointed to the tendency to impose broad geographic uniformity by concentrating on a limited number of cultures as archetypal of that region and ignoring those that did not fit the model (Woods, 1934).

As it matured, anthropology progressed through schools of thought that emphasized evolutionary models that employed diffusion and migration from an epicentre to explain similarities in traits among cultures remote from each other. Dissatisfaction with this approach led some anthropologists to seek the dynamic phenomena of culture change through exhaustive studies of individual cultures and to defer general theorizing to "a future time when the actual conditions of culture change are better known" (Boas, 1920, p. 314). In pursuit of their objective, students of ethnology relied on biography, personal narratives and storytelling as integral elements to understanding and interpreting historical conditions of particular culture groups (Cole, 1995). Even as students were busy collecting the life stories of informants, critics were charging that descriptive ethnography was heading nowhere and adding nothing new to anthropological knowledge. Partly reacting to this complaint, anthropologists began to reorient their studies from whole societies toward psychological explanations of behaviours of individuals where culture was not dismissed as statistical fiction, an accessory to lived experience (Goldenstein, 1941; Meggers, 1946). Not everyone was eager to abandon ethnographic methods, and some still argued that such methods were an essential practice of anthropology (Lowie, 1940). However, it was already clear that classical ethnology had had a short shelf-life and was left behind, essentially because of the rapid modernization of the Indigenous peoples. Nevertheless, it would be illusory to believe that the demise of this discipline would mean the end of scientific interest in Indians – indeed, the opposite is true. Instead, the fracturing of the sciences in ever-more-specific research topics means that the literature is more dispersed.

The Problem of Science

Ironically, the current challenge from Native science is reminiscent of the early days of modern science itself. Then the organic philosophy of the Aristotlean tradition reigned supreme while the "new world" of Copernicus and Galileo was stuggling for acceptance because its iconoclastic tenets

were tearing at the officially sanctioned ideas on the nature of things. It was best stated by Nathanael Carpenter (1589–1628) when he chastised the learned men of his day as all too "ready to lick up the dust under Aristotles feet, [and] with a supercilious look contemne all other learning, as though no flowers of science could growe in another garden" (cited in Livingstone, 1988, p. 283). The philosophy of science eventually gained wider social approval, but not without some persecutions and excommunications. Its acceptance was dependent on the development of a scientific subculture with a coterie of like-minded individuals who pursued topics of common interest. Often these took the form of amateur societies comprised of wealthy lay persons who also acted as patrons to professional scientists (Cravens, 1976). However, this represents only one model by which science is socialized into its host community and as such it may not be a model adopted in another society. For example, Indigenous cultures may accrue knowledge about natural systems but for purely pragmatic reasons. If hunters cannot anticipate the behaviour of their quarry then they have no food. Likewise, a great deal of plant food may exist, but harvesting the best of it might require differentiating toxic from non-toxic plants, and this knowledge would be reflected in the taxonomies of Indigenous peoples. Descriptions of Indigenous thought on the nature of things has defied description, and terms like Aboriginal botany, ethno-botany or ethnobiology must suffice to describe their acute powers of observation (Clemont, 1998).

For example, in the search for medicines, too often their efforts were dismissed as superstitious behaviour, or too laden with magic, to be taken seriously as real science because of the ritual surrounding its practice (Wrangler, 1974). Challenging that prejudice, Guerra (1969) pointed to the role that Aztecan science and technology played in placing their society in a dominant economic and political position in MesoAmerica without diminishing the role of ritual. Likewise, Brown (1975) emphasized the analytical skills and observation of natural phenomena by Native people led to practical results in medicine and engineering. Marcus and Flannery (1978) approached their inquiry into Native medicine through ethnobotanical and archival research; their survey of historical texts revealed the persistence of such knowledge within the extant cultures of central Mexico. Ascher and Ascher (1986) discussed ethnomathematics as a basis for science in non-Western cultures; they concluded that all cultures imposed arbitrary order on nature, that systematic inquiry required a familiarity with number systems, and that literacy was not a necessary prerequisite for comprehending complex mathematical operations. As these samples of Native inquiry aptly illustrate there is room for science in

Native Studies, for example in subjects like ecology, where Indians could provide their unique insights about the environment (Thornton, 1978).

Brown (1975) opined that negative stereotyping constrained the acceptance of science by Indians and Indians as scientists. It may not be strictly a cultural distance since similar and parallel sentiments were expressed by Gold (1990) to explain the paucity of women who choose a career in science. Perhaps for such reasons the efforts to encourage Native students to pursue science careers has had only a minor impact during the last two decades, and more so among males than females (Statistics Canada, 1993). Health professions requiring scientific literacy attract more women, while men are found more commonly in engineering or technical trades. Where science is concerned, as with so many other facets of society, Indians find themselves struggling against established authority. The bad reputation that science occupies within Indian thought is a legacy of the practices that were condoned under the guise of advancing knowledge. Patterns established in 19th-century science continue to operate today; for example, scientists thought it completely valid to phrase race relations within a scientific context that systematically placed non-White races in an inferior position. They made no pretentions about an objective search for knowledge, and their theories justified the social policies that were responsible for displacing Indians and that forever cast science in an adverserial role (Horsman, 1975; Bieder, 1981). Twentieth-century science may be more sophisticated, but it still serves the same objectives, only on a global scale. Such disparities in power relations were exemplified during the Cold War, when military installations along the Distant Early Warning line literally brought 20th-century science and technology to the hunting grounds of Inuit bands who then had to contend with the ensuing social changes. The fact that the Arctic was to have been the nuclear battleground only concerned military strategists or policy makers, and, of course, the Inuit were given no voice in considering its merits (Stenbaek, 1987). Fortunately, nuclear war never became a reality. but it continues to haunt the Inuit environment because the contaminants released near military bases have invariably found their way into the arctic food chain. Occurences like these do not ameliorate the negative impression that Native people have of scientific achievements since they reap the hazards and benefit the least.

The experience of Inuit is not unique – other Indians face similar issues when their lands, because of their remoteness from dense populations, are considered as potential storage sites for waste products from nuclear power stations (Churchill and LaDuke, 1985). Indeed, disposal of waste, and not just nuclear waste, has become one of the more vexing problems

of this age, and it seems that Indian lands are inevitably proposed as receptacles for domestic and urban solid waste as a means of economic development in chronically underdeveloped regions (McNally, 1996). It is no understatement to say that Indians do not occupy favoured positions in society, so it is unlikely that their lands will be a priority for policy makers if contaminants degrade reserve environments. The discrepancy between social justice and allocation of resources for improving environmental quality likely will not cause protest, since concern for one's environment tends to decrease as distance increases, both in geographical and social terms (Higgins, 1993). A case in point was cited by Gamble (1986) through his personal experience with an arctic community to point out how intellectual arrogance and indifference to local concerns can impose solutions to the detriment of the community. His part in the failure of a planned community caused him to rethink the trend to specialization that hinders the scientist from being able to integrate information from related fields.

Alternative systems of knowledge do not gain the same acceptance when they are formulated at the margins of society. Thus, current discourse regarding Native science tends to be expressed as another example of the uneven distribution of power (Nader, 1996), of "the West vs. the rest," where real science only orbits the Western world (Scott, 1996). Still, the idea of a scientific subculture among Indians appears to be gaining acceptance with the appearance of professional organizations, like the American Indian Science and Engineering Society, which are devoted to promoting scientific careers for Indian students (Hawkins, 1995), or applying the results of research to improve the quality of their social environment (Coulter, 1995). While talk of a paradigm shift as proposed by Kuhn (1964) may be premature, there is a gradual understanding that science is not exclusive to Western society, that systems of knowledge equivalent to science exist in Other societies and it is ethnocentric to define science exclusively within the ambit of contemporary Western thought (Bazin, 1995). However, prejudice is a reciprocal process and despite these positive appraisals there have been few attempts to promote a culture of science within Native communities, partly because of the social trends that have dominated the dialectics within Native Studies and partly because of understandably cautious attitudes. Perhaps the place to start then is to examine the ways that Native cultures of the past employed scientific thought and practices to gain a greater degree of control over their natural and cultural environments. In this way it may impart a degree of confidence that the scientific method of inquiry is not anathema to Native life.

Skywatching

Francis Bacon, in *Novum Organun* (1620), articulated the basis of scientific learning through the inductive approach. Essentially, induction constitutes observation, analysis, explanation and prediction; observation of natural phenomena leads to analysis of inherent patterns that yield explanations that make possible predictions of further occurrences. Skywatching provides the best evidence that Indian thinkers exercised this process in their attempts to create order out of an ostensibly chaotic universe. By observing the behaviour of stars, skywatchers became familiar with the paths each travelled, and their observations were the basis of accurate calendrical systems founded on seasonal stellar procession. The firmament of stars was the backdrop for the more quixotic motion of planets and other bodies in the solar system, and the challenge for these ancient astronomers was to predict their cycles. Skywatching was arcane knowledge and its use was the domain of medicine men who meditated on the meaning of unusual stellar visitors and the messages they brought from the spiritworld. It has no clear analogue in the modern Aboriginal world, because it was one of those obsolete skills that was lost to Native people with the advent of modern times. Ironically, for those who cared to look for these cryptic messages, it was as apparent as the stars in the night sky. Stellar observation was the ultimate mnemonic device, and story-telling that featured personalities associated with planets and constellations was a method of codifying Native astronomical knowledge.

Among the mobile Plains cultures, the observable paths travelled by the denizens of the sky country were reliable indicators by which to plan yearly events (Williamson, 1984), or to locate people in time, either nightly, seasonally or historically. Accurately recalling events was the basis for the long-count of winters (or years), which were given names and recorded as mnemonic panels on a painted robe; read together they constituted a tribal history, or winter-count. Unique occurrences, like supernovas or comets, were impressive and useful for collating memories in an attempt to preserve and communicate their experiences to succeeding generations. Moreover, unusual celestial events, like meteor showers, which were witnessed by many people, were favoured to denote a winter, thus allowing modern researchers to calibrate winter-counts with the Western calendar by cross-referencing the chronological sequence of winters with historically recorded astronomical events (Chamberlin, 1984). Documenting their observations in the picture-writing format was meant to augment the oral tradition, but it was also a medium for expressing their knowledge of astronomy (Brandt and Williamson, 1979; Koenig, 1979).

The emphemeral nature of painted hides requires special curation to endure; however, images of fantastic apparitions appearing in the sky were just as likely to find their way onto cliff faces and into rock shelters in the form of pictures that have come to be known as rock art (Young 1986). Whether labelled as pictographs, petroglyphs or petroforms, they pique the curiosity of those who encounter them in an archaeological context.

Rediscovery of ancient astronomy began with the systematic study of megalithic structures such as Stonehenge (Baity, 1973). It was first noticed that highlights of the solar year, like the solstices and equinoxes, were marked by the alignment of obelisks along the henge perimeter. Thereafter, researchers began to turn their gaze not to the sky, but to the cultures that inhabited the ancient world, to assess their astronomical knowledge and to determine the manner in which it was manifested in their physical constructions (Ellegard, 1981). Aveni (1977, 1982) presented the situation for Native American astronomy and, as with so many other areas of learning, Meso-Americans demonstrated a most sophisticated understanding of celestial phenomena, which they incorporated into their physical and intellectual culture (Aveni, 1981, 1988; Kelley, 1980). However, they were not the only American cultures to ponder the night sky and wonder at its meaning. Hively and Horn (1982) have provided evidence that the Moundbuilding cultures also had an advanced knowledge of astronomy, which they subsequently incorporated into their earthworks. This activity was not restricted to extinct peoples – lunar markers were still used by historic Puebloan cultures to harmonise their celebrations and each particular full moon was assigned a unique name to correspond to its appearance in relation to the natural seasons (Zeilik, 1986; Malville et al., 1991). McCluskey (1977) noted this and posited a discernible pattern that differentiated mobile and sedentary societies: mobile hunting cultures were more likely to incorporate stellar constellations to mark the passing of time, while sedentary agricultural cultures relied more on solar and lunar observations.

Agriculturalists paid particular attention to points of sunrise and sunset along the plane of the horizon as a basis for calibrating their calendars. The northernmost and southernmost points were given special consideration, precisely because they announced the expected change in season. Their ability to anticipate an approaching planting season through observation of reliable patterns that herald the arrival and departure of seasons would be advantageous for capturing seasonal rains and maximizing soil moisture, which would ensure bountiful harvests (Zeilik, 1984, 1986). Further evidence of the importance of the solar year was obtained from sun shrines

constructed near Pueblos; ceremonies were performed there to announce the beginning of the planting season (Zeilik, 1985*b*). Similar cultural behaviour was displayed by the so-called "sun daggers" reported at Fajada Butte in New Mexico (Sofaer et al., 1979; Newman et al., 1982; Zeilik, 1985*a*; McCluskey, 1988). Rays of the midday sun on the soltices and equinoxes collimate rectangular beams of sunlight on spiral petrogyphs constructed on the cliff face beneath a natural rock fall. The makers of this petroglyph had deliberately placed it at this locale after several years of careful observation. Familiarity with seasonal solar movement was central to the well-being of agricultural communities that they were incorporated into every aspect of domestic and ritual life. Reyman (1976) examined Puebloan architecture in Chaco Canyon and noted that observation of the winter solstice sunrise was built deliberately into their window design. Sunlight on the winter soltice was aligned with the interior axis of the room when the sun appears to stand still on the horizon for three or four days, and then begin moving again toward its position at the approaching vernal exquinox.

Astronomy may be a forgotten tradition, but it provides a good example of the inductive reasoning employed by ancient skywatchers as they interpreted the nature of the cosmos. Naked-eye astronomy was a widespread tradition that transcended individual cultures and persisted through countless generations; it was common to both the agricultural and mobile hunting cultures that occupied the American landscape. Their experience with astronomy began with observations that were a challenge for Indian thinkers to fathom. Once events were analyzed and patterns were discerned, they formed the basis for continued speculation on the meaning and significance of observed events with the ultimate intent of predicting the next event. Successful explanations had the immediate benefit of expanding the limits of control that they could exert on their environment. Indians wove their knowledge into the fabric of their folklore and ritual life in order to codify it and pass it on to future generations (Williamson and Farrer, 1992).

Earthwatching

Just as astronomy is important to situating oneself in time, geography is crucial for locating oneself in space. Unlike skywatching, which has left few contemporary parallels, earthwatching has been enhanced by the advent of modern times. In the past, knowing the land was the result of a lifetime of travel across it. Familiarity and experience created the perceived landscape, while memory drafted it onto the mind in the form of a cognitive

map. Without permanent media, cognitive maps of the subjective world allowed people to comprehend and order the landmarks, paths, features, routes and barriers strewn across the earth (Abler et al., 1992). Ephemeral media available to the Aboriginal cartographer consisted of snow, sand, wood, birchbark and even animal hides, but it was not a limitation for their spatial analytical skills (Bagrow, 1948; Pentland, 1975). Thus, the Aboriginal's *terra cognita* was an indispensible aid to early surveyors who sought to fill in the empty space of the European's *terra incognita* (Lewis, 1986; Rundstrom, 1987, 1990; Belyea, 1992) and their cognitive maps were readily transferable to the new media of pencils and paper introduced in historic times (Boas, 1885; Flaherty, 1918; Mathiassen, 1931, 1933; Moodie and Kaye, 1977).

Negotiating the Aboriginal's memorized landscape required its own spatial analysis, since it encompassed both the physical contours of the corporeal earth, as well as its ethereal terrain. Travelling across the known landscape was made easier through experience because all travellers had their favourite resting places and campsites. Likewise, certain areas elicited specific emotional responses, or were considered taboo, because they charted the intangible environment of their spiritual geography (Norris, 1993). This fact compelled the traveller to be familiar with hazards unique to a world animated by spirits and revealed through visions and dreams (Lindquist, 1995; Hallendy, 1997). Traversing this spiritual topography has a timeless appeal that has been discovered recently by post-modern neo-primitives seeking comfort for their spiritual angst in the rites and rituals of Aboriginal cultures. This is happening at the same time that Aboriginal people are amending their cognitive maps and rediscovering their world with the aid of space-age technologies (Conant, 1994).

Today that mental landscape can be transferred onto maps, aided by geographers' tools like geographic information systems, satellite imagery (LANDSAT), global positioning systems and low-altititude remote sensing (Goodchild, 1991; Unwin, 1994). These technologies allow people to see beyond the visual range, even beyond the limits of the horizon, to comprehend a more complex world. There are significant reasons for employing modern cartographic tools since any activity that relies on spatial data will require precise and detailed knowledge of the land. It will be necessary to ensure that qualified personnel are in place to maximize the potential of these technologies (Epp et al., 1991) since Aboriginal lifeways have grown beyond simply divining the route of migrating animals to ensure a successful hunt. Living off the land may mean interpreting thematic satellite images to assess the quality of natural habitats in order

to devise and implement effective wildlife management policies (Meredith, 1985; Ferguson, 1991; Mathews, 1991; Pearce, 1991; Lowi, 1997).

Spatial analysis will take on new meaning in the coming years as Native people settle land claims and assume control over forest, land and water rights in their ancestral lands (Marozas, 1991). This is certainly the case of Nunavut, carved out of the Northwest Territories in 1999, and particularly the Inuit Owned Land within this complex geopolitical entity (Canada, 1993). As the Arctic becomes more accessible to the larger world it will not be possible to rely solely on personal experience and cognitive maps. It is intertwined with legal definitions of customary lands, exerting ownership, exercising governmental powers and constructing Aboriginal identity. These tracts of land will be scrutinized for their resources and potential wealth, and they will be surveyed for community infrastructure, traditional hunting areas, transportation and housing (Keller, 1986). For reasons like these, Inuit have adopted cartographic methods to document the movement of caribou and other migratory wildlife in the pages of the *Nunavut Atlas* (Riewe, 1992). It records habitat data, like calving grounds, migratory routes and seasonal feeding locations, to inform managers who may have to plan for the effect that industry would have on local environments, or anticipate its effects on wildlife (Wolf and Walker, 1987; Stirling, 1990). They must also respond to events outside their control that will have local impacts – for example, as global warming alters the ecological regime of the Arctic, it will require better monitoring of cold-adapted land species since they are the most sensitive indicators of that change (Wenzel, 1992; Stirling and Derocher, 1993).

Similarly, the Inuit of Nunavik (the Inuit homeland north of 55°N latitude in Quebec) initiated a project to produce detailed maps to preserve cultural spatial information. This ambitious scheme has resulted in 1:50,000 scale topographic maps that record geographic data using Roman orthography and Inuktitut syllabics. These map sheets are modelled on the National Topographic System and use the standard cartographic grid, contour lines, elevations and geographical symbols (Muller-Wille, 1991). Complementing spatial representation is the practice of toponomy, or the naming of places, in which the use of Inuit place-names provides an Inuktitut description of the rivers, bays and highlands (Muller-Wille and Weber, 1983; Michaud-Samson, 1982). Although Inuit toponyms have been collected as a by-product of ethnographic and other research, there was no attempt previously to systematically chronicle Inuit geography. Therefore, the primary objective of the Nunavik toponomy project is to reclaim their cultural landscape by documenting an Inuit geography to

make known their culture's presence on their ancestral land (Muller-Wille, 1991, 1987, 1985). It is also a nationalist act since maps are powerful media used by polities to assert their spatial sovereignty.

Whithers (1995) examined archival maps to chronicle the creation of Scottish national identity through the lens of the surveyor. He concluded that inductive analysis of physical space fosters a sense of national identity by providing the citizens with a tangible representation of their community's boundaries. Similarly, Native people define their identity in relation to the land; they use borders of their reserves or their ancestral lands as one way of knowing themselves and their culture. This is certainly true for the Navajo (Goodman, 1982) and Zuni (Ferguson and Hart, 1985) who have adopted cartographic techniques to provide spatial information of their lands. Their atlases include demographic data, physical geography, settlement patterns and the legal status of tribal land; they also include historical information to illustrate the evolution of their tribal real estate from the boundaries that defined their autonomy to the lines that delimit their reservations. Thornton (1997) reports that among the Tlingit of Alaska geographic knowledge is fundamental to organising their social structure and subsistence production, and toponomy is an important symbolic element in their cultural identity. Other Indigenous groups, like Maoris, address their geography outside the strict ambit of physical space (Gale, 1996). They do not reside on reserved lands: they co-exist with a foreign polity and their communities are dispersed across Aoteoroa; in response, they describe their homeland in terms of cultural space. The lesson to be learned is that geography may start with putting lines on a map to determine distances between points, but it also consists of constructing one's identity, history and culture.

Further Considerations of Science and Native Studies

As Native Studies continues to mature, the number of subjects within its repertoire likely will expand as Native students infiltrate more disciplines and insert their perspectives. As technical expertise becomes commonplace, it will be necessary to encourage a more cosmopolitan view of science and Native Studies. Although it is not possible to anticipate all areas that will influence Native Studies, a few that have potential include medical research, medical anthropology, physical anthropology, archaeology, genetics and molecular biology. Such topics can generate new knowledge for Native Studies because Indian subjects, ancient and modern, provide the raw data for this research. Studying human remains has become more complex with the advent of new techniques in the field of molecular biology, especially

with scrutiny of variations in mitochondrial deoxyribonucleic acid, decoding the human genome, retrieval of ancient DNA from mummified specimens, and analysis of DNA by polymerase chain reaction amplification. It is important to have Indian students strategically placed to verify, interpret and evaluate the results of scientific research. By doing so, they will be in a position to act as intermediaries, to assess the merits of particular research and to make informed decisions on implementing programs that apply the results of research.

Of immediate concern, and a field that should be promoted actively, is the health of Aboriginal people, which is in poor condition throughout the country. MacMillan et al. (1996) report that Indians live shorter lives than Canadians and they sustain a burden of suffering that is disproportionately large for their population. This situation is exacerbated by the fact that Indians are desparately underrepresented in the health sciences professions. There are only 100 physicians and 250 nurses of Native ancestry across Canada; if they were servicing strictly the status Indian population, then it would mean a ratio of one doctor for every 7500 people and one nurse for every 3000 people (Tookenay, 1996). It means the chances of an Indian being treated by a Native physician or nurse are slim indeed, though changing attitudes appear to be bearing fruit by the establishment of medical programs that encourage Native students to pursue careers in medicine (Greenwood, 1995). Their influence and experience in two parallel systems of medicine have caused health professionals to reconsider the benefits of traditional medicine (Rhoades, 1996). Medical research focused on health issues in their communities allows researchers to discern patterns of illness that reflect their historical relations to Canada (Graham-Cumming, 1967; Jarvis and Boldt, 1980) or the effects of socioeconomic conditions, like chronic poverty, poor housing and poor diet (MacMillan et al., 1996). While the number of Indian medical researchers is unknown, if the above statistics are any indication then it is likely non-existent, or miniscule at best. This has not always been the case. Richards (1995) reported the discovery of human remains in an archaeological context that reveal the practice of complex cranial surgery in ancient times. Indian medical research has great time depth given the discovery of therapeutic drugs and their use in traditional medicines. Many of these medicines are still used in modern pharmacology, although not always in the exact form as the Aboriginal usage (Vogel, 1977).

Although health professions should not be limited by ethnic origin, nevertheless there are areas, like medical anthropology, that target Native populations. Medical anthropology is a promising avenue of research for

better understanding emerging health issues in Native communities, and is one that seeks to understand Indigenous forms of medicine. For example, Indians are at greater risk of suffering from pregnancy disorders (Godel et al., 1992; Edouard et al., 1991), respiratory diseases (Herbert and Burchak, 1967; Enarson and Gryzbowski, 1986), certain cancers (Band et al., 1992) and nutritional problems (McIntyre and Shah, 1986; Price et al., 1993; Miewald, 1995). Particularly disconcerting is the exceptionally high incidence of metabolic disorders, especially diabetes which is manifest in epidemic proportions in Indian populations (Grams et al., 1996; Brassard et al., 1993; Delisle and Ekoe 1993; Young et al., 1990). Non-insulin-dependent diabetes mellitus appears to be the more common form and is associated typically with individuals older than thirty-five years of age, leading Indians to accept the erroneous idea that daibetes is a natural part of the aging process. The appearance of metabolic disorders may not be accidental – in fact, it has been theorized that they are the culmination of patterned traits that may have their origins at a genetic level (Neel, 1962; Norman et al., 1997), or they may be a result of the rapid modernization of Native communities, especially in relation to diet (Price et al., 1993). It has even been suggested that these metabolic disorders represent a "New World Syndrome" of culture-gene-environment interaction brought on by rapid changes in diet, physical activity and cultural traditions (Weiss et al., 1984). Remedial action may require a cultural response, one in which Indians have the opportunity to exercise control over their health by the lifestyle choices they make.

It also possible that these diseases may be a function of natural selective pressures that acted upon Indian ancestors in the remote past (Wendorf, 1989). Following that line of reasoning indicates that future research will take place with the techniques and procedures applied by physical anthropologists and archaeologists. The methods vary between direct examination of human remains to distinguish specific pathologies, like tuberculosis, which are often associated with crowding (Pfeiffer, 1984), to indirect analysis of human activity, for example the study of by-products like coprolites to evaluate parasitic diseases that afflicted human hosts (Reinhard, 1990). Searching the archaeological and ethnographic records can shed light on pre-contact ailments (Saunders and Melbye, 1990) and assess the impact of post-contact pathogens introduced in the early historical period (St. Hoyme, 1969; Newman, 1976; Stannard, 1990; Merbs, 1992; Larsen, 1994). One recent study by Herring. 1992) examined the effect of the 1918 Spanish flu pandemic on Indian reserves in Manitoba and noted the differential patterns of infection between settlements. The

data gleaned from Hudson's Bay Company and parish records indicate that Norway House suffered high mortality while neighbouring communities were left unscathed. While the study of epidemics in historic settings is fraught with uncertainties, there is evidence showing that epidemics have been, and continue to be, agents of cultural change. Epidemiological research is especially important given the recent appearance of diseases that have the potential to cause more profound change for Indians. However, since it involves the controversial practice of studying human remains, Indians will have to arrive at some accommodation for this type of research (Ubelaker and Grant, 1989).

Research on human remains can concentrate on different levels ranging from the macroscopic scale of groups or individuals to investigations at the microscopic level. Discoveries regarding nuclear and mitochondrial DNA have broadened the debate concerning human origins, and for some scientists it has the potential to solve the vexing mystery about the ancestry of American Indians that linguistic, dental and archaeological evidence could not (Szathmary, 1993; Bailliet et al., 1994; Cann, 1994). The quotable Yogi Berra once observed that everything has changed but it's all still the same. A lot has changed since Fewkes et al., 1912) expressed their views on American Indian origins, but everything is still the same when it comes to research questions on the same topic. It is accepted generally that their ancestors originated in northeast Asia and the route to the Americas was via Beringia (Shields et al., 1992; Lahr, 1995), and it is felt that examining the genetic relationship between Indian and Asian peoples can eventually determine the source of the founding population(s) and the time of their arrival(s) (Torroni et al., 1994; Forster et al., 1996; Merriwether et al., 1996). Genetic research is not restricted to studying extant populations, as the current interest in dinosaur DNA demonstrates. In fact, the invention of the PCR method of cloning DNA indicates that it is possible to extract samples from anicent human and non-human sources for studies of population movements (Handt et al., 1996); it even holds the promise for a new discipline of genetic archaeology (Stone and Stoneking, 1993; von Haeseler et al., 1995). Not everyone is convinced of its promise: as Stoneking (1995) points out, this "technological curiosity" is vulnerable to contamination, the sample size is limited and the merits of the questions it addresses are debatable. Nevertheless, undaunted scientists claim to distinguish at least four founding lineages colonizing this continent. These ersatz haplotribes are the proposed evidence that migration into America was not one single event (Torroni and Wallace, 1995; Santo et al., 1996). Analysis of ancient DNA has allowed other scientists to identify relatedness

between genetic and linguistic populations and to speculate about a three-wave hypothesis of migration out of Asia (Ward et al., 1993). However, Bonatto and Salzano (1997), using similar evidence, argue instead for a single early migration scenario for the settlement of America. About the only thing that has come clear is that the distant past is as murky as ever.

Interest in molecular biology is not restricted to answering esoteric enigmas like the peregrinations of ancient humans – far from it. The human genome project is a case in point. It is an ambitious plan to produce a genetic map of the twenty-three different pairs of human chromosomes (Watson, 1990; Jordan, 1992), extending knowledge of human anatomy to the molecular level (Casalino, 1991). Initiated in 1987, this project is expected to take at least fifteen years to complete and will occupy the resources of an international research group because human DNA contains over three billion nucleotide sequences. The goal seems straightforward, but nothing is ever as it seems. As always, there are social implications and ethical dilemmas that will challenge society (Waugh, 1994). One only has to review the consequences of developing the atomic bomb to know that not all scientific achievements end up in a benevolent form.

Native people tend to be treated as the human resources that can be mined for their proteins and nucleotides. So far there has been no effort made to explain the benefit, or utility, of this research to them; instead, it is portrayed as scientific largesse that is bestowed on an ungrateful population. The novelty and specialized nature of molecular biological research will require scientifically literate personnel to inform the subject populations of the social implications of theories generated in the laboratory. Where the health of Indians and their communities is concerned, it is important that they take control and be in a position to affect change. If they do not, it will be a continuation of the long history of dependency and the unequal distribution of power that has stifled progress in Native communities. So long as Native people are only the subjects of study, few of the benefits of this research will accrue to their communities and none of the knowledge generated at their expense will be of any value to them.

Conclusion

It seems true at present that Native people exhibit limited interest in science, the results of its research, or in its careers, which is problematic because, more and more, it intrudes into their daily life. Of course, science itself is a term used to describe a broad range of topics, but at its core is a philosophy and a method of inquiry that has been excluded from Native Studies. It is understandable that Native people would see little value in

research in which they are not directly involved, or have any control over the objectives, or where they only play a passive role as subjects. Perhaps scientific research is considered too esoteric to have any practical value, or perhaps it is viewed as a method of knowing that has wreaked so much havoc on Indian lives that it has become synonymous with danger. The low regard Native people hold for scientific research may be symptomatic of a long history of conflict between two cultures, and between two systems of knowledge. Whatever the underlying reasons, this credibility gap is an obstacle that must be overcome if there is any possibility of raising the profile of science for Indian students and make it an appealing option. Herein lies the problem of science, and a possible role for Native Studies, which is ideally placed to be the medium between the institutions that support scientific research and the people whose experience it represents. This literature review illustrates the many areas where the two disciplines cross paths as academics pursue their research interests; these can be the basis for a future dialogue.

Native people employing the scientific method can broaden the meaning of traditional knowledge, and introduce new avenues of investigations for Native students. Native traditional learning has been burdened by stereotypes that preserve the mystical aura surrounding Indian lore and promote the idea that Indians live with a heightened sense of awareness regarding nature because it is the essence of their culture. Such romantic explanations evoke 19th-century notions of savage folk living in a buccolic state, contentedly nestled in primitive comfort somewhere in the wilderness. In fact, Native traditional knowledge was built around directed investigations into the nature of things, and in their deliberations they arrived at conclusions that demonstrate an aptitude for inductive reasoning. The knowledge indicates that Native people were careful observers of nature and possessed a capacity for systematic analysis of natural phenomena. Accepting these facts eliminates the need to resort to simplistic, supernatural explanations and recognizes the rational approach of traditional learning methods in developing ways of interacting with the world.

"Strangely estranged" describes the current state of affairs between science and Native Studies, but it does not have to become a chronic situation. Success in future endeavours will depend on the willingness of both sides to engage in an open dialogue, to explain the objectives of any new research and to explain its potential contribution to the well-being of Native communities when they are the subject population. When one looks at the world, it is evident that science exerts a great degree of influence on society through the products of its researches. It can be debated whether all

scientific achievements deserve admiration, but it cannot be denied that daily life would be considerably different in their absence. One thing that is certain is that the future will be dominated even more by science as theories become realities and as the resulting technologies become commonplace. Therefore it is all the more important that Native people incorporate science courses into their education programming; otherwise, there is a real danger that a marginalized group will be left farther behind if its members cannot exhibit the rudiments of scientific literacy.

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