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Einstein, sacred science, and quantum leaps a comparative analysis of western science, Native science and quantum physics paradigm

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**EINSTEIN, SACRED SCIENCE, AND QUANTUM LEAPS
A COMPARATIVE ANALYSIS OF WESTERN SCIENCE, NATIVE SCIENCE AND
QUANTUM PHYSICS PARADIGM**

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This study is dedicated to my Dene Tha' Grandmothers and Grandfathers who sent the guides ahead to bring me home.

Abstract

Science is curiosity about the natural world translated into knowledge; it serves to identify laws and validate hypotheses. The quest for knowledge is influenced by the paradigm of the scientist. The primary object of this study is to examine Quantum Mechanics and Sacred/Native science for similarities and differences. This will be accomplished through an extensive use of authorities from both Western and Native sciences in an in depth examination of the paradigms upon which their foundations are based. This study will explore language and how language used leads the scientist down a particular pathway. This study will conclude in a summary fashion, an exploration of a few select key concepts from both Native and Western sciences from a comparative perspective.

Acknowledgements

"Wonsedle ndedeysi edawondi'hi ka, I tell you a little bit so that you may know."

(Dene Tha Elder as cited in Goulet, 1998, p. xxxv).

It does indeed take a village. In Native American life, community is everything. Since wisdom and knowledge are essentially experiential, knowledge is transmitted physically, emotionally, mentally and spiritually. So it is with this thesis. Its journey brought many gifts from the Grandmothers and the Grandfathers, and it all began with a dream.

Travelling west into the valleys; 90 clicks showing on the speedometer. A bird spirals overhead . . . closer, closer. "An eagle," I call out to my friend in the passenger seat, as these words play over and over in my being: "He's come to take care of the baby." What baby, I wonder? I'm not going to have a baby; I'm too old to have a baby. Is my friend going to have a baby? No, the message is for me. The great winged one circles above, calling for me. I have to pull over. The eagle stands by the side of the road, waiting. My sister-friend— my witness— stands in questioning silence, echoing my own bewilderment. Instinct tells me to lie down upon the earth. The great golden eagle hops upon my chest and looks at me. I stare into those ancient eyes, shocked but willing to see what will happen next. Suddenly, his beak opens and a steady stream of brilliant white light enters directly into my heart. It is physical. It is real. It is total. How can this be? Not magic— reality. I receive the light in stunned amazement. I surrender, completely and utterly astonished. I am honoured and humbled. My weary heart is renewed. This is the beginning.

To Leroy Little Bear and Amethyst First Rider, professors at the University of Lethbridge in Alberta; it's all about "identity;" and it's about coming home to that identity. They are my eagle and my beam of light. It was beneath their wings that I finally began to understand my DNA. The knowing, so long sought after, was recognised, embraced and brought to fruition. A coming home that explained all the incongruity I felt growing up in my colonized life. "Shit—I wasn't nuts after all!" My Grandmother's, "only two days away," guided and protected me, and brought me to my eagle, Leroy and Amethyst, who went to work and transformed me into the knowing. What greater gift can a teacher give to his pupil than identity? Gratitude is not enough. But when you travel with Leroy and Amethyst, you better be ready for the unexpected. Like the Japanese physicist who whispers mathematical poetry to you every chance he gets, Sam Kounosu makes physics a dance and tops it off with vitamin C! Thank you, my dear Sam, for your time, your spirit and most of all your patience. And thank you, Cam Goater, for your no nonsense reminders, and willingness to explore another paradigm. Of course, it takes more than your committee; it takes money to live your dream. For people like me who don't subscribe to a category like manager or nurse, it takes the Aboriginal Achievement Foundation, North Peace Tribal Council, Sun Core Energy, Imperial Oil Esso and Interior Health for compassionate support. And how does one navigate the financial mystery without Becky Lore, financial genius? Becky always sustained this old woman when I went into the office, weeping and wailing "help!" Native scientists aren't exactly in demand! An

extra special sister hug to Jim and Laura Hamm, who believed in me enough to negotiate and co-sign a safety net that has sustained me and my boy over and over again. Your faith in me inspired and motivated me. Thank you. And thanks to all who put their money where their mouths are and became a part of the dream.

When you travel with Leroy and Amethyst, you never know where you will end up. Like a quantum leap, I followed the medicine. From Nelson, to Lethbridge, to Banff, to New Mexico and back again; once, twice and lots of times. And when you live in the mountains, study in the prairies, and have a 1987 Dodge van a.k.a. "The Arrow," those places are a little bit distant and precarious. But, strong and true, The Arrow always brought me home! So to CC, AKA Sal, Lolly, Lorraine and Johnson, a hearty "Thank you" to you who gave me the wings to fly over mountains and sleep under stars.

And when you are hanging around with Leroy and Amethyst, expect to be an international nomad with one foot in Canada and the other in the United States. Borders don't matter, because as Joseph Rael, Tewa Elder and Albakerrrkeey cohort says: "the land is in love with you." So to my sacred places: "Inn The Cedars," a.k.a. Patricia's house; and Six Mile Beach where my prayers always came true NOW, and where the waters healed my bruised academic bones; and to Park Lake, where I soothed my mountain addiction and watery cravings, blessings always. And to Alvin Many Chief and Jennie Bruised Head, Blackfoot buddies who took a Dene Tha' daughter into their hearts on the first day when I was a stranger in a strange land, thanks for the medicine! And last, but not least, thanks to my four-legged friend 'Pepper' who helped me endure a parade of in-limbo housing. Process includes community, and in that community I have been blessed and honoured to have the support of the dearest people on this planet who housed me, fed me, watered me, led me, cried me, laughed me, and loved me. Kicking and screaming, I let them! To all of those who sheltered me, one way or another, I am humbled and grateful for your generosity and kindness: Debbie Hellwig, sweet, sweet sister; Patricia Rawson, wise woman; Deb and Les Scheidel, sidecar shenanigans; Mary Parish, houseboat dreams; Phyllis MacDonald a.k.a. "Bipse"; John and Doris Barbour; and, Richard and Janice for garden glory. Also thank you, Heather Pratt, for housing my home in your basement for a very, very, long time. To flying fingers Lorna, thank you for your precision and willingness to save my sorry butt.

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So that's my village, and you can't have a village without a family. My family is my boy, Adrian Jon Ferguson, who sacrificed Mom for scholar, and is now putting me through the wringer for it! Love you, Boo Bear! Couldn't have done it without you; couldn't do it with you but, hey, that's family! Thank you, my boy, for being willing to be on this crazy adventure with me.

You don't just write a thesis—you live it—and if you are really lucky, you have the support that I have. Just like particles that have ventured to the outer regions of space, know that we who have interacted can never be separated again. Blessings to you all. And to you and yours—Think Round—Mahsi Cho.

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Chapter One

"...while the American Indian would never again control the continent, he would forever haunt it."(D.H Lawrence as cited in Deloria, 1973, p. 74).

Science is the quest for knowledge. Dr. Leroy Little Bear states that: "The business of science is reality. And I've come to define, as a result of Einstein's definition for what the purpose of science is about, I have come to say that science is really about search. Search for knowledge." (L. Little Bear personal communication, August 2003). In the quest for knowledge the physics community, the Indigenous community and Western society all have various opinions as to what constitutes reality. The method of extracting knowledge is dependent upon perspective and that perspective is dependent upon the paradigm of the scientist. In Western thought, there is a dedicated passion for and commitment to the scientific method. Western perspective denies that which cannot be proved. Native science is holistic and includes a spiritual affinity, so it is often relegated to the metaphysical realm, which implies a fantasy of sorts. To Indigenous people we are indeed "all related". Western methods of experimentation support quantum mechanics, the mysteries of which would be inaccessible without adherence to strict rules of experimentation. However, the inception of quantum physics in the 1900s forced proponents of the Cartesian order to reconsider the makeup of the natural world. Quantum physics challenged those notions with experimentally proven concepts of relationship, interconnectedness, probability and non-locality. Some of these concepts correlate with Indigenous ways of knowing. The paradigms of Western science, quantum physics and sacred or Native science will be explored to define and identify the foundational basis of those sciences. Furthermore, quantum physics and Native science are examined for similarities and differences. The exploration of the paradigms of Western science, Native science and quantum physics within a comparative framework is the subject of this study.

At times there may be what could be considered a critical tone within this thesis; however, its primary objective is to provide a comparison of the paradigms of Western science, Native science, and quantum physics, not a critical analysis. For example, some of the references used such as those of Fritjoff Capra propose ideas and concepts revealed through their own critical analysis regarding the shortcomings inherent in Western ideology. One such idea is the belief that there is only one way to practice science. These arguments are used to illustrate the differences in Western and Native thinking. In addition, the Aboriginal voice may sometimes have an edge that echoes the frustration of voices long silenced, or voices constantly filtered through a predominantly Western lens. Aboriginal voice is often missing in academia and therefore its articulation may be harsh, given the long-standing resentment of Western interference in traditional values. Assimilation practices and colonial domination cast a long shadow over the Aboriginal community, which is reflected in strong Aboriginal voices speaking out. Elizabeth Lynn Cook, scholar, poet and activist states:

The Invasion of North America by European peoples has been portrayed in history and literature as a benign movement directed by God, a movement of moral courage and physical endurance, a victory for all of humanity. As the face of Europe (as well as Asia and Africa) changes at the close of the twentieth century, this portrayal of colonialism and its impact on the unfortunate Indians who possessed the continent for thousands of years before the birth of America, seems to go unchallenged either in politics or letters by most mainstream thinkers. It arrives in academia unscathed, to be spoon-fed to future generations. (Lynn-Cook, 1996, p. 29)

The critical tone is a by-product of the “silencing of the Aboriginal voice” and this writer would like to emphasize that despite an undercurrent of criticism, the purpose of this study is one of comparison between Western and Native sciences. This is not a critical analysis, and this study should be engaged in from that perspective.

Methodology

The methodology consisted of an intensive literature review of Native science, quantum physics and Newtonian science in order to identify the inception and development of each paradigm. The literature researched included books, articles, conference transcripts and internet sources. Conferences fluent in the Bohmian method hosted by the Source for Educational Empowerment and Community Development in Albuquerque, New Mexico, were attended annually. These are known as “the dialogues” since they refer to the intensive discussions and dialogue among the physicists, linguists, Native American scientists and Elders at the conference. Some of the information also comes from the lectures of Dr. Leroy Little Bear, Amethyst First Rider and Sam Kounosu at the University of Lethbridge.

Literature Review

The literature explored falls into three categories: Western science, Native science and quantum physics with the accent being upon Native science and the quantum theories. Western science is explored through an historical lens with emphasis upon the development of current Western scientific foundations and how they evolved. The information is garnered from Fritof Capra’s book *The Turning Point*, as well as from timelines and various historical synopsis of science. Supplementary information on the meaning of paradigm and the influence of language is also included. Paradigm is defined through the dictionary. Benjamin Lee Whorf’s book *Language, Thought and Reality* explores Native American language and how the cosmos, time, space and reality are understood through symbols and meaning. This information is crucial to understanding the foundations of the Native paradigm.

Information on Native science was difficult to access because it is not accepted as a discipline in its own right, and because it is overshadowed by Western doctrine. Vine Deloria argues that

accepting Western doctrine as gospel undermines the quest for knowledge or truth, creating an imbalance that academia fails to address and continues to perpetuate. In the article, *If you think about it, you will see that it is true*, published in *Ions: Noetic sciences review*, Deloria states:

Non-Western knowledge is believed to originate from primitive efforts to explain a mysterious universe. In this view, the alleged failure of primitive/tribal man to control nature mechanically is evidence of his ignorance and his inability to conceive of abstract general principles and concepts. Tribal methodologies for gathering information are believed to be "pre-scientific" in the sense that they are pre-causal and incapable of objective symbolic thought. This belief, as we shall see, is a dreadful stereotypical reading of the knowledge of non-Western peoples, and wholly incorrect. (Deloria, 1993)

In his book, *Wisdom of the Elders*, David Suzuki corroborates Deloria's conjectures and takes it one step further, proposing that:

Native spiritual and ecological knowledge has intrinsic value and worth, regardless of its resonances with or "confirmation" by modern Western scientific values. As most Native authorities would be quick to point out, it is quite capable of existing on its own merits and adapting itself over to meet modern needs. (Suzuki, 1992, p. 22)

Native Science may also lack validation because it has not been clearly defined or recognised; however, Gregory Cajete in his book *Native Science, Natural Laws of Interdependence* clearly defines the foundations and methodology of Native science. Cajete states that:

Native science is a broad term that can include metaphysics and philosophy; art and architecture; practical technologies and agriculture; and ritual and ceremony practised by Indigenous peoples both past and present. More specifically, Native science encompasses such areas as astronomy, farming, plant domestication, plant medicine, animal husbandry, hunting, fishing, metallurgy, and geology—in brief, studies related to plants, animals, and natural phenomena. Yet Native science extends to include spirituality, community, creativity, and technologies that sustain environments and support essential aspects of human life. (Cajete, 2000, p.3)

This definition of Native science will be further clarified in the thesis, but Cajete's book will be fundamental in exploring the foundations and methodology of Native science, since he also addresses such issues as time, oral tradition, place, interrelationship, tricksters and astronomy. Although David Suzuki is trained in the Western scientific paradigm, he confirms that indigenous science bears detailed investigation:

The ecological impact of industrial civilization and the sheer weight of human numbers is now global and is changing the biosphere with frightening speed. It is clear that major problems such as global warming, ozone depletion, species extinction, and world-wide toxic pollution will not be solved in the long run by perpetuating the current worldview... We need a radically different way of relating ourselves to the support systems of the planet. (Knutson and Suzuki, 1992, p. *xliv*)

Suzuki confirms Cajete's hypothesis that Indigenous science has been ignored yet has valuable insights to offer. In *Wisdom of the Elders*, Suzuki provides examples of science from a banquet of Indigenous nations, illustrating how Native knowledge has contributed to Western science. He addresses the concepts of time, relationship, sacred places and the importance of observation—all key components of Native science. Suzuki's views are further corroborated by David Peat in his book *Blackfoot Physics*. Peat defines and classifies key components of Native science and relates those concepts to physics. These three books will be key to establishing the foundations of Native science.

Integral to the concepts of Native science are the concepts of constant flux, renewal, interrelationship, trickster, animate/spirit and sacred space; all foundational components of Native paradigm which coexists with Native science. To further substantiate Native paradigm, and therefore the foundations of Native science, this author explored several other books: *Those who know: profiles of Alberta's Native Elders* by Dianne Meili; *Circle works transforming*

Eurocentric consciousness by Jean Frye Graveline; *House of the Shattered Light and Vibration and Being* by Joseph Rael; and *No word for Time* by Evan T. Pritchard. These books confirm and substantiate Indigenous thought and how Native science evolves from this consciousness.

It may not be called "science" in Native languages, but Indigenous knowledge refers to scientific skills Native people value and have used since the beginning of time to discover the way things work in the world. When speaking about Native science or traditional knowledge, one is really talking about the entire edifice of indigenous knowledge. (Lambert, 2001, p.1)

Although the perspectives of the authors varied from elder, feminist, scientist, healer and academic respectively, without exception, these books provided insight and validation of the concepts of Native paradigm.

The literature for quantum physics consists of: *Dancing Wu Li Master's* by Gary Zukav; *The Turning Point* by Fritof Capra; *The End of Science* by John Horgan; and *Blackfoot Physics* by David Peat. Horgan explores the history and discipline of science through the eyes of the experts, the scientists themselves, to garner opinions as to the past, present and future foundations of science. This book provides a wealth of information as to the foundations of quantum physics from the scientists who present varied and sometimes controversial viewpoints. Peat, Capra, and Zukav all present the inception, history and theories of quantum physics. Peat, in *Blackfoot Physics*, makes correlations between the quantum world and Blackfoot physics, providing a clear and concise argument as to the differences between Western and Native science and ideology.

Both Zukav and Peat imply a correlation between the new physics and the quest for reality, including what some scientists would term "mysticism" or "philosophy," and suggest that to ignore these holistic theories of reality excludes crucial knowledge. This issue is also raised in *The End of Science*, where John Horgan states:

“...Bohm also seemed intent on making physics even *more* philosophical, speculative and holistic. He went much further than Wheeler did in drawing analogies between quantum mechanics and eastern religion. He developed a philosophy, called the implicate order, that sought to embrace both mystical and scientific knowledge...Few scientists combine these two contradictory impulses- the need to clarify reality and to mystify it- in such a dramatic fashion.” (Horgan, 1996, p. 85)

Horgan contends that a departure from empirical science to what he calls “ironic science” heralds the end of science, and that combining the metaphysical and the empirical is not practicing science. Carl Sagan supports Horgan and argues the merits of empirical data in his book *The Demon Haunted World: Science as a Candle in the Dark*. “But in the light of the findings in the last few centuries, it seems foolish to complain about reductionism. It is not a deficiency but one of the chief triumphs of science” (Sagan, 1996, p. 274).

It is not the purpose of this thesis argue the merits or failings of Western science, but simply to illustrate the similarities and differences of these paradigms. The literature reveals that science is in a transitory state, that Western precepts fall short, that quantum physics supports some aspects of Indigenous science, and that we may be on the threshold of a whole new way of defining science.

Supplementary information comes from *The Language of Spirituality* conferences in Albuquerque New Mexico in 2002, 2003 (transcript) and 2004 (participant). The Albuquerque Dialogues unite physicists and Elders in Bohmian dialogue, reiterating the confines of language and enlightening physicists to the workings of Indigenous paradigm, while encouraging the international exchange of Native thought. Sam Kounosu, retired professor of Physics from the University of Lethbridge, poet and author, revealed the mysterious quantum world through intense discussion and dedicated much of his personal time. In addition to the dialogues and

discussions are lectures by Dr. Leroy Little Bear from 2001 to 2004. Dr. Leroy Little Bear differentiates aspects of the quantum world and Newtonian physics and reiterates Native paradigm. As well, the dissertation of David H. Begay and Nancy Cottrell Maryboy entitled *Living The Order: Dynamic Cosmic Process of Dine' Cosmology*, contributes Navajo perspective and wisdom.

The literature reveals that very little is written about Native science because, more often than not, it is categorized as environmental science, anthropology, literature or philosophy. A literature search of the Internet confirms that this is the case. As a consequence, Native science references are buried among the vast amount of material encompassed by the aforementioned disciplines. Although the task was daunting, every effort was made to find all relevant Native science material, especially those sources that represented an Aboriginal perspective. Despite the fact that the application of Native science has been ongoing for thousands of years as Cajete, Graveline, Suzuki, Rael, Meili, Pritchard, and Maryboy reveal, this discipline still has not earned its own academic accreditation. In the case of accessing information on Western science, here again the information was overwhelming. This proved the same for quantum physics. There is also a certain amount of controversy surrounding quantum mechanics, despite the fact that theories in quantum physics are mathematically supported and experimentally proven. Some maintain that quantum mechanics is rubbish: "perhaps the most prominent was Einstein, who rejected quantum mechanics because it implies that God plays dice with the universe. (Horgan, 1996, p. 279) Then, there are those like David Bohm, physicist, author and father of the Bohmian Dialogues "...who see scientific determinism as a threat to human freedom and thus embrace uncertainty and randomness. We are either pawns of destiny or wildly improbable flukes. Take your pick."(Horgan, 1996, p. 279)

Limitations and Explanatory Note

This study is not meant to be a full examination of science. There is no experimental documentation or technological data involved. This is not meant to be a comprehensive study, nor is it subject-specific in one single area such as environmental science. The reader will readily note an extensive use of quotes of different authorities in the areas of both Native and Western science. The extensive use of quotes fulfills several purposes. Firstly, I wanted to bring out the voice of scientists and bring that voice to the general public. I want the public to hear it from the “horse’s mouth” so to speak. Secondly, the extensive use of quotes is a subtle way to introduce not just science, but the ‘scientists’ and their works to the public. Thirdly, the extensive use of quotes serves to introduce science to the non-scientist. Most members of the general public, in the opinion of this author, ever begin to take the time to reflect on the modern conveniences that science has brought about in the past few decades. Lastly, this study is a comparative study. By using the authorities own words, the reader will, hopefully, get a good idea of the similarities and differences between Native and Western sciences as stated by the authorities themselves.

Definition of Terms

Some of the terminology or concepts used will be foreign to some readers, especially those used in defining the Native paradigm. The Native paradigm consists of a belief in constant flux, the interrelationship of all beings, renewal of relationship, belief in spirit (animate/inanimate), trickster, observer created reality, and sacred space or place. Constant flux is continuously evolving energy. Order is created out of chaos and flux, and maintained through renewal ceremonies that establish relationship and honor the animate world. These practices transform outcomes, and this is known as observer-created reality. The Native American Paradigm, which encompasses holistic meanings and concepts, will be referred to simply as Native paradigm;

however, this is not meant to change the original holistic concept of Native paradigm. In the quantum physics section, definitions of the concepts are included in the explanations. For the purpose of this study, the terminology of Native American, Aboriginal, Indigenous, Native and Elder all refer to the descendents of original inhabitants in North America before contact. These descendents include what is now known as Aboriginal, First Nation, Metis and Inuit peoples. Reference is also made to the particular Nations of Aboriginal people such as Blackfoot, Navajo, Dene Tha' and so on, and all are of Native American ancestry.

Chapter Summaries

Chapter One introduces the reader to the content of this study. Chapter Two defines paradigm in both the scientific and societal norms. Chapter Two also addresses language, and the influence of language upon paradigm. Culture affects language, and the old premise that everyone thinks in the same way given the same word is challenged by Benjamin Lee Whorf, chemist and inadvertent linguist. Whorf also makes some interesting points regarding an alignment between language and the natural movement of the cosmos in Native languages. Chapter Three focuses upon the Western scientific paradigm. The inception of scientific method is charted, beginning with early Greek investigations of the natural world, and follow its evolution to the eventual mechanization of the natural world that forms present day scientific ideology. Chapter Four describes the paradigm of Native Americans and how science emerges in concert with that paradigm. Native science is defined, and its foundational practice and values are illustrated in a medicine wheel model that further enhances Native paradigm and its operational goals. In Chapter Five we are introduced to a few main concepts in quantum physics. These concepts include quantum jump, particle wave duality, the uncertainty principle and complementarity. Non-locality and the theories of David Bohm are also introduced. Chapter Six speaks to the similarities between quantum paradigm and Native American knowledge.

Each paradigm is explored in length, so that the reader may garner a solid understanding of how the paradigm influences understanding of the natural world and the ensuing foundations of science. For this study the reader will have to embrace foreign concepts and new ways of understanding. To facilitate this, the definition of paradigm and a study of language and its influence on the paradigms of Western science, Native science and quantum physics will be examined in detail. For example, Western ideology demands proof in order to find answers. Often this answer is studied in isolation from the natural world. This does not hold true in Native science. In Native science the whole, and effects upon the whole, are always considered first and foremost. Harmony is the ultimate goal and the driving force in the quest for knowledge in Native science. Part of that whole is spirit. Dr. Nancy Maryboy, Cherokee/Navajo cosmologist explains:

Dr. Nancy Maryboy, an indigenous astronomer, teacher, and Cherokee/Navajo woman, reflected on the nature of worldview in a slightly different way: "I remember looking up the meaning of 'science,' because science as we know it today, it's like an arbiter of a way of life. Science as it was conceived back in the days of the Greeks meant 'to know.' Knowing. When we use the word 'knowing,' we mean ways of knowing—and we say 'ways' with an 's'. It's 'multiple ways of knowing.' Knowing is not static. It's always in process. It's always growing and regenerating. So we say 'ways of knowing.' "When I look at the Newtonian-Cartesian model of Western science, I think of an exclusionary process. One of the things that is excluded is spirituality. Many scientists have their own spirituality, but they have to leave it at the door. They can't hold it up and say, 'This is where I got my idea. This is how I know it's true.' Spirituality is not a commonly accepted validator in science as we know science today. However, spirituality infuses all of native ways of knowing, so you can't leave it at the door and be talking about native ways of knowing, or native science; it's all one. You can't reduce it to the smallest common denominator because it's all one. You can't experiment with a frog, take it to pieces, and then give it life and let it live again, because it just doesn't happen that way. So there are protocols for native research, and spirituality and intuition are not excluded. The participant is not excluded. It's a much more inclusionary way of knowing." (2004, p. 49)

So, for the non-Native, the deconstruction of Western values will be tantamount to understanding Native paradigm and quantum physics. Native paradigm will be explained at length in an effort to

communicate understanding and assist the reader in transcending their own paradigm. Just as Native understanding of science differs from that of Western concepts, so does Native methodology differ from Western methodology. For this reason, I have included quotes from the Native Science experts, Native elders and Native intellectuals in their entirety. Every effort was made to rely upon Aboriginal voice, the exceptions to this being David Peat, who was schooled in Native thought by Native elders; and Benjamin Lee Whorf, who begs precision in an alternate description of Native understanding of the cosmos. There is an inherent responsibility to accurately echo the voice of the speaker and to acknowledge their particular expertise. In the Aboriginal way, when you tell a story it is the storyteller's responsibility to tell the story correctly. Therefore, rather than paraphrase and run the risk of taking knowledge out of context, this writer will rely on the actual words of the experts. In addition, each chapter is introduced with a story. These stories are meant to provide relief from academic study and also prepare the reader for the content of the following chapter. The stories are our traditional way of documenting and transferring knowledge. Oral history and direct experience are the traditional methods of learning. I also used seven chapters in my study as a way of connecting to the medicine wheel which represents the four cardinal directions, as well as the concepts of above, below and within. Again, this is meant to transmit to the reader an aspect of Native American paradigm.

Chapter Two - Paradigm and Language

Paradigm

A Story

– An alder leaf, loosened by wind, is drifting out with the tide. As it drifts, it bumps into the slender leg of a great blue heron staring intently through the rippled surface, then drifts on. The heron raises one leg out of the water and replaces it, a single step. As I watch I, too, am drawn into the spread of silence. Slowly, a bank of cloud approaches, slipping its bulged and billowing texture over the earth, folding the heron and the alder trees and my gazing body into the depths of a vast breathing being, enfolding us all within a common flesh, a common story now bursting with rain.(Abram, 1998, p.274)

The word “paradigm” originates from the Greek word *paradeigma* meaning model, pattern, or example. The Merriam Webster Dictionary (1997) defines paradigm as a “model, pattern or standard”(p. 534). A paradigm is the psychic filter through which humanity lives that has been transmitted (whether or not we are consciously aware of it) through societal norms, spiritual practice, intellectual pursuit or, as we shall see, through language. A paradigm pervades every aspect of how the world is viewed by an individual. It is a mindset that guides us through our daily lives. Initially, the word paradigm referred only to academic pursuits. “Paradigm, pre-Kuhn, referred merely to an example that served an educational purpose; Amo, Amas, Amat, for instance, is a paradigm for teaching conjugation in Latin” (Horgan, 1996, p. 43). In 1962, Thomas Kuhn introduced the term paradigm in his work, *The Structure of Scientific Revolutions*. “Kuhn used the term to refer to a collection of procedures or ideas that instruct scientists, implicitly, what to believe and how to work” (Horgan, 1996, p. 43), citing a “coherent tradition of scientific research” (p. 11). Over time the term paradigm expanded to refer to collective world views, or collective agreements in general. Paradigm is a set of collective and/or individual beliefs and ideals, encompassing experience, morals, values, wisdom and knowledge. “Paradigm is a whole way of working, thinking, communicating and perceiving with the mind. It includes tacit

infrastructures which are mostly unconscious, pervading the work and thought of a community. Tacit infrastructures are unspoken basic assumptions” (A. First Rider, personal communication, Jan. 13, 2003). Paradigm echoes world view. Cajete states that:

A worldview is a set of assumptions and beliefs that form the basis of a people’s comprehension of the world. The stories, symbols, analogies, and metaphors that express a worldview in coded form are called mythology. Worldviews are conveyed via mythology in informal, formal, unconscious and conscious ways through family, community, art, media, economic, spiritual, governmental and educational institutions. (Cajete, 2000, p. 62)

There are many kinds of paradigms: Christian, Native American, scientific and so on. Western scientific paradigm has been defined by the methodology of the scientific method and: “Most scientists never question the paradigm. They solve puzzles, problems whose solutions reinforce and extend the scope of the paradigm rather than challenge it”(Horgan, 1996, p. 43). Western science is based upon observation, reductionism, rationalisation, mathematics and experimentation.

Because paradigms are structures of belief, paradigms are influenced by culture: “... philosophies are culturally relative, founded on the worldview of the culture from which they come and on which they are created to serve” (Cajete, 2000, p. 64). Native paradigm differs from Western paradigm because the culture of Native Americans differs from that of Western civilization.

Cajete contends that in Native culture:

Native people were interested in finding the proper, ethical, and moral paths upon which human beings should walk.... Native scientific philosophy reflects an inclusive and moral universe. No body of knowledge exists for its own sake outside the moral framework of understanding (Cajete, 2000, p. 76)

Native paradigm will be closely explored in greater detail at a later time, but what follows is a small synopsis of Native paradigm. In a lifelong effort to enlighten and articulate Native

paradigm, Dr. Leroy Little Bear and Professor Amethyst First Rider of the University of Lethbridge have identified the following concepts as integral to Native paradigm. These concepts are constant motion or flux, spirit/animate, interrelationship, trickster, sacred space/landscape, observer-created reality and renewal or, as Dr. Leroy Little Bear states: “Constant motion and flux, existence consisting of energy waves, interrelationships, all things being animate, space/place, renewal, and all things being imbued with spirit “ (as cited in Cajete, 2000, p. x). Although these concepts may be expressed by different Nations in their own terms, this is the foundation of Native American paradigm. Constant flux is the notion that all of creation is in constant motion or flux at all times. All of creation is imbued with spirit. Everything is alive. Interrelationship works on the premise that everything is connected, that all species rely on each other to sustain life. When one aspect is out of balance, it affects the whole. Trickster epitomizes chaos or the flux, the shapeshifter of change. Renewal is manifested through ceremony and is an integral part of Native America that maintains, sustains and influences life. Order is created through renewal ceremonies and thus we have observer-created reality, the belief that we create order from chaos. Integral to these concepts is the belief that “Natural democracy must prevail; Everything is related; All relationships have a natural history; Native science orients itself to a space and place; Everything has a time and an evolutionary path” (Cajete, 2000, p. 76). These concepts are transmitted through story, song and ceremony in order to maintain a continuous balance and harmony in all relationships.

The difference between Native science and Western science and how science is defined, practised, and applied is dependent upon the foundational collective agreements of Native paradigm and Western paradigm. Cajete suggests that:

Indigenous consciousness defines itself in the experience of personality, the ego as agent, separate and simultaneously connected and previous to other egos, to

the land, the seasonal cycles, to spirit, the world of transcendence, dreams and ancestry. Therein lies the difference between Western and Indigenous paradigms. The issue is a matter of perspective. Indigenous consciousness has always included, along with the practical relationships of the natural world, aspects such as the direct relationship of communities of people with the spirit of the place in which they have lived and the places they have come to know and understand. (Cajete, 2000, p. 78)

The inherent danger of any particular paradigm is the inability to extend beyond the limits of that paradigm and explore other options. Because Western paradigm is the prevailing dominant paradigm, and because Native paradigm includes aspects that are incompatible with Western science, Native science as a discipline has been largely ignored, as has most of the expertise of Indigenous cultures. This is reiterated by Cajete:

In the past five hundred years of contact with Western culture, Native traditions have been viewed and expressed largely through the lens of Western thought, language, and perception. The Western lens reflects all other cultural traditions through filters of the modern view of the world. Yet, in order to understand Native cultures one must be able to see through their lenses and hear their stories in their voice and through their experience. (Cajete, 2000, p. 4)

Western science paradigm and Native science paradigm are incompatible, for there are aspects that Western science embraces that Native science does not ascribe to, and vice versa. However, new theories in quantum physics are challenging Western scientific paradigms. "Theoretical physicists F. David Peat and David Bohm have proposed an alternative view of science, a view that is based on the realities quantum physics implies and that is inclusive of the central views of Native Science" (Cajete, 2000, p. 79).

This thesis is an exploration of the paradigms of Western science, Native science and quantum physics. It includes the foundations of these paradigms, describes the application of their science, and examines the similarities and differences among these paradigms. And as we shall see, because belief and culture structure paradigm, language has a profound impact on paradigm.

Language

A Story

According to Nalungiaq, an Inuit woman interviewed by ethnologist Knud Rasmussen early in the twentieth century:

*In the very earliest time
when both people and animals lived on earth,
a person could become a animal if he wanted to
and an animal could become a human being.
Sometimes they were people
and sometimes animals
and there was no difference.
All spoke the same language.
That was the time when words were like magic.
The human mind had mysterious powers.
A word spoken by chance might have strange consequences.
It would suddenly come alive
and what people wanted to happen could happen –
all you had to do was say it.
Nobody could explain this:
That's the way it was. (Abram, 1998, p.87)*

If one is to investigate the paradigm of science, one must investigate language to establish the role it plays in influencing the lens through which science is viewed. Language is the reference point of paradigm as stated by Leanne Hinton, professor and chair of the Department of Linguistics at the University of California:

Leanne Hinton, an expert on California Indian languages, points out that “our language does not limit us to certain viewpoints, but it does guide us strongly along particular mental pathways. And from this perspective, languages are far more than words and arbitrary rules of grammar – they are windows to whole systems of beliefs and values.”(Begay & Maryboy, 1998, p. 182)

Language is the means by which humanity communicates. Gary Witherspoon describes language as an encoding process. “Language is, among other things, a symbolic code by which messages are transmitted and understood, by which information is encoded and classified, and through which events are announced and interpreted” (Begay & Maryboy, 1998, p. 153). Language

reflects the paradigm of the speaker. While the early Greeks assumed that: “a line of thought expressed in any language could be translated without loss of meaning into any other language” (S. Chase as cited in Whorf, 1956, p. vii), Native science and Western science paradigms have different notions of reality which are linguistically evident. David Peat, author and physicist observes that:

When we enter the world of Indigenous American languages . . . we encounter profoundly different concepts and worldviews. Indeed, not only are the concepts enfolded within the languages radically different, but even the meaning of language itself and the function of the sounds people make is profoundly different. Language, so traditional Indigenous people say, is the door into their world. (Peat, 2002, pp. 222-223).

Benjamin Lee Whorf initiated one of the first scholarly studies of Native American languages. His findings were published posthumously in a compilation of essays called *Language, Thought and Reality* published in 1956. Whorf explores such Indigenous languages as Hopi, Nootka, and Cheyenne. He concluded that culture influences language: “...all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar, or can in some way be calibrated” (Whorf, 1956, p. 214). Whorf calls this the:

“linguistic relativity principle,” which means, in informal terms, that users of markedly different grammars are pointed by their grammars toward different types of observations and different evaluations of externally similar acts of observation, and hence are not equivalent as observers but must arrive at somewhat different views of the world. (Whorf, 1956, p. 221)

In other words, language reflects the culture and that culture may have different conclusions about how reality operates. Gary Witherspoon, linguist, elaborates:

...Witherspoon elaborates, “like language, culture is a symbolic code through which messages are transmitted and interpreted. But, more than a code, culture is a set of conceptions and orientations to the world, embodied in symbols and

symbolic forms. Through the adoptions of and adherence to particular concepts of and orientations to reality, human beings actually create the worlds within which they live, think, speak, and act. (Begay & Maryboy, 1998, p. 154)

Whorf's linguistic relativity principle is demonstrated in the way that Hopi people view time and space. "Concepts of 'time' and 'matter' are not given in substantially the same form by experience to all men but depend upon the nature of the language or languages through the use of which they have been developed" (Whorf, 1956, p.158). Whorf discovered that, for the Hopi, space and time were interrelational. Newtonian time disappears and space is altered so that "it is no longer the homogenous and instantaneous timeless space of our supposed intuition or of classical Newtonian mechanics" (Whorf, 1956, p. 58). For example, as opposed to three notions of time—past, present and future—Hopi time operates out of the manifested and/or the manifesting. The Hopi live in a state of being where time and space are fused, not fragmented. The manifested, also referred to as the objective, includes the past and the present synonymously, all that is known without differentiation. The manifesting, or the subjective, includes future events, the mind, the heart and all of creation. At the risk of breaking academic etiquette, what follows is Whorf's own explanation of manifesting:

The subjective or manifesting, comprises all that we call the future, BUT NOT MERELY THIS; it includes equally and indistinguishably all that we call mental-everything that appears or exists in the mind, or, as the Hopi would prefer to say, in the HEART, not only in the heart of man, but in the heart of animals, plants, and things, and behind and within all the forms and appearances of nature in the heart of nature, and by an implication and extension which has been felt by more than one anthropologist, yet would hardly ever be spoken of by a Hopi himself, so charged is the idea with religious and magical awareness, in the very heart of the Cosmos, itself. The subjective realm (subjective from our viewpoint but intensely real and quivering with life, power, and potency to the Hopi) embraces not only our FUTURE, much of which the Hopi regards as more or less predestined in essence if not in exact form, but also all mentality, intellection, and emotion, the essence and typical form of which is the striving of purposeful desire, intelligent in character, toward manifestation—a manifestation which is much resisted and delayed, but in some form or other is inevitable. It is the realm of expectancy, of desire and purpose, of vitalizing life, of efficient causes, of thought thinking itself out from an inner realm (the Hopi HEART) into

manifestation. It is in a dynamic state, yet not a state of motion—it is not advancing toward us out of a future, but ALREADY WITH US in vital and mental form, and its dynamism is at work in the field of eventuating or manifesting, i.e. evolving without motion from the subjective by degrees to a result which is the objective. (1956, pp. 59-60)

The manifested and the manifesting flow through inception. The inceptive is the emerging idea of the manifested—the process of experience, of doing so. The notion of the expective is the idea manifesting, emerged and completed. The manifesting turns into the manifested and this cycle is repeated over and over and is: “in some form or other ... inevitable” (Whorf, 1956, p. 60). It is circular as opposed to linear. The subtlety here is that past, present and the future as we know it, are one. One moves in space between that which is known and that which is unknown, but what is done this day (inceptive), and all the days before, influences the unknown or the future (expective). “And with each exhalation, the universe is given new life. This is how we create the future: what we choose to live in each and every moment, and we are presentness: we exhale in the next and we are futureness” (Rael, 1993, p. 49). In this circular spatial reality, as proposed by Whorf and reiterated by Rael, the future comes to you from behind. Begay and Maryboy also point out that:

Whorf compared the western metaphysical realms of time and space with that of the Hopi cosmic form, for which he employed the terms “manifested” and “manifesting (or unmanifest)”, which he causally equated further as “objective” and “subjective.” ... Bitsisiléi refers to that which precedes, which goes before, which forms the foundations of the present, or as Whorf might say, that which has been prepared for the way it is now manifesting ...“you are your own past.” (Begay & Maryboy, 1998, pp. 171-172).

This concept of past actions moving into future reality requires attention to every action in the present. Focus upon the present moment is of utmost importance, as Peat observes:

... in a society that uses time as a circle, there is never that sense of separation, nor is there a need to keep control over the world through scientific prediction. To use the example of the Hopi world view, future events exist within the realm

of the manifesting, that realm of subjectivity that includes the mental, as well. Thus, prediction would not so much mean the ability to see into the future from the past, but rather a concern with that edge of manifesting where things pass from one world into another. (Peat, 2002, p. 253)

This circular notion of time demands a continual responsibility for actions today (the inceptive) to ensure that tomorrow (the expective or emerging) manifests what is desired. This process is further developed through the idea of renewal or ceremony. “Renewal is about relationships” (A. First Rider, personal communication, October 17, 2002). These relationships extend to the infinite and are “contracts” between humanity and the cosmos. Renewal is the pivotal point (inceptive), which influences possibility (expective), or as one would say in quantum physics, probability. This idea of influencing probability through renewal process is a reality that is shared by the majority of Native American Nations.

The idea of probability or potential is alive in the language of Native America. Comologist Nancy Maryboy believes that:

The movement, the process is embedded in the language. It is, what I might say, verbocentric. Everything in the universe is in constant motion. It has been said that the Navajo language has more than 200,000 ways to say “go”. Much in the Navajo language is full of potentiality, that which can be. It only when it is translated into English that the potentiality is left behind. (Maryboy, 2003, pp. 37-38)

Indigenous language is predominantly verb-based, as opposed to the dominant use of nouns in Western language: “English, and for that matter French, German, Italian, and the other European languages are noun orientated. They are employed to divide the world into physical objects (nouns), and thinking into separate concepts (nouns). Many Native American languages do not work this way. They are verb-based.” (Peat, 2002, p. 128). Joseph Rael, Tiwa, Picuris elder reiterates this fact: “The Tiwa language has no nouns or pronouns, so at Picuris things don’t exist

as concrete, distinct objects. Everything is in motion and seen in its relationship to the other motions” (Rael, 2002, pp. 127-128). Further documentation is provided by Begay and Maryboy:

Navajo language needs to be explored more in terms of relationships, rather than through static nouns and permanency. Like almost all other Native American languages, it is a language of verb, process and motion. In the Navajo language, nouns are often constructed from verbs, in direct opposition as to how verbs are often constructed from nouns in English. For example, one can put *igii* or *ii* on the end of a Navajo verb and it will become a noun. Contrast this to the English present participle where one can put *-ing* on the end of a verb and it becomes a noun. Navajo ceremonial names are generally translated as nouns, but a more accurate translation by traditional people reveals them to be words of action and interaction expressing continuous movement and transformation. (Begay & Maryboy, 1998, pp. 157 - 158)

If you think predominantly within the notions of movement and process, as reflected in Native languages, then the outcome of your reality will be different and relationship then becomes the methodology for navigating the world. “Maybe if you dropped the nouns and the pronouns in the English language and just used verbs you’d begin to see the world the way the Tiwa-speaking see it—a flow, with everything in motion and in relationship to everything else” (Rael, 2002, p. 128).

Through language the natural world is seen as vibration. Rael states that:

It’s a language based on the resonating vibration of the land and what comes out of the land, like the trees, like the river. The river is named after the sound that the river makes. Wood is named after the sound that wood makes. The words used for walking, or for land, or for tree, are all based on the way things sound” (Rael, 2002, p. 160).

Dr. Leroy Little Bear from the University of Lethbridge, and member of The Blackfoot Confederacy, explains that Blackfoot language operates as a combination of sounds. Picture a “periodic table” of sounds. A good Blackfoot speaker can be identified through his/her skill in combining these sounds. Western language operates on the rules of subject-verb-object, and each object has its own definition or identity. Therefore, one must carry in his/her head “many

definitions, whereas in the Blackfoot language one only needs to carry the periodic table” (L. Little Bear, personal communication, September 2001). In Blackfoot language each sound carries its own vibration, which is considered to be in tune with the movement of the universe and holistic in nature just as previously mentioned in reference to the properties of Navajo language. Sa’ke’j Youngblood Henderson, professor and research director of the Native Law Centre of Canada at the College of Law, University of Saskatchewan, Canada, relates his experience of translating English from his Native language, MicMaq. Documented by David Peat, in his book *Blackfoot Physics*, Peat writes:

English, Sa’ke’j says, is a language for the eye, while an Algonquian language is a language for the ear. When he has to speak English instead of MicMaq, Sa’ke’j feels he is being forced to interact with the world of objects, things, rigid boundaries, and categories in place of the more familiar world of flows, processes, activities, transformations, and energies. For Sa’ke’j, the MicMaq language is in itself a world of sounds that echoes and reflects the vibrations of the physical world. While the surface world of objects and material things can easily be identified by the eye, it is the ear that must deal with the more subtle levels of flux, transformation, and reality behind appearances. The English language, in his opinion, does little more than mimic what the eye can do far better by giving emphasis to names and objects, while the Algonquian family of languages complements the eye’s abilities by addressing a world of sounds and energies. (Peat, 2002, pp. 231-232)

Movement and rhythm coincide with the natural movement of the cosmos, but moving from a predominantly verb-based language to a noun-based language causes problems in interpretation.

Meaning, essence and understanding are lost, as further documented by Peat:

When I speak with Leroy Little Bear or Sa’ke’j Henderson, I sense their struggle to find the right words in English for the sound vibrations within their own languages; for these sounds relate to a very different system of thought. As Sa’ke’j says, “Some mornings I wake up with my head full of rhythms and rhythms of rhythms and rhythms of rhythms of rhythms and to have to speak English is like having to put on a straight-jacket.” When I get into deep questions with Leroy, he will remark, “Well, in Blackfoot we say...” and produce a pattern of sound for me, or he may pause and say to himself, very softly as he tries to discover a way of putting the vibrations, and all that they convey, into the particular linguistic structure demanded by English. (Peat, 2002, pp. 222-223)

Language influences the notions of either relationship or objectification. Western noun-based language creates fragmentation, classification and objectification: “Objectification is part of the map of the English, German, or Spanish, but not of many Native American languages” (Rael, 2002, pp.129). Classification and objectification defy relationship, removing one from a relational network into a hierarchical domain. In a relational network there is an obligation to the whole. You are operating from an expanded reality that assumes a reciprocal relationship. “Native American languages, such as Navajo, have the ability to express complex and holistic ideas, but they go much further than that. In their very essence, they are themselves complex, polysynthetic and at the same time holistic, containing elements of process, relationship and wholeness in virtually every utterance” (Begay & Maryboy, 1998, p. 154). But in a hierarchical language you are removed from relationship.

Expand the notion of holistic linguistics into the field of science and you will see that Native science is holistic. This holism is a reflection of Whorf’s principle of relativity; while Native America speaks a paradigm of expansion, Western language isolates and fragments. Physicist David Bohm states that:

It is pointed out that the subject – verb – object structure of modern languages implies that all action arises in a separate subject, and acts either on a separate object, or else reflexively on itself. This pervasive structure leads in the whole of life to a function that divides the totality of existence into separate entities, which are considered to be essentially fixed and static in their nature. (Bohm, 1980, p. xii)

If one is operating from a hierarchical stance, then the subject’s responsibility to the object diminishes. If one is operating from a holistic stance, then responsibility increases. The

ramifications of this linguistic distinction heralds a fundamental split in how Native science and Western science are practised.

Taken one step further, we see that a relational network of fluid reality supercedes physical boundaries and includes an evolution of the heart from the visible to the invisible. This means that words/sound/vibration are alive and have their own power. That power manifests potential.

As Joseph Rael, Tiwa elder and linguist, states in his book *Being and Vibration*:

To me, Tiwa is the language of nature, words made from the audible sounds that occur moment by moment in the natural environment in each twenty-four-hour day... With each inhalation we identify our purpose to be alive, vibrations of the here and now, and our universe is created (Rael, 1993, p. 49).

Therefore: “Spoken words are constantly creating our universes because we are essences of perpetuity. Everything on the earth, since the beginning of time, has been and is being created by the sounds of words as they are spoken” (Rael, 1993, p. 161). In other words, you must always be aware of what you are saying or thinking—for, as Whorf proposed, you are manifesting your reality. It’s about a reciprocal relationship with universal vibration, since sound is a vibration that creates alliances with the natural flow of universal energy. Peat reminds us that:

Within Indigenous science, thoughts are inseparable from language. The language that is spoken is not simply a medium, or a vehicle for communication, rather it is a living thing, an actual physical power within the universe. The vibration of its words are energies that act within the transforming processes we call reality. (Peat, 2002, p. 224)

Each sound carries its own vibration, and those vibrations carry energies, and those energies have the potential to manifest into form. As Peat points out:

Within Indigenous science, to say something is to create an objective event and release a process of energetic vibration that enters into relationship with the other

powers and energies of nature. Thus, since every sound is an event of significance, a person must take responsibility for whatever he or she says. Language was created by the Ancestors as a direct connection to nature... (Peat, 2002, p. 226)

It is intention expressed through language that is the catalyst for the manifesting reality, the principle being that what you put out there (energy, inceptive) will return to you (energy, expective). Time and space in the sense of past, present and future are irrelevant, what matters is relationship in the moment. So, what works on a material, physical level also works on a universal, vibrational level, and these concepts are embedded in a language that embraces process, movement, respect and reciprocity.

Language can also reflect the documentation of environmental events or a change in landscape.

Peat relates that:

Sa'ke'j Henderson has explained how in MicMaq, the names of trees are the sounds that the wind makes as it moves through their leaves in the fall. The name of a tree is therefore far from arbitrary. It is based upon the direct experience of listening to a specific sound that refers to a particular tree – for each of the different species of trees makes a different sound. It is, moreover, a sound made at that time of the year when the leaves begin to dry, a sound specific to a particular area of Turtle Island as the salt-laden wind blows in from the Atlantic Ocean. Tree process, the manifestations of animating energies in a particular environment move to a different part of the world and the tree, in its deeper sense, is no longer the same.... The material manifestations of the process are all tied to the changing context of the actual landscape. (Peat, 2002, p. 226-227)

Professor Amethyst First Rider of the University of Lethbridge states: “there is no such thing as metaphor”(A. First Rider, personal communication, September, 2001) in Native American paradigm. A Western scientist would disagree with this assertion. For example, if I say: “I am part of the land,” it is not due to an ecological affinity with the land, rather, it is because the bones of my ancestors become the land, and the land includes all our stories, ceremony and history. This makes the land a part of me; the land is my relative. I am in direct relationship

with that land. It is my blood. Add the Blackfoot concept of time/space (same as manifested, manifesting) or, as Dr. Leroy Little Bear has stated in his lectures, “my ancestors are only two days away,” meaning that you have a direct and continuous relationship with that land because you can access your ancestors at any given time. Metaphor in the Western sense is not reality in Native American language. The land, you, the ancestors are all one reality. As David Abram, author of *The Spell of The Sensuous: Perception and Language In A More Than Human World* states:

there remain, on the edges and even in the midst of this ever-expanding monoculture, small-scale local cultures or communities where the traditional oral, indigenous modes of experience still prevail – cultures that have never fully transferred their sensory participation to the written word. They have not yet closed themselves within an exclusively human field of meanings, and so still dwell within a landscape that is alive, aware, and expressive. To such peoples, that which we term “language” remains as much a property of the animate landscape as of the humans who dwell and speak within that terrain. Indeed, the linguistic discourse of such cultures is commonly bound, in specific and palpable ways, to the expressive earth. (Abram, 1998, p.139)

Language is also the repository of historical events, often expressed in storytelling, which is often looked upon as myth or legend. Begay and Maryboy note that:

In the present American society, myth is seldom considered to be equal to science as an acceptable way of knowing. Thus western society, which largely lacks the cultural background to understand the significance of indigenous story and song, continually associates native myth with primitive paganistic fable. (Begay & Maryboy, 1998, p. 277)

Western civilization defines myths, legends and stories in a fictional context. Ever since colonization, Native American storytelling has been trivialized and treated as “tall tales” with little or no basis in fact or reality. The anthropological definition of myth is: “a sacred narrative believed to be true by the people who tell it” (Lehmann, 2001, p. 413), and the Merriam Webster Dictionary (1997) defines myth as: “Legendary narrative that presents part of the beliefs of a

people or explains a practice or natural phenomenon 2: an imaginary or unverifiable person or thing” (p. 489). Anthropology defines legend as: “A folkloric category that relates an important event popularly believed to have a historical basis though not verifiable” (Lehmann, 2001, p. 413). The Merriam Webster Dictionary (1997), defines legend as: “a story coming down from the past: one popularly accepted as historical though not verifiable” (p. 425). The common thread in these definitions is that myth, story and legend cannot be verified. Therefore, they are not true. For Native Americans, language documents history. Percy Bullchild, a member of the Blackfoot Confederacy, explains the importance of oral tradition in documenting history:

We Indians do not have written history like our white friends. Ours is handed down from generation to generation orally. In this way we have preserved our Indian history and our legends of the beginning of life. All history the Native learns by heart, and must pass it on to the little ones as they grow up. We Natives preserved our history in our minds and handed it down from generation to generation, from time unknown, orally. From the time human life began. (Bullchild, 1998, pp. 2-3)

Narcisse Blood, Kainai, of the Blackfoot Confederacy explains:

Oral history is often told in a ceremonial way, with the history of the people being related through songs, told in a particular sequence, reflecting their historical relationships. The words of songs remain the same, even over centuries of change. By encoding history in songs, the Nitsitapi (Blackfeet) remember their history from generation to generation. (Blood, 1993, p. 1)

Xaye t’an, a Tewa, explains in Beck and Walters, *The Sacred*, that songs are the “very essence of our lives: they are sacred...” (Graveline, 1998, p.62) Song, sound, vibration all define the collective agreement of the people—not as myth or metaphor, but as reality. Song has a longer life than paper, and it is a living entity. Accuracy in a song’s recital is mandatory, and ceremony reiterates and repeats this living history through the elders. Song is the collective agreement of the people; it solidifies landmarks of place and space, and it defines identity.

Whorf proposed that Hopi reality explains a lot that Western physics has yet to understand and maybe, just maybe, Western reality could learn a few things. “A change in language can transform our appreciation of the Cosmos” (Whorf, 1956, p.263). Several leading-edge thinkers in physics suggest that nature is not a collection of objects in interaction, but is a flux or series of processes. The whole notion of flux and process is fundamental to the Indigenous sciences of Turtle Island. Algonquian speaking people such as the Cheyenne, Cree, Ojibwaj, MicMaq and Blackfoot, all share a strongly verb-based family of languages that reflect this direct experience (Peat, 2002, p. 6-7). Dan Moonhawk Alford, one of the co-founders of S.E.E.D. University in Albuquerque, New Mexico, and a gifted linguist, studied Whorf extensively. Alford “highlights two of Whorf’s major insights in relation to the Hopi, ‘that the Hopi language was closer to the language of quantum reality than are Western languages,’ and ‘that their own native cultural physics passed down through the language was closer to quantum than Newtonian reality’” (Begay & Maryboy, 1998, p 164-165). This understanding of time and space is not exclusive to Hopi Nations as identified by Begay and Maryboy:

We found that many of Whorf’s understandings regarding the Hopi language could well be applied to Navajo language. . . . Subsequently, at the Fetzer Science Dialogues, we found that many Algonquin scholars (for example, Mi’kmaq, Blackfeet, Ojibwa) felt the same as we felt. (Begay & Maryboy, 1998, p. 160)

The ideas of a reality that is in constant motion, expressed verbally; of time and space open to probability and influenced by renewal; and of time that both is and is not, are all markers in Whorf’s “linguistic relativity principle” as it relates to Native American populations. Begay and Maryboy reiterate:

It is the “verby,” transformative processes and relationship-oriented qualities of native languages, the lack of emphasis on individual and separate western “nouns,” that makes them so conducive and appropriate to discussions of quantum concepts and relativity. We can provide one example using the Navajo language, related to Whorf’s discussion of Hopi language: “light flashing.” Whorf’s point is that, in the Hopi language, one does not need to mention the

noun in order to say, “a light is flashing.” In Hopi one just says, “flashing.” Similarly, in Navajo one can say *jilgish*, and mean “flashing,” in relation to lightning. No noun is necessary. *Adindiin*, in Navajo, means “lighting,” implying the light process is there and is also constantly moving toward you. Our point here is that at the quantum level, nouns are not particularized, nor necessary. It is the process that counts. The verb is very significant in this realm, as is the relationship between “non-things.” (Begay & Maryboy, 1998, p. 166)

The imposition of Western paradigm through the concerted effort to conform all nations to its dialect has come at a cost. Many Native languages are on the verge of extinction. Even Westerners have lost the meaning of their own scientific language. “What we call “scientific thought” is a specialization of the Western Indo-European type of language, which had developed not only a set of different dialectics, but actually a set of different dialects. THESE DIALECTS ARE NOW BECOMING MUTUALLY UNINTELLIGIBLE” (Whorf, 1956, p. 246). This may have cost Western society the wisdom of ancient knowledge—a knowledge that holds unparalleled gifts and even a loss of credibility. Whorf cautions that:

We all know now that the forces studied by physics, chemistry, and biology are powerful and important. People generally do not yet know that the forces studied by linguistics are powerful and important, that its principles control every sort of agreement and understanding among human beings, and that sooner or later it will have to sit as judge while the other sciences bring their results to its court to inquire what they mean. (Whorf, 1956, p.232)

If, in truth, Western science has backed itself into a linguistic corner, with the result being an fragmented understanding of reality; then alternative paradigms must be explored so that we are not the products of a one dimensional reality, based upon one worldview. Valerie Gremillion, complex systems scientist, and Albuquerque dialogue participant explains that:

This is important, because we are missing the very ability to use language as an implement of reasoning in the tool-use sense of the word. You can see that by the actions we are taking. We’re not making good choices. In other words, the tools we are using are not appropriate for the task, and it’s time for us to now expand our tool kit to include and acknowledge the contributions of all the other

languages on this planet. Science needs to understand that its language is stifling its thinking, and especially, I would say, for women, who are wanting to convey through language things that are more non-linear, more inter-relational, more interactive and far larger in scope than a tiny aperture. (Gremillion, Dialogues, 2003, p. 26)

Native American language may hold the key to another way of being; it may offer crucial insights into the quantum world, and perhaps even open the door to that elusive paradigm shift. Physicist David Bohm suggests an alternative, the creation of a language that embraces aspects of Native American language. He suggests an emphasis on verb-based communication. "Such forms will have as their content a series of actions that flow and merge into each other, without sharp separations or breaks. Thus, both in form and in content, the language will be in harmony with the unbroken, flowing movement of existence as a whole." (Bohm, 1980, p. xii). Bohm goes on to identify this language as "...The rheomode (flowing mode), a new mode of using the existing language...intended mainly to get insights into the fragmentary function of the common language rather than to provide a new way of speaking that can be used for practical communication" (Bohm, 1980, p. xii). It is the scholars that are leading the way into a new way of looking at the world. It is also the elders, whose wisdom and knowledge of language are being validated by the scholars. Begay and Maryboy explain the importance of preserving indigenous languages:

Today languages can borrow and reinforce one another in the development of intellectual, technological and spiritual language. For these reasons the world should work for the preservation of indigenous languages, in order to retain the incredible linguistic diversity that complements our biodiversity. (Begay & Maryboy, 1998, p. 182)

The next step to congruency in scientific venues is the inception of Native American scientists. "Perceptual and language barriers bring to light the need, not only to train Aboriginal researchers in Western methods, but to train Western researchers in Aboriginal approaches to understanding the environment and the holistic rather than compartmentalized ways of defining the universe"

(Freeman, 1992, p. 25). Only then will we see the first steps to a paradigm shift because humanity will speak a common language, based on holistic principles, incorporating the best of Western science and finally validating what has been known to Native America all along. Cajete observes that:

The cosmology of the Hopi is as valid and internally consistent as that of Western science.... We are the universe and the universe is us; Evolution is a continuum of creative becoming; We are the Earth being conscious of itself; Humans are but one manifestation of an implicate universal order.... "we are all related"; We continue to engender and cultivate reverence for life; we revere all living things, taking responsibility for our relationship to the Earth. (Cajete, 2000, pp. 60 - 61)

And so I end with a story that was shared with Western physicists and Native American elders at the Albuquerque dialogues, and which also illustrates this most important aspect of Native American language—it is our language to tell a story....

My grandfather was a weaver. He made moccasins, he made bows and arrows, you know, all of the old things, because this was a shaman, a medicine man. He was a beautiful spirit. One day in the living room he was putting together a warp to begin a belt. And again, my mouth took off. Finally, he quietly put the warp and the yarn down and he looked at me. And I knew that look. And I got quiet. He said, "You know, you can learn more by listening." He picked up his warp and kept on. And I wondered, "What does that mean?" I spent a lot of years trying to understand that message, then realized much later the effect that it would have on my life. (Borbon, Dialogues, 2003, p. 164)

Chapter Three – The Newtonian Science Paradigm

A Story

One evening an old Cherokee told his grandson about a battle that was going on inside himself.

He said, "My son, it is between two wolves. One is evil: Anger, envy, sorrow, regret, greed, arrogance, self-pity, guilt, resentment, inferiority, lies, false pride, superiority and ego.

The other is good: Joy, peace, love, hope, serenity, humility, kindness, benevolence, empathy, generosity, truth, compassion and faith."

The grandson thought about it for a minute and then asked his grandfather, "Which wolf wins?"

The old Cherokee simply replied, "The one I feed."

(A. Proznick, personal communication, October 19, 2004).

To articulate the paradigm of Western science one must first consider the historical progression of events to identify how certain ideas came to be because: "...much of what Western scientists do flows from their particular paradigms, world views, and belief systems" (Peat, 2002, p. 100).

Those worldviews are formed by time and influenced by language and culture, as previously stated. Science includes the categories of mathematics, physics, astronomy, chemistry and earth sciences. It is not the intention here to focus upon these disciplines, or even individual scientists, rather the interest is in documenting the progression of scientific query to identify key concepts that contributed to the development of the Western scientific paradigm.

Albert Einstein ventured to say: "God does not play dice with the universe. He may be subtle, but he is not malicious" (Heartmath). In 1922, Albert Einstein won the Nobel Peace Prize in Physics for his discovery that light could be both a wave and a particle at the same time, by using one of Max Planck's theories to explain the phenomenon of photoelectric effect. In doing so, Einstein had inadvertently furthered the cause of quantum physics. Quantum mechanics was to challenge the laws of Newtonian physics, laws that had been in operation for over two centuries.

Unfortunately, Einstein could not accept the unpredictability inherent in the mysterious world of quantum physics, and he never fully embraced or considered its possibilities. He believed in a grand unified theory and that, given enough time, all the mysteries of the universe could be revealed through scientific exploration. Einstein believed that

Everything is determined, the beginning as well as the end, by forces over which we have no control. It is determined for insects as well as for the stars. Human beings, vegetables or cosmic dust, we all dance to a mysterious tune, intoned in the distance" (Heartsmath).

After his stunning success in the 1920s with the Theory of Relativity (for which he did not receive the Nobel Peace Prize), Einstein dedicated the rest of his life in a vain attempt to unite the forces of gravity and electromagnetism to prove a grand unifying theory. It is ironic that Einstein could not accept the slippery paradoxical world of quantum physics, yet contributed to its inception. Was Einstein's quest for the Theory of Everything bound by the parameters of his own scientific paradigm to such a degree that he was blinded to new ideas? And where, in fact, did Einstein's scientific paradigm originate?

The first recorded venture into what we now call "scientific thought" is attributed to Thales of Miletus, Turkey, in about 585 BC. He introduced the notion that nature should be explored as a phenomenon unto itself, challenging the belief that nature was solely controlled by outside force. Thales introduced the idea that everything was composed of water, accurately predicted a solar eclipse, and introduced geometry as a means of validating his theories. He is also credited with the inception of physics, astronomy, and philosophy. Anaximander, a pupil of Thales, introduced the notion that the universe had depth, proposing a cylindrical universe in which the stars were rings of fire as opposed to living gods. It was this questioning of natural phenomena that began scientific dialogue and introduced mathematical constructs as a tool for accessing knowledge.

This was the first departure from the belief that the magic of nature was at the mercy of an arbitrary God.

Around 550 BC, Pythagoras, a student of Socrates, undertook experiments that explored the relationship between mathematics and music. His academy, the Order of the Pythagoreans (the first “university”), focused on the study of mathematics and the physical world. His belief was that everything was related to mathematics. He proposed a spherical universe as opposed to a flat earth or Anaximander’s proposition of a cylindrical earth. In 470 BC, Anaxagoras proposed that matter is made of “seeds” and that the cosmos and the earth were composed of the same material. Democritus took these notions one step further and suggested that infinite space and matter were made up of atoms that could combine or disintegrate, given their shape, and could be distinguished by taste. His theory reduced everything in existence to atoms. There was no grand design or God. Everything was atoms. This is determinism in its purest form. Gary Zukav, author of *The dancing Wu Li Masters* explains that:

Ordinary determinism states that once the initial situation of a system is established, the future of the system is also established since it must develop according to inexorable laws of cause and effect... According to superdeterminism, not even the initial situation of the universe could be changed. Not only is it impossible for things to be other than they are, it is even impossible that the initial situation of the universe could have been other than what it was. No matter what we are doing at any given moment, it is the only thing that ever is possible for us to be doing at that moment (Zukav, 1979, p. 300).

Plato emphasized reason and a logical approach to science. He believed in a benevolent creator who worked for the people he created in his own image, thereby influencing the later ideas of Christianity’s theologians. He believed that the world had a soul and was alive; it was wrapped in “aether” which he identified as a fifth element. He emphasized reason in the study of science.

In 335 BC, Aristotle, a student of Plato, founded the lyceum (university) in Athens, emphasizing the study of the world and defining science as its own discipline. He created a science department and was famous for practising methods of detailed observation and dissection, documenting 500 species of animals, fish and insects. He is credited with refining and developing the scientific method based upon observation, reason and documentation. His investigative approach to a problem, systematic work and logical argument contributed to the foundation of detailed empirical investigation. (Some give this credit to Ptolemy because he verified his assertions mathematically). This empirical approach to science gave Aristotle an authority that would remain unchallenged, even by the church, for several hundred years. Fritof Capra, author of *The Turning Point* states:

The scientific framework of this organic world view rested on two authorities – Aristotle and the church. In the 13th century Thomas Aquinas combined Aristotle's comprehensive system of nature with Christian theology and ethics and, in doing so, established the conceptual framework that remained unquestioned throughout the middle ages. The nature of medieval science was very different from that of contemporary science. It was based on both reason and faith and its main goal was to understand the meaning and significance of things, rather than prediction and control. (Capra, 1982, p. 53)

Despite all previous observations of the cosmos, up until this time it was believed, that the universe operated as a geocentric universe, meaning that the planets revolved around the earth. In 1543, after 1000 years of belief in a geocentric universe, Copernicus introduced the notion of a heliocentric (sun-centred) universe. "The scientific revolution began with Nicholas Copernicus, who overthrew the geocentric view of Ptolemy and the Bible that had been accepted dogma for more than a thousand years. ... And man was robbed of his proud position as the central figure of God's creation" (Capra, 1982, p. 54).

Luckily for Copernicus, the church did not see his assertions as a threat until Galileo proposed these same theories and backed them up with empirical evidence. “Galileo was the first to combine scientific experimentation with the use of mathematical language to formulate the laws of nature he discovered, and is therefore considered the father of modern science” (Capra, 1982, p. 55). His use of a telescope, invented by Lippershay, and which he modified, introduced scientific instruments as an aid to scientific discovery. “Directing the newly invented telescope to the skies and applying his extraordinary gifts for scientific observation to celestial phenomena, Galileo was able to discredit the old cosmology beyond any doubt and to establish the Copernician hypothesis as a valid scientific theory” (Capra, 1982, p. 54). He was threatened with imprisonment for religious heresy (the church still believed in a geocentric universe), and was forced to renounce his heliocentric view of the earth. He remained under house arrest for the rest of his life.

Francis Bacon believed in the separation of spirit and matter. Bacon’s conjecture was that nature was a slave to be conquered and controlled. “The terms in which Bacon advocated his new empirical method of investigation were not only passionate but often outright vicious. Nature, in his view, had to be “hounded in her wanderings,” “bound into service,” and made a “slave.” She was to be “put in constraint,” and the aim of the scientist was to “torture nature’s secrets from her” (Capra, 1982, p. 56). This attitude may have been influenced by the witch trials that were happening at that time and a view of nature as female. “...His view of nature as a female whose secrets had to be tortured from her with the help of mechanical devices is strongly suggestive of the widespread torture of women in the witch trials of the early 17th century” (Capra, 1982, p. 56). Bacon’s premise of power over nature (the feminine) encouraged a paternalistic attitude that infiltrated society and became the norm. “Bacon’s work thus represents an outstanding example

of the influence of patriarchal attitudes on scientific thought” (Capra, 1982, p. 56). Bacon criticized Aristotle’s method of deduction and argued for an inductive approach:

Francis Bacon was the first to formulate a clear theory of the inductive procedure – to make experiments and to draw general conclusions from them, to be tested in further experiments – and he became extremely influential by vigorously advocating the new method. He boldly attacked traditional schools of thought and developed a veritable passion for scientific experimentation (Capra, 1982, p. 55).

Descartes is known as a philosopher and mathematician. His focus was to plot a single point in space, which led him to the development of the Cartesian co-ordinates system (a combination of algebra and geometry). “The Cartesian view of the universe as a mechanical system provided a “scientific” sanction for the manipulation and exploitation of nature that has become typical of Western culture” (Capra, 1982, p. 61).

This hierarchical premise of supremacy over nature, mathematically sanctioned, allowed scientists to “treat matter as dead and completely separate from themselves and to see the material world as a multitude of different objects assembled into a huge machine” (Capra, 2000, p.22). God was seen as the ultimate ruler of man, and man became the ruler of nature, a nature that was to be viewed with a critical eye as one would view a specimen under a microscope. Capra explains:

To Descartes, the material universe was a machine and nothing but a machine. There was no purpose, life, or spirituality in matter. Nature worked according to mechanical laws, and everything in the material world could be explained in terms of the arrangement and movement of its parts. This mechanical picture of nature became the dominant paradigm of science in the period following Descartes. It guided all scientific observation and the formulation of all theories of natural phenomena until twentieth-century physics brought about a radical change. ...Descartes gave scientific thought its general framework – the view of nature as a perfect machine, governed by exact mathematical laws. (Capra, 1982, p. 60)

These notions are reminiscent of Democritus, the early Greek scholar who reduced reality to the subatomic world, nothing more, nothing less. Descartes believed that: “All science is certain, evident knowledge, he wrote. We reject all knowledge which is merely probable and judge that only those things should be believed which are perfectly known and about which there can be no doubts” (Capra, 1982, p. 57). This assertion of Descartes, that truth exists only as scientifically proven was based upon the cumulative knowledge of his predecessors and became the cornerstone of Western society and its ideals. Capra states that:

Between 1500 and 1700 there was a dramatic shift in the way people pictured the world and in their whole way of thinking. The new mentality and the new perception of the cosmos gave our Western civilization the features that are characteristic of the modern era. They became the basis of the paradigm that has dominated our culture for the past 300 years and is now about to change (Capra, 1982, p. 53).

This shift in thinking was fortunate for the field of classical physics, but unfortunate for holistic-based cultures whose expertise was diminished by the dominant paradigm developed by Western society.

The pivotal point in history at which rational thought, measurement and categorization were defined as the only means of gaining knowledge of the natural world was achieved through the work of Sir Isaac Newton. Capra reports that:

The man who realized the Cartesian dream and completed the scientific revolution was Isaac Newton, born in England in 1642, the year of Galileo’s death. Newton developed a complete mathematical formulation of the mechanistic view of nature, and thus accomplished a great synthesis of the work of Copernicus and Kepler, Bacon, Galileo, and Descartes. Newtonian physics, the crowning achievement of the 17th-century science, provided a consistent mathematical theory of the world that remained the solid foundation of scientific thought well into the 20th century. (Capra, 1982, p. 63)

Newton introduced differential calculus, which eventually led Newton to propose the laws of motion. Capra refers to Newton as the father of differential calculus:

He invented a completely new method, known today as differential calculus, to describe the motion of solid bodies; a method that went far beyond the mathematical techniques of Galileo and Descartes. This tremendous intellectual achievement has been praised by Einstein as “perhaps the greatest advance in thought that a single individual was ever privileged to make.” Kepler had derived empirical laws of planetary motion by studying astronomical tables and Galileo had performed ingenious experiments to discover the laws of falling bodies. Newton combined those two discoveries by formulating the general laws of motion governing all objects in the solar system, from stones to planets. (Capra, 1982, p. 63)

Newton believed that small solids made up all matter, space was immovable, and that time was absolute and could never be altered from its uniform course of past, present and future. Every effect had a cause that could be proved, and nature could only be described from an objective point of view. Only God was immune from scrutiny. God created the laws and they could not be altered, nor were they subject to analysis. In Capra’s words:

In the Newtonian view, God created in the beginning the material particles, the forces between them, and the fundamental laws of motion. In this way, the whole universe was set in motion, and it has continued to run ever since, like a machine governed by immutable laws. The mechanistic view of nature is thus closely related to a rigorous determinism, with the giant cosmic machine completely causal and determinate. All that happened had a definite cause and gave rise to a definite effect, and the future of any part of the system could – in principle – be predicted with absolute certainty if its state at any time was well known in all the details. This picture of a perfect world-machine implied an external creator; a monarchical god who ruled the world from above by imposing his Divine Law on it. The physical phenomena themselves were not thought to be divine in any sense, and when science made it more and more difficult to believe in such a god, the divine disappeared completely from the scientific world view, leaving behind the spiritual vacuum that has become characteristic of the mainstream of our culture. The philosophical basis of this secularization of nature was the Cartesian division between spirit and matter. (Capra, 1982, p. 66)

The idea of the world as a machine, and science as the definitive means to access the secrets of nature flourished in the 16th and 17th centuries. “The medieval outlook changed radically in the

16th and 17th centuries. The notion of an organic, living and spiritual universe was replaced by that of the world as a machine, and the world machine became the dominant metaphor of the modern era” (Capra, 1982, p. 54). Western scientific paradigm solidified into an enduring standard that remains to this day. It was even believed at one time that there was not much more left to discover.

In the middle 1800s, Newtonian mechanics was at its zenith. There seemed to be no phenomena which could not be explained in terms of mechanical models. All mechanical models were subject to long-established principles. The chairman of the Physics Department at Harvard discouraged graduate studies because so few important matters remained unsolved. (Zukav, 1979, p. 311)

Science as we know it today is considered truth. The results are recorded through: “textbooks, scientific papers, lectures and student apprenticeships” (Peat, 2002, p. 250), further validating that notion of truth. It was the early Greeks who introduced the concepts of scientific thought, mathematics, experiment, observation, documentation and determinism, but it was Newton and company who solidified the notions of absolute observation and reason. “The Great Machine is impersonal. In fact, it was precisely this impersonality that inspired scientists to strive for “absolute objectivity” (Zukav, 1979, p. 30). The authority of science has led us to believe that nature can indeed be controlled and manipulated into submission. Zukav reiterates:

According to this view, nature, in all her diversity, is ‘out there.’ The task of the scientist is to observe the ‘out there’ as objectively as possible. The premise behind observation is that “the world should be described objectively without any relationship between the observer and the observed. These observations were then measured and validated mathematically. To observe something objectively means to see it as it would appear to an observer who has no prejudices about what he observes. (Zukav, 1979, p. 30)

According to David Peat, author of *Black foot Physics*, the foundations of Western scientific paradigm, such as experiment and objectification, have illuminated technology, but Peat argues that experiment is based upon an artificial premise that has led to self-fulfilling outcomes, and

that objectification has removed us from the essence of nature. Absolute objectivity presumes that one can divorce oneself from observation, and also presumes that there can be no influence by the observer in that observation. Zukav states:

The old physics assumes that there is an external world that exists apart from us. It further assumes that we can observe, measure and speculate about the external world without changing it. According to the old physics, the external world is indifferent to us and to our needs. (Zukav, 1979, p. 29)

The new physics is proving that this is not so and the foundational framework built by Newton and his predecessors is crumbling. If this is so, then the outcome of any experiment can only be as good as the person conducting that experiment. And if that person is looking for a certain result, then perhaps that is what they are getting. “The problem that went unnoticed for three centuries is that a person who carries such an attitude certainly is prejudiced. His prejudice is to be “objective,”... They affect his perceptions of reality...” (Zukav, 1979, p. 30).

Any anomaly taken out of context can only bear witness to itself, but even Western scientists such as Bohm and Suzuki are questioning the wisdom of the minimal engagement of holistic thought. “The foundations of experimentation, objectification and rationalization, and their by-products of fragmentation and isolation, have contributed to a bits-and-pieces society that is divorced from itself and the effects of its actions. “... almost the whole weight of science was put behind the fragmentary approach to reality” (Bohm, 1980, p. 9). There is no doubt that science has benefited humanity, however, fragmentation has also handicapped humanity. “Such a mode of thought implies unending development of chaotic and meaningless conflict, in which the energies of all tend to be lost by movements that are antagonistic or else at cross purposes” (Bohm, 1980, p. 16). Bohm further suggests that:

Fragmentation is now very widespread, not only throughout society, but also in each individual; and this is leading to a kind of general confusion of the mind, which creates an endless series of problems and interferes with our clarity of perception so seriously as to prevent us from being able to solve most of them. Thus arts, science, technology, and human work in general are divided up into specialties. (Bohm, 1980, p. 1)

The apathy of an exhausted, instant gratification, consumer-driven population has seduced humanity into a sweet dream of compliance in its own demise. Suzuki and McConnell, authors of *The Sacred Balance: Rediscovering Our Place in Nature* agree with the assertions of Bohm:

Scientists focus on arts of nature, attempting to isolate each fragment and control the factors impinging on it. The observations and measurements they make provide a profound understanding of that bit of nature. But what is ultimately acquired is a fractured mosaic of disconnected bits and pieces, whose parts will never add up to coherent narrative. (Suzuki and McConnell, 2002, p. 15)

This fragmented approach has consequences. One only has to look at global warming, the by-product of technology run rampant. Science and technology are Gods; the Gods that will deliver to humanity all the problems that a fragmented approach to nature has created. This fragmentation has also allowed society to abdicate any culpability, accountability or moral responsibility for its “knowledge” should that knowledge prove to have undesirable consequences. Capra contends:

The belief in the certainty of scientific knowledge lies as a very basis of Cartesian philosophy and of the world view derived from it, and it was here, at the very outset, that Descartes went wrong. Twentieth century physics has shown us very forcefully that there is no absolute truth in science, that all our concepts and theories are limited and approximate. The Cartesian belief in scientific truth is still widespread today and is reflected in the scientism that has become typical of Western culture. (Capra, 1982, p. 57)

Humanity remains at the mercy of scientific advances that threaten impending worldwide ecological disaster as observed by Bohm:

...The attempt to live according to the notion that the fragments are really separate is, in essence, what has led to the growing series of extremely urgent crises that is now confronting us today. Thus, as is now well known, this play of light has brought about pollution, destruction of the balance of nature, overpopulation, world-wide economic and political disorder, and the creation of an overall environment that is neither physically nor mentally healthy for most of The People who have to live in it. Individually there has developed a widespread feeling of helplessness and despair in the face of what seems to be an overwhelming mass of disparate social forces, growing beyond the control and even the comprehension of the human beings who are caught up in it. (Bohm, 1980, p.2)

There are those who have begun to question the wisdom of a science based upon the parameters of the old wise men such as Descartes and Newton. Peat writes:

Recently, this experimental philosophy has come under attack for its association with the certain dominant or even "paternalistic" attitude toward nature, the sort of thing that is contained in Francis Bacon's dictum that we should put nature on the rack and force her to reveal her secrets. The poet and philosopher, Goethe, had pointed out the artificial nature of scientific experiments for, in their retreat from the fullness of phenomena, they have the effect of isolating and tricking nature. So while experiment is the key to Western science, it has also been criticized as being artificial, as increasing our sense of distance from nature, and possibly even leading to a fundamental distortion of the way we relate to in the world. (Peat, 2002, pp. 250-251)

The foundational methodology of Western science has contributed an enormous amount of positive growth for humanity. That cannot be denied. What is at question here is: are the parameters of Western science still benefiting humanity's quest for knowledge? What knowledge has been lost because it did not fit into the parameters of the scientific method? In the quest for knowledge, are we asking the right questions? Even Einstein's quest for the Theory of Everything blinded him to his own scientific paradigm so much so that he could not accept the concepts of quantum physics. Instead he attempted to construct a unified field theory by geometrizing physics, much as he had done to create his general theory of relativity. "Had these attempts been successful, Einstein could well have said, like Descartes, that his entire physics was nothing other than geometry" (Capra, 1982, p. 82).

Einstein could not see beyond his own paradigm and one can only speculate as to where humanity would be if this brilliant man had been able to transcend the limits of his own determinism and apply that brilliance to the field of the new physics. We stand on the eve of unforeseeable consequences spawned from a technological soup, the by-product of a science whose conditions evolved from the early Greeks and were refined by Newton and company. "In the west, technology is tied to notions of progress and the belief that "more is better". Some scientists contend that the difficulties we face today involving energy, sickness, social violence, and ecological damage will eventually be solved by better science and improved technologies" (Peat, 2002, p. 261). But Suzuki and Knudson argue that this allegiance with technology in its present form is not enough to address current problems and requires deeper understanding and exploration. Their point is that:

The ecological impact of industrial civilization and the sheer weight of human numbers is now global and is changing the biosphere with frightening speed. It is clear that major problems such as global warming, ozone depletion, species extinction, and worldwide toxic pollution will not be solved in the long run by perpetuation of the current worldview and applying Band-Aids such as tax levies, greater efficiency, and recycling. Knowledge gained through science is unique and profound, yet also extremely limited. Not only does the Newtonian worldview fail to comprehend the complexity of life on earth, we have barely begun to understand its dimensions. (Suzuki and Knudson, 1993, p. xliii)

This is a brief history of how the Western scientific paradigm was developed. Although experimentation, mathematics, observation, classification and rationalization have been utilized in different forms over the ages, the refinement of these concepts is absolute and forms the basis of Western scientific thought today. Western science prides itself in its ability to be objective, to mathematically represent nature, to offer a rational reality second to none, and to be the bearer of the one absolute truth. Questioning the parameters of this scientific method means certain death for science in the Western sense. The notion of a separate reality, objectively investigated without

consideration for the whole, has led to a fragmented, technologically-savvy world that is slowly suffocating us; it has also created a world that suffers a deep and abiding spiritual vacancy.

“Modern science’s dazzling achievements in rationally dissecting the natural world may also be contributing to a sense of psychological, emotional, and spiritual detachment from the rest of the natural world” (Suzuki and Knudson, 1993, p. 78). The new physics has led us full circle, back to a renewed interest in a holistic vision of the universe. This has prompted a resurgence of interest in Indigenous knowledge. What follows is an exploration into the paradigm of Native American science.

A Chapter Four – Native Science Paradigm

A Story

Okay, now I'm ready to talk about this. Everything is connected to this question. I want to tell you a story that I heard when I went to Fairbanks, Alaska a couple of weeks ago. It has to do with an Inuit hunter, someone who lives way up north, even north of Fairbanks, in conditions that are very severe. Up there, they are able to predict the weather sometimes three days in advance. Now you know they have to be able to do that, because they go on three-day trips and they have to know what it's going to be like. They don't go to the Inuit Weather Channel to get their information. They have knowledge. I'm not going to define what that is. They call it different things, because they have to use English now to explain it to other people. It has been called traditional knowledge. Sometimes it's called indigenous knowledge. Sometimes it's called indigenous science. Some word that will communicate to the outside world.

Well, there's a story about this Inuit hunter. And this is not a legend in terms of stories from the past. This is reality. Each hunter, I was told, carries with him or her a stick, dependent on the size of that person. I guess this is a male hunter, but it doesn't matter. So whenever they move away from the mainland and they have to get back, they have to know whether it's safe. I was told that they will drop the stick, and depending on how much it will penetrate, they will intuitively know whether or not it's safe to cross the ice. Now sometimes it's very clear they should not cross over that ice. But of course, the consequences are pretty bad if they don't try to cross the ice and it gets warmer. You can imagine that.

But I was told that the hunter, when he decides to cross, he will create a wave in front of him. Then he will know when to step on the crest of that wave. Now behind him, that ice may be breaking up, but in front of him, he is creating a wave, and he has to know, obviously, how fast the wave is traveling, and the wave length, in order to be able to know what stride to use.

My point is, there is an example in which science and human existence are integrated. It is not an abstract notion, it is a real notion. Go to that hunter and ask him to draw the equation of that wave – you know, it has to be some higher power, because it's obviously a vibration, it's obviously cyclical, but I don't think he'll be able to tell you that. He doesn't need to know this other way of mathematically explaining science. But I hasten to say that I believe that a person who has 100 PhDs in all the areas of science would not be able to do what that hunter does without being trained. The point is that many of us are outside the realm of knowledge that many people have, but we don't recognize it, we're not aware of it. And obviously, much of this science is not written down.

So there is a case in which survival and science are very much the same. The reason they need to know that is because if they don't know it, if the hunter steps on the trough of the wave, obviously, he will sink, and then his science would be of no use. Much of science, as I understand it from associating and talking with elders and indigenous people in general about their traditions – I learned so much that does not connect directly with the formulas I am familiar with. (Duran, Dialogues, 2003, p. 103-104)

Defining Native Science

Webster's dictionary defines science as: "knowledge covering general truths or the operations of general laws especially as obtained and tested through the scientific method" (The Merriam Webster Dictionary, 1997, p. 656). Native science is an ancient practice that supports a holistic reciprocal relationship with the natural world. Native science does not subscribe to the confines of the scientific method. Native science embraces power from the unseen world, which further invalidates Native science in the Western scientific community. In his book, *Native Science: Natural Laws of Interdependence*, Greg Cajete explains: "the word science is derived from the Greek word for knowledge..." (Cajete, 2000, p. 14). Dr. Leroy Little Bear defines science as: "the pursuit of knowledge...not only of the Earth, but also the cosmos" (as cited in Cajete, 2000, p. xi). Dr. Leroy Little Bear states that: "The business of science is reality. And I've come to define, as a result of Einstein's definition for what the purpose of science is about, I have come to say that science is really about search. Search for knowledge. Here, I immediately want to make a distinction. A lot of people confuse technology and science. I usually make the distinction to say that technology is really application of the known; science is looking into the unknown" (L. Little Bear as cited in SEED 2003, p. 63). In the Indigenous scientific world: "...the terms "knowledge" and "science" are used interchangeably among indigenous scientists" (Cajete, 2000, p. 4). Native science includes all knowledge in a universal, holistic context: "Native science is used as a metaphor for Native knowledge and creative participation with the natural world in both theory and practice" (Cajete, 2000, p. 14). Native science is a holistic reflection of reality, supported by cumulative knowledge gained through personal experience. "True knowing is based on experiencing nature directly" (Cajete, 2000, p. 66) "This includes the visible and the invisible: ...science is evolutionary – its expression unfolds through the general scheme of the creative process of first insight, immersion, creation and reflection...it is tied to spirit, and is both

ecological and integrative” (Cajete, 2000, p. 14). Western scientist David Suzuki supports Cajete and Dr. Little Bear in his book *Wisdom of the Elders*:

Native knowledge about nature is firmly rooted in reality, in keen personal observation, interaction, and thought, sharpened by the daily rigors of uncertain survival. Its validity rests largely upon the authority of hard won personal experience- upon concrete encounters with game animals and arduous treks across the actual physical contours of the landscapes, enriched by night dreams, contemplation's, and waking visions. The junction between knowledge and experience is tight, continuous and dynamic, giving rise to “truths” that are likely to be correspondingly intelligent, fluid and vibrantly “alive.” (Suzuki and Knudson, 1993, p. 20)

It is the belief in a conscious universe that is alive which distinguishes Native science or sacred science from Western science.

Language is relative to culture, and so is science. One could say that Native science operates out of a scientific relativity principle, therefore: “One has to understand the culture/worldview/paradigm of Native American people” (L. Little Bear as cited in Cajete, 2000, p. x). One must understand Native American paradigm to understand Native science. “Native American science is incomprehensible to most Westerners because it operates from a differing paradigm” (L. Little Bear as cited in Cajete, 2000, p. x). This knowledge is not gathered to prove a specific hypothesis; it is knowledge that according to Milton Freeman, author of the 1992 article *The Nature and Utility of Traditional Ecological Knowledge* published in *Northern Perspectives*:

...refers to the knowledge base acquired by Indigenous and local peoples over the generations through direct contact with their environment. This knowledge includes an intimate and detailed understanding of plants, animals and natural phenomena, the development and use of appropriate technologies for hunting, fishing, agriculture and forestry, and holistic knowledge, or “world view”, which parallels the scientific disciplines of ecology and environmental studies. In practice, knowledge and know-how are virtually inseparable, and as such, Indigenous knowledge does not lend itself to ready definitions for straightforward extraction and assimilation; it is embedded in a dynamic,

multidimensional universe in which cultural, economic, environmental and political factors intersect and influence one another. (Freeman, 1992, p. 24)

Sacred science induces suspicion because of the relationship with the unknown. “The ordinary distinctions between mind and matter, human and other life forms, nature and human beings, and even our species and the divinity were not considered valid ways of understanding experience” (Deloria, public presentation, 1977). In fact Native paradigm, inseparable from Native science, is largely misunderstood given that most knowledge regarding Native paradigm is documented through a Western lens. It should come as no surprise that Native science is a foreign concept to most people. As Cajete points out:

In the past five hundred years of contact with Western culture, Native traditions have been viewed and expressed largely through the lens of Western thought, language, and perception. The Western lens reflects all other cultural traditions through filters of the modern view of the world. Yet, in order to understand Native cultures one must be able to see through their lenses and hear their stories in their voice and through their experience. (Cajete, 2000, p. 4)

Native science is regenerative and includes spiritual awareness. This knowledge is transferred into daily life and applied to technology. Cajete states:

Native science is a broad term that can include metaphysics and philosophy; art and architecture; practical technologies and agriculture; and ritual and ceremony practiced by Indigenous peoples both past and present. Native science encompasses such areas as astronomy, farming, plant domestication, plant medicine, animal husbandry, hunting, farming, metallurgy, and geology - in brief, studies related to plants, animals, and natural phenomena. Yet Native science extends to include spirituality, community, creativity and technologies that sustain environments and support essential aspects of human life. (Cajete, 2000, p. 3)

Native science is a holistic engagement with all of creation. Its foundations are based upon creative diversity, acute sustained observation, subordinate reciprocal relationship, experiential knowing and sustainable process. “Seeking life is more than just a Native metaphor. It is an

operational principle that is an extension of our instinctual predisposition for seeking life encoded in our genes” (Cajete, 2000, p. 109). Seeking life embraces intuition manifested through Native paradigm concepts of constant flux, spirit, interrelationship, trickster, chaos/order, sacred space, renewal and observer created reality. Native science operates in the space/time continuum of manifesting and manifested, concepts first academically proposed and articulated by Benjamin Whorf. The ultimate goal of Native science is balance and harmony, and for that reason the model of the medicine wheel will be used to demonstrate and clarify the relationship of Native science and the paradigm.

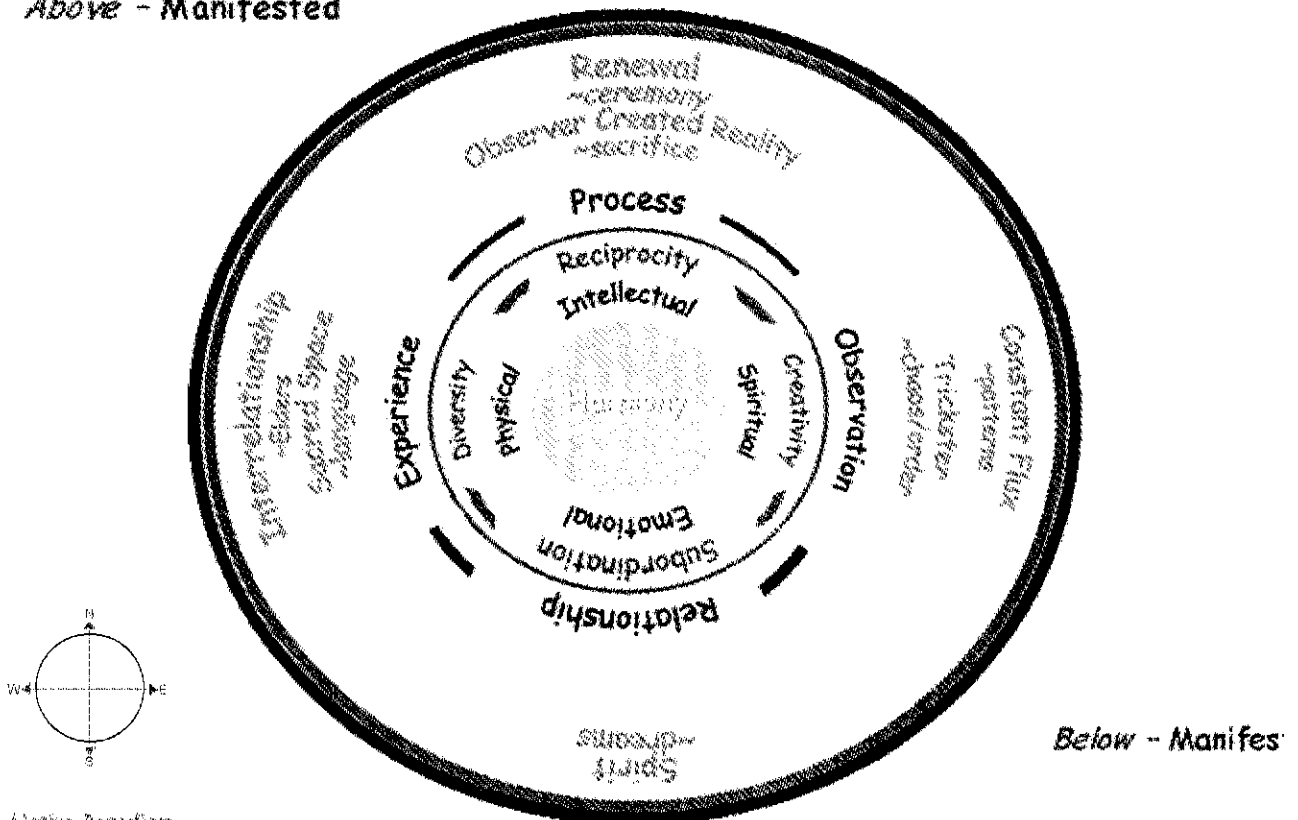
This medicine wheel model of Native science incorporates the foundations, values and paradigm of Native science in order to transmit a culturally appropriate vision of Native science and its operational properties. This method was chosen because no one part can operate without the other in the medicine wheel and because it reflects a culturally appropriate model. The model that follows of a Native Science Medicine Wheel was inspired by Nancy Maryboy, Navajo cosmologist. Maryboy incorporated the medicine wheel concept in her dissertation of Navajo worldview. The Native Science Medicine Wheel is incorporated here because it has a cyclical movement and fluid boundaries that continually interact and coalesce into harmonic balance, all of which are properties of Native science. The Native Science Medicine Wheel is: “a tangible object seen as possessing non-rational powers to unite or bind diverse elements into a community, a psychic and spiritual whole” (Gunn Allen, 1986, p. 80). This sacred science medicine wheel encompasses all aspects of Native science identified by Peat, Freeman, and the Alaska Native Knowledge Network, (see Appendix 1, 2 and 3). Although the concepts may not be articulated in this particular model, they are all included; however, for simplicity’s sake, only the core values and foundations are expressed.

The Native Science Medicine Wheel (see Figure 1), starts at the eastern door and goes clockwise to the northern door, inclusive of the properties of spiritual, emotional, physical and intellectual being. Above and below incorporate the space/time continuum as proposed by Benjamin Lee Whorf and his astute understanding of the space/time continuum of the Hopi People. The four cardinal directions reflect the key foundations, values, and paradigm of Native science. Each door is opened with a story, the traditional method of transmitting knowledge in Native ways of knowing.

Figure 1

Native Science Medicine Wheel

Above - Manifested



Native Paradigm

Foundational Practice of Native Science - Observation, Relationship, Experience, Process

Foundational Values of Native Science - Creativity, Subordination, Diversity, Reciprocity

Native Science Medicine Wheel

The Eastern Door

A Story

In Blackfoot, we're sky people, and so much of our knowledge comes from the stars. So, in putting up our teepees, the top part of our teepee is the star people, and that connection with the sky people; the middle of the teepee is this Earth relationship; and at the bottom of our teepee are the underground beings or the water beings. Encompassed in that is all of the universe relationships in our sacred geometry: the rocks, the earth we sit on, our altar—it's all about non-locality. But the most important thing, it's holy; and it reminds us when we enter that we're entering into holiness, and it's just a reflection of what's bigger in the world. (Amethyst First Rider, 2002)

The eastern door is the door of the new day. The sun rises, bringing fresh opportunities and new beginnings. The east is the conduit between the seen and the unseen, the door of the spiritual realm. When ones prays, one faces east, and “everything begins with a prayer” (R. von Thater-Braan, personal communication, August 7, 2004). In Native America, spirit is integral to Native science/paradigm. In Native science, creativity is a core value; it is an offspring of the spirit and may be expressed through story, art, dance and ceremony. “Native science embraces the inherent creativity of nature as the foundation for both knowledge and action with regard to “seeking life” (Cajete, 2000, p. 15). Integral to this process of “seeking life” is an alignment with the cosmic forces often expressed in creation stories that Cajete contends:

... depict the lines separating humans, animals, and forces of nature as rather fluid instead of rigid. Animals transform into humans and humans transform into animals. Biologically, the metaphor is accurate, because when we eat an animal we are “transformed” into that animal, and the animal is “transformed” into us. When we are eaten by animals (including by the small bacteria that will eat us all eventually), we are then transformed back into cycles of nature. In many ways, ancient Native myths preceded biological theories of evolution and transformation. (Cajete, 2000, p. 40)

Creation stories cement identity and relationship to the cosmos. That identity is translated to art forms that reflect the relationship with the cosmos. “Creativity and transformation are interrelated

in every context or act of art creation. Apprenticeships, formal and informal, are the primary vehicles for learning a particular art form ... In the making of ceremonial art, these conditions were extended to include the “transformation” of the apprentice to a requisite level of consciousness” (Cajete, 2000, p. 47). This level of consciousness, creative consciousness, embodied such practices as purification, right time, place, and give away (Cajete, 2000, p. 47). This alignment of intention speaks to the holistic process of creativity from inception (story to physical embodiment of an item), to completion that dictates relationship with the natural world. Gregory Cajete, Native scientist, quotes Briggs and Peat from, *Seven Life Lessons of Chaos:*

Timeless Wisdom from the Science of Change:

Creativity is both the universes’ ordering principal and process. Creativity in all forms is part of the greater flow [constant flux] of creativity in nature. It flows from” implicit order” or inherent potential of the universe, and whatever it produces becomes part of the “explicit order” of material or energetic expressions. These expressions range from entire galaxies to the quarks and leptons of the subatomic world. (2000, p. 15)

Acute observation is a foundational methodology of Native science. Observation can be sustained over time, even centuries (expressed linguistically); it is practised without interference (respect for the creative), and includes the whole of the natural world—the sky, the earth and all living things. The knowledge garnered from observation is transmitted through language, story, art and ceremony. It can be translated into technology. The ultimate goal of Native science is to use knowledge to restore, maintain or seek balance with the cosmos.

Constant Flux

Constant motion, or flux, is the idea that every aspect of the universe is in constant motion or movement. According to Dr. Leroy Little Bear: “Everything in creation consists of a unique combination of energy waves. In other words, what appears as material objects is simply the manifestation of a unique combination of energy waves. Conversely, all energy wave

combinations do not necessarily manifest themselves in terms of material objects” (L. Little Bear as cited in Cajete, 2000, p. xi). Capra points out that:

Modern physics thus pictures matter not at all as passive and inert but as being in a continuous dancing and vibrating motion whose rhythmic patterns are determined by the molecular, atomic, and nuclear configurations. We have come to realize that there are no static structures in nature. There is stability, but this stability is one of dynamic balance, and the further we penetrate into matter the more we need to understand its dynamic nature to understand its patterns. (Capra, 1982, p. 88)

Flux in Indigenous thought, means the visible and invisible, the known and unknown, positive and negative, all of which are continually balancing and rebalancing within a constant state of reciprocity. “Thinking about the ever-present flux is something like thinking about waves coming onto a beach. You are on a surfboard and you are constantly making minute adjustments to the waves to keep your balance on the surfboard. You are coming in on the flux of the waves. The way you are coming in is through constant balancing. This is also a deep part of Navajo thinking” (Maryboy, 2003, p. 37) One could say flux is cosmic breath, expanding and contracting—an invisible dancing energy of shape-shifting probabilities. Constant flux is a continual, non-stop wave of movement that encompasses all that is and all that is not. It is a symphony of change that is ever present and elusive to the eye, yet it influences every aspect of humanity. Capra explains that:

The conception of the universe as an interconnected web of connections is one of two major themes that reoccur throughout modern physics. The other theme is the realization that the cosmic web is intrinsically dynamic. The dynamic aspect of matter arises in quantum theory as a consequence of the wave nature of subatomic particles, and is even more central than relativity theory which has shown us that the being of matter cannot be separated from its activity. The properties of its basic patterns, the subatomic particles, can be understood only in a dynamic context, in terms of movement, interaction, and transformation. The fact that particles are not isolated entities, but wave-like probability patterns implies that they behave in a very peculiar way. (Capra, 1982, p. 87)

Constant flux is beyond what we know, yet it is accepted as a fundamental truth of reality in Native American paradigm, influencing the way Native science is practised: “Where Western science has always thought fixed laws and ultimate levels, Indigenous science deals in flux, change, and transformation” (Peat, 2002, p. 44). This viewpoint is supported by Cajete who reminds us that:

The world of nature is in constant flux; therefore, Native science does not attempt to categorize firmly within the domains of ideas, concepts, or laws formed only through an analysis bent on a specific discovery as is the case with Western scientific analysis... This does not mean that Native science excludes rational thought, but rather that it includes heart and being with rational perception to move beyond the surface understanding of a thing to a relationship that includes all aspects of one’s self. (Cajete, 2000, p. 76)

The flux is fluid, yet it maintains patterns or cycles: “If everything is forever moving and changing, one has to look at the whole to discern developing patterns. For instance, the cosmic cycles are a part of the constant motion but have a regular pattern resulting in reoccurrence like seasons and migrations of animals. Constant motion, as it manifests itself in cyclical or repetitive patterns, emphasizes processes” (First Rider, 1994, p.15). “...the Navajo world is experienced as a process of constant interactional motion. Although Navajos recognize the fixed order of the natural elements, they also know at the same time the world is going through interaction, flux, processes and regeneration” (Begay & Maryboy, 1998, p. 155).

Patterns are the landmarks of the flux and guideposts to survival for humans. Native science emphasizes an alignment with these processes and patterns, an alignment so deeply embedded in relationship that it is reflected in the language of the people. Maryboy reiterates that:

There are two main components of Navajo thinking that have to do with flux. They are process and relationship. Process has everything to do with motion, with moving, with seeing the universe as a cosmic flux. I could tell you in a few minutes in the holistic Navajo language things that would take hours to tell in English, a non-holistic, fragmented language. There is so much encoded in the

high Navajo language. The word *nanit'a* encompasses a dynamic, ongoing, never-ending cosmic energy. *Nanit'a Sa'ah Naaghai, Nanit'a Bikeh Hozhoon* includes complementaries of processes that in the western way are labeled polarity, for example, good versus evil. Where these complementaries come together and provide dynamic energies of continuous regenerative motion, you can say *alkee na'ashii*. This is the motion of the cosmos. This is the motion of what we are. This is similar to Cherokee thinking, I am told by my uncles, and this is also Pueblo thinking, I am told by my friend, author Joseph Rael. (Maryboy, 2003, pp. 37-38)

It is from this flux that the creative manifests into a holistic daily life; and it is the acute observation, sometimes over long periods of time, that the application of science comes from. Nowhere is this more evident than in the study of the stars. "...celestial bodies are traditionally viewed by Native cultures as living beings with a creative life force that relates to and affects human beings physically and spiritually" (Cajete, 2000, p. 216). Patterns are used to mark time and direction, to guide planting times and ceremony. Patterns can be documented in creation stories as pointed out by Cajete:

The Pawnee Bright Star gives Great Star a pebble, which he drops into the water to create the Earth....The Navajo First Woman uses the stars as a tablet upon which to write the rules of proper conduct...The Mescalero Apache use the movement of the Big Dipper to time girls' puberty ceremony....Trickster and culture heroes may create or arrange the stars, spoiling the plans of Black God and the creators. Raven walks across the sky in snowshoes, and his tracks become the Milky Way. (Cajete, 2000, p. 217)

Creation stories are the guideposts for living: "Providing guidance for proper human behavior toward the natural world and interceding on behalf of humankind is a common theme in many Native star myths" (Cajete, 2000, p. 217). "In reality, the stories are alternative ways of understanding relationships, creation, and the creative process itself, as that process is involved in the underlying thought, as well as in how the tales are represented" (Cajete, 2000, p. 44). Cajete continues:

Observations of the sun, moon and stars formed the basis for the ceremonial calendars designed to time essential life activities such as hunting, gathering, planting and fishing. These observations also formed the foundation for attempts to predict celestial events; set ceremonial events; mark the time of festivals and war; and legitimize political and religious authority.... Native cultures recognized no clear dividing lines between nature and the cosmos on the one hand, and human spirituality on the other. "The stars provided important ritual symbols and at other times can be personifications of the Trickster, the reflection of the cosmic principle of chaos." (Cajete, 2000, p. 218)

Trickster epitomises a departure from patterns, manifested in the principle of chaos: "The stars provided important ritual symbols and at other times can be personifications of the trickster, the reflection of the cosmic principle of chaos" (Cajete, 2000, p. 217). As we shall see, Trickster is the master of chaos.

Trickster

The trickster has many identities. He/she is at once culture hero, clown, teacher and giver of gifts. Trickster embraces all the notions of Native paradigm. He/she moves in harmony with constant flux, crossing boundaries of time, space and place, transforming from one state of being to another, while remaining interconnected with all the beings of Mother Earth. In Cajete's words:

Many Native stories relate how the world has changed.... Coyote then is a transformer, as well as a culture hero and trickster. He represents aspects of human nature, including creativity, transformation and curiosity, and he is sometimes too clever for his own good; the trickster stories also deal with the destructive elements of human nature and knowledge. (Cajete, 2000, p.p. 43 - 44)

Trickster is a transformer, shape-shifter and wild card who inhabits many Native American Nations in such forms as Raven, Rabbit, Ikotomi, Napi and Coyote. Trickster is change, constant flux, and the in-between. He/she is ageless and all encompassing—creative chaos incarnate. To quote Cajete:

The role of chaos also appears in mythology throughout the world in stories of the trickster, the sacred fool whose antics remind us of the essential role of disorder in the creation of order. Chaos theory describes the way nature makes new forms and structures out of the potential of the great void. It also represents the unpredictability and relative randomness of the creative process. (Cajete, 2000, p. 17).

Trickster reminds us that we are at the mercy of the flux, and teaches humanity to be humble.

Should we break our compacts with the animate world, we will surely suffer the consequences.

To go against the natural patterns of the flux is an invitation to calamity. Trickster is the protector of protocol, and his antics are used to reflect teachings necessary for survival in the flux. Trickster is contradiction in motion. Trickster wisdom is constantly renewed within the ancient art of storytelling. Trickster's antics offer the gift of wisdom through "reversal lessons" (hindsight his/her best friend); through humor (inviting us to laugh at ourselves); and through humility, by reflecting humanity's inability to control outcome and destiny beyond personal values. Maryboy points out that:

Every indigenous community that I know has a trickster element that has to do with creating chaos. It is very much a part of everyday life. In Navajo, that element, that process, is identified with the coyote, *Ma'ii*. In Cherokee it is a rabbit. In Blackfoot, I am told, it is *Napi*. They carefully speak to the idea of chaos, contained in a larger order of complexity. (Maryboy, 2003, p. 37)

Chaos and order cohabit; one cannot exist without the other. "Chaos theory, derived from the cutting edge of Western scientific research itself, implies that systems are beyond the ability of scientists to predict or control except at the most superficial levels, and that all of nature is a chaotic system (Cajete, 2000, p. 16) For Indigenous cultures, chaos is reality; and out of that chaos comes order, influenced by the subtle process of renewal ceremonies that honour the cyclical waves and patterns of the flux as manifested in the cycle of the seasons, sunrises and sunsets, the phases of the moon and in animal migrations. Peat goes on to explain:

The sacred figures of The People—Raven, Coyote, Napi, Nanabush, and the rest—are all tricksters, beings who turn the world on its head. Even our own Western science has its trickster: entropy, or disorder. Thermodynamics tells us that for nature to continue in her work, she must metaphorically defecate. In scientists' terms, the overall entropy of a system and its environment must increase or, to put it another way, if we insist upon generating order, this can only be done at the expense of creating disorder somewhere else. (Peat, 2002, p. 83)

One small action can cause a ripple of waves that will, in turn, influence and transform existing combinations and relationships. "Chaos theory shows that everything is related, everything has an effect, and that even small things have an influence" (Cajete, 2000, p. 18) Out of chaos comes order. "... chaos theory shows us: small, apparently insignificant things play major roles in the way a process unfolds...plays a central role in the creation of the universe, the earth, humankind, and other major elements of the world. Chaos and its offspring, creativity, are the generative forces of the universe" (Cajete, 2000, p. 17). In physics, this anomaly is known as the butterfly effect, first identified by meteorologist Edward Lorenz. Butterfly effect in chaos theory "...is really the cumulative influence of a small change in a system. It may be an increase or decrease of temperature in a weather pattern, an individual such as Gandhi taking a stand against oppression, or a Native prayer, song, dance or ritual to bring rain to a parched land. In the world of chaos, anything is possible" (Cajete, 2000, p. 18). Cajete elaborates:

There is an ordering or self-organizing process that results from chaos, called "order for free"...[i.e. boiling water]...a chaos theorist might describe it, the water in the pan exercises its "maximum degree of freedom"...the water self organizes into a pattern of vortices called the "bifurcation point," the point just before the system transforms itself, in this case, to boiling water. The bifurcation point is the direct result of the interaction of "positive feedback," which amplifies the transformation to boil, and "negative feedback," which dampens the transformation. These tendencies interact to create a stable pattern of vortices. (Cajete, 2000, pp. 17 - 18)

This coagulating interrelationship is defined and preserved within the collective agreement of the indigenous people. The Western belief is that the universe is an ordered operating machine, and

that what cannot be explained belongs to a supreme being. But for the Native scientist balance can manifest from chaos as Peat elaborates:

Chaos theory (or, more generally, the science of nonlinear systems) explores the different consequences that randomness, chance, and probability can play in our world. It demonstrates that our universe is far from being simplistic clockwork because chance plays a guiding role in a vast number of processes, including weather, fast flowing rivers, the shock waves from supersonic aircraft, the growth of materials, and the fluctuations of insect populations. ... Thus, the heart of nature, it appears is more concerned with this chance than with simple order. At one time order was considered to be the norm, with chaos pictured as the breakdown or disintegration of this order – thus chaos was equated with lawlessness. Now scientists are discovering, as Indigenous science has long taught, that stability and harmony can also result from chance... In so many ways, scientists are beginning to perceive the underlying duality of chaos and order, the one emerging out of the other. (Peat, 2002, pp. 175-176).

Upon contact, a new version of reality was to bring order to the perceived chaos of the Wild West and the “heathens” inhabiting the continent. The desire to control all elements of nature eliminated the values of responsibility, sacrifice and respect. Mother Earth, Indigenous Nations, and the living universe were subjected to this new “order”. The values of Native science were buried beneath this precept. Currently, there is a resurgence of curiosity about the science of Indigenous people, and a recognition that perhaps knowledge previously dismissed offers insights that will assist in eradicating the global crisis that humanity now faces—a crisis that is the offspring of Western order. “Whenever we have made our plans and laid down the path of our future, the Trickster will come along and play a trick on us” (Peat, 2002, p. 156).

The Southern Door

A Story

I was going to talk a little bit about Native science, and one of the things we were talking about was greetings. In Blackfoot, we would say Okisnedatbe [phonetic], and as you said, it's not a matter of saying “Hello,” it's a matter of saying, “How are you connected?” But it's not even about human beings. It's about everything that we greet in the day. So we're instructed to recognize all our

connections, from the sky to this dimension of earth, and underground or the water beings. So in our science, our knowledge comes from experiencing, not experimenting, but experiencing how is the connection. And we do this in our daily lives. It's a very soft way to dance, a soft way to walk, because we do it very naturally. I think Native science is about, as Leon was saying, interrelationships, it's about the connecting. (First Rider, Dialogues, 2003, p. 100).

The southern door brings the gifts of the heart. Here are the teachings of love—love of cosmos, community and self. Love is about humility and relationship. In Native science these values are manifested in a relationship that is equal, subordinate, non-controlling and non-manipulative. Native science methodology includes a subjective relationship motivated from a desire to know, as opposed to a desire to control. This is manifested from a deep, abiding belief in the spiritual essence of everything in the cosmos, and it is accessed through the heart. “When the heart beats, it is said, ‘Your heart is breathing.’ The Micmac recognize a close relationship between life, breath and the heartbeat...” (Pritchard, 1997, p. 130)

Spirit

Native paradigm is immanence: “the belief and knowledge of and respect for unseen powers” (Gravoline, 1998, p. 52). Everything is considered to be “alive” or animate, and imbued with “spirit” or energy. The spirit is not an authority outside of ourselves, but rather an extension of flux that embraces all that which is—place, space, above, below, within and without, and manifested experience. Jean Graveline, author of *Circle Works: Transforming Eurocentric Consciousness* states:

The power of that spirit may manifest in different forms, but the unifying essence is the same. These mysterious powers are found in all Earth's creatures: rocks and crystals, birds and feathers, trees and wood, plants, animals and humans, and are visible especially in dreams and visions and through ceremony. In our world all things have inherent value, because all things are beings. (Graveline, 1998, p. 52)

Spirit is the “glue” that binds flux together. Spirit is energy: “In Native science there is then an inclusive definition of ‘being alive.’ Everything is viewed as having energy and its own unique intelligence and creative process” (Cajete, 2000, p. 21). Spirit is the life force that permeates all things, even in objects that Western civilization might consider inanimate. “A stone has its own form of animation and unique energy.” (Cajete, 2000, p. 75) For example, one could look at a rock and say it has no spirit: however, in the animate world, “the rock may vibrate at a much slower pace than ours, making it appear as an inert object” (Little Bear, 2000). Pritchard explains that:

Man is farther from the Creation than the animals, so he honors them. The rocks are revered for this reason. The rocks have been here for many thousands of winters, and have been sitting there, seeing everything and becoming very wise. That is why “stone people” can be so helpful to us. They are closer to Creation, they are older than almost anything else we can touch. (Pritchard, 1997, p. 152)

Western scientists can agree with the concept of constant motion or flux, but the notion of spirit is problematic. Spirit, in Western thought, relates to religion. Religion and science do not mix. Nor can spirit be “proved” by the scientific method. But neither can love, yet humanity does believe in love. For example, I could tell you that I love my son, but if you were to tell me to prove it, I could not. I may be able to present you with all kinds of behaviors that look like love, but you would not be able to see it. One can only speculate that love does indeed exist based upon experience. So it is with spirit. Spirit is not tangible, and that is where Western science and Native science part company. Western science cannot believe what it cannot see. Everything must be proved. Thus we have a science that eliminates spirit: “...the modern description leaves out so much—it leaves out the sacredness, the livingness and the soul of the world. And it does get troublesome when scientists tell us, often with a voice of authority, that the part they leave out is really not there” (L. Little Bear, as cited in Cajete, 2000, pp.viii - x). To the Native scientist, spirit is a basic and fundamental truth. “The interdependence between animated and inanimate

matter was deeply understood that life was felt in everything and death regarded as merely a descriptive name for another way of life” (Meili, 1991, p. 53). The meaning of animate in Native thought and animate in Western interpretation are not the same. As Cajete points out:

In Native science, there is then an inclusive definition of “being alive.” Everything is viewed as having energy and its own unique intelligence and creative process, not only obviously animate entities, such as plants, animals, and microorganisms, but also rocks, mountains, rivers, and lakes large and small. Everything in nature has something to teach humans. This is the Indigenous view of “animism,” not the anthropologically defined, superficially understood, and ethnocentrically biased term used to categorize the Indigenous way of knowing the world... (Cajete, 2000, p. 21)

Spirit is simply another aspect of existence, an invisible dimension that is nonetheless a fundamental reality. Cajete suggests that:

Death and the body’s ultimate decomposition into the primal elements of wind, fire, air and water mark the transformation of one’s relatives and ancestors into living landscape, its plants, animals, waters, soils clouds and air... Life and death are transformations of energy into new forms, the material and energetic fuel of nature’s creativity. Death is understood as a metamorphosis, wherein the spirit of the deceased does not disappear, but becomes part of the animating and creative forces of nature. (Cajete, 2000, p. 21)

The cosmos, the earth, the four-leggeds, the plant people, the rock people, the water beings—all of creation—is alive. This view has been labeled by Western society as animism. “...animism continues to perpetuate a modern prejudice, a disdain, and a projection of inferiority toward the worldview of Indigenous peoples” (Cajete, 2000, p. 27). To the Native scientist, animism is reality, observable within the whole. To ethnologist Lucien Levy –Bruhl:

...”the animistic logic of Indigenous, oral peoples for whom ostensibly ‘inanimate’ objects like stones or mountains are often thought to be alive and from whom certain names, spoken out loud, may be felt to influence the things or beings that they name, for whom particular plants, particular animals, particular places, persons and powers may all be felt to participate in one another’s existence, influencing each other and being influenced in return.” (as cited in Abram, 1996, p. 57)

Access to the divine is a normal part of life in Native American community. Spiritual knowledge is assessed through prayer and ceremonies such as Sweatlodge, Bundle openings, Sundance, Potlatches, Corn Dances and Ti dance. All across this continent, relationship with the spirit world is reinforced and acknowledged through renewal practices.

All Native Nations have their own unique spiritual practice. For example, the Dene Tha', a small nation in northwestern Alberta, continues ancient spiritual practice in the form of Ti dances. Due to the remoteness of the community, Western influence has been slow to arrive in this area and that has helped preserve Dene Tha' spiritual practice. The Dene Tha' are related to the Navajo:

Interestingly, the word that Navajos use for themselves, Dine, and the word that Northern Athabaskans use for themselves, Dene, are strikingly similar. We have interacted with many Northern Athabaskans in Alaska and Northern Canada, finding many similarities in language, particularly in words related to body parts, celestial objects and other elements of nature such as, fire, snow and certain animals. (Maryboy & Begay, 1998, p. 142)

The Dene Tha' are known as dreamers, meaning that dreams are used to access knowledge between worlds. "Dreams carried the soul to distant lands—to what might be called "the other side". Dene Dhéh beliefs in the supernatural were assisted by head prophets (ndatini) or dreamers who are "people who know through dreams and visions" (Goulet, 1998). "One informant MAT [informant reference] gave the word, "inkoze" as meaning "medicine man". The term inkoze refers to this power and was translated by this informant as meaning "willpower." A person who "did medicine" and was believed for his efficacy in curing was said to have inkoze. One of the chief functions of supernatural powers was to cure illness. It was recognized, however, that such power could also be used for sorcery" (Honigmann, 1946, p. 77). A prophet was called to his

profession through dreaming and the guidance of animal spirits. Prophets used these animal spirits as assistants.

Animals came to the individual to impart information regarding future events, to give songs and sustain that person's power. To receive these gifts was to be known as someone who knows an animal. "Animals have special abilities, which they depend upon to live, giving us only the powers which they no longer need. An animal chooses someone to receive these leftover powers. The person who has treated the animals with respect" (Goulet, 1998, p. 65). If laws were broken, the perpetrator might go insane or get sick. For example, blood from an animal had to be properly disposed of; women in moon time (women had increased power during menstruation and were isolated from others during their moon time) could not cross a hunter's path or step over his weapons; if a person died, their possessions had to be burned or disposed of; and to eat parts of the animal promised death. "If the person caught his medicine in a trap, both the animal and the trap had to be thrown away" (Honigmann, 1947. p. 77).

Power came to an individual from the animal during childhood, sometime after weaning and before the first sexual experience. Children were sent to the bush alone to seek an animal helper, song or power. In the words of an elder, when the children returned with their power: "...they are not supposed to tell you. If they do, their power just goes away... If you are in the bush and the animal is talking to you or coming to you and someone comes your way, the animal disappears. The Dene do not talk about their animal helpers. They are prohibited of killing or eating animals representative of one's animal helper under the threat of severe illness or death" (Goulet, 1998, pp.69-70).

Humility also seems to be an important factor in receiving animal power. “Dene elders always emphasized how pitiful they were when they encountered their animal helpers. The poverty and pitifulness in question is not so much a material one as an existential one. The recognition of one's existential poverty compared to other beings is a necessary condition to become the recipient of gifts and powers from these other beings” (Goulet, 1998, p.66).

This is just one example of one Nation's relationship to the spiritual realm, and how knowledge and power are accessed. For the Dene Tha', the dream world is just as real as the waking world, and the dream world can be used to access information for use in the physical world. “...Dreams can have a predictive quality, or to put it another way, in which the dreamer is not confined to a single present but can move back and forth along the curve of time... It appears to be a form of direct connection to knowledge” (Peat, 2002, p. 253).

Spirit is the Great Mystery in Native paradigm, since spirit is both real and elusive simultaneously. “No two Native American tribes or nations share exactly the same customs or beliefs, and there are at least 255 in North America today. Each is unique. Yet there is an earth way which all Native North Americans hold in common—the Red Road, which some also call the Beauty Road (Pritchard, 1997, p. 168). “The Algonquin way of life, its customs, speech, medicine, philosophy and spirituality are all part of one thing. They are all interrelated. Many refer to the whole of it as ‘the Red Road.’ Underlying all these principles is the fundamental truth of life as a circle of being, a sacred hoop, which interconnects all of us. This I believe to be the foundation of Native American spirituality, both historically and forever” (Pritchard, 1997, p. 172).

It is accepted that one can never really know or prove that spirit exists, yet spirit is everything. As

Pritchard points out:

While the spiritual teachers speak of honoring Creation and all four directions, they know that we are here for only a short time, to fulfill our tasks and be done, but that God is eternal and a person's spirit goes on forever; that the Red Road is a path of beauty in this physical world, but that there is a greater path to which it leads—the path through the stars, the world beyond the sun. (Pritchard, 1997, p. 205)

Native scientists are specialists in accessing the Great Mystery. The training to become such a specialist is lifelong and experiential, demanding sacrifice and humility. This does not mean that only those who develop these powers have access; it is simply that some have special gifts which allow them to access other realms.

The Western Door

A Story

*We are the plant people...
We grow toward the light
We walk in the light
We move in light
We breathe for you.*

Linda Hogan
Science Dialogues II – Banff, Alberta 2004

The western door is the door of the physical. It is about relationship to self (inscape) and land (sacred space). Here we also have a value of Native science expressed as diversity. Diversity is action on knowledge gained from many sources, and applied in a variety of forms. “Everything has its source in the natural world; therefore, learning about and preserving natural resources, the sources of one's life in all senses of the term, are important parts of Indigenous science...

“(Cajete, 2000, p. 98). Direct experiential learning, coupled with the notion of non-interference,

is a foundational aspect of Native science. Native scientists look at everything in context. As an example, Suzuki relates the following experience:

I was reminded of a visit I made to the World Wildlife Fund research station near Manaus in the Amazon rain forest. Three scientists, frog experts, were there at the time, and their knowledge of their subject was impressive. One of them took us on a night hike and in pitch dark, could find frogs that were barely half an inch long. But when I asked about a bird we scared up and a strange plant on a tree, he shrugged his shoulders. "Don't ask me, I'm a herpetologist," he said. Yet, whenever I asked Kayapo Indians on the Zingu River in Brazil about an insect, plant or bird, they always knew it by name and could relate an anecdote about it. Scientific expertise is so narrowly focused and specialized that it can barely comprehend the dimensions and the interconnectedness of life. (Suzuki and Knudson, 1993, p. xxxvi)

Everything is interconnected. It is the elders who are the experts, and who transmit the knowledge through storytelling, example and language.

Interrelationship

In this world of constant motion, it is the spirit of the invisible particle waves that gives everything life. Spirit is the connector that binds everything together so that everything is interrelated and interconnected. "Recognition that the human beings hold an important place in such a creation is tempered by the thought that they are dependent on everything in creation for their existence...the awareness of the meaning of life comes from observing how the various living things appear to mesh to provide a whole tapestry" (Deloria, 1992, p.88). Graveline leads the reader to the point that:

Wah 'kon-tah is the sum total of all things, the collective totality that always was—without beginning, without end. Neither a force, nor a spirit, it is the inexplicable sharing togetherness that makes all things, animate and inanimate, of equal value, equal importance and equal consequence because they are all Wah 'kon-tah simultaneously, their forms collectively creating the form of Wah 'kon-tah which is, obviously, incapable of being anthropomorphized. (Graveline, 1998, p. 30)

Western scientific theory generally operates within boundaries that embrace fragmentation through objectivity and isolation. Native science operates with the understanding that everything is in relationship with everything else. “Lyall Watson, author of *Supernature* states: ... “there is a continuous communication not only between living things and their environment, but among all things living in that environment. An intricate web of interaction connects all life into one vast, self-maintaining system. Each part is related to every other part and we are all part of the whole, part of *Supernature*” (Suzuki and McConnell, 2002, p. 28).

Every aspect of traditional life is reflected in the concept of interconnectedness because: “The complexity of daily subsistence required a shared vision, a clear understanding of and respect for the interconnectedness of all life”(Graveline, 1998, p. 54). This “... understanding and describing the balancing of various forms of energy is a foundation of traditional “science” (Graveline, 1998, p. 54). Gravelines assertion is supported by Cajete:

Native community is about living a “symbiotic” life in the context of a “symbolic” culture, which includes the natural world as a vital participant and co-creator of community. That is to say, the life of the Indigenous community is interdependent with the living communities in the surrounding natural environment. Communities mirrored the stages of creative evolution and the characteristics of the animals, plants, natural phenomena, ecology, and geography found in their place through a rich oral tradition. Through the oral tradition, story becomes both a source content, as well as methodology. Story enables individual and community life and the life and process of the natural world to become primary vehicles for the transmission of Native culture. The culture’s vitality is literally dependent on individuals, in community with the natural world. Indigenous cultures are really extensions of the story of the natural community of a place and evolve according to ecological dynamics and natural relationships. (Cajete, 2000, p. 94)

“He does not so much live in a tribe; the tribe lives in him” (Cajete, 2000, p. 95). The community was comprised not only of the human community, but it was extended to the landscape. An example of this would be the plant community. Sage, sweetgrass and tobacco are ceremonial

“helpers” used in smudging, to purify and accentuate communications between the human world and the spirit world. Great care is taken in their gathering and it was understood that as Cajete states:

...that plants, like animals, had a quality of spirit that they shared and that actually could be used to ensure the survival of a tribe. Therefore, ceremonies performed by tribes throughout North America incorporated symbolic representatives of plants and plant kingdoms. Ritual plants such as cornmeal, tobacco, and sweet grass were used as offerings to the spirit world and provided the material substance for both food and medicine. Moreover, plant symbols reflecting the sacred procreative power of Earth abound in Native American philosophies.” (Cajete, 2000, p. 112)

If proper respect was not shown for the life and essence of a plant, then the medicinal gifts of that plant would deteriorate. “...we depend upon the same kinds of invisible elements as plants and animals. Therefore, we share a life of co-creation in an interrelated web of relationship that had to be understood, respected and manipulated to maintain right relationships among important parts” (Cajete, 2000, p. 105). Pritchard explains in detail “right relationship” in the following excerpt from his book *No Word For Time*:

The Micmac and other Wabanaki people smudge themselves every day, often stopping for a quick *big sod* many times during the day. They smudge gifts before they're given; they smudge gifts when they're received; they smudge their houses, their yards, their tools and their pipes. They smudge their cars, animals, their clothes and each other. The first time I met my Miramichi Indian Aunt Helen, she gave me the gift of sweetgrass to take home. “You burn it and it smells nice,” she said, but there was a lot more to the story. Over time I have come to associate it with prayer and “speaking as one with the Creator.” If I have a dream of a plant or object and *big sod* or smudge smoke is rising from it, I know it is going to be medicine for me; that it “prays for me...The sacred tobacco, called *dtemaway*, (or *speebaq'n*, a mixture of red willow, natural “Indian” tobacco and other herbs such as sweetgrass) plays many roles. It is medicine, it is from the earth, but once you have prepared it, it is an embodiment of your own energy. Through your thoughts, words, and deeds, you can transfer almost any energy into the tobacco, so that it becomes a medium. It is also a medium of exchange which spirit recognizes....It is understood that any offering of tobacco is sure to bring a fair exchange, an equal return from spirit, so the idea of self-sacrifice in the conventional sense is foreign.

Originally, sacrifice meant simply “to make sacred” (*sacre facere*), which is very close to *sa-syeh-wyn* (sacrifice) in meaning, but which convention has twisted into something regrettable. When you give up everything for your people in the *soo-ney-wen* (fasting ordea) you do it for the sake of others and for the earth’s sake, but you also do it to strengthen your own spirit, your own vision, and your own gifts. *Soo-ney-wen* (fasting) is the basic “technique” in the Algonquin path of knowledge. (Pritchard, 1997, pp. 37-38)

This relationship with the plant world was taught by those who knew, Elders, and that knowledge evolved over time. “Coming to know, or understanding the essence of a plant, derives from intuition, feeling and relationship, and evolves over extensive experience and participation with green nature...plants have their own destinies separate from humans...have their own volition ” (Cajete, 2000, p. 110). “Through experience, careful observation and participation with plants, Native people came to possess a deep understanding of plant uses and their relationship to humans, animals and the landscapes” (Cajete, 2000, p. 109).

Physiologically, we are related to the stars, and in the great circle of life we are also related to the plant world “...human hemoglobin and plant chlorophyll share similar biochemical structures...humans breathe oxygen produced by plant respiration and ... plants depend on the carbon dioxide produced by other animals” (Cajete, 2000, p.108). Pritchard points out that:

The sun is the single most important element in Micmac spirituality and is always involved in every aspect of creation. Neesgam means sun, the Creator, grandfather, and literally means “where you came from.” It figures prominently in the preparation of any traditional medicine or in the performance of a ceremony of any kind. Therefore, sunlight should not be overlooked in any scientific interpretation of Micmac creation. Either ultraviolet rays or infrared light contributed the missing ingredient to the first life forms, if the Micmac stories are any indication.” (Pritchard, 1997, p.192)

These interconnections, taken out of context, create fragmentation and are disrespectful of our fellow relations; therefore, Native science includes and embraces the notion of interconnection

which extends from within to without, such as in relationship to the land. It extends to all relationships, as First Rider points out:

In fact, in our greetings, when we see somebody else—as I think it was Angelita was saying, “You are me” or something to that effect—in Blackfoot, we say *Tsani-a-beo* [phonetic]. *A be* can be a happening; it can be something like a rope that connects, so really, the true intent, the true meaning of *Tsani-a-beo* is really asking, “How are you connected?” and maybe “How are we connected?” So that notion of connection, *a be*, is very deep in the mind of Blackfoot thought. When we say everything is interconnected, interrelated, it comes from that notion of *a be*, a happening, and that happening being interconnected from, you know, every which way but loose [chuckles]. (First Rider, 2003, p.63)

Sacred Space

Place/space or landscape has a special significance for Native Americans and is considered to be an extension of one’s being. Peat reiterates this notion:

Indigenous science, however, refers to the particular landscape that The People occupy. Connection to the landscape is one of the most powerful things within an Indigenous society, which explains the pain and anger that people experience when they see the land around them exploited and destroyed. The Native people I have spoken to refer to the land as their mother, and the Blackfoot say that to walk on the land is to walk on your own flesh. The memory of this landscape transcends anything we have in the west, for its trees, rocks, animals, and plants are also imbued with energies, powers, and spirits. The whole of the land is alive and each person is related to it. The land sustains and, in turn, the ceremonies and sacrifices of The People aid in its renewal. (Peat, 2002, pp. 85-86)

This concept differs from Western thought, and it is here that a divide between Western science and Native science is evident as Peat points out:

...the two sciences, Indigenous and Western, part company, for Western science has traditionally claimed to be objective and value-free, its particular truths quite independent of where or who discovers them. It is in the relationship to land and history and language, and to the wider sense of reality, that the clash of paradigms between the two cultures can be found, for, to The People, their origin within the landscape is of great importance. (Peat, 2002, pp. 86-87)

The land is the historical repository and it lives through oral tradition. Survival of the stories transfers across time as knowledge that can mean survival in everyday life now as Cajete explains:

For the Inuits, the Aleuts, and the Athabascans who live in the unforgiving Far North, it is clear that people must understand how to relate to the land in a way that ensures their survival. Such understandings are conveyed through stories about how to hunt, how to find the plants and animals one needs for food and to respect their sources, and how to shelter oneself from the cold. This is essential applied science, on which human survival depends. (Cajete, 2000, p. 44)

Some places hold more power than others; this may be because they are power spots or because they are an important landmark. Blackfoot territory is said to be the body of Napi, trickster hero; and Chief Mountain is the landmark for home, known as a sacred, powerful reference point in the history and culture of the Blackfoot people. This affinity to the land is recognized by Cajete:

Tribal people share in a deep and abiding relationship to place. Early tribal communities reflected natural community in terms of structural and mythic orientation, intimately oriented to the stars, to mountains, deserts, rivers, lakes, oceans, plants, animals and spirits of a place. The natural geographies that were important to the identification of a tribal people as a people of place were deemed sacred. (Cajete, 2000, p. 91)

Place and identity are one and the same. The landscape is the reference point in space, as opposed to time being the reference point in Western thought. The belief in a living landscape that has medicine power extends across all the Nations. Tewa elder, Joseph Rael, states in his book *Being and Vibration* that:

Because we lived as energy, we began to understand that everything in each designated location was the resonating vibration of the play of principal ideas. The holy shrines were placed there because the vibrational essence of those holy sites would enhance the psyche of community and of each individual within community. The vibration would bond us to a love relationship, a knowing that life was in love with us, that we held the living life within our lives. This kept me loyal to my beloved landscape. (Rael, 1993, p.21)

One way that relationship to the land is expressed in Blackfoot territory is by the use of red earth (red ochre) for face painting and ceremony, an ancient practice in many Native American cultures. "Ancient graves of Circumpolar Red Paint People who traded with Europeans long before Columbus 'discovered' America had been dug up, revealing funerary offerings colored with red paint and indicating historical reverence for the practice..." (Meili, 1991, p.102). When Josephine Crowshoe of the Pekuni queried an elder as to why the red paint was used, she was told: "For the Great Spirit to recognize His people, so He will see the ones who still carry on with the things He taught them..." (Meili, 1991, p.102).

Ceremony and ritual conducted in a certain place will imbue that particular place with power or, sometimes, the land may already have special power. Disrespect to those sacred places invites calamity, because there is real possibility of destroying the balance of medicine in that sacred place. This is why degradation or interference of such sacred places as the Black Hills of South Dakota causes such grief among Native Americans.

The land is a reference point in the spiritual cosmos of the flux and is interconnected. This holds true for Nations from north to south and all across Turtle Island. The land holds the stories. It is the timekeeper and it keeps the ancestors present. As Linda Hogan, author and member of the Chickasaw Nation states: "This land is the house we have always lived in. The women, their bones are holding up the earth." (L. Hogan as cited in Jim, 1994, p.24)

The Northern Door

A Story

"Where does the sun live?" . . . To the Indian child who asks the question, the parent replies, "The sun lives in the earth." The sun-watcher among the Rio Grande Pueblos, whose sacred task is to observe, each day, the very point of the

sun's emergence on the skyline, knows in the depths of his being that the sun is alive and that it is indivisible with the earth, and he refers to the farthest eastern mesa as "the sun's house" . . . Should someone say to the sun, "Where are you going?" the sun would surely answer, "I am going home," and it is understood at once that home is the earth. All things are alive in this profound unity in which are all elements, all animals, all things . . . [M]y father remembered that, as a boy, he had watched with wonder and something like fear the old man Koi-khan-hole, "Dragonfly," stand in the first light, his arms outstretched and his painted face fixed on the east, "praying the sun out of the ground.." (Momaday as cited in Abram, 1998, p.221)

The door of the North is the door of the intellect, the door of wisdom. Wisdom is holistic; its seeds lie in reciprocity, a fundamental value of Native science. This reciprocity is expressed in a give-and-take dynamic relationship born out of respect for the natural world. This requires a dedicated alignment with process, a trust that all will be revealed. Actions induce the least amount of disturbance to that process. Respect is amplified through sacrifice and humility, and sustained through ceremony. It is ceremony that influences chance to ensure process continues.

Renewal

Renewal refers to sacred intention, manifested in the form of ritual for the sole purpose of honoring the spiritual resilience of life. Renewal revives, respects, resurrects and reveres. This way of life demands a fluid fusion of reciprocity, manifested in the form of ceremonies. Cajete states:

Native science reflects a celebration of renewal. The ultimate aim is not explaining an objectified universe, but rather learning about and understanding responsibilities and relationships and celebrating those that humans establish with the world. Native science is also about mutual reciprocity, which simply means a give and take relationship with the natural world, and which presupposes a responsibility to care for, sustain and respect the rights of other living things, plants, animals and the place in which one lives. (Cajete, 2000, p. 79)

Renewal is manifested through such practices as Pipe Ceremony, Smudge, Sweatlodge, storytelling, dance and song, and it is based in the ancient traditional spiritual practices of the

Native American Nations. “Ceremonies evolved as techniques for accessing knowledge. The Pipe ceremony, used by many peoples, is such a technique wherein the person takes in breath, thinks and reflects. Breathing out, blowing out the smoke, is a way of sending thoughts to places and beings” (Cajete, 2000, p. 45). Pritchard states that:

One cannot write about the pipe. One can only write about what the pipe is not. It is not ever intended for smoking marijuana or other illicit drugs. It is not meant to be boasted about or taken up without initiation and training. It is not meant to be used in anger. It is not meant to be used to make money, or other selfish goals. It is not a souvenir. It is simply to connect the person with their heart and their people, and to connect the heart with heaven and earth in a sacred manner. (Pritchard, 1997, p. 204)

In the pipe ceremony: “‘You don’t carry the pipe; the pipe carries you.’ This is a basic medicine teaching”(Pritchard, 1997, p.58).

Renewal can be ceremony for the landscape/place, sacred objects, self or all of creation. Renewal honors spirit and may be practiced differently by different Nations dependent upon the immediate environment of that Nation as Cajete suggests:

Traditionally, Indigenous peoples understand that compacts must be made between sources of life, the land, their place, and with the natural entities there. The key relationships they established are reflected in ceremonies. Fishing peoples in the Northwest established compacts with the animals they fished, and because they were also forest people, they made compacts with the trees and the entities of the natural processes of the forest. Compacts differ among desert peoples, plains peoples, coastal peoples, people living near volcanoes and so on.” (Cajete, 2000, p. 81)

Ceremony can happen daily or annually, for an individual or for the whole of the universe. “Native practices and ceremonies that specifically help people to remember and act on their responsibilities to the natural world and help perpetuate the harmony of the universe include world renewal ceremonies such as the Yurok White Deer Skin Dance, ceremonial complexities

such as the various forms of Plains Indian Sun Dance...” (Cajete, 2000, p. 74). Renewal practices happen daily, as well. One such ceremony in Blackfoot territory is the Sunrise ceremony. This is so in many nations: “People are expected to rise at dawn, face the east, make their offerings and begin their daily activities” (Cajete, 2000, p. 224).

Renewal can involve one or many. It may include objects or the manipulation of space, place and time. “Humans were responsible for the renewal and offering of those objects. Offerings gave back to the gods that which was their property from the start “(Cajete, 2000, p. 124). The sweatlodge is used as a sacred space of purification and rebalance, and a conduit to spiritual helpers. This ceremony is held in complete darkness. Some Nations refer to the sweat as the womb of the mother, through which the participant is transported to the beginning time of life and has the ability to transcend “normal” time constraints. This manipulation of space enhances the ability of the participants to remove themselves from the outer world and its illusions of time.

Renewal ceremonies carry great responsibility. One engages in ceremony with intention. Dianne Meili, referring to Elder Joe Crowshoe from the Peigan Reserve, in her book, *Those Who Know: Profiles of Alberta’s Native Elders*, writes:

When Joe opens his bundle, he must pay meticulous attention to performing numerous songs and dances of the ceremonial properly, lest he make a mistake and bring misfortune upon himself and others. This requires a remarkable memory and patience during the hours-long ceremony. If humans pray and sing messages to animals, showing they respect them and want to live beside them always, they will respond and perhaps offer, on a spiritual level, assistance. (Meili, 1991, p. 104)

Utmost respect for method and process are integral to ceremony, otherwise one might invite harm to oneself or the community. “This dynamic balance in the natural order had to be maintained

and reestablished through ceremony and ritual, the proper execution of prayer, and care for oneself and one's community. Balance was emphasized through ceremonial calendars from year to year and generation to generation" (Cajete, 2000, p. 119). The ultimate goal of achieving balance extends from the inner workings of heart and spirit to the outer physical world. "Offerings and prayers of thanksgiving made to animals taken were a part of a well-evolved web of spiritual relationships gained through the Indigenous process of participation with nature" (Cajete, 2000, p. 161). Maintaining balance was crucial to survival: "If you depend upon a place for your life and livelihood, you have to take care of that place or suffer the consequences" (Cajete, 2000, p. 79). Cajete reiterates:

During the ten-thousand year tradition of hunting among Indigenous tribes in America, songs, ceremonies, rituals and art forms evolved that ensured the sources of the hunter and the very survival of the communities and families they represented. Rituals cultivated a spiritual quality in the act of hunting. Such rituals were founded upon an intimate understanding of the behavior of the animals hunted, a respect for their life needs and for the ways those animals should be properly used and treated. These understandings formed the basis for an ecological ethic of such a depth and intimacy that it continues to have a profound impact on contemporary Indigenous people. (Cajete, 2000, p. 159)

It is through renewal ceremonies that influence is created. That influence returns as a created reality; in which case, we have observer-created reality.

Observer-Created Reality

Order is created out of the chaos/flux, through ceremony and renewal. Renewal (ceremony) keeps order in the cosmos and this concept complements notions of observer-created reality. As Peat observes:

Native science, for its part, is concerned with relationship, harmony and balance of the movement of the sun, moon and planets; the sequence of seasons; the arrival of the thunderbirds in spring; the four winds; the movements of game; and the fertility of the land. Scientific control of these phenomena would imply a distancing and a separation from them. The use of ceremony and renewal within

Native traditions involves a different metaphysics. Ceremonies are held to ensure success in hunting or in planting corn. In these ceremonies direct participation within natural processes is called for, along with acts of obligation and sacrifice. To hold a ceremony in order that the sun will rise tomorrow is different from the desire to seek a way of controlling, or exerting force, over the sun's movement. (Peat, 2002, p. 254)

Observer-created reality is the manifestation of reality, from the invisible to the visible, through intention, ceremony and thought. This requires a reciprocal dialogue of give-and-take with the cosmos. Peat reiterates:

Indigenous peoples are also able to make use of certain processes in order to bring about desired effects. Indeed, the bringing about of effects, or entering into relationship with them, is very important. Examples include the ability to heal and to extract diseases from the body, or to negotiate with clouds in order to produce rain. Songs could also be thought of as processes, or scientific instruments, that bring about certain effects. And if Indigenous science is not so concerned with control, it is definitely occupied with the idea of power or energy. For, in order for a person to move within a world of powers, spirits, and energies, it is very important to have a map, to be able to enter into relationships with the surrounding energies and to have knowledge of the sources of power. (Peat, 2002, p. 254)

It is based on the premise that all relationships exist in a marriage of influence and communication. Dreams are reality, animals speak and rocks hold power. To influence this relationship requires sacrifice, obligation, responsibility and negotiation through renewal ceremony. "Herein lies the true power of individual and collective creativity and its subtle power to influence the entire world ... a single individual's vision may transform a society or ... a rain dance, done properly with one mind, can bring rain" (Cajete, 2000, p.19). "Can bring rain" is the premise of observer-created reality. Renewal, action and intention manifest a desired result. Communication involves respect, proper protocol, listening, acceptance and action. "It must be emphasized that what we think and believe and how we act in the world impacts on literally everything. We bring our reality into being by our thoughts, actions and intentions" (Cajete, 2000 p.73). Peat says:

The stress is laid upon direct subjective experience and upon closeness to nature. The powers, energies, and spirits of the world are personified to the extent that it is possible to enter into direct relationship with these elements and negotiate pacts, compacts, and ways of living together with them. If objectivity implies the ability to abstract and distance oneself from nature, then this is definitely missing within Indigenous science. In its place, however, stand consistency, integration, harmony, and balance. (Peat, 2002, p.255)

The contemporary view of science consists of experiments, technology and research. Given that Native science is a way of life, and that Native paradigm and Native science are one in the same, it is easy to understand the confusion. Western science has clear boundaries and markers in the quest for knowledge, regardless of outcome. We now have a planet in crisis. Our Mother suffers the indignities of a world gone mad with unbridled desire. The Western world has created a reality of “more is better,” and “my better must be better than yours.” Such thinking has led to inequity, fuelled by greed and a lust for power, which has bred fear and hatred among those who do not “have.” *Imbalance*. Let’s call it observer-created reality—Western style. The scientific sanctions of control and fragmentation have created a global mentality that is out of control and taking the sacred Mother with her. Great minds are challenging old methods and crying out in the darkness, warning humanity to change its ways. Suzuki and Knudson reiterate:

... our problem is inherent in the way we perceive our relationship with the rest of Nature and our role in the grand scheme of things. Harvard biologist, E.O. Wilson, proposes that we foster biophilia, a love of life. He once told me, “We must rediscover our kin, the other animals and plants with whom we share this planet. We are related to them through our DNA and evolution. To know our kin is to come to love and cherish them.” (Suzuki and Knudson, 1993, p. xxx)

These metaphysical concepts do not work in concert with Western ideology.

One can only speculate what would have happened if Native science/paradigm had been the dominant paradigm upon contact. Imagine a world where equality and sustainability manifested in a respectful relationship with all life. Imagine reverence for the four-leggeds, the stone people,

the plant people, water beings, and the star people. Imagine spirit as a fundamental truth and recognized ally. Imagine all relationships being interdependent and supportive of each other. Imagine living in a sacred environment, fully engaged, aware of each and every action. Imagine if your every thought had a direct, observable result. Imagine that your prayers made the flowers bloom and the sun rise before your eyes. You would pay attention. In the article; *The Nature and Utility of Traditional Ecological Knowledge*, Milton Freeman states:

The essential difference between the scientists' approach to knowing what is happening and that of the tradition-based resource user is not the difference existing between the attenuated database available to the scientist compared to the more extensive dataset of the local user. Nor is it the reductionism of the scientist versus the holism of the local resource user, important as these particular differences may be. Perhaps the principal difference is epistemological: the scientist is concerned with causality, with understanding an essentially linear process of cause and effect. This case of causes of observed effects can be measured and understood, then predictive statements about future outcomes can be made and the natural world can be managed. But the non-Western forager lives in a world not of linear causal events but of constantly reforming multidimensional interacting cycles, where nothing is simply a cause or an effect, but all factors are influences impacting other elements of the system-as-a-whole. Linear approaches to analysis cannot be applied to cyclical systems, and, as everyone now realizes, ecosystems are in fact complex cycles of recirculating energy matter, and relationships. Nowhere does the Cartesian model of modern science fail so completely and utterly as in trying to explain the workings of natural ecosystems. (Freeman, 1992, p. 10)

There are those who think that this is in process and they come from Western science. They are physicists who engage in the wisdom of the elders through dialogue. They are the scientists who recognize that holistic relationship may save humanity. They are cutting-edge scientists who suggest that quantum physics is the bridge that is creating an alliance between the Native scientist and the Western physicist. Ancient practice gives way to the irrefutable truth of molecular reality.

Chapter Five - The Foundations of Quantum Physics

A Story

There is a story I know. It's about the earth and how it floats in space on the back of a turtle. I've heard this story many times, and each time someone tells the story, it changes. Sometimes the change is simply in the voice of the storyteller. Sometimes the change is in the details. Sometimes in the order of events. Other times it's the dialogue or the response of the audience. But in all the tellings of all the tellers, the world never leaves the turtle's back. And the turtle swims away.

One time, it was in Lethbridge I think, a young boy in the audience asked about the turtle and the earth. If the earth was on the back of the turtle, what was below the turtle? Another turtle, the storyteller told him. And below that turtle? Another turtle. And below that? Another turtle.

The boy began to laugh, enjoying the game, I imagine. So how many turtles are there? he wanted to know. The storyteller shrugged. No one knows for sure, she told him, but it's turtles all the way down. (King, 2003, p. 31, 32)

The field of quantum physics began as a collective birth, heralding a new way of understanding reality. "Newtonian physics still is applicable to the large-scale world, but it does not work in the subatomic realm. Quantum mechanics resulted from the study of the subatomic realm, that invisible universe underlying, embedded in, and forming the fabric of everything around us" (Zukav, 1979, p. 19).

The midwives of quantum mechanics as identified by Capra were such international scientists as:

...Max Planck, Albert Einstein, Niels Bohr, Louis de Broglie, Erwin Schrodinger, Wolfgang Pauli, Werner Heisenberg, and Paul Girac. These men joined forces across national borders to shape one of the most exciting periods of modern science, one that saw not only brilliant intellectual exchanges but also dramatic human conflicts, as well as deep personal friendships, among the scientists. (Capra, 1982, p. 77)

New revelations about the molecular world catapulted physicists out of the Newtonian comfort zone and into the minute realm of probabilities, randomness and spooky action at a distance. Up to the early 1900s, everything in the universe, including space and time, were believed to operate according to Newton's laws—predetermination, predictability, no effect without cause—everything worked like a finely-tuned machine, flawlessly operating within a well-ordered universe.

Quantum physics changed those notions. “The new physics necessitated profound changes in concepts of space, time, matter, object, and cause and effect; and because these concepts are so fundamental to our way of experiencing the world, their transformation came as a great shock (Capra, 1982, p. 77). Here Capra states:

This exploration of the atomic and subatomic world brought scientists with a strange and unexpected reality that shattered the foundations of the worldview and forced them to think in entirely new ways. ...Every time they asked nature a question in an atomic experiment, nature answered with a paradox, and the more they tried to clarify the situation, the sharper the paradoxes became. In the struggle to grasp this new reality, scientists became painfully aware that their basic concepts, their language, and their whole ways of thinking were inadequate to describe atomic phenomena. (Capra, 1982, p. 76)

“Quantum theory, or quantum mechanics as it is also called, was formulated during the first three decades of the century” (Capra, 1982, p. 77). Zukav explains that:

A “quantum” is a quantity of something, a specific amount. “Mechanics” is the study of motion. Therefore, “quantum mechanics” is the study of the motion of quantities. Quantum theory says that nature comes in bits and pieces (quanta), and quantum mechanics is the study of this phenomenon. Quantum mechanics does not replace Newtonian physics, it includes it. The physics of Newton remains valid within its limits. (Zukav, 1979, p. 19)

Physicists want to know how the universe works. To the ordinary layman: “physicists are explaining the world” (Zukav, 1979, p. 8). Physicists explore energy, force and motion. The

language they use to access that knowledge is mathematics. “Mathematics is the tool of physics” (Zukav, 1979, p. 4). Zukav states:

High-energy particle physics is the study of subatomic particles. It usually is shortened to “particle physics”. Quantum theory and relativity are the theoretical tools of particle physics... The original purpose of particle physics was to discover the ultimate building blocks of the universe. This was to be accomplished by breaking matter into smaller and smaller pieces, eventually arriving at the smallest pieces possible. The experimental results of particle physics, however, have not been so simple. (Zukav, 1979, p. 195)

Max Planck is considered the father of quantum physics. In a competitive effort with France to improve the quality of steel, Plank was hired by Germany to enhance the efficiency of the steel furnace. Plank studied ultraviolet catastrophe, or why colour changes when temperature increases, such as from red hot to white hot (S. Kounosu, personal communication, n.d.). Classical physics says that light should remain the same colour when exposed to high temperatures. “Plank mathematically dissected chunks of light into what he called “quanta”, which were in essence small packets of energy. Plank himself was uncomfortable with his discovery because it: “involved an assumption so bizarre that he distanced himself from it for many years afterward: that energy was emitted only in certain finite chunks, or ‘quanta’. Yet this strange assumption proved extremely successful” (Tegmark and Wheeler, 2001, p. 69). The word quanta is derived from the Latin word *quantus* which means “how much”.

Atoms were first thought to be solids, much like a period at the end of a sentence, with smaller particles called elementary particles revolving around the nucleus, like planets around the sun. The whole idea of solid, unbreakable atoms gave way to a vision of electrons surrounding the nucleus. Then the nucleus was discovered to consist of protons (positively charged particles) and neutrons (neutral particles). Much later, it was discovered that within the particles, electrons and

protons are quarks. Electrons (negative charge) orbit the nucleus, creating a surreal essence of energy that is more ethereal than tangible. “Atoms consist of particles, and these particles are not made of any material stuff. When we observe them we never see any substance; what we observe are the dynamic patterns continually changing into one another—the continuous dance of energy” (Capra, 1982, p. 91). This notion of invisibility is supported by Zukav:

A subatomic particle cannot be pictured as a thing; therefore, we must abandon the idea of a subatomic particle as an object. Quantum mechanics views subatomic particles as “tendencies to exist” or “tendencies to happen”. How strong these tendencies are is expressed in terms of probabilities. A subatomic particle is a “quantum”, which means a quantity of something. (Zukav, 1979, p. 32)

Two problems exist in the study of the subatomic realm. The first is size. “The smallest object that we can see, even under a microscope, contains millions of atoms. To see the atoms in a baseball, we would have to make the baseball the size of the earth” (Zukav, 1979, p. 31). The second problem is location: “Its fleeting parts and processes are not revealed to the curious physicist’s ‘eye’ in sharp relief: rather, they appear as if glimpsed through a perpetual haze, as cottony clouds of probability” (Suzuki, 1992, p.78).

“A quantum leap is a random, discontinuous jump, an abrupt change in a system without a transitory trail. All matter is subject to quantum leaps, an emission or absorption of energy. This anomaly is not visible because of size, but if one were able to see these ‘jumps’ the world would present itself as a continuous moving tapestry of erratic energy. The jump of an electron from one atomic orbit to another, or the disintegration of a subatomic particle, may occur spontaneously without any single event causing it. We can never predict when and how such a phenomenon is going to happen. We can only predict its probability” (Capra, 1982, p. 86). “Contrary to Newtonian physics, quantum mechanics tells us that our knowledge of what governs events on

the subatomic level is not nearly what we assumed it would be. It tells us that we cannot predict subatomic phenomena with any certainty. We can only predict their probabilities” (Zukav, 1979, p. 28).

In 1805, Thomas Young, author of the *Double Slit Theory*, designed the following experiment to identify the properties of light. The results of this experiment would cement the foundation of the quantum theory. Zukav explains:

He used an experiment that was both simple and dramatic. In front of the light source (Young used sunlight coming through a hole in a screen) he placed a screen with two vertical slits in it. Each slit could be covered over with a piece of material. On the other side of the double slit screen was a wall against which the light coming through the double slit could shine. When the light source was turned on and one of the slits was covered up, the wall was illuminated like the first drawing on the next page. When both slits were uncovered, however, Young made history. The projection on the wall should have been the sum of the light from the two slits, but it wasn't. Instead the wall was illuminated with alternating bands of light and darkness! How could this happen? The simplicity of the answer is what makes this experiment a great one. The alternating light and dark bands are well known phenomena of wave mechanics called interference. Interference results when the waves of light diffracting from the two slits interfere with each other. (Zukav, 1979, p. 60-61)

Despite the fact that Young's double slit theory confirmed light acted as a wave, Young was ostracized by the scientific community. Subsequent experiments, however, proved that Young's assertions were correct as demonstrated by the following experiment using protons instead:

The experiment is set up as before, except that only one slit is open. Now we fire the photon, it goes through the open slit and we mark where it hits the wall (using a photographic plate). Because we have done this experiment before, we notice that the photon has landed in an area that would be dark if the second slit were open. That is, if the second slit were open, no photons would be recorded in this area. To make sure, we do the experiment again, but this time we leave both slits open. Just as we thought, there are no photons recorded now in the area where the photon hit our first experiment. When both slits are open interference is present, this area is in the middle of the dark band. The question is, “How did the photon in the first experiment know that the second slit was not open?” Think about it. When both slits are open there are always alternating bands of illuminated and dark areas. When we fired our photon and it went through the

first slit, how did it “know” that it could go to an area that must be dark if the other slit were open? In other words, how did the photon know that the other slit was closed? There is no definitive answer to this question. (Zukav, 1979, p. 63)

This experiment worked not only for protons and electrons, but for all quantum particles. The most controversial and stunning revelation was the propensity toward a conscious state. Gribbon qualifies:

“...the quantum entities seem to know when you are watching them, and adjust their behavior accordingly (again, we emphasize that this version of the experiment really has been carried out). Each single quantum entity seems to know about the whole experiment set up, including when and where the observer is choosing to monitor it, and about the past and future of the experiment.” (Gribbon, 1998, p. 113)

Particles *make choices* and *know* when they are being observed. As unbelievable as this seems, these are fundamental foundations of the subatomic reality. Zukav reiterates:

Some physicists, like E.H. Walker, speculate that photons may be conscious! Consciousness may be associated with all quantum mechanical processes... since everything that occurs is alternately the result of one or more quantum mechanical events; the universe is “inhabited” by an almost unlimited number of rather discrete conscious, non-thinking entities that are responsible for the detailed workings of the universe. (Zukav, 1979, p. 63)

The double slit theory: “... in the words of Richard Feynman, encapsulates ‘the central mystery’ of quantum mechanics” (Gribbon, 1998, p. 109). Light waves were the accepted theory until: “Einstein initiated two revolutionary trends in scientific thought. One was his special theory of relativity; the other was a new way of looking at electromagnetic radiation, which was to become characteristic of quantum theory, the theory of atomic phenomena” (Capra, 1982, p. 75).

Einstein experimented with Planck’s ideas of “quanta”, applying it to photons: “by assuming that radiation could transport energy only in such lumps, or ‘photons’, he explained the photoelectric

Niels Bohr introduced the notion of complementarity. He considered the particle picture and the wave picture two complementary descriptions of the same reality, each of them only partly correct and having a limited range of application. Both pictures are needed to give a full account of the atomic reality, and both are to be applied within the limitations set by the Uncertainty Principle. The notion of complementarity has become an essential part of the way physicists think about nature ...the revolution of the particle-wave paradox forced physicists to accept an aspect of reality that calls into question the very foundation of the mechanistic world view—the concept of the reality of matter. (Capra, 1982, pp. 79-80)

The uncertainty principle was developed by Werner Heisenberg in 1927. It states that the more you know about one aspect of a subatomic particle, like velocity (speed and direction), the less you can know about its position. The electron: "...itself does not have both a precise position and a precise momentum at the same time. At any instant, the electron itself cannot know both where it is and where it is going. (Some reference books still tell you that quantum uncertainty is solely a result of the difficulty of measuring position and momentum at the same time; do not believe them!)" (Gribbon, 1998, p. 417). What Gribbon is referring to here is that measurement is not the only defining marker of the uncertainty principle, but also refers to the indeterminacy of the particles themselves. Capra and Zukav support Gribbon:

It was Heisenberg's great achievement to express the limitations of classical concepts in a precise mathematical form, which is known as the Uncertainty Principle. It consists of a set of mathematical relations that determine the extent to which classical concepts can be applied to atomic phenomena; these relations stake out the limits of human imagination in the atomic world. Whenever we use classical terms – particle, wave, position, velocity – to describe atomic phenomena, we find that there are pairs of concepts, or aspects, which are interrelated and cannot be defined simultaneously in a precise way. The more we emphasize one aspect in our description, the more the other aspect becomes uncertain, and the precise relation between the two is given by the Uncertainty Principle. (Capra, 1982, p. 79)

Whatever it is that we are observing can have a determinable momentum, and it can have a determinable position, but of these two properties *we must choose*, for any given moment, which one we wish to bring into focus. This means, in reference to "moving particles" anyway, that we can never see them the way they "really are" but only the way we choose to see them. As Heisenberg wrote: What

effect, which is related to the processes used in present-day solar cells and the image sensors used in digital cameras” (Tegmark & Wheeler, 2001, p. 70). Zukav explains:

In short, Einstein demonstrated, using the photoelectric effect, that light is made of particles, or photons, and that the photons of high frequency light have more energy than the photons of low frequency light. This was a momentous achievement. The only problem is that 102 years earlier, an Englishman named Thomas Young had shown that light is made of waves, and no one, including Einstein, was able to disprove him. (Zukav, 1979, p. 54)

As further explorations reveal, both Young and Einstein were correct. “While electromagnetism dethroned Newtonian mechanics as the ultimate theory of natural phenomena, a new trend of thinking arose that went beyond the image of the Newtonian world-machine and was to dominate not only the 19th century but all future scientific thinking. It involved the idea of evolution: of change, growth and development” (Capra, 1982, p. 70).

In 1927, Niels Bohr, a Danish physicist, proposed the Copenhagen interpretation. Zukav reports that:

In the autumn of 1927, physicists working with the new physics met in Brussels, Belgium... What they decided there became known as the Copenhagen Interpretation of Quantum Mechanics... The Copenhagen Interpretation marks the emergence of the new physics as a consistent way of viewing the world. It is still the most prevalent interpretation of the mathematical formalism of quantum mechanics. (Zukav, 1979, p. 37)

The Copenhagen interpretation “... marked the completion of a consistent theory of quantum mechanics in a form where it could be used by any competent physicist to solve problems involving atoms and molecules...” (Gribbon, 1998, p. 88). The ideas of uncertainty principle and complementarity are both essential aspects of the Copenhagen interpretation. Complementarity proposed that energy could act as both particle and wave at the same time; either/or was just not part of the equation, one had to think in terms of coexisting dualities. Capra explains further:

we observe is not nature itself, but nature exposed to our method of questioning.
(Zukav, 1979, p. 114)

The Copenhagen interpretation validated the quantum world. “The Copenhagen Interpretation said, in effect, that it does not matter what quantum mechanics is about. The important thing is that it works in all possible experimental situations. This is one of the most important statements in the history of science” (Zukav, 1979, p. 37).

At this point in the quantum world, we have particles that transform as particles or waves, make choices and know when you are watching them! But quantum behavior would reveal a stranger phenomenon yet. Non-locality is the term used to describe instantaneous communication between particles. Einstein refused to believe that anything could travel faster than the speed of light.

Capra reiterates:

Einstein could never accept the existence of non-local connections and the resulting fundamental nature of probability. ...Einstein had to admit that quantum theory, as interpreted by Bohr and Heisenberg, formed a consistent system of thought, but he remained convinced that a deterministic interpretation of terms in terms of local hidden variables would be found sometime in the future. (Capra, 1982, p. 82)

To refute the possibility of non-locality, Einstein proposed that hidden variables generated instantaneous communication and that quantum mechanics was an incomplete theory. To prove his point, Einstein developed: “...a thought experiment that has become known as the Einstein-Podolsky-Rosen (EPR) experiment” (Capra, 1982, p. 83). As Horgan explains:

Together with Podolsky and Nathan Rosen, Einstein proposed a thought experiment—now called the EPR experiment—involving two particles that spring from a common force and fly in opposite directions. According to the standard model of quantum mechanics, neither particle has a definite position nor momentum before it is measured, but by measuring the momentum of one particle, the physicist instantaneously forces the other particle to assume a fixed position—even if it is on the other side of the galaxy. Deriding this effect as

“spooky action at a distance”, Einstein argued that it violated both common sense and his own theory of special relativity which prohibits the propagation of effects faster than the speed of light. Quantum mechanics must therefore be an incomplete theory. (Horgan, 1996, p. 88)

In 1964, John Bell challenged the [Albert Einstein, Boris Podolsky and Nathan Rosen], thought experiment and as Capra states:

Three decades later, John Bell derived a theorem, based on the EPR experiment, which proved that the existence of local hidden variables is inconsistent with the statistical predictions of quantum mechanics. Bell’s theorem dealt a shattering blow to Einstein’s position by showing that the Cartesian conception of reality as consisting of separate parts, joined by local connections, is incompatible with quantum theory. (Capra, 1982, p. 83)

Non-locality was verified experimentally by Alain Aspect and colleagues in 1982. Horgan relates:

In 1980, however, a group of French physicists carried out a version of the EPR experiment and showed that it did, indeed, give rise to spooky action. (The reason that the experiment does not violate special relativity is that one cannot exploit non-locality to transmit information.) Bohm never had any doubts about the outcome of the experiment. “It would have been a terrific surprise to find out otherwise,” he said. (Horgan, 1996, p. 88)

Non-locality was the final nail in the Newtonian coffin proving 1. that subatomic particles do have the ability to communicate instantaneously despite distance and 2. that the universe is interconnected, an undivided wholeness. “Thus, if all actions are in the form of discrete quanta, the interactions between different entities (example given, electrons) constitute a single structure of indivisible links, so that the entire universe has to be thought of as an unbroken whole” (Bohm, 1980, p. 175). In fact this unbroken whole could be thought of as a grand unifying theory, but not the one Einstein was looking for.

Einstein could not accept the paradoxical nature of the quantum world and for the rest of his life he focused his energy on the quest for a grand unified theory. “Einstein strongly believed in nature’s inherent harmony, and throughout his scientific life, his deepest concern was to find a unified foundation of physics” (Capra, 1982, p. 75). But the door was open to a new and mysterious world, invisible to the eye, a world that explained the paradoxical nature of matter. The fundamentals of quantum paradigm, mathematically expressed and experimentally proved, are established in probability, uncertainty, observer influence and non-locality. Accepting the ambiguous nature of particles and probability permanently cracked the walls of classical determinism. What follows is a chart that depicts differences between the classical Newtonian view of physics and quantum mechanics (Table 1).

Table 1 Summary of differences between Newtonian physics and quantum mechanics.

Newtonian Physics	Quantum Mechanics
<ul style="list-style-type: none"> ◆ Can picture it. ◆ Based on ordinary sense perception. ◆ Predicts events. ◆ Describes things: individual objects and space and their changes in time. ◆ Assumes an objective reality “out there”. ◆ We can observe something without changing it. ◆ Claims to be based on “absolute truth”; the way that Nature really is “behind the scenes”. 	<ul style="list-style-type: none"> ◆ Cannot picture it. ◆ Based on behaviour of subatomic particles and systems not directly observable ◆ Describes statistical behaviour of <i>systems</i>. ◆ Predicts probabilities ◆ Does not assume an objective reality apart from our experience. ◆ We cannot observe something without changing it. ◆ Claims only to correlate experience correctly.

Zukav, 1979, p. 41.

Quantum Potential

Physicist David Bohm studied plasma (a highly-charged, subatomic rich gas). He noticed that electrons behaved as a connected whole, which he called plasmons. The difference between individual particles expressing non-locality, and the particle party that Bohm observed in his study of plasma, was that all the particles knew what each other was doing. According to Bohm: "photons ...are able to register what happens to one another, not because they are sending signals back and forth, but because their separateness is an illusion and they are actually all part of the same fundamental and cosmic unity" (Talbot, 1993, p. 146). In other words, instant communication did not exist just between two particles, but rather among all the particles simultaneously because, in essence, they were all one and the same.

This led Bohm to believe that a deeper reality, an interconnected whole, was host to the party. This subfield is the catalyst below the quantum level. He named this host or subfield the quantum potential. Bohm's investigations into order coalesced when he saw a demonstration that included a double cylinder with glycerine infused in between the two sides. A drop of ink was dropped into the glycerine and rotated. The ink disappeared. Upon rotation to its previous position the ink reappeared. Horgan explains:

His ideas were inspired in part by an experiment he saw on television in which a drop of ink was squeezed into a cylinder of glycerine. When the cylinder was rotated, the ink diffused through the glycerine in an apparently irreversible fashion. Its order seemed to have disintegrated. But when the direction of rotation was reversed, the ink gathered into a drop again. Upon this simple experiment, Bohm built a worldview called the implicate order. Underlying the apparently chaotic realm of physical appearances—the explicate order—there is always a deeper, hidden implicate order. (Horgan, 1996, p. 88)

These two orders, the implicate order and the explicate order, dance in an endless embrace, folding upon and within each other. The dance itself is called the holomovement. Capra reiterates:

In his view, the holomovement is a dynamic phenomenon out of which all forms of the material universe flow. The aim of his approach is to study the order enfolded in this holomovement, not by dealing with the structure of objects, but rather with the structure of movement, thus taking into account both the unity and dynamic nature of the universe. To understand the implicate order, Bohm has found it necessary to regard consciousness as an essential feature of the holomovement and to take it into account in his theory. He sees mind and matter as being interdependent and correlated, but not causally connected. They are mutually enfolding projections of a higher reality which is neither matter nor consciousness. (Capra, 1982, p. 96)

The holomovement is an unending process from an unbroken whole, the quantum potential, from which the explicate and the implicate orders emerge. Bohm explains:

...This enfoldment or unfoldment takes place not only in the movement of the electromagnetic field but also in that of other fields. ...So the totality of movement of enfoldment and unfoldment may go immensely beyond what has revealed itself to our observations thus far... We call this totality by the name holomovement ...though the full set of laws governing its totality is unknown (and, indeed, probably unknowable) nevertheless these laws are assumed to be such that from them may be abstracted relatively autonomous or independent sub-totalities of movement (example given, fields, particles, et cetera). Having a certain recurrence and stability of their basic patterns of order and measure. (Bohm, 1980, p. 178)

To reiterate:

The implicate order has its ground in the holomovement which is, as we have seen, vast, rich, and in a state of unending flux of enfoldment and unfoldment, with laws most of which are only vaguely known, and which may even be ultimately unknowable in their totality. (Bohm, 1980, p. 185-186)

The quantum world defies all our notions of common sense. It is a world of probability, uncertainty, complementarity, paradox and 'spooky action at a distance'. Energy comes in little packets that randomly jump in erratic, discontinuous spurts of excitation. Chaos defines order. Particles point and wave at the same time, dependent upon observation. Particles communicate instantaneously and Newton's ordered world crumbles under the weight of microscopic mayhem. According to David Bohm, the key features of quantum theory that challenged mechanism are:

1. Movement is in general discontinuous, in the sense that action is constituted of indivisible quanta (implying also that an electron, for example, can go from one state to another without passing through any states in between).
2. Entities, such as electrons, can show different properties (example given, particle-like, wave-like or something in between), depending on the environmental context within which they exist and are subject to observation.
3. Two entities, such as electrons, which initially combine to form a molecule and then separate, show a peculiar non-local relationship, which can best be described as a non-causal connection of elements that are far apart (as demonstrated in the experiment by Einstein, Podolsky, and Rosen). (Bohm, 1980, p. 175)

Bohm presents an enduring argument to rectify the anomalies through four orders: the quantum potential, the holomovement, the implicate order and the explicate order. The new quantum physics consists of such theories as the superstring theory, the many worlds theory, symmetry and super-symmetry. The aim is always the same, to unify the laws of relativity and the quantum world. None has succeeded. As Heisenberg wrote: "What we observe is not nature itself, but nature exposed to our method of questioning" (Zukav, 1979, p. 114). Repeated testing, experiments, and verifiable results prove the quantum world dictates the properties of all matter and defies Newton's laws. It is a world onto itself. Zukav elaborates:

Particle physics shows us that the "rest of the world" does not sit idly "out there". It is a sparkling realm of continual creation, transformation, and annihilation. The ideas of the new physics, when wholly grasped, can produce extraordinary experiences... Each of these different experiences is capable of changing us in such ways that we never again are able to view the world as we did before... The experience is always changing. (Zukav, 1979, p. 16)

Chapter Six: A Comparative Analysis of Quantum Physics and Native Science

A Story

The tradition of the drum had been going on for many years, before the non-Dene came into our country. The old people tell me that the Creator gave our people medicine powers to help them survive the hardships of living. It was part of religion. All people did not have the same kind of powers. Some individuals had strong medicine power, and to some a drum song was given. It is known that three or four of these special people existed in every tribe. Our people had some songs just for fun and dancing, but the sacred drum songs were to be used for praying, healing and looking into the future. Life was so hard in the old days people depended on the drum songs. They prayed to the Creator through the drum song. Some of the songs are thanksgiving songs to the Creator when people gathered together after they'd been apart all winter. Spiritual songs come from different areas and people learned them from each other. There are also different ways that people got their songs, through visions or through their medicine powers.

For example, there was a man who had a vision in which four drums appeared in front of him. No one was holding those drums, yet it was just like someone was singing. The man knew that it was meant for him, so he didn't have to learn it. He just sang the song, words and all. It had lots of power. This particular song was a preaching song. The words went something like this,

“My people, the time on this earth is very short, so be good people. Help each other. You have to work hard for a living. That's part of the order of our Creator. But don't complain. Love each other. Listen to this drum song and live by it. If you do this, you will see the promised land.”

There was another special man who could look into the future with the drum. He would hit the drum and then he would predict important things that would happen. Because of the powers he possessed, the people had great respect for this man. People were good in that area of the land.

We all know that in the early days, the Dene kept moving around, following the game, but every summer they would have a gathering of all the people. And that's when they would have the big Ti Dance. At that time, their medicine people would sing prayer songs, and they would concentrate and ask the Creator for what the people needed. They would start walking slowly in a circle as they sang and the crowd followed. Everyone sang, and in doing that, they were praying, too. They would do a couple of rounds and stop and then start a different song. Some songs were for thanksgiving, some were to have good luck and good health. And after the prayers, the social part of the Ti Dance, just to have a good time, would begin. This was the proper traditional way to conduct a Ti Dance in the old days. (Dene, 1984)

Western science bears an allegiance to linear notions of time and space, and a belief in a smooth, well-ordered universe. Embedded within that belief is an unswerving dedication to the scientific

method, an approach which has simultaneously produced miracles and global fragmentation. Native science is a holistic, spiritually cohesive process, alive with an interrelated energy, but its concepts have been buried beneath the precepts of Western ideology. Quantum theory postulates probability, paradox, uncertainty, complementarity and non-locality as tangible concepts, and believes in an invisible interconnected flux that binds matter to reality. As we can see, three mutually exclusive agreements operate simultaneously in the human consciousness on the planet at this time. Although Western science ideology dominates, two of the agreements share commonalities: quantum physics and Native science. Western science has suffered the shock of quantum theories which have challenged Newton's holy notions of universal operation as Bohm points out:

The Cartesian order is suitable for analysis of the world into separately existent parts (example given particles or field element). ...We look into the nature of order with great generality and depth, and discover that both in relativity and in quantum theory the Cartesian order is leading to serious contradictions and confusions. This is because both theories imply that the actual state of affairs is unbroken wholeness of the universe, rather than analysis into independent parts. Nevertheless, the two theories differ radically in their detailed notions of order. Thus, in relativity, movement is continuous, causally determinate and well defined, while in quantum mechanics it is discontinuous, not causally determinate and not well defined. (Bohm, 1980, p. xiii)

The shock that the universe is not as predictable as was once thought, is still not enough to convince the scientific community that perhaps Native science deserves more scrutiny. Quantum theory validates concepts of Native American paradigm. The elements of quantum physics have been in application for thousands of years in Native American paradigm. "Western science used to laugh at the Native cosmology as 'primitive superstition'. At best, it romanticized the cosmology as 'beautiful poetry', but it wasn't 'real'. Then there came relativistic quantum (the second quantization). The new physics said that Natives are not wrong. In deeper science, there are things the old science did not know" (S. Kounosu, personal communication, n.d.). The allegiance between quantum theory and Native science is manifest in constant flux, trickster, chaos theory, animate, interrelationship or interconnectedness, and

observer created reality. But unlike Native science, quantum physics (experimentally founded) does not subscribe to notions of sacred space or renewal.

Constant flux is the idea that the cosmos is in a state of constant flux or movement. If we could see the subatomic level, we would see a tapestry of unpredictable continuous movement, like popcorn popping, or the way the ribbons move on a man's fancy dance regalia as he dances. "According to particle physics, the world is fundamentally dancing energy, energy that is everywhere, incessantly assuming first one form then another. What we have been calling matter (particles) constantly is being created, annihilated and created again. This happens as particles interact and it also happens, literally, out of nowhere" (Zukav, 1979, p. 193-194).

"The world of particle physics is a world of sparkling energy forever dancing with itself in the form of its particles as they twinkle in and out of existence, collide, transmute and disappear again" (Zukav, 1979, p. 194). Native America has always believed in energy waves. Out of this wave energy, patterns develop. In Native American paradigm, and consequently science, these patterns manifest as sacred astronomy; cycles of the seasons; birth, death and rebirth; growing seasons; bird migrations; sunrise and sunset. Patterns are identified through sacred mathematics. The number four encompasses the four directions, the four chambers of the heart, the mental, physical, spiritual and emotional, the four elements, and so on.

Coincidentally, four forces make up all that is known about the operational mechanics of the universe; electromagnetism, gravity, strong force and the weak force. Interestingly David Bohm's notions of order—the quantum potential, the holomovement, and the resulting implicate and explicate orders—equal four as well. Observe a fancy dancer's ribbons as they twirl and sway in frenzy (flux), while the dancer's feet move rhythmically (pattern) to the heartbeat of the drum, and you will get a visual idea of the flux, and all the patterns within that flux. These patterns mark the importance of balance. It is the recognition that the cosmos is in constant motion, coupled with the commitment to harmonize with all patterns of energy that

distinguishes the Native scientist from the Western scientist. The Native scientist strives to be “in allegiance” with these fluctuating energies. There is no illusion of control; rather, one is in “awarement” or “being” with the patterns and energy.

This awarement is obvious in Indigenous languages, and in the meaning behind sound, as presented by Benjamin Lee Whorf. It is illustrated in the foundational values of reciprocity, creativity, subordination and diversity. Process, observation, relationship and experience are keys to being present in allegiance with the flux. Energy is everywhere and demands respect. For example, the Native biologist does not collect specimens at random. The Native biologist will wait for the correct time, based upon acute observation and direct knowledge, then make an offering to the spirit of the plant being and engage with prayer so that the medicine that the plant gives back is honoured and, therefore, potent. This methodology fosters respect for relationship, with the ultimate goal of maintaining balance.

In Western science, no such relationship exists. Matter is matter; it can be manipulated any way one sees fit. To the Native scientist, the notion of matter differs from that of the Western scientist. The old picture of an atom revolving around a nucleus, much like the planets around the sun, is obsolete. Physics has proven no such entity exists, and that this picture is only an analogy at best. "... 'Matter' is actually a series of *patterns out of focus*. The search for the ultimate stuff of the universe ends with the discovery that there *isn't any*. If there is any ultimate stuff of the universe, it is pure energy, but subatomic particles are not *made of* energy. They *are energy*" (Zukav, 1979, p. 193).

What many consider as empty space is actually full of energy: "In particle physics there is no distinction between empty, as in 'empty space', and not empty, or between something and not-something", or as Physicist David Bohm states: "...it may be said that space, which has so much energy, is *full* rather than empty" (Bohm, 1980, p. 191). "The theories of modern physics indicate that this state of

nothingness is, in fact, an infinite ocean of energy in potential " (Peat, 2002, p. 74-75). At any given moment, all matter in the universe is dancing to its own invisible beat, quanta energy.

Scholar Sa'ke'j Youngblood Henderson in conversation with physicist David Peat, explains: "Sa'ke'j Henderson once asked me what I thought a molecule was. I offered him an explanation from modern science, that a molecule is a geometrical arrangement of atoms. Of course, he knew this sort of answer, but replied that a molecule was an alliance of spirits, and that when taken into the body, this alliance dissolves and takes up new configurations" (Peat, 2002, p. 130). A harmonious relationship, an alliance with the spirits, a relational recognition—this is the goal of the Native scientist. And it requires timing.

Time is how we measure the units of our lives, but to the Native American time is circular. Westerners have been trained to believe in a linear notion of time: "Time separates us from the past and the future, but in Micmac, the emphasis is on the here and now" (Pritchard, 1997, 12). As described earlier, time in Native America thought is "now." It is attached to the rhythms of the moment, and that is still in operation today. Pritchard supports:

There is a past tense, and a future tense as well, there are tales of the great past, and prophecies of the future, but it all is related to the now. When anthropology students are upset when Algonquin people use modern conveniences as part of a sacred tradition, such as using a public address system at a powwow or a compound bow to go hunting, it is because they are confused by past and future. Native traditions have been in the process of constant change for 10,000 years yet are always in the now. (Pritchard, 1997, p. 12)

To the Native scientist, this sense of the now is crucial for outcome. Scientific instruments offer precision and can be utilized for expediency; however, as in the example of the harvester of the plant, all is for naught if the time of the plant itself is not in harmony with that of the harvester. In fact, one could say that the energy of the plant and the harvester must be in allegiance. In the "now," the attachment is not to the

appointment, but to the process. It is the relationship with the moment or, rather, the movement that is important—not the relationship to the timepiece. Time is “manifested” in the now, but it is continually “manifesting” in the flux; therefore, one must pay careful attention in the now. For those reasons, there is no word for time in some Native languages. Pritchard reiterates:

There is no word for time in the Micmac language, nor in most Algonquin tongues. You can't say it. You can ask “*Donn?*” or “When is it?” but your answer may be expressed in images, not numbers. There are words for day, *nagwew*, and night, *depkik*, one for sunrise, sunset, for one lunar cycle, one yearly cycle, youth, adulthood, and old age, but no word for an absolute time which measures the universe from outside of it. (Pritchard, 1997, p. 11)

In Native science, time is always expressed in waiting for the right moment. That moment may be the correct time to pick the sweetgrass, pollinate the corn or perform a ceremony. That moment will influence the results; therefore, everything must be done correctly and with great care. In Western thought, time is a psychological construct, a linear state that allows progress but only if it is forward. In linear time, relationship does not matter. In quantum physics and Native paradigm, time can move forwards or backwards. A particle that moves backwards is called an anti-particle. “In other words, according to quantum field theory, *an anti-particle is a particle moving backward in time*” (Zukav, 1979, p. 218), but: “experience has taught us to associate increasing entropy with the forward movement of time. . . . In short, time ‘flows’ in the direction of high probability, which is the direction of increasing entropy” (Zukav, 221).

Increasing entropy means increasing disorder; this means that the more complex the entity, the further away from pure essence or coherence a subatomic particle becomes, which is why we do not notice this subtlety in our macro state. The transition from micro to macro dilutes the original essence of subatomic movement. There is some evidence to support this “timelessness” at the level of consciousness as well. “*If at the quantum level, the flow of time has no meaning; and if consciousness is fundamentally a similar*

process; and *if* we can become [aware] of these processes within ourselves, then it is also conceivable that we can experience timelessness” (Zukav, 1979, 222).

It is this timelessness that the harvester is in tune with. It is this timelessness that allows the Native scientist to know when the “time” is right. If all this sounds a little strange and unbelievable, ask the ceremonialist who sits in the womb of the sweat lodge about time. Or ask the biologist who harvests a new strain of corn about time. Ask the Blackfoot traditionalist who engages in the sunrise ceremony about time, or rather timelessness.

Energy manifests as probability or chance. Native America has always understood the randomness of an ever-changing, dynamic cosmos that is chaotic in nature. Enter the trickster, epitome of unpredictability, chaos incarnate, the quantum leap manifest. Trickster is known as creator or flux. It is from creation that trickster appears in many different forms, using the properties of probability to shape-shift form, manipulate matter and transcend boundaries. The Western scientist may scoff at this notion of the trickster, but in the quantum world: “the position of a particle could not be defined with absolute certainty but only by statistical probability. If there is no absolute certainty at the most elementary level, then the notion that the entire universe is understandable and predictable from its components becomes absurd” (Suzuki and McConnell, 2002, p. 16).

Trickster lives in quantum reality, but not only in notions of probability or uncertainty. Integral to transmutation or shape-shifting is the ability to engage in quantum leaps. Quantum leaps are “discontinuous transitions” or instantaneous transformations of energy from one state of being to another – shape-shifters. “The quantum jump is not a dance. It is the abrupt collapse of the developing aspects of the wave function, except the one that actualises. The mathematical representation of the observed system literally leaps from one situation to another; with no apparent development between the two. . . . The quantum leap is from a

multi-faceted potentiality to a single actuality. The quantum leap is also a leap from a reality with theoretically infinite dimensions, into a reality which has only three" (Zukav, 1979, p. 75). The rules of four dimensions do not apply to the trickster. Trickster is known as chaos creator at the same time—a paradox, much like particle wave duality. In one quantum leap, trickster can manifest chaos from the creative at any given moment.

Native America has always left room in the circle for the trickster and for creativity to enter. Often the trickster teaches lessons through reversals that defy the sanctity of proper relationship, or breaks the boundaries of renewal, with chaos as the result. Westerners believe in a well-ordered universe, but Native American belief is that the cosmos is in flux (chaos) and that order is created through alignment or “awarement” of cyclical patterns, reinforced through renewal and relationship. Here again, there is an alignment between trickster and quantum physics. Zukav explains:

The old worldview was a picture of order beneath chaos. It assumed that beneath the prolific confusion of detail that constitutes our daily experience lie systematic and rational laws that relate them one and all. This was Newton's greatest insight: The same laws which govern falling apples govern the motion of planets. There is still, of course, much truth in this, but the worldview of particle physics is essentially the opposite. (Zukav, 1979, p. 194)

As previously stated, the Indigenous worldview subscribes to the notion that it is up to us to establish order from chaos, which is partially done by the observation of cycles, rhythms and patterns. Particle physics subscribes to this same viewpoint. Zukav states:

The worldview of particle physics is a picture of *chaos beneath order*. At the fundamental level is a confusion of continual creation, annihilation, and transformation. Above this confusion, limiting the forms that it can take, is a set of conservation laws. They do not specify what must happen as ordinary laws of physics do; rather they specify what cannot happen. They are permissive laws. At

the subatomic level, absolutely everything that is not forbidden by the conservation laws actually happens. (Zukav, 1979, p. 194)

Out of disorder, order is established, and it is the trickster that facilitates the process of establishing order in the flux. The trickster always brings gifts coming from a high degree of order. One might say that the notion of disorder is a matter of perspective. Talbot explains:

As Bohm delved more deeply into the matter, he realized there were also different degrees of order. Some things were much more ordered than others, and this implied that there was, perhaps, no end to the hierarchies of order that existed in the universe. From this it occurred to Bohm that maybe things that we perceive as disorder aren't disorder at all. Perhaps their order is of such an "indefinitely high degree" that they only appear to us as random. . . . (Talbot, 1991, p. 44)

The cosmos is in a constant state of readjustment in an effort to maintain balance. Trickster acts as a catalyst to maintain order, coming from a highly-ordered state of perfection and creativity, manifesting as chaos, but ultimately creating balance. Renewal is also creating balance. First Rider elaborates:

And as Peter was telling us his story about raven, it reminded me – was it Sam who wrote this paper called "Raven, The Original Scientist"? – it talks about the power of the raven, and, of course, how raven and many tricksters and many tribal people, how the world is chaotic, and how we create order through our connections and through our rituals. And how we continue to try and maintain a balance. It reminds me, because at home right now in Blackfoot territory, we're creating balance. We're just going through our Sun Dance. Our Sun Dance is going on right now, and that whole is about creating balance for us. So we're always very aware in Native science about experiencing that balance. (First Rider, Dialogues, 2003)

Remember that Gary Zukav, physicist and author of *Dancing Wu Li Masters*, suggests that atoms have consciousness. He cites Thomas Young's double slit theory experiment and poses the question: "*How did the photon in the first experiment know that the second slit was not open?*" (Zukav, 1979, p.62). This implies a consciousness on the part of the photon. Zukav explains:

The astounding discovery awaiting newcomers to physics is that the evidence gathered in the development of quantum mechanics indicates that subatomic “particles constantly appear to be making decisions! More than that, the decisions they seem to make are based on decisions made elsewhere. Subatomic particles seem to know *instantaneously* what decisions are made elsewhere, and elsewhere can be as far away as another galaxy.” The keyword is *instantaneously*. How can a subatomic particle over here know what decisions another particle over there has *made at the same time the particle over there makes it?* All the evidence belies the fact that quantum particles are actually particles. A particle, as we mentally picture it (classically defined) is a thing which is confined to a region in space. . . .For a particle here to know what is going on over there while it is happening, it must be over there. But if it is over there, it cannot be here. If it is in both places at once, then it is no longer a particle. This means that “particles” may not be particles at all. It also means that these apparent particles are related with other particles in a dynamic and intimate way that coincides with our definition of organic. (Zukav, 1979, p. 47)

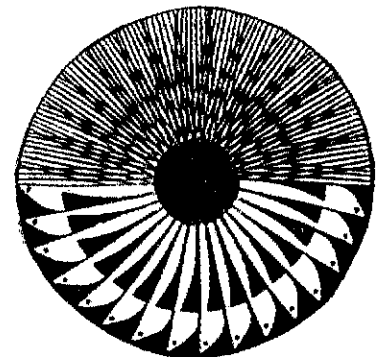
Quantum theory states that once two atoms have a relationship, they can never be separated; and they do, in fact, continue a discourse that operates instantaneously. “Thus, eighty-two years after Planck presented his quantum hypothesis, physicists have been forced to consider the possibility, among others, that the whole superluminal transfer of information between space-like separated events may be an integral aspect of our physical reality (Zukav, 1979, p. 296). This is called non-locality. Non-locality implies unity. Native American paradigm states that the whole of the cosmos is alive and imbued with spirit, including that which is considered inanimate. Begay and Maryboy explain further:

A deeper analysis of many of the Navajo stories will show the biased narrow limits of popular western thinking which disallow the deeper significance of story and song which, in fact, strongly correlate with the cutting edge of scientific thought, Quantum Physics, Chaos Theory and Systems Theory. Although Navajo and other native people may discuss these concepts through cultural and metaphysical story and song, they nevertheless will recognize similar fundamental concepts in quantum physics and chaos theory; however they may understand them within a spiritual consciousness. (Begay & Maryboy, 1998, p. 277)

Zukav says that electrons have consciousness and act collectively. David Bohm agrees and calls this collective consciousness the holomovement, an endless dance between the implicate and the explicate orders, a deep manifestation of the quantum potential. The quantum potential is the ultimate space/place of superbeing and knowing that eludes the vision of humanity, yet potentializes all of creation.

Bohm's observations of order resulted from the experiment with glycerine and ink encased in a cylinder. The ink is dropped into the cylinder, which is then rotated, where the ink turns to thread until it becomes: "too fine a thread for the eye to resolve it" (Nichol, 2004). If you turn the crank back the other way the ink reappears. "Flux story may have something to it. A little more diffusion in the implicate order and we become more defined. Like a Pueblo pot, a picture of emergence—underneath is the unknown, and the upper is formed" (Nichol, 2004). "Bohm's view is that we are emerging from another dimension just the same as the ink and then going back into it" (Gold, 2002).

Figure 2



Pueblo Pot – A Visual illustration of David Bohm's implicate and explicate order – Nichol, 2004

Creation stories speak of emergence: emergence from the earth; emergence from the sky; or emergence from a song—a vibration materialized. Navigating alternative dimensions is normal in Native America. It is from these dimensions that knowledge is sought and applied. Remember the story about the hunter who offers tobacco, and the animal that offers itself in return, the

transaction communicated in a dream? It is about co-creation with spirit dimension, which is sought after in ceremony, dreams and prayer.

It is in the sacred space of the quantum potential where spirit and quantum physics meet. The quantum potential is the catalyst of spirit, infinite potentiality, the Great Mystery, Creator—all that which we: “have the propensity to be” (Nichol, 2004). This concept mystifies the Western scientist because it challenges the tenets of Western science methodology, which is so adept at exclusion: “...Cambridge’s Brian Josephson, winner of the 1973 Nobel Prize in physics... “believes Bohm’s implicate order may someday even lead to the inclusion of God or Mind within the framework of science, an idea Josephson supports” (Talbot, 1991, p. 54). This view is not shared by all physicists and, in fact, both Bohm and Josephson have been ostracized by the scientific community at one time or another in their illustrious careers for making such daring assertions.

Thus far, it has not been scientifically proven that spirit exists. Native America paradigm is allied to spirit, the Great Mystery, the Creator. Everything exists within this spiritual realm that cannot be scientifically proved nor denied. The people of North America have always known that this atomised reality is but a dream. They have celebrated, conversed, visited and danced with the waves, while nurturing their relationship with this creative potentiality. It has been their survival, and it may one day prove to be the survival of all of humanity. “All of the things in our life have power, and how we use them and take care of them strengthens or limits their power for us. In the traditional way, everything has life spirit in and around it and should be treated with caution and respect, and perhaps awe” (Pritchard, 1997, p. 129).

Interconnectedness, or interrelationship, is another aspect of Native American thought because of the belief that everything is alive with energy or imbued with spirit; therefore, everything is connected. Pritchard explains:

Each thing we encounter on our journey is either the embodiment of one spirit or soul, *otchitchahau-mitch(oh)*, such as a person or moose or beaver, or it is imbued with a greater spirit or soul which can also be embodied elsewhere. A single blade of the great grass sweetgrass, *umptseegoabee*, puts you in touch with the spirit of sweetgrass everywhere, just as much as a whole armful would. It is all one spirit. (Pritchard, 1997, p. 131)

Quantum physics tells us that reality does indeed operate out of a whole as Suzuki and Knudson attest to:

The power and utility of scientific reductionism had been demonstrated in physics, where energy locked in all matter was released by splitting or fusing atoms. Yet physicists themselves were finding that the Newtonian paradigm was seriously flawed. Werner Heisenberg discovered that we can never really know what Nature is like because in order to observe it, we have to pin it down and thus change it; Niels Bohr found that the properties of subatomic particles can be described only by probability, never with absolute certainty. Parts of nature and other systems were shown to interact *synergistically* so that the actions and properties of a system as a whole cannot be predicated on the basis of what is known about its individual components. Thus, while science yields powerful insights into isolated fragments of the world, their sum total is a disconnected, inadequate description of the whole. Ironically, scientists today are faced with the devastating possibility that the whole is greater than the sum of its parts. (Suzuki and Knudson, 1993, p. xxix)

Remember that one aspect of uncertainty refers to the inability to measure speed and momentum at the same time. Another aspect is virtual particles. “. . . they differ from real particles because they only exist during exchange” due to the fact that “we cannot know both the energy and the lifetime of a particle, so a subatomic event occurring within a tiny time frame involves an uncertain amount of energy” (McTaggart, 2002, p. 19). Elementary particles exchange energy randomly: “all elementary particles interact with each other by exchanging energy through other quantum particles, which are believed to appear out of nowhere, combining and annihilating each

other in less than an instant- 10^{23} seconds to be exact – causing random fluctuations of energy without any apparent cause” (McTaggart, 2002, p.19).

This massive amount of energy is referred to as the vacuum or zero point field, because when it is reduced to absolute zero, no movement should be detected. “Zero point energy was the energy present in the emptiest state of space at the lowest possible energy, out of which no more energy could be removed— the closest that motion of subatomic matter ever gets to zero” (McTaggart, 2002, p. 20). “Physicists erase this phenomenon in mathematical equations because this energy always exists but does not change anything,” however, “this subatomic tango, however brief, gives rise to enormous energy, more than is contained in all the matter in the world” (McTaggart, 2002, p. 19). McTaggart also states that:

But if you add up all the particles of all varieties in the universe constantly popping in and out of being, you come up with a vast, inexhaustible energy source – equal to or greater than the energy density in an atomic nucleus --all sitting there unobtrusively in the background of the empty space around us, like one all-pervasive, supercharged backdrop. It has been calculated that the total energy of the Zero Point Field exceeds all energy in matter by a factor of 10^{40} , or 1 followed by 40 zeros. (McTaggart, 2002, p. 23)

This massive amount of energy, invisible, and mathematically erased by physicists, reflects David Bohm’s quantum potential. It also unifies theories in physics with the concept that “we are all related”; by products of an energy field that fuels continual interconnected relationships. Native Americans have always believed in an interconnected whole. This eternal sea of moving energy acts as a cohesive backdrop of exchange: “Wave-like and particle-like behaviours are properties of *interaction*” (Zukav, 1979, p. 95). Zukav supports Bohm:

“Parts” wrote David Bohm: are seen to be an immediate connection in which their dynamical relationships depend, in an irreducible way, on the state of the whole system (and, indeed, on that of bordering systems in which they are contained, extending ultimately and in principle to the entire universe). Thus, one is led to a new notion of *unbroken wholeness* which denies the classical idea of

analyzability of the world into separately and independently existing parts.
(Zukav, 1979, p. 297)

The fabric of life is not contained in parts, but rather the whole of creation is alive and operating in one unified cohesive state. Talbot referring to Bohm, explains that:

Similarly, he [Bohm] believed that dividing the universe up into living and nonliving things also has no meaning. Animate and inanimate matter are inseparably interwoven, and life, too, is enfolded throughout the totality of the universe. Even a rock is in some way alive, says Bohm, for life and intelligence are present not only in all of matter, but in “energy”, “space”, “time”, the fabric of the entire universe, and everything else we abstract out of the holomovement and mistakenly view as separate things. The idea that consciousness and life (and indeed all things) are ensembles enfolded throughout the universe has an equally dazzling flip side. Just as every portion of a hologram contains the image of a whole, every portion of the universe enfolds the whole. (Talbot, 1991, p. 50)

That is why Native science cannot be separated from daily life, because it is all about relationship and interaction. Quantum physics knows this as well: “Whereas in classical mechanics the properties and behavior of the parts determine those of the whole, the situation is reversed in quantum mechanics; it is the whole that determines the behavior of the parts” (Capra, 1982, p. 86).

“Underlying all these principles is the fundamental truth of life as a circle of being, a sacred hoop, which interconnects all of us. This I believe to be the foundation of Native American spirituality both historically and forever” (Pritchard, 1997, p. 172). “Subatomic particles, then, are not “things” but are interconnections between “things”, and these “things”, in turn, are interconnections between other “things” and so on. In quantum theory you never end up with “things”; you always end up with interconnections. This is how modern physics reveals the basic oneness of the universe” (Capra, 1982, p. 80-81).

The experiment that proved the phenomena of non-locality began with Bell's theorem (later supported by EPR and Aspect experiments), and ultimately: "tells us that there is no such thing as "separate parts". All of the "parts" of the universe are connected in an intimate and immediate way previously claimed only by mystics and other scientifically objectionable people (Zukav, 1979, p. 257). Capra supports Zukav:

The fundamental role of non-local connections and of probability in atomic physics implies a new notion of causality that is likely to have profound implications for all fields of science. Classical science was constructed by the Cartesian method of analyzing the world into parts and arranging those parts according to causal laws. The resulting deterministic picture of the universe was closely related to the image of nature as a clockwork. In atomic physics, such a mechanical and deterministic picture is no longer possible. Quantum theory has shown us that the world cannot be analyzed into independently existing isolated elements. The notion of separate parts – like atoms, or subatomic particles – is an idealization with only approximate validity; these parts are not connected by causal laws in the classical sense. (Capra, 1982, p. 85)

In quantum physics, the theories of complementarity and uncertainty address wave particle duality. The premise behind these theories is that as soon as you observe an electron it reduces from a wave into a particle and that the very act of observing the wave defines how it will behave under observation. "The new physics, quantum mechanics, tells us clearly that it is not possible to observe reality without changing it. If we observe a certain particle collision experiment, not only do we have no way of proving that the result would have been the same if we had not been watching it, all that we know indicates that it would not have been the same, because the result that we got was affected by the fact that we were looking for it" (Zukav, 1979, p. 30-31). Capra reiterates:

The crucial feature of quantum theory is that the observer is not only necessary to observe the properties of an atomic phenomenon, but is necessary even to bring out these properties. My conscious decision about how to observe, say, an electron will determine the electron's properties to some extent. If I ask it a particle question, it will give me a particle answer; if I ask it a wave question, it

will give me a wave answer. The electron does not have objective properties independent of my mind. In atomic physics, the sharp Cartesian division between mind and matter, between the observer and the observed, can no longer be maintained. (Capra, 1982, p. 87)

In Native paradigm, observer-created reality is manifested through ceremony or ritual. The premise is to influence probability. The elders say to watch what you say and think because your thoughts are energy, and the energy you put out there is reciprocal. Zukav elaborates:

Scientists, using the “in here – out there” distinction, have discovered that the “in here – out there” distinction may not exist! What is “out there” apparently depends, in a rigorous mathematical sense as well as a philosophical one, upon what we decide “in here”. The new physics tells us that an observer cannot observe without altering what he sees. Observer and observed are interrelated in a real and fundamental sense. The exact nature of this interaction is not clear, but there is a growing body of evidence that the distinction between the “in here” and the “out there” is illusion. (Zukav, 1979, p. 92)

You create what you observe in your mind and in the words that you speak. “Quantum mechanics is based upon the idea of minimal knowledge of future phenomena (we are limited to knowing probabilities) but it leads to the possibility that our reality is what we choose to make it” (Zukav, 1979, p. 29). Zukav makes the point that:

Not only do we influence our reality, but, in some degree, we actually *create* it. Because it is the nature of things that we can know either the momentum of a particle or its position, but not both, *we must choose* which of these two properties we want to determine. Metaphysically, this is very close to saying that we *create* certain properties because we choose to measure those properties. Said another way, it is possible that we create something that has position, for example, like a particle, because we are intent upon determining position. And it is impossible to determine position without having some thing *occupying the position that we want to determine*. (Zukav, 1979, p. 28)

The quantum world does not depend on renewal ceremonies; it exists on a microscopic level that defies understanding, oblivious to the manipulations of the macroscopic world. We do not know if renewal affects a particle in the scientific sense or not. However, to the traditionalist, we do

affect probability and outcome. To the atom, what we do or not do is immaterial. This does not mean that renewal ceremonies are ineffective just because that there is no proof in the scientific sense. A subatomic particle can choose, can remember who it danced with, can communicate instantly, and can move any which way it wants to. It is part of a whole and has infinite choices, but it exists independently without us. The logical conclusion is that particles do not need renewal ceremonies. However, in Native paradigm renewal is integral to the art of existence. It is a way of complementing and cementing relationships and compacts with the universe. Ceremony is intention, and intention attracts outcome through relationship.

Quantum energy exists everywhere. To Native America it is all sacred space, although some places may resonate with more power than others do. Recognized sacred sites have been nourished with prayer and ceremony over an extensive period of time, and as we saw in observer-created reality, the energy may be amplified because of the dedication and intention of the observers. In the landscape, here again we have no proof that the atomic world responds differently to a particular place, or has a relationship or loyalty to landscape. To the physicist it is not important that the atom have a sacred place or space. But to the traditionalist, the particle is all the land, inseparable from the whole; and if we believe Zukav, Bohm, and Suzuki's propositions of interconnectedness, then in truth we are all one particle. In that sense, we cannot say that the quantum world is without relationship to the land.

"The only constant is change" (L. Little Bear as cited in Cajete, 2000, p. xi). Quantum physicists are beginning to prove what Native America has known all along. "What to Bohm had been a major breakthrough in human thought—quantum theory, relativity, his implicate order, and rheomode – were part of everyday life and speech of the Blackfoot, MicMaq, Cree and Ojibwaj" (Peat, 2002, p.238). More importantly, the physicist is departing from the reductive notions of

how the universe works and beginning to explore the unknown. Quantum physicists are proving the notions of interconnectedness, animate, constant flux, trickster and observer-created reality.

The old physics established the foundations of quantum physics; since then, the search for a grand unified theory has been elusive. The new physics proposes such theories as the string theory, super-symmetry, holograms and fields. To date, none of these theories has achieved the cohesion of all four forces: electromagnetism, gravity and the strong and the weak forces. What we do know is that Western science has built its society on the premise according to McTaggart, that:

The human being is a survival machine largely powered by chemicals and genetic coding.

The brain is a discrete organ and the home of consciousness, which is also largely driven by chemistry – the communication of cells and the coding of DNA.

Man is essentially isolated from this world, and his mind is isolated from his body.

Time and space are finite, universal orders.

Nothing travels faster than the speed of light. (McTaggart, 2002, p.224)

We also know that physicists are finding that those tenets are flawed and that, again according to McTaggart:

The communication of the world did not occur in the visible realm of Newton, but in the subatomic world of Werner Heisenberg.

Cells and DNA communicated through frequencies.

The brain perceived and made its own record of the world in pulsating waves.

A substructure underpins the universe that is essentially a recording medium of everything, providing a means for everything to communicate with everything else.

People are indivisible from their environment. Living consciousness is not an isolated entity. It increases order in the rest of the world. The consciousness of

human beings has incredible powers, to heal ourselves, to heal the world, - in a sense, to make it as we wish it to be. (McTaggart, 2002, p.224)

“Common sense contradictions, in fact, are at the very heart of the new physics. They tell us again and again that the world may not be what we think it is. It may be much, much, more” (Zukav, 1979, p. 256). Western science is built upon the Newtonian vision, whereas Indigenous knowledge correlates with the quantum vision of reality. It is a higher unknown order that governs reality, such as David Bohm’s quantum potential, or McTaggart’s zero point field theories that correlate to Native American vision of a cosmos that operates on a vibrational level.

Zukav suggests that:

We previously have seen that quantum phenomena seem to make decisions, to *know* what’s happening elsewhere. Now we shall see how quantum phenomena may be connected so intimately that things once dismissed as “occult” could become topics of serious consideration among physicists. In short, both in the need to cut castoff ordinary thought processes (and ultimately to go “beyond thought” altogether), of enlightenment and the science of physics have much in common. (Zukav, 1979, p. 256)

Quantum physics proves that at least some aspects of this are truth. Theories of chaos and order, non-locality and interconnectedness have always been a part of Native paradigm and these notions are reflected in Native science. Native science is beginning to attain more credibility in the scientific world, especially with the realisation that fragmentation has led humanity into serious trouble.

The fact that particles have some form of consciousness and operate out of some super order, be it the holomovement or zero point field, suggests that science, for all its posturing, has yet to engage fully in reality. If we look at how we previously thought matter existed: linear, predictable and stable—a highly questionable explanation as quantum reality illustrates—then it is logical to conclude that alternative realities are possible. Even the layman knows that there is something

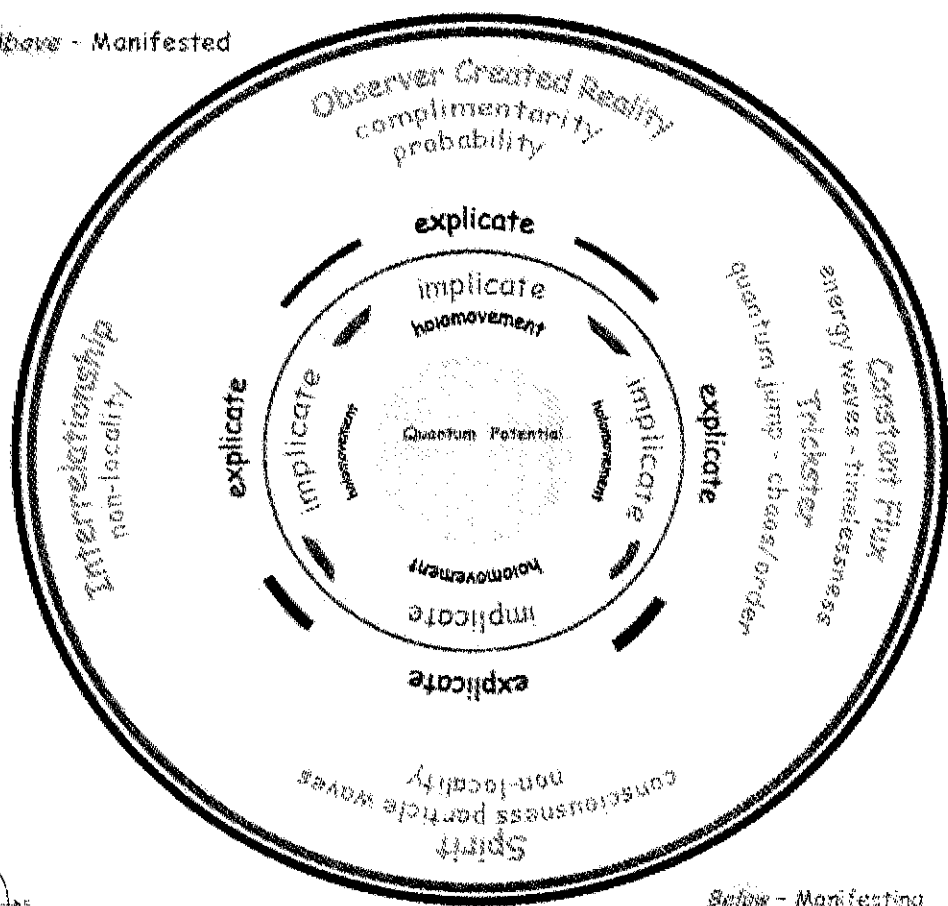
lacking in our current knowledge of reality. “It is ironic that while Bohm’s theories are received with some skepticism by most professional physicists, they find an immediately sympathetic reception among the thousands of people in our culture who have turned their backs on science in their own quest for the ultimate nature of reality” (Zukav, 1979, p. 309-310).

The Western world perpetuates a knowledge base that extracts only what is visible to the eye, only what can be proven. Any departure from this norm is invalidated, considered to be paganism, or even worse, New Ageism. An insistent whisper of the heart tells humanity that there is more to life than meets the eye, and many people are hungry for answers. They sense that much of what passes for reality is but illusion, and they are searching for meaning beyond the material world. Some New Age practitioners have been drawn to Native American spirituality, as witnessed by the current cultural appropriation of Native American spiritual practices. But New Ageism reduces the spiritual beauty of Native American spirituality to a nondescript bastardization of reality, and it is but a pale shadow when compared to the complex reality envisioned by Native spiritual practitioners who have dedicated their life to practice with clear and holy intent. And now, ironically, we have physicists discovering a whole new world and turning to the Indigenous community in search of answers; but their quest, too, still revolves around and is influenced by Western perceptions and paradigm—by what one might call the Western dream.

Figure 3

Native Science Quantum Wheel

Above - Manifested



Native Science Quantum Wheel

Chapter Seven - Conclusion

A Story

There was a white man who was such a sharp trader that nobody ever got the better of him. Or so people said, until one day a man told this waisichu: "There's somebody who can out cheat you anytime, anywhere."

"That's not possible," said the waisichu. "I've had a trading post for many years, and I've cheated all the Indians around here."

"Even so, Coyote can beat you in any deal."

"Let's see whether he can. Where is Coyote?"

"Over there, that tricky looking guy."

"Okay, all right, I'll try him."

The waisichu trader went over to Coyote. "Hey, let's see you outsmart me."

"I'm sorry," said Coyote, "I'd like to help you out, but I can't do it without my cheating medicine."

"Cheating medicine, hah! Go get it."

"I live miles from here and I'm on foot. But if you'd lend me your fast horse?"

"Well, all right, you can borrow it. Go on home and get you're cheating medicine!"

"Well, friend, I'm a poor rider. Your horse is afraid of me, and I'm afraid of him. Lend me your clothes; then your horse will think that I am you."

Well, all right. Here are my clothes; now you can ride him. Go get that medicine. I'm sure I can beat it."

So Coyote rode off with the waisichu's fast horse and his fine clothes, while the waisichu stood there naked. (Erdoes & Ortiz, 1984, p. 342)

New paradigms require new vision. Thinking outside the box and exploring alternate paradigms is a place to begin. It is only recently that Native Americans have even had a voice in this culture. In the transition from holocaust to partial redemption, many Native American people are not ready to share their truth, or to engage in the transmission of knowledge within the confines of academia, or even to believe that their voice can make a difference.

Indigenous "ways of knowing" deserve the respect of Western culture, not so much for the sake of the Indigenous culture, but rather, for the sake of Western culture. The theories of quantum physics have challenged the old notions of a mechanical universe. It is the exclusion of

indigenous knowledge as viable knowledge, and the presumption that Western knowledge is the only right knowledge, that is problematic. Rose von Thater-Braan, Cherokee artist, scientist, facilitator and instructor, clarifies:

To imagine that there is only one way to know something is not conceivable. Knowledge is held by lineages, families, and societies; it is brought together for the good of all the people. . . . Whenever native people come together, it's a very natural thing to explore different topics and to share your understandings. What a distortion it would be to say 'That couldn't be so.' One could say, 'We don't know it that way, 'or 'We don't have that in our system of thought.' But that it couldn't be that way? It's extremely important that you retain the integrity of your own understandings, and that you offer them. But the shutting out of other ways of knowing—it's like madness.(Thater-Braan, 2004, p.49)

A shift in paradigm requires a new language. It requires a way of speaking that honors precision and exploration as Western science does, yet it must also embrace the heart and be open to the dialogue of spirit. Quantum paradigm is opening the sleepy eyes of Western construct and has already opened the eyes of many people, as witnessed by the extreme interest in the cult movie *What the #\$*! Do We Know!?*. Although the movie makes some pretty big leaps and assumptions (blind Natives that could not see Columbus coming for one), it does present some basic truths of quantum physics and, even for the most skeptical, it challenges the constructs of Western ideology. Perhaps it is the quantum paradigm from which this new language will develop. The language must reflect a new awareness, a holistic emergence of thought that creates and allows a dialogue that is honorable, one that keeps the Red Road and The Beauty Way. "Indigenous science and Indigenous languages do not seek to control or to hold on to stability within this flux with analytic ideas, laws and concepts. Instead they seek balance, harmony and relationship" (Peat, 2002, p.278). Quantum physics is the bridge that links ancient understanding and Western science. And the Dialogues, where the physicists and elders engage in deep discussion about the nature of reality, already exist, thanks to David Bohm. Phil Duran goes on to explain:

My point is that maybe because theoretical physicists are writing about physics and connecting them with the whole concept of reality, the concept of consciousness, and so forth – it could be part of this renewal that belongs to the prophecies of indigenous people that someday there will be a coming together time of the four directions. That maybe the prophesy of the Hopi and Maya – of the eagle and the condor will have the mind of the eagle will have the heart of the condor of the south, and the condor will have the mind of the eagle for the north – that there will be a coming together of these dual systems of behavior, thought and history, in order to create the healing that's needed. And it seems to be happening at this level that we call the quantum world, that none of us really know or understand – and probably will never understand because we don't have the language to understand it. (Duran, Dialogues, 2003, p. 64)

A change will require a shift in thinking. Fear of ridicule, and the need for large amounts of money to fund research, both contribute to the continuation of Western scientific paradigm. Perhaps the biggest fear of all is that humanity would have to take responsibility for its actions, and change the lifestyle to which we have grown so accustomed, in order to embrace a holistic paradigm. One can only wonder where we would be, if the two worldviews had collaborated upon first contact. There is no doubt that modern science, based upon the Newtonian vision and the scientific method, has created many modern miracles; however, a shift in perception is required now. Science must re-evaluate and redefine itself. The “end of science” means the coming of Western civilization, in its own time and in its own way, into the higher dimensions of human experience (Zukav, 1979, p. 313). Zukav makes the point that:

Scientific revolutions are forced upon us by the discovery of phenomena that are not comprehensible in terms of the old theories. Old theories die hard. Much more is at stake than the theories themselves. To give up our privileged position at the center of the universe, as Copernicus asked, was an enormous psychological task. To accept that nature is fundamentally irrational (governed by chance), which is the essential statement of quantum mechanics, is a powerful blow to the intellect. Nonetheless, as new theories demonstrate superior utility, their adversaries, however reluctantly, have little choice but to accept them. In so doing, they also must grant a measure of recognition to the worldviews that accompany them. Today, particle accelerators, bubble chambers and computer printouts are giving birth to another worldview. This worldview is as different

from the worldview at the beginning of this century as the Copernican world view was from its predecessors. (Zukav, 1979, p. 192)

Quantum physics may be the key to the secrets of the universe and the secret to salvation; certainly, it should be the validation needed to convince the powers that be that the “heathens” had it right all along. But Western scientific powers still refuse to recognize that Indigenous people do, indeed, have a science. Grants are denied upon this basis. For example, Rose Von Thater –Braan, CEO of the Native Science Academy, was told by NASA in a recent grant application that there was no such thing as Native science. Her request for grant money to bring together the Native scientists was turned down. Once again our experts are invalidated. Yet theories in quantum physics validate the wisdom of the elders. Where is the financial support for them? According to Henderson and Battiste in their book *Protecting Indigenous Knowledge and Heritage: a Global Challenge*:

There is a growing body of literature on vanishing cultures, language endangerment, and environmental destruction. Ethnobiologists, human ecologists, and other social as well as biological scientists are recording Indigenous use of ecosystems, Indigenous ecological concepts, and Indigenous strategies for resource management. They are also documenting the causes and consequences of local cultural and environmental disruption. Cognitive anthropologists and psychologists are studying Indigenous peoples’ perceptions and categorizations of the natural world, their biological learning and reasoning, their environmental beliefs, and their environmentally relevant decision making. Political scientists and ecological economists are looking at Indigenous institutions and economic models from the point of view of Indigenous ecological sustainability. (2004, p.15)

Somebody thinks we have it right! This knowledge requires accessibility, and not just through a paper by a scholar who might benefit financially or academically. The pressing need is for Indigenous science centers and conferences, and for dialogues in concert with Western scientists who come out of a genuine search for knowledge, and not just for curiosity or academic elitism. Our science lives in tradition, in the Sweatlodge, Sundance, Potlatch, and Ti dance. Our science

lives through the Pipe ceremony and the Corn dances. We live through Trickster and the values of strength, kindness, humour and generosity—the legacy of our ancestors. Our science lives in our hearts and in our dreams. The Aboriginal scientist knows that consciousness affects reality. Reality is created through language; and language is action and/or process-orientated and subjective. Reality is animate and in constant motion; what affects one, will affect all. Our science manifests from acute observation, and it is experienced directly. Our science is subordinate, a process of relationship. Knowledge is first hand and must be renewed. The universe is in constant transformation and we accept the Great Mystery. Our science sustains our children. Our science is about maintaining balance holistically. People say that our traditions are dying, but they are wrong. Our tradition is about relationship and those relationships are being renewed. Native science and physics is much more fluid. “Random movement is inclusive, holistic, adaptive and identifies with everything” (Little Bear, personal communication, July, 6, 2002). Every day, the healing continues on “poor” reservations, and in the continual fight to maintain, regain and take pride in identity. We are remembering who we were before our nations were interrupted with assimilation policies. David Peat reminds us that:

Somehow, the Indigenous science, beliefs, relationships with the land, compacts with the spirits, and energies of the world – call it what you will – enabled The Peoples of Turtle Island to live in harmony for a very long time. The Native American people I have spoken to always speak of obligations rather than of rights, and of the importance of their ceremonies of renewal, for, they say, nothing persists; all is flux and unless society is willing to renew itself through sacrifice, it will pass away. It appears that this was the world view that enabled The Peoples of the north to support themselves by hunting, fishing, and gathering; The Peoples of the plains to live in harmony with the buffalo; and those further south to practice a mixed economy that included farming. In all cases, it appears that a balance was maintained between The People and the land around them. (Peat, 2002, p. 113-114)

The quantum physicist believes in a reality where consciousness does affect reality, a reality that is in constant motion and can appear as a particle, or a wave. This reality is animate and part of an

indivisible whole that is uncertain, but full of possibility and potential. It is the physicists who will help people remember that intention is creation. One can only hope that quantum theory is reversing the deterministic paradigm that Western civilization is built upon. However, we have a long way to go to reverse that hierarchical structure and challenge "...the very foundations of Western scientific epistemology and ontology" (Cajete, 2000, p. 7). Physicists are finding that the network of energy known to Indigenous people is being proved through quantum physics: "All matter is vibration; all matter is energy. The electrons are speaking to us, but physicists are just not understanding the messages" (Duran, personal communication, August 7, 2004).

Humanity needs a conscience, a new map that is inclusive and honorable and revives the values of kindness, sharing, respect and strength. Humanity needs to remember to feed the electrons through sacrifice and humility. Can I prove that? No. Can I disprove that? No. But I do know that attention and intention are co-creative, and if humanity continues to embrace a "mall rat" mentality without respect or reverence for the gifts we exploit from the earth, then we will only have ourselves to blame. The Western scientist follows an objective reality: time is linear; matter consists of inanimate objects, made up of singular particles that are static in nature. Western society operates in dichotomies and polarizations, reducing nature to measurement and experiment, in its ultimate quest for proof. These beliefs translate into the assumption that, given enough time, it is possible to know every thing about the universe. Newtonian physics says that everything is already predetermined; and Descartes said we are simply part of a big machine. In fact: "We do not know and maybe we will never know what binds the universe together. In the early part of the twentieth century, physics demonstrated the notion of scientific "certainty" – at least in the realm of subatomic phenomena – was extremely elusive. In fact, within microcosms of a single atom, nature is *never* fully knowable" (Suzuki and Knudson, 1993, p. 78). The old ones, our wisdom keepers, already know that we cannot know it all, as Pritchard explains:

The Algonquin people I've encountered have taught me that you can't have it all, you can't know it all, you can't explain it all, and it's a good thing. It's bigger than we are. Life is much more enjoyable when you take it as it comes. "Keep looking, you'll find your answers," is a phrase one hears a lot. But the answers you find are not final ones. They are your answers, in the present moment, and there is much more to the story. Keep looking. Creation is not only a mystery, it is still happening, and it's happening around and within us. (Pritchard, 1997, p. 132)

"Recognition that human beings hold an important place in such a creation is tempered by the thought that they are dependent on everything in creation for their existence...the awareness of the meaning of life comes from observing how the various living things appear to mesh to provide a whole tapestry" (Deloria, 1994, p. 88). It is not necessary to know it all, it is only necessary to do it well. Life is a mystery. To the Native American it is all about process. Physicists realize that to know everything requires feats we are incapable of as explained by Horgan:

Rossler was a theoretical biochemist and chaos theorist from the University of Tubingen, Germany, who in the mid 1970's had discovered a mathematical monster called the Rossler attractor. Rossler saw two primary limits to knowledge. One was inaccessibility. We can never be sure about the origin of the universe, for example, because it is so distant from us both in space and in time. The other limit, distortion, was much worse. The world can deceive us into thinking we understand it when actually we do not. If we could stand outside the universe, Rossler suggested, we would know the limits to our knowledge, but we are trapped inside the universe and so our knowledge of our own limits must remain incomplete. (Horgan, 1996, p. 235)

If humanity were to embrace the concepts of Native America and trust that spirit leads us to the truth, we would be much further ahead. But "...according to some philosophies, Indigenous and otherwise, that knowledge is never really lost; it comes into being when it is needed and leaves when it is no longer needed or properly used" (Cajete, 2000, p. 9). If science truly is the quest for

knowledge, then all of reality is open to investigation. Atoms are not visible, neither is spirit. To the quantum physicist, atoms exist; to the traditionalist, spirit is. Sacred science will continue with or without Western validation. It is not the end of Western science, it is the quest for a science that is inclusive of the holistic, interconnected, continually changing cosmos that quantum theory proves and Native scientists practice. Remember that the future comes from behind you, and if we are to create a new future, we must recognize that the future is now and know that the “universe is breathing and is imbued with intelligence” (P. Gunn Allen, personal communication, August 7, 2004). The intelligence of the universe is there to facilitate us, and humanity needs to pay attention to that relationship, to feed that relationship with the seeds of an expanded vision of science and ways of knowing, in other words a holistic paradigm shift. Our future lies in what we do this day right now. We are co-creators in our reality. *”Who is looking at the universe? Put another way, how is the universe being actualized? The answer comes full circle. We are actualizing the universe. (Zukav, 1979, p. 79).* Then let us begin...let us begin with quantum spirit.

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Appendix 1 – Comparisons of Western and Indigenous Science

Western Science

Experimentation	Instrumentation	Observation
Prediction	Mathematics	Representation
Control	Objectivity	Distancing
Freedom of External Social Values	Causality	Uniformity
Models	Fragmentation	Technology
Progress	Truth	Explanation
Authority		Transformation

Indigenous Science

Spirituality	Location	Observations
Initiation	Cosmology	Causality
Role of Humanity	Harmony	Ceremony
Elders	Artifact	Practice
Spirit	Dreams	Visions
History	Maps	Symbols
Subjectivity	Relatedness	Understanding
Sanction	Transformation	Paths
Sacred Mathematics	Sacred Space	Representation
Technology		Patterns

(Peat, 2002, p. 249)

Appendix 2a - Comparisons between traditional and scientific knowledge styles

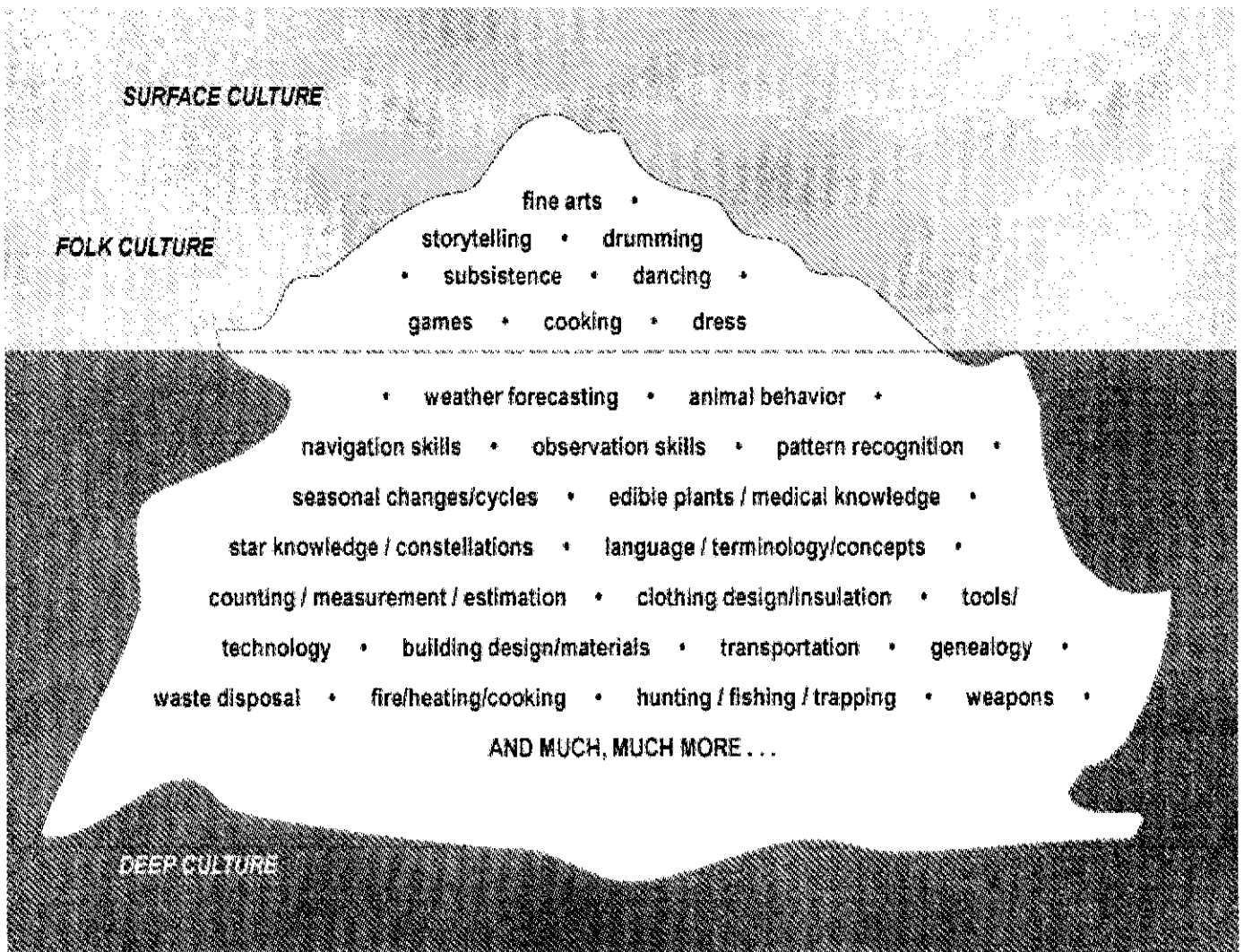
Indigenous Knowledge	Scientific Knowledge
assumed to be the truth	assumed to be a best approximation
sacred and secular together	secular only
teaching through storytelling	didactic
learning by doing and experiencing	learning by formal education
oral or visual	written
integrated, based on a whole system	analytical, based on subsets of the whole
intuitive	model- or hypothesis-based
holistic	reductionist
subjective	objective
experiential	positivist

Appendix 2b - Comparisons between traditional and scientific knowledge *in use*

Indigenous Knowledge	Scientific Knowledge
lengthy acquisition	rapid acquisition
long-term wisdom	short-term prediction
powerful prediction in local areas	powerful predictability in natural principles
weak in predictive principles in distant areas	weak in local areas of knowledge
models based on cycles	linear modeling as first approximation
explanations based on examples, anecdotes, parables	explanations bases on hypothesis, theories, laws
Classification: <ul style="list-style-type: none"> • a mix of ecological and use • non-hierachical differentiation • includes everything natural and supernatural 	Classification: <ul style="list-style-type: none"> • based on phylogenic relationships • hierarchical differentiation • excludes the supernatural

Retrieved April 06, 2005 from http://www.nativescience.org/html/traditional_and_scientific.html

Appendix 3 – Alaska Native Network Knowledge Network



Indigenous people are defined by their culture. Most people outside the culture recognize certain aspects of the Indigenous people. Those aspects are the tip of the iceberg. There is so much deep knowledge embedded in the culture that it does not appear on the surface. This model was developed by the Lower Kuskokwim School District.