

# **Native Science**

**Natural Laws  
of Interdependence**

**Gregory Cajete**

**Foreword by Leroy Little Bear, J.D.**



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## Dedication

*This work is dedicated to the Indigenous children of the seventh generation. May their good spirits guide the consciousness of the science of the twenty-first century.*

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# Contents

Foreword by Leroy Little Bear, J.D. ix

Dedication and Acknowledgments viii

Introduction 1

## Chapter 1 Telling a Special Story 11

First Insights 13

The Creative Context 15

Chaos Theory 16

Sense, Perception, and Creative Participation 20

Perceptual Blindness versus Creative Sensibility 22

Body Sense 25

The Metaphoric Mind 28

Native Stories of Creation and Emergence 31

Art as a Means of Ceremony and Transformation 46

Meanings and Possibilities 52

## Chapter 2 Philosophy of Native Science 57

Eco-Philosophy 58

Tenets of Native Philosophy 64

Process of Native Science 66

Native Science Practice 71

Guiding Stories 74

Guiding Thoughts 75

Native Science Paradigm 77

Meanings and Possibilities 82

## Chapter 3 The Ecology of Native American Community 85

We Are All Related 86

A Personal Story 87

For the Good of the People: Foundations for Leadership,  
Service, and Community Value 90

Workings of Native Community 90

Native Science Practice in Native Communities 98

Meanings and Possibilities 104

## Chapter 4 Plants, Food, Medicine, and Gardening 107

A Green Philosophy 108

Plants Are the Hair of Mother Earth 111

Plants and the Foundations of Health and Wholeness 115

The Ecology of Native Healing 118

The Quest for Healing Knowledge 122

Native Gardening 127

“Native People Loved Their Gardens” 129

Native Food Contributions 133

Native Permaculture and Agricultural Technology 140

Meanings and Possibilities 146

## Chapter 5 Animals in Native Myth and Reality 149

Animals and the Native Worldview and 150

Animal Nature 152

Our Relatives, the Animals 156

The Hunter of Good Heart 158

Animals in Myth 165

Animals and Spirituality 167

American Indian Animal Husbandry 168

Meanings and Possibilities 174

## Chapter 6 A Sense of Place 177

Living in Relationship 178

The Role of Language 183

The Human Body as Metaphor for Landscape 185

The Psychology of Place 186

Applied Technologies on Land, River, and Sea 188

Mining 189

Hydraulics 190

Transportation Systems 197

Sacred Space 204  
The Mythic Body of the Landscape 206  
Orienting to Place and Space 210  
Meanings and Possibilities 211

**Chapter 7 Native Astronomy: A Skyward View 215**

Living the Heavens: An Introduction 216  
A Navajo Perspective on Cosmology and Astronomy 218  
A Relational Philosophy: The Stars Are Our Relatives 226  
Community: The Skidi Pawnee, Star People of the Plains 234  
Star Visions and the Role of Plants 237  
The Nazca Animal Geoglyphs of Peru 242  
Place and Astronomical Orientation 246  
A Cosmic Journey 250  
Meanings and Possibilities 255

**Chapter 8 Creating New Minds and Worlds 259**

A New Sun 260  
Finding Face 265  
Finding Heart 266  
Finding a Foundation 267  
Meanings and Possibilities 282  
“Land and Stars, The Only Knowledge” (Simon Ortiz) 288

**References 291**

**Further Reading 298**

**Index 302**

## Foreword

*By Leroy Little Bear, J.D.*

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Science has been and can be defined many different ways depending on who is doing the defining. But one thing that is certain is that “science” is culturally relative. In other words, what is considered science is dependent on the culture/worldview/paradigm of the definer. Immanuel Kant, who divided knowledge into appearances, reality, and theory, suggests the appearances of the world are deeply conditioned by the human sensory and intellectual apparatus. Other beings no doubt experience the same world in radically different ways. Scientific facts—the appearances themselves—are as much a product of the observer’s human nature as they are of an underlying reality. We see the world through particularly human goggles (Herbert 1985).

Albert Einstein said that the business of science is “reality.” I agree, but the reality brought about by modern science is largely based on Western paradigms. Western paradigmatic views of science are largely about measurement using Western mathematics. But nature is not mathematical. Mathematics is superimposed on nature like a grid, and then examined from that framework. It is like the land survey system: a grid framework of townships, sections, and acres superimposed on the land. These units, in turn, are used as the basis for dealing with the land, but they are not part of the nature of the land. Einstein was so enthralled with the mathematization of nature that he once observed, “How can it be that mathematics, being a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality?” (Lindley 1993) But Jeremy Hayward, among others, feels that in spite of the usefulness of modern scientific discoveries, there is a lot left out of Western science. According to Hayward, the modern world relies on a narrow, distorted view of science to attempt to relate what reality is all about. “It is just that the modern description leaves out so much—it leaves out the sacredness, the livingness, the soul

of the world. And it does get troublesome when some scientists tell us, often with a voice of authority, that the part they leave out is really not there" (Hayward 1997).

If science is a search for reality and if science is a search for knowledge at the leading edges of the humanly knowable, then there are "sciences" other than the Western science of measurement. One of these other sciences is Native American science. Native American science is incomprehensible to most Westerners because it operates from a different paradigm. Measurement is part of Native American science but does not play the foundational role that it plays in Western science. Measurement is only one of many factors to be considered.

In order to appreciate and "come to know" in the Native American science way, one has to understand the culture/worldview/paradigm of Native American people. For Thomas Kuhn, a paradigm is a whole way of working, thinking, communicating, and perceiving with the mind. A paradigm includes tacit infrastructures, which are mostly unconscious, pervading the work and thought of a community (Bohm and Peat 1987). What is the Native American paradigm about?

The Native American paradigm is comprised of and includes ideas of constant motion and flux, existence consisting of energy waves, interrelationships, all things being animate, space/place, renewal, and all things being imbued with spirit. Gary Witherspoon, studying Navajo language and art observes, "The assumptions that underlie this dualistic aspect of all being and existence is that the world is in motion, that things are constantly undergoing processes of transformation, deformation, and restoration, and that the essence of life and being is movement" (Witherspoon 1977). The constant flux notion results in a "spider web" network of relationships. In other words, everything is interrelated. If everything is interrelated, then all of creation is related. If human beings are animate and have spirit, than "all my relations" must also be animate and must also have spirit. What Native Americans refer to as "spirit" and energy waves are the same thing. All of creation is a spirit. 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.

Renewal is an important aspect of the Native American paradigm. From the constant flux, Native Americans have detected certain regular patterns, be they seasons, migration of animals, or cosmic movements. This gives rise to the view that creation is a continuous process but certain regularities that are foundational to our continuing existence must be maintained and renewed. If these foundational patterns are not maintained and renewed, we will go the way of the dinosaurs. We will be consumed by the constant flux. Hence, the many renewal ceremonies in Native American societies.

The land is a very important referent in the Native American mind. Events, patterns, cycles, and happenings occur at certain places. From a human point of view, patterns, cycles, and happenings are readily observed on and from the land. Animal migrations, cycles of plant life, seasons, and cosmic movements are detected from particular spatial locations; hence, medicine wheels and other sacred observatory sites. Each tribal territory has its sacred sites, and its particular environmental and ecological combinations resulting in particular relational networks. All of this happens on the Earth; hence, the sacredness of the Earth in the Native American mind. The Earth is so sacred that it is referred to as "Mother," the source of life.

I define science as pursuit of knowledge. The Native American mind is in constant search for meaning and reality in the constant flux, not only of the Earth, but also of the cosmos. One can readily apply Einstein's definition of science as a search for reality to Native Americans. For Einstein and Western science, creation and existence were made in a certain way by God and will always remain the same; everything and anything in creation and existence just needs to be discovered by humans. Nothing is certain unless it can be referred to as a regular pattern after long-term observation. But, for the Native American, even regularities are subject to change. Native Americans never claim regularities as laws, or as finalities. The only constant is change.

Storytelling is a very important aspect of Native America. It is not just the words and the listening but the actual living of the story. The author does a beautiful holistic treatment of Native American science by giving it "livingness" and spirit. The Native American paradigm comes to life as the author weaves through ecology, relational networks of plants, animals, the land, and the cosmos. It is a renewal ceremony of Native American knowledge, a storytelling of the discoveries of regular patterns manifesting themselves in the flux. In other words, Native American science is a search for reality, and that is "science." This story about Native American science admirably fills the gaps that Hayward identified in Western science: sacredness, livingness, and the soul of the world. It is a science that is many centuries old and continues to be the basis of Native American reality.

Let me conclude with a personal note. I have always had a great interest in science, both Native American and Western. I truly see science as pursuit of knowledge on the edges of the humanly knowable. When asked by the author to participate in his book by writing a foreword, I felt that I would be twice blessed: firstly, when I read his earlier work, *Look to the Mountain*, a path-blazing work in Indian education, and secondly, when I read this work. There was no hesitation on my part because I saw in this work a manifestation of Native American science as a search for reality.

## Introduction

In Native languages there is no word for “science,” nor for “philosophy,” “psychology,” or any other foundational way of coming to know and understand the nature of life and our relationships therein. Not having, or more accurately, not needing, words for science, art, or psychology did not diminish their importance in Native life. For Native people, *seeking life* was the all-encompassing task. While there were tribal specialists with particular knowledge of technologies and ritual, each member of the tribe in his or her own capacity was a scientist, an artist, a storyteller, and a participant in the great web of life.

Native science is a metaphor for a wide range of tribal processes of perceiving, thinking, acting, and “coming to know” that have evolved through human experience with the natural world. Native science is born of a lived and storied participation with the natural landscape. To gain a sense of Native science one must *participate* with the natural world. To understand the foundations of Native science one must become open to the roles of sensation, perception, imagination, emotion, symbols, and spirit as well as that of concept, logic, and rational empiricism.

Much of the essence of Native science is beyond literal description. Indeed, incorrect or misapplied words often destroy the real and holistic experience of Nature as the direct participatory act around which these sciences have evolved. In the literal terms of biology, Native science may be seen as an exemplification of “biophilia,” or the innate instinct that all life forms share for affiliation with each other. In anthropological terms, Native science has been viewed as “animism,” “totemism,” or the worship of nature. In the conceptual framework of philosophy, Native science may be said to be based on perceptual phenomenology. In its core experience, Native science is based on the perception gained from using the entire body of our senses in direct participation with the natural world.

What is Native science? In order to address this question it is important to define boundaries. 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. 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. It may even include exploration of questions such as the nature of language, thought, and perception; the movement of time and space; the nature of human knowing and feeling; the nature of human relationship to the cosmos; and all questions related to natural reality. Native science is the collective heritage of human experience with the natural world; in its most essential form, it is a map of natural reality drawn from the experience of thousands of human generations. It has given rise to the diversity of human technologies, even to the advent of modern mechanistic science. In profound ways Native science can be said to be “inclusive” of modern science, although most Western scientists would go to great lengths to deny such inclusivity.

Some moderns, both scientists and non-scientists, argue that there is no such thing as Indigenous science, that science is essentially a Western construct or concept. And that while Indigenous people have folkways and folk knowledge, this knowledge is not scientific. This argument states that the term “Indigenous science” is essentially meaningless. Others perceive science as a way of understanding the world, a story of how things happen, a way that human beings have evolved to try and explain and understand existence in time and space and relationships vis-a-vis the natural processes of the world. In this perspective, every culture has science.

Another major issue that arises is cultural bias. Some Western scientists insist that science must be objective to qualify as science, that it is culturally neutral and somehow exists outside of culture and is thus not affected by culture. The counterargument is that social scientists in particular must agree that nothing people do is divorced from culture, including systems of knowledge, technology, and education. Everything is contexted in culture. There are various myths within Western science itself that are being tested by Western scientists.

When speaking about Indigenous or Native science, one is really talking about the entire edifice of Indigenous knowledge. Using the word

“science” is in many ways arbitrary, and it can be said to relate specifically to the ways in which people come to know something, or anything at all. But Indigenous science encompasses all of the kinds of knowledge that are part of an Indigenous mind-set, which is essentially relational. Thus, the terms “knowledge” and “science” are used interchangeably among Indigenous scientists.

Native science is most akin to what Western science calls environmental science or ecology. And while Native people don’t have a particular word for either of those Western terms, they certainly have an understanding of the practice of those disciplines of Western science at the individual and communal levels. And so this understanding that Indigenous people have is a very particular and very profound relationship to the natural world. This relationship is predicated on the fact that all Indigenous tribes—their philosophies, cultural ways of life, customs, language, all aspects of their cultural being in one way or another—are ultimately tied to the relationships that they have established and applied during their history with regard to certain places and to the earth as a whole.

This book attempts to provide a different lens through which to view Native traditions of science and technology. As is true of all lenses, what one can see depends on the clarity of the images made possible through the use of a particular lens. 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.

A culturally mediated lens based on “participation with nature” is the view from which Native science has evolved. In my focus on relationship and participation, I have purposefully reviewed Native “contributions” or presented comparisons of Native and Western science only when they are necessary to illustrate the “psychology” of participation in Native cosmology, philosophy, relationship to plants, animals, and landscapes. Participation provides the grounding for the way of Native science at all

levels and in all expressions. The dynamics of this participation are founded on an ancient human covenant with plants, animals, the forces of the earth, and the universe. It is the depth of our ancient human participation with nature that has been lost and indeed must be regained in some substantial form in modern life and modern science. The cosmological and philosophical must once again become “rooted” in a life-centered, lived experience of the natural world.

This work is an exploration of the *creative participatory process* of Native science that is alluded to, but rarely explicated, in the usual presentation of the achievements of Native technologies. Native technologies are the result of a very sophisticated and multi-level understanding of ecological processes. This work will not attempt an encyclopedic presentation of examples of Native science and technology, but rather, an in-depth exploration of selected expressions of Native knowledge that illustrate its inherent creative process.

My objective in this book is to provide a general understanding of the Indigenous science paradigm. Each chapter follows the general format of the creative process, beginning with *first insights*, followed by *immersion* in the thoughts guiding a particular theme of Native science, followed by the exemplification of *creation* or creative technology reflecting that theme, discussion of *presentation* of the creative process of science, and implications for the integration of science and spirit.

Chapter 1, “Telling a Special Story,” metaphorically presents the center, the inner dynamic where all things come into being and to which they return. This chapter is an exploration of the participatory, holistic nature of the creative process and its reflection in the ethnosciences of Native American cultures. The goal of this chapter is to help the reader develop a basic grounding in the creative process as it is reflected in the natural world and in the context of Native American cultural expression.

Chapter 2, “Philosophy of Native Science,” metaphorically represents the East, the orientation of the rising sun, morning wind, and the first light of day. It explores the philosophical Earth-centered, “ordering” paradigms (patterns of thought) of Native North, Central, and South America. Emphasis will be on the ways in which these paradigms of



sensate participation, ecological awareness, and relationship have guided the thoughts, values, aesthetics, ethics, and actions of Native American expressions of science, art forms, symbols, oral poetry, mythology, and literature. Special focus is placed upon the components of Native science, in order to enhance understanding of the traditional process of "coming to know" in relationship to place and community.

Chapter 3, "The Ecology of Native American Community" presents the orientation of the West, the place of the setting sun and the dry wind, which metaphorically corresponds to ancestral continuity and the essential role of community. This chapter focuses on the interdependence of social and ecological paradigms and their influences on the cultural psychology and social ecology of Native American people, past and present.

Chapter 4, "Plants, Food, Medicine, and Gardening," presents the orientation of the South, the place of the healing winds, which bring rain and nourish the land. This chapter revolves around the various aspects of herbology and concepts of holistic health in Native American traditions that exemplify relationship to plants, that are, in turn, governed by the history, practical applications, and underlying concepts of health and wholeness. The chapter begins with traditional Native perspectives of plants as food and medicine and then works through to contemporary holistic health therapeutic practices and perspectives.

Chapter 5, "Animals in Native Myth and Reality," metaphorically represents the North, the place of animals and the hard wind, and presents an exploration of tribal/Indigenous education, ecology, and philosophy as seen from the perspective of animal mythology and actual relationships to animals. Emphasis is placed on this special relationship as expressed in art, applied science, visionary experiences, and environmental ethics.

Chapter 6, "A Sense of Place," metaphorically represents the orientation of the Below, or Earth. This chapter explores the Native American ecological ethic as expressed in thought and action regarding the primal elements of the physical world and the land itself. The format will revolve around an exploration of the ecological relationships and understandings of these elemental forces as they are reflected in the cultural fabric of

Native America. Areas emphasized include language, story, art, architecture, philosophy, and applied science.

Chapter 7, "Native Astronomy: A Skyward View," reflects the orientation of the Above, the place of celestial origins. This chapter explores the skills, approaches, cultural perspectives, and guiding cosmologies that characterize Native American expressions of astronomy. Emphasis is placed on how Native Americans have creatively represented their sense of relationship and resonance with the sky. The intent is to create a basic understanding of the influences that observation of the stars, planets, moon, sun, and other celestial phenomena have had on the cultural perceptions of past and present Native Americans.

Chapter 8, "Creating New Minds and Worlds," presents final thoughts on the meaning of Native science in the context of forging a new view of Western science that would be inclusive of the ecological consciousness and mutual reciprocal relationships at the foundation of Native science in its day-to-day expression and practice. This chapter connects the perspectives presented on Native science to thought and action that can be undertaken today and tomorrow to bring about the "new sun" of a more hopeful and joyous future for the earth, and therefore, humans as well.

My hope for this book is that for Indigenous people it will provide mindful material of key principles and understandings of Indigenous science to serve as a foundation for dialogue and discussion. For those wedded to Western culture and science, I hope that the book will provide deeper insight and appreciation for the wisdom of Indigenous science. What all of us need at this time is a mutually beneficial bridge and dialog between Indigenous and Western scientists and communities. This book and other works of the same genre constitute a first step.

As Native science becomes more widespread in terms of dialogue and discussion, the greater will be the challenges to the very foundations of Western scientific epistemology and ontology. In these circles of debate, scientists such as F. David Peat and Fred Alan Wolf, and many Native scholars, are discussing science in a kind of give-and-take on benefits and insights useful to both. Among Indigenous people themselves, Native

science had become a kind of rallying cry for lots of things, such as attempts to begin revitalizing and disseminating their own basis of knowledge. It has to do with empowerment and reinforcement of important basic ideas in order to bring them into modern culture.

What is problematic from the perspective of Native peoples is the fact that they have become very suspicious of the assumptions and motives underlying Western science in terms of relating the meaning of stories, ceremonies, rituals, and anything else that represents core ideas and principles. Indigenous people have become more cautious than ever before because of the appropriation of their cultural concepts and ideas. This concern about appropriation extends to plants that are now being taken from the Amazon and patented by pharmaceutical companies, essentially without compensating the Native peoples of the region who have provided information on the usefulness of the plants and/or who have lived in that ecosystem for centuries and perhaps millennia.

Knowledge and information have become commodities. Indigenous peoples have experienced the expropriation of their land, their places, and their labor. At this stage in history, they have become sensitive to having their special knowledge appropriated in a context where the understanding, let alone concrete viability, of reciprocity does not exist. Consequently, control of information and access to information are issues facing Indigenous peoples. One could say that an equal playing field is essential for exchange of information between practitioners of Indigenous and Western science.

Some tribes are certainly less wary of sharing information than others. The Huichol of Mexico is one of the tribes that has been less suspicious for their own reasons (although they too may be in the process of reconsidering their so-called liberal ways). They have become a type of icon for some New Age groups who have exposed Huichol traditions to the rest of the world. Meanwhile, the Huichol continue to be engaged in a long-term struggle for basic rights, such as control of their lands, resources, educational system, and communities. Like other Indigenous peoples, the Huichol are looking for social equality and the right to maintain their traditional way of life.

Given this situation, Indigenous people have utilized various strategies, and one of them is to withhold information. However, this is a double-edged sword in the sense that many of the elders who have specific knowledge of natural processes and ecosystem understandings die without passing on the information to others. Hence, this intricate, beautifully organized information is lost—erased. Of course, there is also the possibility, according to some philosophers, 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.

Perhaps the payoff for Indigenous peoples is taking place in terms of greater understanding on the part of Westerners of the profound wisdom contained in Indigenous science, greater notoriety for Indigenous people, and greater respect on the part of the general public for Indigenous ways of life, rights, and issues. Nevertheless, tremendous problems continue in terms of abuse, exploitation, and misunderstanding perpetrated by corporations, governments, and other entities. We hope that sooner rather than later Western society will realize that Native peoples are not simply vestiges of the past and sources of interesting and even beautiful ideas, but rather that they are very much alive today, and their economic and political issues must be addressed on their own terms.



Huichol yarn painting depicting culture hero, Watakame, in the mountains.  
Courtesy Hallie N. Love, *Watakame's Journey* (1999)

## CHAPTER ONE

# Telling a Special Story

*“Creating the world and humankind”*

In the beginning of time, in the First World, when animals could take human form, there lived a special boy named Watakame. Watakame came from a village shared by humans and animals, but they fought among themselves and were jealous mischief-makers. Watakame preferred living in the mountains away from their trouble making.

Watakame knew the mountains well. He knew the best places to plant and the places to find good drinking water. One day he found an exceptionally good spot in the mountain crags for planting corn. As he swung his machete to clear the undergrowth, he lost his concentration and struck his leg. Wrapping his throbbing leg with his bandana, he thought to himself, “My machete cut me, I will punish it!” Watakame beat his machete against a rock, dulling the blade. “There,” he said, “that will teach you!”

When he started to work again his machete would barely cut. His work was more difficult than

ever before, and he realized that his machete was having the final word. He tried to burn the brush he had cut but the fire he built would not burn. Tired and angry, he returned home and fell asleep.

But when Watakame returned the next day, his field looked as if no one had worked there at all. The brush had grown back thicker than ever before. He fell back in anger and amazement. When he thought of the arduous work ahead of trying to clear the soil again with a recalcitrant machete, he sighed.

"All right," he said to his machete, "you win!" He resharpened the blade, sprinkled water and cornmeal upon it and said, "There. I have fed you; now work with me." By the end of the day, he had cut more brush than he could imagine.

Watakame found his field overgrown once more the next day. Again he cleared it, but again the next day when he returned, the brush had grown up thickly. That night he decided to sleep in his field to catch the mischief-makers. He built a big beautiful fire, feeding it fragrant woods from the day's cuttings. In the flame, Watakame could see many natural forms and flowers of the mountains. He knew that the fire would show him who was undoing his hard work. He was glad to have a good fire.

—Adapted from Hallie N. Love,  
*Watakame's Journey* (1999)

## First Insights

The dynamic, holistic nature of creativity and its reflections in Native science are celebrated in a culture's emergence stories. These guiding stories of the "First World" mirror the processes of chaos, creative participation, and the metaphoric mind and bring a deep intuitive understanding of the creative process inherent in nature and in human beings. Native myths embody metaphors of natural creativity, imagination, and deep spiritual relationships in a people's long journey of evolution. Native myths chart the development of human beings in relationship to the places in which they have lived. These myths are simultaneously evolutionary, ecological, spiritual, psychological, and creative.

Like other Native myths, the portion of the creation myth of the Huichol Indians of Mexico presented above relates central ideas of interdependence and respect for plants, animals, places, even tools, and for those behaviors that have assisted human survival in the natural world. In the dim past, humans lived "in nature" and "with animals," but also became conscious of the qualities that differentiated them from other living things. Humans learned to make the first tools, and began to apply technology to live in various natural environments. Discoveries like the use of fire, coming to know key ecological relationships and responsibilities to the natural world, having a sense of how things began and how things are in the natural order, the domestication of animals and plants through agriculture, the innate affiliation humans have with nature, and understanding the order and cycles of nature are among the first elements of science. From this view, science becomes essentially a story, an explanation of the how and why of the things of nature and the nature of things. The human mind as an extension of nature and as creator of story becomes the fertile ground where myth, science, and our human perception of reality meet.

All the basic components of scientific thought and application are metaphorically represented in most Native stories of creation and origin. Indeed, both Native science and modern science have elements of the primal human story in common. They have, however, evolved very different orientations to the natural world and very different expressions of thought regarding the role of humankind in coming to know our place

and our responsibility to the creative unfolding of the greater story of the universe. As we enter the first decade of a new millennium, Native and Western cultures and their seemingly irreconcilably different ways of knowing and relating to the natural world are finding common ground and a basis for dialogue.

Native science is a product of a different creative journey and a different history than that of Western science. Native science is not quantum physics or environmental science, but it has come to similar understandings about the workings of the natural laws through experience and participation with the natural world. The groundwork for a fruitful dialogue and exchange of knowledge is being created. But it must be a dialogue in which Native cultures have the opportunity to gain as much as they share about their understanding of natural laws.

The word "science" is derived from the Greek word for "knowledge." In this book, science is used in terms of the most inclusive of its meanings, that is, as a story of the world and a practiced way of living it. "Native science" is used as a metaphor for Native knowledge and creative participation with the natural world in both theory and practice. This book celebrates and acknowledges the Native contribution to an evolving philosophy of science as well as ecological awareness. This is not a book about Native religion; in fact, religion will be discussed only as a reflection of environmental philosophy. The essence of Native spirituality is not religion in the Western sense of the word, but rather a set of core beliefs in the sanctity of personal and community relationships to the natural world, which are creatively acted upon and expressed at both the personal and communal levels.

Native science reflects the unfolding story of a creative universe in which human beings are active and creative participants. When viewed from this perspective, science is evolutionary—its expression unfolds through the general scheme of the creative process of first insight, immersion, creation, and reflection. Native science is a reflection of the metaphoric mind and is embedded in creative participation with nature. It reflects the sensual capacities of humans. It is tied to spirit, and is both ecological and integrative.

## THE CREATIVE CONTEXT

An understanding of the nature of creativity is important for gaining insight. Native science embraces the inherent creativity of nature as the foundation for both knowledge and action with regard to "seeking life." Seeking life is the most basic of human motivations since it is connected to our natural instinct for survival and self-preservation. Linguistic metaphors of "seeking life," "to find our life," "for life's sake," are reminders of this essential motivation and the proper context of expression in human interaction with our natural sources of life. Ultimately, the universe is a creative expression at a magnitude beyond human recognition. Human life at all levels is wholly a creative activity and may be said to be an expression of the nature within us. We are, after all, a microcosm of the macrocosm. We are a part of a greater generative order of life that is ever evolving. It is from this creative generative center of human life that central principles of Native science emanate. Native people relate all things in myth by virtue of being born of this creative center.

Creativity is both the universe's ordering principle and process. Creativity in all forms is part of the greater flow of creativity in nature. It flows from the "implicate order" or inherent potential of the universe, and whatever it produces becomes a part of the "explicate order" of material or energetic expressions. These expressions range from entire galaxies to the quarks and leptons of the subatomic world (Briggs and Peat 1999:28-30). Human creativity is located in this immense continuum.

Three basic concepts of creativity will be discussed in this chapter: chaos theory, the participation mystique, and the metaphoric mind. These concepts lend themselves specifically to the way in which Native peoples envision the process of science. They also form a conceptual bridge between Native and Western science, although Native science refers to them differently through particular cultural representations in story, art, and ways of community. These theories and their connections to quantum physics have brought Western science closer to understanding nature as Native peoples have always understood it—that is, that nature is not simply a collection of objects, but rather a dynamic, ever-flowing river of creation inseparable from our own perceptions. Nature

is the creative center from which we and everything else have come and to which we always return (John-Steiner 1997 in LoRé 1998:173).

### CHAOS THEORY

Chaos is both movement and evolution. It is the process through which everything in the universe becomes manifest and then returns to the chaos field. The flux, or ebb and flow, of chaos appears in everything and envelops us at all times and in all places. From the evolving universe to the mountain to the human brain, chaos is the field from which all things come into being. No wonder Native science envisions the spirit of the natural world alive with disorder becoming order and all the mystery of mirrored relationships.

Today, with the creative influence of chaos theory and quantum physics, a new scientific cultural metaphor has begun to take hold. The insights of this new science parallel the vision of the world long held in Indigenous spiritual traditions. Because of this undeniable parallel, Indigenous thought has the potential to inform a contemporary understanding of chaos. Such understanding allows modern consciousness to encompass the primal wisdom of Indigenous thought and with this to understand the fallacy of scientific and societal control. The modern obsession of being in control and the dream of eliminating uncertainty through control of nature, which is the underlying philosophical premise of Western science, must give way to the reality of moving creatively with the flow of events, which is the true reality of the universe.

Western science is committed to increasing human mastery over nature, to go on conquering until everything natural is under absolute human control. In this vision, when we have fusion power, when we farm the oceans, when we can turn weather on and off, when all things natural can be controlled, everything will be just fine. Western science and technology are viewed as the great panacea and as the ultimate means for human survival.

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.

Rather than seeking to control natural reality, Native science focuses its attention upon subtle, inner natures wherein lie the rich textures and nuances of life. This is exactly what chaos theory shows us: small, apparently insignificant things play major roles in the way a process unfolds. Indeed, Native science may be said to be the "science of the subtle."

In the mythology of all ancient cultures, chaos 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. In Mayan cosmology, for example, the first sun-fire beings, Tepeu and Gucumatz, arose out of the dark turbulent waters of the void. In Egyptian mythology, Ra, the sun, rose out of the chaos of Nun, the great floodwaters of the universe. Another example is in expansion and contraction, the primordial yin and yang, which flow from the primal soul of the Great Tao. In Chinese mythology, creativity is associated with nine dragons that arise from the vortex of heaven and whose heavenly presence guides creative order. Like the dragons of Chinese mythology, the theory of chaos represents nature in its creative activity. 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.

There is an ordering or self-organizing process that results from chaos, called "order for free." A simple example may be found in the boiling of water. As water is heated, the water at the bottom of a saucepan starts to rise to the top while cooler water at the top moves to the bottom. This causes a turbulence, which takes the form of boiling water, or as a chaos theorist might describe it, the water in the pan exercises its "maximum degree of freedom." In other words, the water in the closed system of the saucepan is exercising the maximum range of behavior available to it. However, if the water is brought slowly to the point just before boiling, something interesting and characteristic of chaotic systems occurs. The water self-organizes into a pattern of vortices. This is

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.

In nature, all systems of energy transformation exhibit a similar kind of behavior. The survival of any self-organizing system depends upon its ability to keep itself open to the flow of energy and matter through it. This necessity may last a millionth of a second or billions of years, as is the case with the universe.

Self-organization or "creativity" out of chaos occurs everywhere in nature. Random interstellar gases and electromagnetic fields of radiation self-organize to form galaxies and star systems. The interaction of rain with the earth's geological landscape leads to the vast patterns of rivers and streams that form drainage systems. Birds or insects fly in perfect unison.

Then there is the notion of subtle influences, or the "butterfly effect" in chaos theory. In chaotic systems, even small things turn out to have large-scale effects over a period of time. For example, if we look at weather we see a recurring climatic pattern over a long period of time. However, if we examine details we see that weather is in constant flux due to the bifurcating and amplifying activity of a host of subtle effects. In a weather system, everything is interconnected. Positive and negative feedback loops are in constant motion, and somewhere in the system, a "butterfly" loop may cause slight changes. Sooner or later, one of these loops is amplified, and we see a dramatic and unpredictable shift in the pattern. The butterfly effect may be called chance, but it 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.

Chaos theory shows that everything is related, everything has an effect, and that even small things have an influence. In a post-modern society ruled by an obsession with control, we as individuals may feel

powerless, but each of us may subtly influence the course of any system, including those that seem to be the most intractable. Human "butterfly power" resides in our ability to create.

Chaos theory offers insight into human creativity. Chaos is embodied in the human mind and body, allowing humans the ability to creatively respond to constant changes in the environment. Our instinctual ability to "flow" with the stream of chaos and creativity leads us metaphorically to the "vortices" of individual and collective truth. What is true from this viewpoint is the experience of the moment of balance inherent in chaos, like that point at which water, not quite boiling, forms vortices.

This moment when a truth comes to be intuitively known is like the still point in the eye of a hurricane; it is that point when a connection is made to a natural principle manifesting itself in the unfolding of a natural process. Like the birth of a child or a bolt of lightning connecting sky and Earth for a moment in time, these are the infinite moments of both chaos and order. This is a precept of Native science, for truth is not a fixed point, but rather an ever-evolving point of balance, perpetually created and perpetually new.

Native science at its highest levels of expression is a system of pathways for reaching this perpetually moving truth or "spirit." This understanding of the creative nature of the world and of human beings is reflected in the core beliefs of Native thought, life, and tradition.

The quality and nature of human life are the result of human consciousness, or the influences of our experiences, perceptions, language, and society. Human consciousness is inherently an open system, and is "created," in that this system is constantly being influenced by the forces of chaos expressed through us and by us at the individual and collective levels. Herein lies the true power of individual and collective creativity and its subtle power to influence the entire world. This is the basis of the precept of Native science that a single individual's vision may transform a society, or that a rain dance done properly with one mind, can bring rain. Hence, Native science is a reflection of creative participation, a dance with chaos and her child, the creative spirit (Briggs and Peat 1999:5-22).

## Sense, Perception, and Creative Participation

The primacy of a lived and creative relationship with the natural world cannot be underestimated in Native science. Native science acts to mediate between the human community and the larger natural community upon which humans depend for life and meaning. In the few remaining Indigenous communities, Native science is practiced, and its practitioners from child to elder to specialist continually engage the entities and natural processes of their environments as "participants" in the greater order of nature. This intimate and creative participation heightens awareness of the subtle qualities of a place.

Nature is reality, and worthy of awe in the perceptions of the person who practices a culturally conditioned "tuning in" of the natural world. He or she sees, hears, smells, and tastes the natural world with greater acuity. The body feels the subtle forces of nature with a heightened sensitivity. The mind perceives the subtle qualities of a creative natural world with great breadth and awareness. In spite of anthropologists' cultural bias and misinterpretations that continue to influence views of the Indigenous experience, none of this sensual participation with nature is "supernatural" or "extra-ordinary." Rather, it is the result of an ancient and naturally conditioned response to nature.

The Indigenous "physicist" not only observes nature, but also participates in it with all his or her sensual being. Humans and all other entities of nature experience at their own levels of sensate reality. The Indigenous experience is evidenced not only through collective cultural expressions of art, story, ritual, and technology, but also through the more subtle and intimate expressions of individual acts of respect, care, words, and feelings that are continually extended to the land and its many beings. *As we experience the world, so we are also experienced by the world.* Maintaining relationships through continual participation with the natural creative process of nature is the hallmark of Native science. This practiced ability to enter into a heightened sense of awareness of the natural world allows the Indigenous physicist intimate understanding of the processes of nature, and forms the foundation for respecting the

compacts of mutual reciprocal responsibility shared with other inhabitants of one's environment.

Through this way of participation, Indigenous peoples receive gifts of information from nature. 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 places large and small. Everything in nature has something to teach humans. This is the Indigenous view of "animism," the anthropologically defined, superficially understood, and ethnocentrically biased term used to categorize the Indigenous way of knowing the world.

Creative participation with the living Earth extends from birth to death and beyond. At birth, humans come new yet recycled through the elegant cycles of metamorphosis, transformation, and regeneration that form the basis for all life on Earth. Indigenous peoples view the body as an expression of the sensual manifestation of mind and spirit. Death and the body's ultimate decomposition into the primal elements of earth, 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. This is a literal biological truth as well as a metaphoric one—hence, the meaning in Chief Seattle's statement, "I cannot sell the body, the blood and bones of my people." 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.

Becoming open to the natural world with all of one's senses, body, mind, and spirit, is the goal of the practice of Native science. The Kogi of Colombia have a way of creating a *mama*, or spiritual leader, who personifies the honing of the initiate to become fully sensitive to the detail and subtle nuances of the natural world. At birth a child who has been chosen to become a *mama* is taken from the mother and sequestered for the first nine years in a dark cave called the Womb of the Earth Mother. The child's experience of the outer world is limited to only the sounds and



environmental qualities of the cave. Other mamas, including the child's birth mother and relatives, constantly keep the child company.

The mamas teach the child the Kogi language, stories, prayers, and ritual philosophy. The mamas also describe the natural world in detail. But the child never really sees, hears, or feels the natural world directly until the long initiation is completed. During the ninth year the child emerges from the "womb" for the first time and is introduced to the Earth Mother. This is an experience that cannot be described in words and that so influences such children it indelibly guides their perception of the natural world throughout their lives. Because of their perceptual conditioning and extensive training in Kogi science, they are able to participate in the world with all of their being. As a result of their long and sustained *relationship* to the natural world, they are able to identify stresses between the human community and the natural landscape, and therefore advise on ways to restore the harmony of relationship. Understanding, maintaining, and restoring harmonious relationships are also foundations of Native science.

The tragedy of modern society is that everyone falls into the trap of abstraction. The host of modern technologies that only mirror ourselves to ourselves hypnotizes perception and attention. While our bodies have been tuned to the sounds of birds and the changing qualities of natural environments, our socialization makes us oblivious to our natural sensibilities.

In many people, such sensibilities quickly atrophy. We are no longer able to participate with nature with our whole being—we cannot hear its subtle voices or speak the language of nature. Herein lies the disregard modern people feel for nature—when something no longer exists in your perceptual memory it also no longer matters.

### PERCEPTUAL BLINDNESS VERSUS CREATIVE SENSIBILITY

The blindness of modern perception with regard to nature prevails throughout post-modern technocratic society. Western science and society continue to deny the spirit and intelligence of nature. Enclosed in a technologically mediated world, people rarely encounter nature in any

significant or creative way. Nature may be the topic of the latest *National Geographic* special or the focus of the newest Walt Disney theme park, but direct experiences with non-human nature, if they happen at all, are limited to pets, zoos, parks, and farms. What most people know about animals and nature comes from television. While moderns may have technical knowledge of nature, few have knowledge of the non-human world gained directly from personal experience.

Native science is an echo of a pre-modern affinity for participation with the non-human world. As a way of knowing the world, it exists at the margins of modern society as an unconscious memory, a myth, a dream, a longing, and as the lived experience of the few Indigenous societies that have not yet been totally displaced by the modern technologically-mediated world.

Creative participation in nature provides a glimpse of the human nature that has grounded our sensual experience. Before we developed modern perceptual habits and linguistic prejudices, this experience was common. The perceptual process upon which Native science rests remains a mystery for most moderns. It is certainly not the "real world" of jobs, school, the mall, and television. Yet, if we learn once again to feel, see, hear, smell, and taste the world as our ancestors did, we may remember something truly wonderful about nature in humans.

This does not mean that we should or even can return to the pre-modern, hunter-gatherer existence of our ancestors, but only that we must carry their perceptual wisdom and way of participation into the twenty-first century, where the environmental challenges we face will require a totally different way of living in nature. Maurice Merleau-Ponty, French phenomenologist, makes the following observation: "We begin by reawakening the basic experience of the world, of which science is the second-order expression. . . . To return to things themselves is the return to that world which precedes knowledge, of which knowledge always speaks, and in relation to which every scientific schematization is an abstract and derivative sign language. . ." (Merleau-Ponty 1962 in Abram 1996:36).

Native science embodies the central premises of phenomenology (the philosophical study of phenomena) by rooting the entire tree of

knowledge in the soil of direct physical and perceptual experience of the earth. In other words, to know yourself you must first know the earth. This process of inter-subjectivity is based on the notion that there is a primal affinity between the human body and the other bodies of the natural world. According to Edmund Husserl (1960 in Abram 1996), the conceptual father of phenomenology, there is a kind of "associative empathy" between humans and other living things, which is grounded in the physical nature of bodies. Sociobiologist E.O. Wilson (1984 in Abram 1996) calls this empathy "biophilia," or the innate human instinct to affiliate with other living things. Others have suggested that biophilia may even be the biological basis for human love, human community, and various other traits of human affiliation that have long been understood as products of human culture.

Husserl believed that lived experience or the "life-world" was the ultimate source of human knowledge and meaning. The life-world evolves through our experience before we rationalize it into categories of facts and apply scientific principles. Our life-world evolves through our experience from birth to death and forms the basis for our explanation of reality. In other words, it is subjective experience that forms the basis for the objective explanation of the world.

The Western science view and method for exploring the world starts with a detached "objective" view to create a factual blueprint, a map of the world. Yet, that blueprint is not the world. In its very design and methodology, Western science estranges direct human experience in favor of a detached view. It should be no surprise that the knowledge it produces requires extensive re-contexting within the lived experience in modern society. This methodological estrangement, while producing amazing technology, also threatens the very modern life-world that supports it.

The life-world that Husserl describes is culturally relative. It is diverse and different for each culture and each person because it is based on the experienced world of distinct peoples who evolved in distinct places and described themselves and their surroundings in distinct languages. Yet, there is a unity in such diversity derived from

the fact that humans share a species-specific experience and knowledge of nature. Humans also share an experience of nature with all other living things, although our perceptions are different from other species due to our unique physical biology. This is the basis of the life-world, a vast ocean of direct human experience that lies below all cultural mediation. This consciousness of the life-world forms another foundation of Native science. Current cultural concepts of time, space, relationships, and linguistic forms are rooted in this pre-cultural biological awareness.

From a phenomenological viewpoint, all sciences are Earth-based. Western science must acknowledge this common foundation, this rootedness in the same physical world as Native science, and for its continued evolution, it must integrate and apply the collective lived experience of human participation with nature. In Abram's (1996:43) words, "Every theoretical and scientific practice grows out of and remains supported by the forgotten ground of our directly felt and lived experience, and has value and meaning only in reference to this primordial and open realm."

### BODY SENSE

The body, as the source of thinking, sensing, acting, and being, and as the basis of relationship, is a central consideration of Native science. This is why the metaphor of the body is used so often by tribes to describe themselves, as well as their communities, social organization, and important relationships in the world. Tribal use of the metaphor describes not just the physical body, but the mind-body that experiences and participates in the world. Indeed, humans and the natural world interpenetrate one another at many levels, including the air we breathe, the carbon dioxide we contribute to the food we transform, and the chemical energy we transmute at every moment of our lives from birth to death. In the words of Abram (1996:47), "the body is a creative, shape-shifting entity."

Phenomenology parallels the approach of Native science in that it provides a viewpoint based on our innate human experience within nature. Native science strives to understand and apply the knowledge

gained from participation in the here and now, and emphasizes our role as one of nature's members rather than striving to be in control of it. "Ultimately, to acknowledge the life of the body, and affirm our solidarity with this physical form, is to acknowledge our existence as one of earth's animals, and so to remember and rejuvenate the organic basis of our thoughts and our intelligence" (Abram 1996:47).

The creative body and all that comprises it—mind, body, and spirit—are the creative, moving center of Native science. Although this may seem to be common sense, modern thinking abstracts the mind from the human body and the body of the world. This modern orientation, in turn, frequently disconnects Western science from the lived and experienced world of nature. The disassociation becomes most pronounced at the level of perception, because our perceptions orient us in the most elemental way to our surroundings. Receptivity to our surroundings combined with creativity characterizes our perception.

In reality, orientation, receptivity, creativity, perception, and imagination are integrated through participation with nature. This is why participation is a key strategy of Native science; it can take many forms and can be individual as well as collective. In Native contexts, creative participation may result in a story, song, dance, new technology, or even a vision, ritual, or ceremony.

We cannot help but participate with the world. Whether we acknowledge and are creatively open to the perceptions that will result, or remain oblivious to its influence and creative possibilities toward deeper understanding, is our decision. This is the perpetual trap of Western science and the perpetual dilemma of Western society: all humans are in constant interaction with the physical reality. Western science and society perpetuate the illusion of "objective" detachment and psychological disassociation.

In encountering the world, our natural tendency is to engage in a reciprocal body of communication. However, if we objectify or rationalize our experience, we distance ourselves from the relationship and repress the full involvement of our senses. "By linguistically defining the surrounding world as a determinate set of objects, we cut our conscious speaking selves off from the spontaneous life of our own sensing bodies" (Abram 1996:56).

Native science continually relates to and speaks of the world as full of *active* entities with which people engage. To our sensing bodies, all things are active. Therefore, Native languages are verb based, and the words that describe the world emerge directly from actively perceived experience. In a sense, language "choreographs" and/or facilitates the continual orientation of Native thought and perception toward active participation, active imagination, and active engagement with all that makes up natural reality. This active perceptual engagement with the animate world was termed the "participation mystique" by French anthropologist Lucien Levy-Bruhl to describe "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" (Levy-Bruhl 1985 in Abram 1996:57).

While this definition of animism is descriptive of its observable traits, it is also a term that has become steeped in Western scientific and cultural bias. Along with words like "primitive," "ancestor worship," and "supernatural," animism continues to perpetuate a modern prejudice, a disdain, and a projection of inferiority toward the worldview of Indigenous peoples. But if, as Merleau-Ponty contends, perception at its most elemental expression in the human body *is* based on participation with our surroundings, then it can be said that "animism" is a basic human trait common to both Indigenous and modern sensibilities. Indeed, all humans are animists.

Likewise, it may be said that we all use the metaphoric mind to describe, imagine, and create from the animate world with which we constantly participate. Just as the focus on participation in Native science brings forth creative communion with the world through our senses, so too does the application of the metaphoric mind bring forth the descriptive and creative "storying" of the world by humans. Science in every form, then, is a story of the world.

## The Metaphoric Mind

The metaphoric or nature mind of humans is our oldest mind and has been evolving for approximately three million years. Its time of greatest development occurred during the Paleolithic era about 70,000 years ago. Paralleling its collective evolution, the metaphoric mind in the individual develops from birth to about the time a child begins to learn language. When language is developed and used extensively, the holistic experience of the metaphoric mind begins to get chopped up and labeled, until, eventually, it recedes into the subconscious. Yet, the metaphoric mind remains very important in a child's continued development because it encompasses the perceptual, creative, and imaginative experience of his or her inner world.

As the rational mind develops, the metaphoric mind slowly recedes into the subconscious, there to lie in wait until its special skills are called upon by the conscious mind. It rises occasionally when children are engrossed in creative play and imaginative reverie, or in dreams and stories. As the rational mind develops further and language becomes literacy, the metaphoric mind becomes significantly differentiated from the rational mind and that of social conditioning.

This differentiation has become compounded in Western society, with its overt focus on scientific rationalism. Despite the conscious separation of the metaphoric mind from the rational, both minds work together when the conditioning of separation is suspended during creative play, meditation, ritual, or other modes of spontaneous thinking. In Native societies, the two minds of human experience are typically given a more balanced regard. Both minds are respected for what they allow people to do; yet the metaphoric mind remains the first foundation of Native science.

Language and its use are the ways a society conditions the mind toward particular ends. Language and its codified meanings are a created structure of culture. Until recently, the power of language to condition thought either toward participation with nature or away from it has been largely ignored. In addition, the power of the written form of language to condition our minds and perception is even more powerful in determining how we view the world. The metaphoric mind on the other hand

communicates and relates to the world in the more holistic structures of oral stories, linguistic metaphors, images, and intuitions.

Our two minds are also symbolically represented in Native myths, like that of the sacred twins (Earth and Sky), among numerous ways of describing these primal entities that can both complement and oppose each another in the dance of nature within the human mind. As the Kogi refer to themselves as "elder brothers," and to whites as "younger brothers," so it might be said that the metaphoric mind is the elder brother and the rational mind the younger brother of human thinking.

Such an analogy is not far from the truth, since the earliest evidence of the application of the linear-thinking rational mind was revealed in an animal bone discovered by Alexander Marshack in the Ishango district of East Africa. The bone was Paleolithic in origin, dating back 30,000 to 40,000 years. What is special about the bone is its series of carved hatch marks, which upon closer observation follows a particular pattern, thought to be an early Paleolithic notational record. The notational system was probably created by Neanderthal hunter-gatherers and represented the monthly lunar phases. The first evidence of the use of a rational mind was to record a natural cycle, and this record shows the first use of applied science.

Which came first, the imaged thought in the form of the Neanderthal lunar record, or the spoken thought in the form of prayer, song, and story? It is likely that they arose together as the metaphoric or nature mind discerned the need for a "younger brother," the rational mind. Bob Samples points out that about 10,000 years ago, stories, myths, and their telling "created the cultural germ plasm of linearity." He adds, "That transformation resulted in the growing preference of linearity in the cultural setting. . . . The eventual price of giving up the metaphoric mind may well be too high, for it results in the severing of the umbilicus of humankind from nature" (Samples 1992:32-33).

In Native science, the metaphoric mind is the facilitator of the creative process; it invents, integrates, and applies the deep levels of human perception and intuition to the task of living. Connected to the creative center of nature, the metaphoric mind has none of the limiting

conditioning of the cultural order. Its processing is natural and instinctive. It perceives itself as part of the natural order, a part of the Earth mind. It is inclusive and expansive in its processing of experience and knowledge. It invented the rational mind, and the rational mind in turn invented language, the written word, abstraction, and eventually the disposition to control nature rather than to be of nature. But this propensity of the rational mind also leads to the development of anthropocentric philosophy and of a science that would legitimize the oppression of nature, and consequently, its elder brother, the metaphoric mind.

Alienation of cultures from each other . . . of humans from culture . . . of humans from each other . . . and perhaps most importantly, of humans from nature—all these are symptoms of the imprisonment of the metaphoric mind by the rational mind. If there is to be survival, the realms of nature, its cyclic time, its metaphoric reservoirs, and its mind in humans must be resurrected (Samples 1992:55).

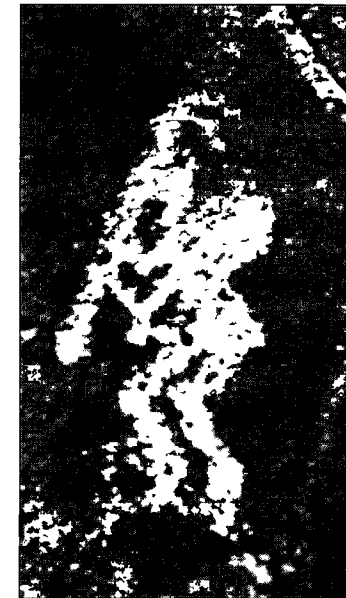
Because its processes are tied to creativity, perception, image, physical senses, and intuition, the metaphoric mind reveals itself through abstract symbols, visual/spatial reasoning, sound, kinesthetic expression, and various forms of ecological and integrative thinking. These metaphoric modes of expression are also the foundations for various components of Native science, as well as art, music, and dance. The metaphoric mind underpins the numerous ecological foundations of Native knowledge and has been specifically applied in creating the stories that form the foundation of the complex and elaborate forms of Native oral traditions. Realizing that the greatest source of metaphor comes from nature, these stories are filled with analogies, characters, and representations drawn from nature, metaphors that more often than not refer back to the processes of nature from which they are drawn, or to human nature, which they attempt to reflect.

Because Native science is thoroughly wrapped in a blanket of metaphor, expressed in story, art, community, dance, song, ritual,

music, astronomical knowledge, and technologies such as hunting, fishing, farming, or healing, rationalistic scientists, its “younger brothers,” have difficulty understanding its essence of creative participation with nature.

## Native Stories of Creation and Emergence

Native peoples have particular understandings of the way the world has come into being, and the ways they have come into being as people. These understandings are communicated in stories in the context of myth and art. Kokopelli, one of the archetypal figures of Pueblo mythology, represents many things to the Pueblo people of the Southwest. Kokopelli represents the creative process or the creative energy that is a part of all things—humans, the earth, and the cosmos as a whole. It is a symbol of the procreative and creative nature of all life, organic and inorganic.



Kokopelli, the seed bringer and lite symbol of creative energy.  
Photograph © Gregory Cajete.

Kokopelli plays a role in Pueblo stories of the "first times," or origins, and is depicted in many forms in Pueblo prehistoric, historic, and contemporary art. He is an archetype of the communicator or teacher in the sense that he was the bringer of news, seeds, and goods. Kokopelli then is also a type of life bringer, a representation of the creative spirit that resides in each of us as in all natural forces. Indeed, there may have been a group of traveling merchants throughout a part of the Americas, from the Incas in South America through the north, who traded with various tribes. They may have played flutes for musical expression as well as to assure the people in the villages they were approaching that they were friendly.

As the Kokopelli brought the news of life to Pueblo people, the Hopi in their remote northern villages also wondered, "Who are we? Why are we here?" The Hopi emergence myth implies and even answers these questions directly: to live and be happy in wisdom and harmony by respecting the love of the creator. But the people continually forgot this religious imperative, and the myth charts their journey from the beginning through several failures to new hope.

Originally, there was only Taiowa, and the first world of endless space existed in his mind. "Then he, the infinite, conceived the finite," and so creation began. Delineating a dependent and active force within himself, Taiowa created his "nephew" Sotuknang and had him arrange the nine-tiered world. Then Sotuknang formed Spider Woman, who with the mixture of earth and saliva (raw material and a fertilizing agent) and creative wisdom (a formative principle) made twin gods to harden the earth, animate it with vibration and sound, and finally to guard it at the two poles. After having formed plants, birds, and animals in the same manner, Spider Woman made the four colors of people in three stages, and the dawn broke, and the sun (Taiowa's symbol) rose to greet the creatures. Only Sotuknang, however, could make people independently creative, and this he did by giving them speech and reproductive power, and the wisdom to use them well.

Physically complete, the people's spiritual development was just beginning. In stages appropriate to psychosexual development as well as

cultural and religious development, the people moved from one stage or world to another in a manner imitative of birthing. They sojourned through the first world of harmony and unity with its sins of intolerance and consequent conflict, to the second world of culture and commerce and its sins of greed and acquisitiveness, and finally through the third world of civilization and technology with its sins of hatred and warfare. The faithful who remain journey at last northeast across water to the new, present fourth world of migrations and final settlement. This is a spiritual odyssey and signs of sacredness permeate the mythic path.

The myth eloquently proclaims the holiness of all, the fundamental unity of spirit and matter, and the relationship of all things through endless correspondences. The four types of life-giving corn, the colors, sounds, plants, animals, minerals, and directions—all resonate with the same holy vibration as the world itself. Microcosms are within macrocosms, the individual's body is to society what society is to the world, and all are ordered in the same fashion, dependent on the holy power of the creator (Sproul 1979:268-69). Many of the emergence stories of the Indigenous peoples of the Southwest provide guidance for behavior and attitudes that will ensure the success of people in creative relationships with the natural world.

After the people had emerged into the fourth world from former worlds of development, stories relate distinctions of tribes or races of humankind, each of whom is given special instruction and sent to a particular cardinal direction. Almost all emergence myths recount the migration of the people through the landscape with stops where important lessons about relationships, ideals, and moral teachings must be learned.

Native creation and origin stories have multiple components, meanings, and variations. One of the recurring themes revolves around the observation of "distributed power" in nature. Energy is distributed throughout the natural world and plants, animals, places, natural phenomena, and human beings share such energy in many ways.

Creation stories reflect a kind of "natural democracy," in that rather than presenting humans as the gifted and favored species of the world, the special traits of plants and animals are regularly depicted again and



The underground kiva structure with its ladder and opening to the world above ground can be understood as a metaphor for the emergence into a new world of creative being. The kiva opening pictured here is located at the Pecos Pueblo ruins, New Mexico. Photograph © Marcia Keegan.

again with mention of human dependence upon them. Some origin stories relate how human-like creatures transform the world in ways that allow for human habitation. In other stories humans strive to possess admired animal qualities or to establish relationships with certain animals for human benefit.

While all Native myths reflect a metaphoric play of imagination to reflect important relationships between the human and non-human, tales of creation relate how humans have been formed by and participate with the creative forces of the universe. Origin stories also show kinship between non-human and human; reciprocity with nature; intermarriage with animals, earthly, and celestial beings; and youths who play a role in bringing humans and nature into closer relationships. These characteristics will be discussed more fully in Chapter 5, "Animals in Native Myth and Reality."

The myths of creation, particularly those that deal with human emergence, relate the stages of human evolution and consciousness. Many of these myths parallel biological theories of evolution, as this Zuni myth does:

In the beginning, there was only moisture, which became clouds. The Great Father Sun, the Creator Awonawilona, thickened the clouds into water that then formed a great sea. With his own flesh, Awonawilona fertilized the sea and green algae grew over it. The green algae produced the earth and sky. The marriage of earth and sky and the action of the sun on the green algae produced all living things. From the lowest of the four caves of earth, seeds of men and animals were incubated as eggs. The Creator provided enough warmth that the eggs were hatched and all living things were produced (Bierlein 1994:67-68).

Emergence stories relate the process by which humans and all other mammals are born into this world, emerging from the darkness of their mothers' wombs into the spaciousness of the open Earth. Earlier tellings of the Zuni emergence, recorded in the last century, relate that long

before the existence of people, the "Sun cohabited with the Earth, and thus life was conceived within the deepest, fourth womb of the Earth. This emergence may be understood as the collective birth of all peoples—after a prolonged period of gestation in the dark depths of the ground" (Abram 1996:218).

Native people have been good observers. They understood that things were always in process, that things were always being created and then destroyed and then created once again in new forms. These basic ideas of science, of evolution, of ways of understanding ecological processes are deeply embedded in symbols like Kokopelli that represent the creative process in nature, human beings, and even the evolution of thought.

Understanding Native science begins with developing the creative ability to decode layers of meaning embedded in symbols. Symbols have been used for thousands of years by Native people, and are used artistically and linguistically to depict structures and relationships to places. They are metaphors encoded with the understandings of Native science.

Essential to the undertaking is the opening up of one's own creative mind and skills and the ability to look at things in new ways. This is the connection between Native and Western science, as at the highest level, Western science also represents a creative process. When Native people look at the world and try to understand *relationships*, it is a scientific (creative) process. Thus, Kokopelli and many other symbols are metaphors, and they serve as bridges for understanding of this process.

Indigenous peoples' science is grounded on an understanding of perspective and orientation. All things are related and interconnected, everywhere and at all times, and understanding this is necessary to apprehend what Native people did as they related to living in a particular natural place.

The idea of evolving, or changing through generations, is part of Indigenous thinking. Native peoples are aware of evolving and their places in these worlds. For instance, the Pueblo creation myth relates that humans evolved through various roles in existence, and in each of these roles they had to understand something about themselves and about

relationships to key things in nature in order to move to the next stage in this evolutionary process, becoming more mature, more human.

But "evolution" in Native thinking should not be understood in the Western way. Native people created their stories and explanations of how things came to be. Their origin stories are predicated on, above all, their own experience, specific to a particular place on the Earth, but also from their own particular viewpoint. The same can be said of every culture that has ever existed, including Western culture. Thus, the various origin stories known throughout the world can be traced to a particular people living in or within a particular place.

The typical myth that deals with the stories of how a people came to be and how they moved in the landscape is embodied in a very elegant way in the general Pueblo story of emergence. Each Pueblo tribe has a different version of this story, and each story has a sacred quality. Consequently, only parts of the story can be disseminated to outsiders. The central story is told as follows: Humans came into this world, their place, after having evolved through three other worlds of being. Before they could come in, they sent messengers to ask the powers of this world if they could live here. As the people received the message that they were indeed invited to come into this Earth, they were very happy. Their messenger, a sparrow, explained the rules they must follow, and those rules dealt with proper relationships.

As the people emerged, the first man and the first woman led them. The sun and the moon and plants and animals greeted the people. They came into a world bounded by mountains, waters, sky, and earth. In that boundedness was their home, and they had certain responsibilities to this place. It is said that they began their journey moving along a rainbow pathway into the place where they now live.

This Pueblo story is a tale of evolution, of journeying, of learning about responsibilities to each other and to all other creatures inhabiting the world with them. This story becomes complex as it guides; it is the story from which other stories come, from which other understandings about relationships develop. Each generation adds to it something of itself and of its experience.



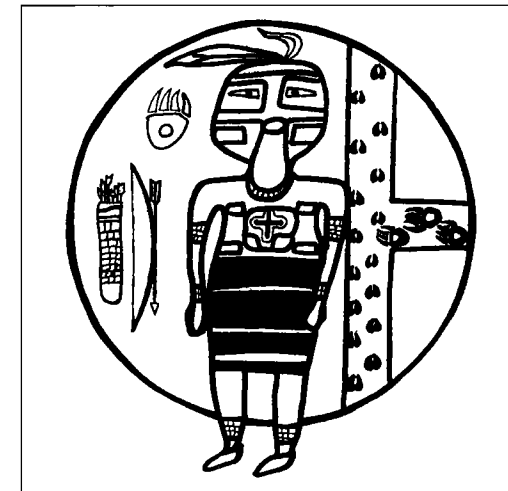
These stories are authentic creation stories: they explain that humans, plants, and animals, and the forces of nature are part of the universe's creative impulse. This very participation in procreation brings with it certain responsibilities and understandings that must be maintained, the *kinds of understandings* that today we call an "ecological compact" or "spiritual ecology." Environmental philosophers recognize that a culture's assumptions about how the world works, the purpose of human beings, and the like, embody how people relate to their place at the deepest levels. A culture's understanding of relationship encompasses everything, from the spiritual to the physical, including the technologies and tools that develop from a specific mode of thinking and understanding of relationships. From this understanding comes a people's ecological compact with all things in the world.

The stories about the time following the creation are filled with metaphorical tales about transgressions in the so-called ecological compact. These myths, stories of creation, and stories of origin and of emergence are similar in the sense that they are told by Indigenous people all over the world and all describe compacts built on relationships established between humans and other living things. These stories embody the understanding that humans, along with all other entities, continually create the world. People are co-creators and their role as co-creators is no more important than that of all other co-creators. Humans have responsibilities to their co-creators, and vice versa. Unless one understands his/her place in the whole, there is always a tendency to move beyond, to glorify, to self-aggrandize. The technologies that humans build tend to follow understanding, or the lack thereof, of their role in the world.

Many versions of players in these stories of origin and creation include the trickster figure or the culture hero. The culture hero is usually responsible for the creation of art or community, or bringing very important knowledge of a ceremony or way of living. In some tribes, the cultural hero may be an anthropomorphic figure or a human figure, probably with supernatural powers. But the culture hero can also be an animal, like the coyote or raven, who has powers to create or introduce something essential to the people living in a particular place. Because

these culture heroes are intelligent, they are often two-sided, and responsible for dis-creation or destruction. Knowledge and its application always have consequences.

The Mimbres figure depicted in the next illustration, a hunter of good heart, shows the concept of learning how to properly relate to the animals that give humans life, food, and clothing, and is a very ancient mythic construct, dating back tens of thousands of years. Hunters, or humankind, have certain responsibilities to the animals that give them life. The earliest human cultures were basically hunting cultures, with direct relationships to those sources of life, the animals they hunted, in mythical ceremony and ritual form. Drawings representing the perspective of the hunter and his connection to the hunted are found in caves in Les Trois Frères, Ariège, France, and elsewhere. The hunter of good heart is found in myth and in the teachings of Indigenous peoples all over the world.



Mimbres Hunter of Good Heart (in Cajete 1994:59).

There have been many kinds of expressions of the relationship between people and animals, but the concept of the hunter of good heart not only delineates the philosophy guiding relationships with animals that are hunted, but also hunting technology, or the technology used in preparing the animals for food, clothing, and other purposes.

Practical biological knowledge revolved around hunting, because hunters learned the animals' habits, how to track them, and which parts of the animals to use, as well as how the animals reproduced and what they needed to live. In this sense, hunting may be considered the first science. Hunters quickly realized that they needed to conserve resources of life, and that the life in the animals they killed was not different from the life they experienced. This realization underlies the development of some implements and hunting methods that were not as painful or disruptive to the animals as others. It also forms part of the understanding of animals as a people, a community that needs certain terrain to live and reproduce. Hunters of good heart did not kill all animals of one kind in an area because they understood the animals could not then live or reproduce.

Hunting was one of humankind's first technologies, along with the uses of plants for medicine. Creation stories and myths incorporate humans and animals as they interact with each other at various levels or planes of the earth and the cosmos as a whole, and in a sense, Native creation stories never end, as they change from generation to generation. One could say that Native peoples developed ecological empathy.

Many thousands of years ago the interplay of humans with the natural world and the cosmos as seen in Native peoples' creation stories 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 the cycles of nature. In many ways, ancient Native myths preceded biological theories of evolution and transformation.

The Mayan creation story involves three worlds, or perhaps three levels of reality in the world. At the bottom is the underworld or Earth, often depicted by a turtle that carries the Earth and all its processes. We ride the turtle's back; Turtle Island is a mythical concept for many Native groups and there are many variations. The middle world is the physical world of humans where we live and walk about. Above is the world of the

sky or the universe. Things happen at each of the three levels, and the worlds or levels are related to one another, as the boundaries between them are not rigid.

In Native science, all relationships are related to other relationships. There is a vertical and a horizontal process, and these processes are constantly intertwining with each other to create reality. As humans, we are familiar with the middle world because we live in it, but the world above and the world below affect what happens in the middle world, as what occurs in the middle world likewise affects the top and the bottom. The Mayans have a very elegant story about the creation of the world and how the three worlds came into being.

Humans live in all three worlds, but we are conscious of only one. Many Native ceremonies are intended to make participants aware of the three levels or the overlaps between them. These ancient rituals alter participants' everyday consciousness to acquire knowledge from the underworld and the universe, which in turn promotes understanding of what goes on in the middle world. One way or another, all human cultures have these basic understandings. Only with the advent of Western science, with its separation from spiritual realms, have these understandings been separated in a very particular, systematic way.

Barriers between realms of knowledge constitute a major area of conflict between Native science and Western science. In the Native science paradigm, it is assumed that all three realms affect humans. Inherent in this assumption is that humans can ignore or dismiss understanding that originates from the upper and lower realms only at their peril. This notion comes from the Iroquois myth of the Great Turtle Island, wherein the turtle represents the procreative female energy, spirit, and life of the Earth itself. Its parallel in Western culture is the Greek Gaia mythology, in which the Earth was essentially female and had a life and spirit above her.

Today these ancient concepts are being reintroduced in the theories and philosophies guiding curricula on ecology and environmental systems, from kindergarten to university level instruction. The Earth is being perceived as a living, breathing entity—a megabeing if you will. These concepts generate still others, such as ecological relationships,

ecological sustainability, and environmental stewardship; that is, the need to avoid polluting the land in which one lives, to care for the land.

The creative process of nature involves happenings in geological time and place, which also happens through metaphoric as well as mythological time and place. When listening to a creation story or viewing a symbol, one apprehends multilayered meanings. Upon learning about metaphoric and mythic relationships, one gains a foundation for maintaining them. Behaviors like caring for land, caring for plants and animals, naming one's place, and developing relationships to natural entities in that space are expressions of Native science.

The idea of journeying expresses the social psychology of Native science. In the oral traditions of many Native peoples, a hero starts with a very naive view, one in which he is coming to know something but has not grasped it yet. In the Scar Face myth, told by the Blackfoot and other Plains tribes, a boy has a facial scar in the form of a crescent moon. He does not know his mother and father and has been adopted by the tribe, and further, the scar sets him apart from the other young people. As he comes of age, he begins to ask the proverbial questions: Who am I? Where did I come from? What is my purpose in life?

Scar Face embarks on a journey of discovery, a pilgrimage that takes him through the land. He is determined to find his parents, as his adoptive parents have told him that his mother and father have moved to the east where the sun rises. As he journeys through the landscape, he experiences various trials and tribulations, much like Joseph Campbell's "hero with a thousand faces." According to Campbell (1949), this archetypal mythological structure appears in some variation in all cultures.

Befriended by various entities and helped by animal allies, Scar Face arrives at a place of "big water," and he does not know how to cross the water. In one version of the story, he falls asleep and has a vision in which he moves along a pathway to the sun into the land of the Sky People. Once again, he experiences trials, but eventually he encounters his brother. He learns that his mother is the moon and his father is the sun. Scar Face then fights battles and receives honors, and the scar is removed from his face. He returns to Earth with new knowledge and maturity.

Scar Face becomes a culture hero, the leader of the Sun Dance ceremony, and a great teacher of the Blackfoot.

Among other Plains tribes, too, there are numerous versions of this story, as well as numerous versions about other culture heroes, creation stories, how things happen, and so on. In effect, as individuals or groups within a tribe take journeys of discovery, they bring back new and useful things that are added or incorporated into the stories.

Another way of accessing creative knowledge in the Native tradition is sometimes called the vision quest or experience. The vision quest or journey is one of the ways in which a person gains knowledge about one's purpose and one's soul, as well as the forces of nature and the surrounding environment.

Native people have traditionally understood that creativity manifests itself in many ways, and that this creativity leads to new knowledge and a greater understanding of relationship. Stories, particularly origin and culture hero stories, are mechanisms by which these understandings are conveyed to the next generation. This process can be compared to the process in which a book is written and then disseminated to the public in published form. Oral storytelling and the use of mythological symbols are used to communicate important information in the same way.

Many Native stories relate how the world has changed. In a Paiute myth, Coyote challenges shamans who have captured fire and are keeping it hostage for themselves atop an obsidian mountain. Coyote and his animal allies challenge the shamans to a dance contest. One by one, they dance the shamans into exhaustion. Everyone falls asleep, and the fire dies to a tiny ember. Coyote then steals the ember and flees with his animal allies. The animals toss the ember back and forth among themselves while running away from the obsidian mountain, and so fire is distributed throughout the land. The ice melts and the darkness is dispelled.

In some tales, particular attention is given to the ice melting. Those tales may have originated during an ice age, a time of (literal) darkness and the subsequent melting of glaciers and return of the sun. In the story, just as the shamans are about to catch Coyote, he gives a war whoop and throws the ember into the sky, which then forms the sun. Coyote then is a

transformer, as well as a culture hero and a 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.

One might say that these and other stories are folk tales, not scientific theory or method. 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.

The Inuit tell of the birth or emergence of the first man from a peapod. As Raven, a trickster figure similar to Coyote, witnesses the first man coming into the world, he tries to teach humanity how to live and relate to the world. Once again, we see the theme of emergence as a tale of learning responsibility. This is a creative tale about how humans obtain knowledge, how they learn responsibility for such knowledge, and then how knowledge is applied in the proper context.

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. Native science was elegantly developed, adapted, and created for the specific places in which people had to survive.

The notion of the diversity of human beings riding the turtle's back, or a global society, is not new. These understandings are part of the Indigenous thinking that includes an ecology of necessary and reciprocal relationships to the natural world as well as among human beings in community.

Both Western science and Native science use research and data gathering. Over the millennia, Native people observed and experimented to understand how the world worked, and to apply what was learned. But to learn about relationship, Native people believed they had to learn through contact or direct experience rather than through abstraction.

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.

The idea of walking to a mountaintop to seek and find a vision is used by both an individual and an entire people. The vision gained is shared with others as part of one's participation in the world and in the creative process of human life and of life on earth. Each person is important and therefore each person's vision is important and blends itself into either the construction or destruction of the world.

The top of the mountain is a metaphor for a place of perspective about where one has been, where one is, and where one may go. The mountaintop gives perspective on the purpose of creation, which always has purpose. In this appreciation of creation, there is a search for the reason behind anything in which one participates. This is both the natural philosophy and the creative process as embodied in Native science.

Teaching people about the creative process involves, first, its demystification. People need to discover, or rediscover, their own creative abilities. Young children are naturally creative until creativity is repressed in the formal process of education. When they become adults, they often feel something missing, but have no idea how to discover what. This type of creativity requires openness and following intuition, looking at symbols and considering many perspectives, and listening and researching what other people have to say. This is what creativity requires in everyone, including writers, visual artists, and scientists of all kinds. Among technical professionals and engineers, however, creative thinking is rare because of their straitjacketed education; very few are able to think creatively, and they may not even wish to, as such thoughts may frighten or surprise them.

A second aspect of the creative process involves thinking in metaphors, that is, in symbols and images. Unless one is open to metaphoric thinking, Indigenous natural philosophy will remain mysterious because it has evolved from multileveled and multilayered symbols.

## Art as a Means of Ceremony and Transformation

Frederick Franck (1981) has written, "Art is a way . . . of seeing . . . of being and of becoming. But in order to see the expressive realities art presents, one must first learn how to look." Just as each individual understands and sees reality in an individual and unique way, so does each society, and each generation in a society. To understand something of this development of art as a way of "seeing" requires that one recognize the inherent ceremony of art as an ongoing dimension of an Indigenous education process.

Indigenous artisans select the features of what is being depicted that convey its vitality and essence and express them directly in the most appropriate medium available. This approach, as opposed to the attempt to conform to intellectualized theory or schools of thought, or to depict the exact form, reflects the basic foundation of ritual making and creation of traditional tribal art. The emphasis in the creation of traditional art is upon getting to the heart, the spirit, of an event or entity.

Art in traditional Native societies, in effect, reflected the ritualization of the life process. For much of Indigenous art, the "aliveness" of an artifact was the primary aesthetic criterion, rather than "beauty." This did not mean that Indigenous artifacts were not beautiful. Instead, their inherent beauty was a natural byproduct of their "life." This vitality of the human experience and nature continues to inform contemporary Indian art today as well as modern art.

The life inherent in much of Indigenous art reflects a process and product of the Indigenous educational process. The effort to gain insight into the nature of Indigenous education through exploration of its various foundations represents an important insight for the future "new" paradigm of education. To get at the "meat" of the matter as it concerns the role of art in the Indigenous education process, an exploration of the ceremony of art is essential.

The ceremony of art touches the deepest realms of the psyche and the sacred dimension of the artistic creative process. The sacred level of art not only transforms something into art, but also transforms the artist at the very core of his or her being. This way of doing and relating to art makes

the process and context of art-making infinitely more important than the product. In terms of Indigenous American "art," this transforming sacred quality of creation is inherent in varying degrees from the purely utilitarian artifact to the shamanistic talisman. The plants and animals used, and the technique and media with which the artifacts are created, reflect an integration and clarity of purpose with mind and heart that even accomplished modern artists have difficulty emulating. The innate "nature centeredness" of Indigenous art forms represents an "educated soulfulness" that unfolds through the creative process of the artist onto the medium.

Traditionally, Indigenous artifacts are created with an acutely developed understanding and acknowledgment of the natural elements from which they are created. The most elaborate examples of such understanding and acknowledgment are Indigenous ceremonial artifacts. Each component of an artifact was carefully chosen with regard to its inherent integrity of spirit and its symbolic meaning within the traditions of a particular tribe. The use of particular kinds of natural pigments, clay, wood, stone, plant or animal parts, gathered from special places in ritually prescribed ways, is common in the creation of ceremonial artifacts. From intention and conception to completion and use, every step of the creation of a ceremonial artifact has inherent meaning within a broader perspective of relationship to spiritual energy.

The spirit, soul, and purpose of each component of a piece and its transformation through artistic creation were practiced and taught through the deliberate creation of a context in which process, product, and self might become one. The context that allowed this process of teaching to unfold might have been ritual, ceremony, dance, song, pilgrimage, or any combination therein.

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 such apprenticeship relationships, the mentor often sets up conditions in which the apprentice would learn how to identify with the creation of an artifact. In the making of ceremonial art, these conditions were extended to include the "transformation" of the apprentice to a requisite level of consciousness.

In this way, art became a process of spiritual training. It is no accident that the first shamans can also be considered the first artists.



Navajo healer preparing sand painting. Photograph © Marcia Keegan.

The contexts discernible in the creation of ceremonial art in Indigenous societies can be seen to follow the general pattern outlined below.

*Preparation (purification).* This is primarily a conscious effort to simplify, to become aware, to sharpen the senses, to concentrate, to revitalize the whole being. The idea here is to develop the ability to imbue an artifact with pure and simple vitality and to have the clarity of mind and stamina required to undertake a very difficult and sometimes dangerous task, such as the initiatory paintings of the caves of Lascaux and Les Trois Frères, France. There is a guiding spirit, or “consistent adherence to original intent,” the notion of applying one’s will to concentrate one’s whole being into a task, a creation, a song, a dance, a painting, an event, a ceremony, a ritual.

*Sources.* Attention to the nature of the sources of raw materials to be used in the creation of an artifact, especially one for ceremonial

purposes, is essential. Not only the quality of materials is important, but also how and where they are obtained.

*Adherence to patterns.* Forms and designs are adhered to while also being transcended. “Generally, ceremonial artistry acknowledged the inherent mystery, the intrinsic integrity of both medium and material, but within the parameters and adherence to a sometimes strict cultural convention” (Garcia 1990:12).

*Time.* Time itself becomes an artistic/creative ingredient as a culturally defined dimension combined with the intuitive and spiritually conditioned sense of timing applied by the master artist in the production of ceremonial art. Artists concerned themselves with the “timeliness” of creation from beginning to end.

If a tribal carver, blacksmith, weaver, singer, storyteller, or whatever was not a diviner of time, such a person would be consulted and a favorable time would be divined for the initiation of a ceremonial artifact. . . . Through the entire creation process there were a series of ‘right’ moments or phases which might be suggested by a certain smell, a quality of the raw material, a feeling, emotion or dream, which might indicate whether or not to proceed to the next phase of creation” (Garcia 1990:13).

In short, the artist sought an alignment of knowing.

*Right place.* Time and place are integrally related. Therefore, the place of creation often becomes a consideration in the creation of ceremonial artifacts. Certain places were considered by Indigenous people as being conducive to certain endeavors. Such places might be characterized by “invisible qualities,” the availability of appropriate materials, environmental areas conducive to heightened awareness and creativity, dreaming places, healing places, dancing places, living/setting places, singing places, and creative places.

Part of the reason for preparation before creation of ceremonial artifacts is to be able to “locate” the appropriate place for creation through sensitivity to feedback at several levels of sensation. Location also includes

sensitivity to the metaphor of spatial orientation and alignment of self to the environment with the material used. Space and location-orientation are important considerations in all Indigenous people's activities.

*Letting go and becoming.* Self-effacement and surrender to the contingencies of the task of creation often characterize the production of ceremonial art. Such a state of being might result from the phase of preparation or at some critical "turning point" in the creative process. Regardless of how the state is reached, it is necessary for it to occur if artist and artifact are to become one and if the authentic transformation of both is to occur.

*Intrinsic well-practiced belief.* "The struggle to create the artifact which is imbued with power and authentically symbolizes an essence . . . is a struggle of finding and sustaining appropriate will. It is only appropriate will, sustained by an integrated and properly focused vigil, that will align with an eloquent expression of a 'truth' of a given indigenous group" (Garcia 1990:16).

The struggle to express such a truth through the creation of a ceremonial artifact comes only from a long-practiced faith in the effect of one's work and purpose. The successful outcome of such a struggle depends on what can be called "appropriate will." Appropriate will results from a full understanding of the repercussions of undertaking a task and the purpose to be fulfilled by the work that is created. Appropriate will integrates the intention for creating work and contexts the planning, vigilance, and devotion required to bring a work to completion.

*Packing of a symbol.* Symbol and symbolization are the essence of art in every form. Indigenous people believe that symbols have a power beyond their literal connotations. A symbol might protect one from a particular danger or invite it. A symbol might heal or kill, induce fertility or prevent it, communicate a universal or a specific example, trigger empowerment or take it away. Through the ceremony of art, Indigenous artists "pack" a symbol with specific meaning and intent. Petroglyphs represent a clear exemplification of such a packing process. Each symbol represents a metaphor whose meaning is contexted in the myth, experience, or understanding of a tribal group or clan. The Kokopelli among

Pueblo peoples and the medicine wheel among the Sioux are but two of the hundreds of examples of such "packed" metaphoric symbols among tribal peoples of the Americas.

*The vigil.* This part deals with the cultivation of patience and focusing a constancy of intent and attention throughout the process of creation of an artifact. Sustaining appropriate attention to every aspect of creating an object is not only a reflection of vigilance but also an honoring of the process of making through which each detail of work is given its due. It is a way of "prayerful work." "A primal artisan would never for a moment leave the proximity of the setting of the task, not for a moment, not even if it were meat or clay cooking slowly in the perfect pit or oven" (Garcia 1990:20).

*The completion.* Everything that needs to be part of a creation is gathered and "packed" into a tangible form. In this stage the intent of a created work is crystallized and given physical birth into the human world of use and understanding, brought into its full physical being, ready to be used and to serve its purpose. As a form, it is packed with "potential," but this is not the end of the Indigenous artistic process, only a transformation of orientation and focus.

*Give-away.* The completed form and the life and meaning inherent in the work's physical being is given up to the purpose and process for which it has been created. The give-away marks the entrance of the artifact into a community for symbolic recognition and use. The artifact may be used once or may be used and reused many times, but its "meaning" is always understood as long as a tribal group "remembers to remember" the context, circumstances, and purpose of its creation.

*Aesthetics and appreciation of intrinsic meaning.* These are reflected in the honored use of the artifact for its designated purpose from one generation to the next or over the life span of the individual(s) responsible for its creation. The aesthetics and value of the artifact are directly related to what it means and the purpose it serves in a tribal context. For instance, the potlatch "coppers" so integral to the potlatch give-aways among Northwest Indian tribes increased in value the more they were given away by the families who honored their

aesthetic and intrinsic meaning to their tribes. This is only one of dozens of similar examples.

The "ceremony of art" inherent in the philosophy and use of art among Indigenous societies presents an essential mind-set for the learning, teaching, and using of art in a contemporary educational context for American Indians. Art and the making of art are a natural cultural mode of expression for American Indians whose development and process are intimately intertwined with their spirits and souls. Art for art's sake, art as individual writ large, art as intellectualization, art as commodity, and art as social commentary are all dimensions of the modern contemporary art world whose consequences Indian artists must come to understand in the evolution of contemporary Indian art. This must be accomplished without losing the understanding of the intrinsic power and value of the ceremony of art that lies at the core of art and the role that it plays in defining the very soul of tribal identity. To accomplish such a task is a great challenge. Yet, it is of paramount importance to find ways to ensure that the process and meaning of traditional tribal arts are not forgotten, because these are a unique and irreplaceable way for "seeing the voices of our hearts" and accessing wholeness through the creative process.

### Meanings and Possibilities

Cosmologies are the deep-rooted, symbolically expressed understandings of "humanness." They predate all other human structured expressions, including religion and social and political orders. The first Indigenous cosmologies were based on the perception that the spirit of the universe resided in the Earth and things of the Earth, including human beings. Because of this perception, these people remained equally open to all possibilities that might manifest through the natural world. In turn, perceptions of the cycles of nature, behavior of animals, growth of plants, and interdependence of all things in nature determined culture, that is, ethics, morals, religious expression, politics, and economics. In short, they came to know and express "natural democracy."

In the inclusive view of natural democracy, humans are related and interdependent with plants, animals, stones, water, clouds, and every-

thing else. Thus, it becomes in every sense abnormal to view the world as dead matter, private property, commodities, or commercial resources. The manifestations and roots of the Native sense of democracy run much deeper than the modern American political version of democracy today in that all of nature, not only humans, has rights. This is the essential "cosmological clash" between the foundations of Native culture and those of modern society.

The cosmology that has shaped the evolution of the West with its focus on dominion over nature, the hierarchy of life, and a transcendent male God, has also shaped modern people's perception of the "real world." Modern Western societies are rooted in institutions based on the old unexamined tenets of this cosmology, although our collective thinking is shifting toward a more inclusive cosmology. But the mind-sets of many modern people are still firmly vested in the old mechanistic worldview. Therefore, conflict at all levels of modern life is inevitable.

The ambiguity, conflict, and tension that we are now experiencing at all levels of modern life are reflections of our inability to come to terms with an essentially dysfunctional cosmology, a cosmology that can no longer sustain us at any level. Although there are different stories from the people who gave moderns the current dominant cosmology, all espouse essentially the same root paradigm. God was seen to live outside the universe, transcendent and greater than the universe, while also having dominion over the universe and all inhabitants. Humans were seen to have a connection to this divine god, but in order to fully consummate this union or connection, people had to transcend the material world, and become transcendent and exercise dominion over it in God's name. This orientation leads to a perception of the world in purely material terms; hence, the objectification, secularization, and scientification of the world. The non-human world (many times including tribal Indigenous peoples) was considered the property of the transcendent God and his chosen people. Although it was considered holy, it was also considered material, without spirit, and therefore eligible to be used or exploited according to the chosen people's needs. This conception of the world as spir-



itless (dead/lifeless) material allowed Western peoples to have a sense of detachment that was religiously justifiable. It was therefore up to Western people as to how they might express or apply this God-given right of dominion over nature.

Ironically, Western society's systems of science and technology have literally come to have a kind of life of their own. The splitting of the atom, creation of the computer, advances in genetics and microbiology, and a host of other developments have given science and technology the aura of invincibility and god-like qualities. Yet, with the advent of the theory of quantum mechanics, theoretical physicists and others have begun to realize that the universe has a non-material dimension, a deep spiritual dimension, and an elegant guiding intelligence. As they have probed the universe and the earth, some scientists have begun to understand the magnitude of their size, complexity, and age, and their macro and micro characteristics. Therefore, they have begun to move from the ready-made and inherently simplistic conception of the universe as a machine to an understanding of it as a "creation in grand process." We are a momentary part of the ongoing creation of the universe, which continues to unfold in ever more complex expressions of cosmic process. The universe and planetary system of which we are a part is but one small eddy in an ocean of creative process that began more than fifteen billion years ago.

Thomas Berry, a Catholic priest and former president of the Teilhard de Chardin Association, argues that the nature of the new cosmology must be life nourishing, in tune with the Earth. De Chardin, a Jesuit priest, was one of the first modern scholars to integrate faith with modern understandings of Western science. Berry brought the profound insights of de Chardin into the present and offered the thesis that what we are really facing is a "crisis of cosmology." Berry believes we must develop a capacity to re-think the predominant guiding story of Western civilization in a new and life-nourishing way. As Berry puts it, "We must stop being autistic to the life, language, and process of our mother the earth."

In essence, Berry talks about renewing our faith in the possibility of a sustainable future in tune with the truth of nature's primal laws, because our images of the future are self-fulfilling. The images we create,

the languages we speak, the economics we manifest, the learning systems we espouse, and the spiritual, political, and social order we profess must all reflect and honor interdependence and sustainability. If we live the images of hopelessness, that these are the final days, that all that matters is "me, mine, now," then these are the realities that we will bring about. Reading the signs of the times in broader ways and allowing the pain of the dysfunction they cause to come into us rather than running away and shielding ourselves are ways to begin to manifest a sustainable future.

Given the dawning of such realizations, the mechanistic, Cartesian model reveals itself as wholly inadequate and inappropriate for founding the kinds of institutions that are inclusive and multidimensional enough to sustain us in the twenty-first century and beyond. The question is what will a new cosmology include? The new cosmology and philosophy must encompass the realization that the Earth is in essence a superbeing in a universe of superbeings and supercommunities. It must incorporate the understanding of human beings as dynamic bodies intimately cradled in the body of the world. We are the Earth becoming conscious of itself, and collectively, humans are the Earth's most highly developed sense organ. In this sense then, "humankind is nature, looking into nature" (Berry 1991).



"Tree of Peace." Painting © Chief Oren Lyons.

CHAPTER TWO

## Philosophy of Native Science

*"Living the earth and facing the sun"*

All is beautiful,  
All is beautiful,  
All is beautiful, indeed.  
Now the Mother Earth  
And the Father Sky,  
Meeting, joining one another  
Helpmates ever, they.  
All is beautiful,  
All is beautiful,  
All is beautiful, indeed.

—Navajo

## Eco-Philosophy

The sacred tree of life, as an analogy for the evolving process of Native science and quest for knowledge, presents a cosmological and structural symbol for Native science that embodies its life- and nature-centered orientations. Native science is in every sense an expression of the evolutionary interrelationship of Native people with nature. The tree presents an archetype of life, learning, and development that begins with the sprouting of a seedling from a seed embedded in fertile ground, then moves to the various stages of growth and development through all seasons of life and its trials and tribulations until it begins to form seeds of its own. The tree is natural analogy for a living philosophy. Each species of tree is of a particular "tribe" originating and rooted in the soil of a particular place, living and growing into its own particular form and completing itself in the distinct way of its species, yet having its own unique and one-of-a-kind expression of life. The leaves, fruits, and seeds of each tree are really the outward expression of its life and its "treeness." Each of these is an expression of the philosophy, art, and soul of the tree and of Native cultures.

The sacred tree is a symbolic metaphor of ecological philosophy represented in many aspects of myth and ceremony throughout Native America. Native stories often refer to the Tree of Life as the life-giving principle of the Earth that nourishes and connects all life. It is a symbol of the core orientations of the Native philosophies of holding life sacred and rootedness to the Earth. It is a living symbol and source of that divine energy of life expressed in language, song, dance, art, and science. The roots, trunk, branches, and leaves of this sacred tree may be seen as symbolic expressions of the various dimensions of Native science. The thousands of expressions of Native science are symbolic leaves of this great Tree of Life. Native science expresses the hope that this great tree will continue to flourish in the hearts of all humankind.

Cosmology is the contextual foundation for philosophy, a grand guiding story, by nature speculative, in that it tries to explain the universe, its origin, characteristics, and essential nature. A cosmology gives rise to philosophy, values, and action, which in turn form the foundation of a society's guiding institutions.

In the West, techno values of power, control, and efficiency are championed by institutions and organizations, and the modern hero is a practical, action-oriented, business-minded individualist, whether he or she wears a three-piece suit or faded jeans, who symbolizes the technological civilization and the cosmology on which it is based. Just as the Faustian person did, modern business acts on its sense of entitlement no matter what the expense. Actions have literally no frames of reference other than individual gratification and institutional profit and include the plunder of the natural world as a means to self-serving ends. Consequently, our applied technology, science, and economics have trivialized our lives and sterilized our spiritual sense of being.

An immature cosmology spawns immature individual values and institutions. But the immature Faustian individual is experiencing final self-indulgence. The era of the "ecological individual" is by necessity dawning. As our society's cosmology has misfired, resulting in environmental destruction, so have its philosophies, values, actions, and guiding institutions. The creation of an ecological cosmology with its philosophy for the individual must now be sought through education and in our political and economic systems. According to Henryk Skolimowsky (1992:3), "Eco-philosophy . . . is like a tree. Out of the roots of eco-cosmology grow the trunk and branches of eco-philosophy. . . . The tree is crowned with ecological consciousness, which in subtle ways feeds back into its roots. Thus the cycle is complete and self-renewing within itself."

Skolimowski was one of the first to articulate an eco-philosophy for the transformation of thought needed for a new ecological consciousness. In his 1981 study, *Eco-philosophy: Designing New Tactics for Living*, he states that because current political systems threaten to rob us of our highest values and because the current basis for action is no longer deeply rooted in life-serving purposes or reverence for nature, we need a new philosophy to inform and guide us. Skolimowski writes of the loss of soul in modern philosophy, bereft of a language that cannot speak of love, soul, or spirit, and advocates the recycling of minds toward the realization of a living philosophy.

Because the current worldview causes escalation of our destructive relationship with the environment at every level of life, human meaning atrophies. The emerging environmental cosmology will be in conflict with the popular mechanistic view. This “cosmic” conflict can be seen in the energy underlying philosophical, political, religious, and economic debates all over the world.

A modern “ecosophy” would be about the rediscovery of meaning as it relates to our universe. It would require not only a different way of thinking, but also a different way of knowing and living. Such an ecosophy would rebuild a unitary view of the cosmos in which everything is interdependent and moved by creative energy, one that views the Earth and the universe with reverence and explores our essential relationships and responsibilities therein. It would be, essentially, the philosophy Indigenous people have lived by for generations, writ large.

“We must not presume,” wrote Skolimowski, “that the present day, scientific explanation of the structure of the universe is the only legitimate explanation, and that scientific cosmology is the only legitimate cosmology” (1992:9). Spurred by the development of quantum physics with its view of the universe as one indivisible whole, some Western scientists have begun to change their orientation from conviction of an absolute to one of relative truth among many truths and possible orientations and cosmologies. In truth, any story of the cosmos has to be metaphysical because every method of research stems from a cultural orientation, a paradigm of thinking that has a history in a particular tradition. There can be no such thing as a fully objective story of the universe. The cosmology of the Hopi is as valid and internally consistent as that of Western science.

Skolimowski (1992:16-27) contends that the emerging eco-cosmology and the philosophies that it gives rise to must rest on seven *internalized* orientations:

- The new cosmology must reflect realization that the fate of the Earth is now intimately intertwined with the fate of the human species. We are the universe and the universe is us.

- Evolution is a continuum of creative becoming, and humans are the result of this process as well as its facilitators.
- With our creative evolution of mind, we are reflections and participants of a greater universal whole. We are the Earth being conscious of itself.
- Humans are but one manifestation of an implicate universal order. All parts of this order interpenetrate one another. They are holistically codependent—“we are all related.”
- Hope for human meaning and destiny underpins the motivation for human attempts to realize themselves and to affirm a future with compassion, courage, solidarity, and action.
- We continue to engender and cultivate reverence for life as a way of action and to acknowledge the beauty of life and the miracle of which it is an expression.
- In understanding the evolution and application of ecological ethics, we revere all living things, taking responsibility for our relationship to the Earth, for doing more with less, and for pursuing wisdom and self-actualization rather than all-consuming materialism.

Application of the above orientations will lead to an eco-philosophy that includes life orientation in contrast to language orientation; commitment to nature and values as opposed to detachment and objectivity; focus on spiritual vitality in contrast to academic spiritualism; an attempt to gain comprehensive understanding rather than piecemeal analysis; a pursuit of wisdom rather than the accumulation of data; a reorientation of economics toward a holistic quality of life rather than an increase in the GNP; a political orientation that truly focuses upon the greater good rather than on financially endowed special interests; and cultivation of social and individual responsibility rather than individualistic autonomy. Such an eco-philosophy honors cultural cosmologies as well as develops a deep inner consciousness of health as the foundation for outer transformation of self, community, and society. “Eco-philosophy signals the beginning of a new epistemology: pluralistic, life-rooted,

cosmos oriented in contradistinction to the present one which is matter-rooted and mechanism oriented" (Skolimowski 1992:55).

These orientations form a distinctly different conceptual framework, a kind of philosophical foundation needed to repair the damage of the former cosmology and to create an eco-consciousness that will engender new mythologies we can live by and a transformative worldview. 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.

It is especially with regard to educational institutions and the entire process of modern education that the creation of eco-philosophy faces its greatest challenge. Mainstream educational institutions are heavily invested in the maintenance and perpetuation of the old cosmology. Education is what molds and conditions people to "fit" into a society. Essentially, modern education conditions a person to be oriented to consumerism, competition, rationalism, detachment, individualism, and narcissism. Education supports the "consciousness" that has led to the ecological crisis and dilemma we face today. Solving the ecological crisis through contemporary educational structures would be next to impossible.

The emphasis of education must be turned toward conditioning for what Skolimowski calls the "ecological person," a contemporary version of the Indigenous man and woman. Ancient axioms of Indigenous education such as finding face, finding heart, becoming a complete man or woman in right relationship to one's self, family, community, and the natural world resound in the following perspective Skolimowski developed in 1992. He postulates an interactive relationship between cosmology, philosophy, values, and action. Education as an institution falls in the realm of "action," the action by which we transfer the cosmology, philosophy, and values to each other and subsequent generations, and which therefore plays a profound role in how

eco-philosophy might take hold. Education is a major part of the problem as well as major part of the solution.

Eco-philosophy is another chapter in our continuous dialogue with the ever-changing universe. In changing ourselves and our relationships, we are changing and co-creating the universe. Out of the lethargic trance of technological inertia, we are emerging with a heightened awareness of our destiny, which is to build a responsible world by assuming our own responsibility, to infuse the world with meaning and compassion (p. 61). The ecological person can be defined as a bundle of sensitivities, which are in the process of continuous refinement toward the enhancement and enlargement of life (p. 120). The ecological person realizes that she or he is the creature of evolution (and as such is a celebration of life), and that he is supported by the whole heritage of life: life unfolding, developing, and emerging into new forms. Human superiority is only an expression of the superiority of life, which is itself capable of self-consciousness and of writing poetry through us (p. 122).

The ecological person is not a miraculous being, but one who perceives that lasting solutions cannot be instant solutions. The first step in the work is one of inner reconstruction, so that we achieve some balance, some harmony within, some clarity of vision, the sense of our place in the larger universe; that we acquire, in short, wisdom (p. 137). The ecological person is a web of dreams of a rather superior kind, which we can make a reality—if we act on it (p. 138).

Eco-philosophy seeks to reintegrate values with a worldview, in a direct and ecologically informed way that mirrors the level of integration once achieved by Indigenous peoples. Just as new forms of life are evolutionary—created out of older forms—so new forms of knowledge and systems of learning must be created out of the most promising spiritual and cultural heritages of the past. Much of our collective heritage is worth saving; there is much that is superior, creative, wise, and already ecologically sophisticated. An eco-education would draw from the knowledge, understanding, and creative thinking of past and present in order to prepare for a sustainable future. These sources are multidimensional, multicultural, and multisituational.

## Tenets of Native Philosophy

Native philosophy has always been broad-based. It is not based on rational thought alone but incorporates to the fullest degree all aspects of interactions of "human in and of nature," that is, the knowledge and truth gained from interaction of body, mind, soul, and spirit with all aspects of nature. In process, reflection, and practice, Native science embodies the natural system characteristics of diversity, optimization, cooperation, self-regulation, change, creativity, connectedness, and niche. As Robert Yazzie, chief justice of the Navajo Nation (1996), explains:

Navajo philosophy is not a philosophy in the Western sense of the word; it is the lived practices of cultural forms that embody the Navajo understanding of their connectivity in the worlds of spirits of nature, humans, animals, plants, minerals, and other natural phenomena. However, explained in terms of Western thought it may be viewed as the practice of an epistemology in which the mind embodies itself in a particular relationship with all other aspects of the world. For me as a Navajo, these other aspects are my relations. I have a duty toward them as they have a duty as a relative toward me.

Unfortunately, many people today have grown up with the Western culturally conditioned notion that only one science and one philosophy exist. But philosophies are culturally relative, founded on the worldview of the culture from which they come and which they were created to serve. A list of the guiding thoughts of Native science might include the following:

- Native science integrates a spiritual orientation.
- Dynamic multidimensional harmony is a perpetual state of the universe.
- All human knowledge is related to the creation of the world and the emergence of humans; therefore, human knowledge is based on human cosmology.

- Humanity has an important role in the perpetuation of the natural processes of the world.
- Every "thing" is animate and has spirit.
- There is significance to each natural place because each place reflects the whole order of nature.
- The history of relationship must be respected with regard to places, plants, animals, and natural phenomena.
- Technology should be appropriate and reflect balanced relationships to the natural world.
- There are basic relationships, patterns, and cycles in the world that need to be understood; this is the proper role of mathematics.
- There are stages of initiation to knowledge.
- Elders are relied upon as the keepers of essential knowledge.
- Acting in the world must be sanctioned through ritual and ceremony.
- Properly fashioned artifacts contain the energy of the thoughts, materials, and contexts in which they are fashioned and therefore become symbols of those thoughts, entities, or processes.
- Dreams are considered gateways to creative possibilities if used wisely and practically.

Native science operates according to cognitive and linguistic "maps" that chart both collective and individual wisdom. How something is related and the nature of causality in a given natural context are foci of deep reflection. The ways in which aspects of nature are transformed through time and space and the nature of proper orientation to "sacred space" demand the observation of subtle details that are the foundation of knowledge. Ritual and ceremony can be personal or communal "technologies" for accessing knowledge, and symbols are used to remember key understandings of the natural world. Native science is a process for understanding in all aspects of Native tradition.

The "coming to know" of Native science revolves around the natural creative process of human learning. Intervention in a natural process is taken on only with great care and much consideration. Continual

emphasis is placed on “being of nature” or working with its natural flow; listening and looking closely are consistently practiced. Teachers act always as facilitators.

Knowledge is presented in “high contexts,” in which many levels of information are shared at many levels of communication. True knowing is based on experiencing nature directly. “Doing” and playing are integral parts of Native learning; apprenticeship is a form of directed learning. Meditation or silence and reflection also play a role in internalizing the lessons of nature.

Elders provide guidance and facilitate learning, often through story along with artifacts and manifestations of traditions, but it is the individual’s responsibility to learn. An individual’s dreams and visions properly prepared for and properly received may bring true knowing. Even the “trickster” (chaos) may facilitate creative understanding, and this role in whatever form it is played is highly respected.

### Process of Native Science

The perspective of Native science goes beyond objective measurement, honoring the primacy of direct experience, interconnectedness, relationship, holism, quality, and value. Its definition is based on its own merits, conceptual framework, and practice and orientation in the tribal contexts in which it is expressed. Concerned with the processes and energies within the universe, it continually deals in systems of relationships and their application to the life of the community. Science cannot divide its application into departments; it is integrated into the whole of life and being and provides a basic schema and basis for action.

For instance, the traditional Yupiaq people based their philosophy and lifeways on maintaining and sustaining relationships among human, natural, and spiritual worlds. The balance of nature, or ecological perspective, was of utmost importance to the Yupiaq. To understand the Yupiaq worldview it is necessary to understand the multiple meaning of a word that epitomizes Yupiaq philosophy. This word is “ella,” which is a base word that can be modified to change its meaning by adding a suffix or suffixes. Examples include “Qaill’ ella auqa?” (How

is the weather?); “Qaill’ ellan auqa?” (How are you feeling?); “Ellapak nunii” (The world’s land); “Ellagpiim yua” (Spirit of the Universe); “Ellapak” (Universe); and “Ella amiglituq” (The sky is cloudy). Variations of this one root word can be made to refer to weather, awareness, world, creative force or god, universe, and the sky. The key word here is awareness or consciousness. Consciousness is the highest attainment of the human being; the human being must be able to make sense out of values and traditions as juxtaposed with the “objects” of the universe. As a manifestation of their “ella,” the Yupiaq developed a body of values and traditions that would enable them to maintain and sustain their ecological worldview (Kawagley 1994:15).

Native science stems from a deeply held philosophy of proper relationship with the natural world that is transferred through direct experience with a landscape, and through social and ceremonial situations that help members of a tribe learn the key relationships through participation and their “ella,” as the Yupiaq would say. Methodological elements and tools of Native science that have traditionally facilitated such learning included:

*Observation.* Careful observations of plants, animals, weather, celestial events, healing processes, the structures of natural entities, and the ecologies of nature.

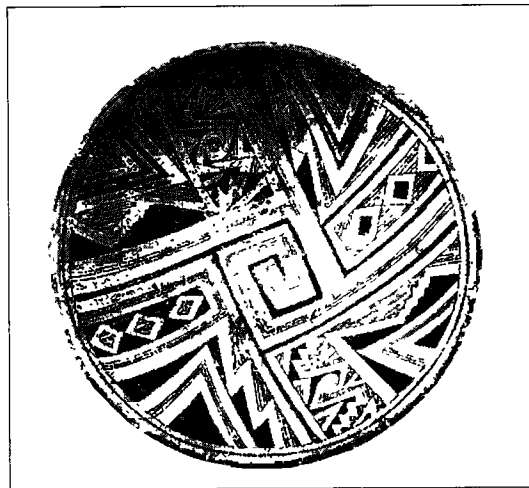
*Experiment.* In Native science, there is no deliberate attempt to distort a natural event beyond observation. Native peoples have traditionally applied practical experimentation at all times to find efficient ways to live in their various environments, and ingenious and ecologically appropriate technologies were developed.

*Meaning and understanding.* These were the priorities of Native science, rather than a need to predict and control. Meaningful relationship and an understanding of one’s responsibilities to those entities in nature that people depended on were the reasons for a Native science, which invited a desired result through entering into specific relationships with the energies of the natural world.

*Objectivity.* Native science reflects the understanding that objectivity is founded on subjectivity. There is a stress on direct subjective experi-

ence, predicated on a personal and collective closeness to nature, which will lead to an understanding of the subtle qualities of nature.

*Unity.* Native science stresses order and harmony but also acknowledges and honors diversity and chaos as creators of reality. "Relationships and renewable alliances take the place of fixed laws, and Indigenous science accepts the possibility that chance and the unexpected can enter and disturb any scheme. Thus, the circle is left open and chance as represented by the clown, the trickster, and gambling games, occupies an important role" (Peat 1994:257).



This plate is representative of ancient Anasazi design motifs that symbolize the four directions and other elements of nature (chaos), along with the fundamental order of the universe in the center. Photograph © Marcia Keegan.

*Models.* Native science also has models. Teaching revolves around high context models in which information is communicated at many levels, and which are highly representational and elicit higher order thinking and understanding. An example of such a ritual process model is the Plains Sun Dance, which may include symbols such as the circle, numbers, geometric shapes, special objects, art forms, songs, dances, stories, proverbs, or metaphors, all of which unify experience with meaning and facilitate the mind's conscious process of connecting with

the energies and animating power of nature. Native symbols go beyond simple archetypes when they represent the universe itself, as with a ceremonial structure such as the Navajo hogan.

*Causality.* Native science reflects a belief in causes that affect and go beyond the physical, principles such as synchronicity and the action of natural energies and entities. Other such principles include the transformation of energy to other forms and resonance with the order of the universe, as reflected in the adage, "as above so below."

*Instrumentation.* Native science relies on preparation of the mind, body, and spirit of each person as the primary vehicle of "coming to know." The mind and body can be used for careful, disciplined, and repeatable experimentation and observation. Knowledge is gathered through the body, mind, and heart in altered states of being, in songs and dance, in meditation and reflection, and in dreams and visions.

*Appropriate technology.* Because social value is gained by honoring mutual reciprocal relationships, spin-offs of Native science in technology are carefully applied. Adoption of technology is conservative and based on intrinsic need, and care is taken to ensure that technologies adopted and applied do not disrupt a particular ecology. Such care is grounded in the belief that it is possible to live well through adhering to a cosmology and philosophy honoring balance, harmony, and ecologically sustainable relationships.

*Spirit.* Native science incorporates spiritual process: no division exists between science and spirituality. Every act, element, plant, animal, and natural process is considered to have a moving spirit with which humans continually communicate.

*Interpretation.* Native science bases its interpretation of natural phenomena on context. Therefore, meaning is based the context of the events and reflection of Native philosophy.

*Explanation.* Native science works with a multiplicity of metaphoric stories, symbols, and images to explain events in nature.

*Authority.* Native science gains its authority partly through the society, elders, direct experience, and dream or vision, and on the sanctity of the relationship established over time with particular environ-



ments. "Authority, if we are to use that word at all in the context of Native science, resides in individuals and their direct experience rather than some social establishment" (Peat 1994:265).

*Place.* Particular places are endowed with special energy that may be used but must be protected. This sentiment extends from the notion of sacred space and the understanding that the Earth itself is sacred. The role of people is to respect and maintain the inherent order and harmony of the land.

*Initiation.* There are both formal and informal pathways to certain levels of Native science. For instance, in the Midewiwin Society of the Ojibwe, there are four stages of initiation, each involving extensive training, learning of songs, ceremonies, stories, interpretation of special scrolls, and petroglyphs (Peat 1994:267-68).

*Cosmology.* All philosophies are founded on an elemental idea of how the universe was created along with humankind's emergence into the world, and Native science is connected to the origins and migrations of people through the American landscape and to notions of time-space, sacred cycles, astronomy, art, myth, ritual, and dance. Cosmology is reflected in the cycles of community celebrations, rites of renewal, and stories, and serves the important function of validating Native peoples' way of life, core values, and social ecology.

*Representations.* Signs and formulas of thought appear in many forms, records in stone, clay, birch bark, hides, structures, and hundreds of other forms. These representations record key thoughts, understandings, and stories important to remembering aspects of Native science.

*Humans.* People play a key role in facilitating knowledge about the natural world in conscious thinking and tool making. Given this role, humans have special responsibilities to the natural world and to other living things. Native science is the study of learning and carrying out these responsibilities. Native science is about stewardship and the practice of deep ecology.

*Ceremony.* Ceremony is both a context for transferring knowledge and a way to remember the responsibility we have to our relationships with life. Native ceremony is associated with maintaining and restoring balance,

renewal, cultivating relationship, and creative participation with nature.

*Elders.* Elders are respected as carriers of Native knowledge, wisdom, and experience. Therefore, they are utilized as the first line of teachers, facilitators, and guides in the learning of Native science.

*Life energy.* Life energy is acknowledged throughout the expressions of knowledge, understanding, and application. All things have life force. There is a natural energy that moves all things that must be understood and respected.

*Dreams and visions.* Dreams and visions are a natural means for accessing knowledge and establishing relationship to the world. They are encouraged and facilitated.

*Paths.* Predetermined systematic activities of learning are viewed as ways to search for and find knowledge. All of nature has these inherent patterns of trajectories, "right paths," which reflect the unfolding of natural pathways through which it may be understood. The "Good Red Road," "Dream-Time Path," "Earth Walk," and "Pipe Way" are some of the ways Native peoples have referred to the directed path in the quest for knowledge, meaning, and understanding.

## Native Science Practice

Native science practice attempts to connect the "in-scape"—our human intelligence, a microcosm of the intelligence of the Earth and the universe—with the heart and mind. Art and language, through story, song, and symbolic dance are used simultaneously to explore relationships to the in-scape and the land.

Exploring the in-scape may be considered a "first step" in Native science practice. This is another way of saying that the practice of Native science begins with setting forth specific intentions to seek knowledge from participation with the natural world and then exploring intuition and creative imagination. These are foundations of the metaphoric mind—the mind without or before words—a natural tendency all people intuitively exhibit when confronted with new learning and knowledge. Native science builds on and encourages this creative and instinctual way of learning. In traditional Native societies, exploring the in-scape is

something that children are encouraged to do and continue to do throughout their lives.

The ability to transform and metamorphose, to think metaphorically, comes with practice, and the development of meaning and understanding comes with increasing knowledge. Language is more than a code; it is a way of participating with each other and the natural world. At one level language is a symbolic code for representing the world that we perceive with our senses. At the deeper psychological level, language is sensuous, evocative, filled with emotion, meaning, and spirit. Meanings are not solely connected to intellectual definition but to the life of the body and spirit of the speaker. In its holistic and natural sense, language is animate and animating, it expresses our living spirit through sound and the emotion with which we speak. In the Native perspective, language exemplifies our communion with nature rather than our separation from it.

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. Rather, Native science attempts to understand the nature or essence of things. 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.

In Native science, sanction of knowledge through appropriate ritual and tribal society acknowledgment is important, because knowledge of the natural world and how best to relate to it is not just a matter of individual understanding but is gained and shared for the benefit and perpetuation of the community. An example is the undertaking of a pledge to Sun Dance in Plains Indian traditions. Commitment to gain and share knowledge is an important aspect of Native science since deep knowledge of nature brings with it responsibilities in its application and sharing. It is a "given" in Native traditions that deep knowledge is not easily gained and requires time and dedication to attain. Sanction and commitment are also connected to ethics, or the care and attitude in which important knowledge

is gained and shared. In this way, sanction and commitment act as foundational safeguards for both individual and tribe and form a kind of check and balance for important knowledge.

The maintenance of dynamic balance and harmony with all relationships to nature is the foundational paradigm of Native science. Reality is based on mutual reciprocity, the rule of "paying back" what has been received from nature. The world operates on a constant flow of give-and-take relationships. In traditional Native hunting, when a hunter takes a deer, an offering is made and thanks given to the spirit family of the deer and, in some traditions, to the "mother of game" who is another mythic manifestation of the Earth Mother. Hunting rituals are performed before, during and after traditional Native hunting to acknowledge the transformation of the deer's life, spirit, and flesh into that of the human. The Native hunter and community know well that this gift from Nature and the game spirits will have to be "paid back" at some time in the future by humans in the universal cycle of death, birth, and rebirth.

This transformation of energy is also exemplified in the continual transformation of energy to matter and back again. Electrons continually borrow energy from the universe to transform themselves into different kinds of atoms. However, what has been borrowed from the universe must eventually be paid back, and this happens when an electron "dies" back to the field of energy from which it came to provide energy for the creation of new electrons and atoms.

Native science applies the principle that we humans bring our reality into being; hence, the focus of Native traditions on prayer to bring about and perpetuate life. 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. Native science is about creating the inner sensibilities of humans, or the inner ear, which hears the subtle voice of nature. The structures and symbols of Native science serve as bridges between realities. In archaic Plains Indian traditions, the medicine wheel was a structure that brought inner and outer realities of nature together. Many Native symbols are representations of the non-human realities of nature, such as the "abiding stone" or dream time.

In Australia the Aboriginal peoples speak of *The Dreaming*, a reality in which the Ancestors walked on the land and special resting points created certain features. Some Ancestors turned into rocks. But this does not mean that the Ancestors stopped Being and metamorphosed into animate rock. Rather, the Ancestor still exists, for Dream Time is different from our linear arrow of time, in which the past is gone forever. Dream Time coexists and interpenetrates the here and now—the Ancestor and the rock enfold one another (Peat 1994:287).

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 complexes such as the various forms of Plains Indian Sun Dance, and seasonal ceremonies such as the various Green Corn Dances among Southeast Indian tribes. Native science applies the principle of being true to all of one's relationships, which means keeping true to all our primal responsibilities, compacts, and alliances with the natural world. All of these reflections of relationships require our constant attention and participation.

### GUIDING STORIES

Native science is a story, an explanation of the ways of nature and sources of life, embedded in the guiding stories of a people and the language and way of life that convey their stories. Indigenous people are people of place, and the nature of place is embedded in their language. The physical, cognitive, and emotional orientation of a people is a kind of map they carry in their heads and transfer from generation to generation. This map is multidimensional and reflects the spiritual as well as the mythic geography of a people.

Knowing the origins of their people, their place, and the all-important things the place contains is considered essential orientation for a tribal person. A people's origin story maps and integrates the key rela-

tionships with all aspects of the landscape. Hence, the origin stories of a people are presented via symbolic language, story, art, song, and ritual.

Essential elements of stories are passed on through societies, art forms, ceremonial complexes, forms of technology, and the everyday activities of life and work. The adoption or adaptation of knowledge usually has a lineage in the origin story of a people. For example, in many Indigenous stories of emergence and migration, the places a people stopped and where important events happened are mentioned. These are actual places marked and named in the map that Native people carry in their stories and in their minds. In brief, Native stories relate the evolution of the people through time, space, and place.

When the Western scientific story meets that of Native origins, a clash of paradigms occurs, because cultural stories of origin are creative interpretations of the experience of a people in participation with places. Literal fact is woven with metaphoric meaning. The ethnocentric notion that only the Western scientific story is accurate prevents any dialogue regarding the participatory meaning of Native origin stories and their orientation to a people's homeland.

### GUIDING THOUGHTS

The guiding thoughts of Native science are simple yet profound, and subtle yet encompassing. Everything is considered to be "alive" or animate and imbued with "spirit" or energy. A stone has its own form of animation and unique energy. Everything is related, that is, connected in dynamic, interactive, and mutually reciprocal relationships. All things, events, and forms of energy unfold and infold themselves in a contextual field of the micro and macro universe.

In the practice of Native science, the more humans know about themselves—that is, their connections with everything around them—the greater the celebration of life, the greater the comfort of knowing, and the greater the joy of being. This relationship to space and time, and between living and nonliving things, is not just physical, but psychological and spiritual, in that it involves dreams, visions, knowing, and understanding beyond the simple objectified knowledge of something. In other

words, it is inclusive of all the ways that humans are capable of knowing and understanding the world.

Native people were interested in finding the proper, ethical, and moral paths upon which human beings should walk. As co-creators with nature, everything we do and experience has importance to the rest of the world. We can not mis-experience anything, we can only mis-interpret what we experience. The information gained through experience is considered in interpreting relationship with the natural world, thereby pointing to the kind of "story" that might contain and convey that information. Concerned about the ethical aspects of knowledge, environmental observation, and understanding received from visions, ceremonies, and spirits, Native scientific philosophy reflects an inclusive and moral universe. No body of knowledge exists for its own sake outside the moral framework of understanding.

The tribal universe is a circle of learning, life, and relationship that is inclusive of all-important information needed to make life decisions. The Plains Indian medicine wheel is an example of the circle of learning by orienting to perceived qualities of the sacred directions these people recognized.

The Lakota wheel is probably best known as the medicine wheel. The four directions, each one symbolizing the relationship of certain qualities to the whole, make up the wheel. . . . [E]ach direction is represented by a word that stands for the quality of that direction. In this wheel, each direction is also represented by an animal. East is illumination, and it is signified by the eagle. South, or innocence, is represented by the mouse. West is introspection and has the bear as its symbol, and north, which is wisdom, is depicted by the buffalo. . . . The Lakota used this wheel to teach people how to bring balance into their lives. They believed that people were born with a certain energy. . . . [A] person's task, then, would be to . . . balance with the qualities of the other three directions (Nelson 1994:18).

The following could be described as foundational premises or realities of the Native worldview, and consequently, of Native science as well.

*Natural democracy must prevail.* The Earth is alive and nurtures all things of her body and all have intelligence and a right to exist. This is the essence of the Native concept of "natural democracy." Democracy, or the concept that all are equal and have a say in how their lives will be lived or affected, is a principle of social ecology.

*Everything is related.* This premise is based on acute observation of the entire web of life in order to gain insight into the relationships among all living things. Such observation was used in making a living that was unobtrusive and life enhancing.

*All relationships have a natural history.* People have a history in a place and a history of relationship to each other. People have a history with regard to plants, animals, nature, and all things in nature.

*Native science orients itself to a "space and a place."* Native peoples' places are sacred and bounded, and their science is used to understand, explain, and honor the life they are tied to in the greater circle of physical life. Sacred sites are mapped in the space of tribal memory to acknowledge forces that keep things in order and moving. The people learn to respect the life in the places they live, and thereby to preserve and perpetuate the ecology.

*Everything has a time and an evolutionary path.* This is the understanding of natural evolution through cycles. "In some undetermined manner, the universe had a direction to it: every entity had a part to play in the creation of the future, and human beings had a special vocation in that they initiated, at the proper time, new relationships and new events" (Peat 1994:43).

## NATIVE SCIENCE PARADIGM

What is the Native science paradigm? Western scientists believe that science is a Western invention, but as discussed previously, Western science has its own specific history and is a particular kind of expression of Western culture. Given this cultural disposition, card-carrying Western scientists believe that non-Western societies relate to nature only

in ways categorized anthropologically as folk tales or cultural technology, and that these ways are not science in their experience of the term.

The word "science" has only recently been used to depict systems of knowledge that refer to the multidimensional world of nature and people's ways or traditions of relationship with the world. Use of "science" by Native peoples contains this type of understanding. This use to describe the experience and traditions of Native peoples remains controversial given the biases and scientism of some Western scientists.

In the introduction to the winter 1996 issue of *ReVision*, Jurgen Kremer writes, "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.

Herbert Read, pioneer arts educator, wrote, "Science is the explanation, and art is the expression of the same reality" (1945:7). That definition has important ramifications for Native science. Within Indigenous consciousness, science is also an art form, which incorporates both an objective explanation of how things happen in the natural world and a way of "looking." The idea that science and art are two sides of the same coin is what Indigenous people have always tried to convey, and this is also in the margin of Western philosophical thinking, as philosophers, artists, humanists, and religious leaders insist that science is a part of the greater whole of human expression.

In Western society, conflict about the definition of science has been underway since the time of Galileo when science was separated from religion. Religion became the antithesis of science—although some would describe science as a kind of religion. These controversies continue to characterize Western philosophical traditions.

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. Like other creative scientists, they have tried to make connections between their current work and past, present, and future ideas in order to build theories. Both participated in a consortium to which Indigenous people from all over the world were invited that met in Canada and Great Britain to discuss the philosophical impact of quantum theory. Peat in particular took an interest in a comparison between Native American ways of knowing and Western science, and used his understanding to develop a philosophy based on quantum relationships. The insights generated by these thinkers demonstrate parallels between new views of science and ways Indigenous people have always sought to understand their world.

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.

This is reflective of one of the oldest ecological principles practiced by Indigenous people all over the world, past and present. If you depend upon a place for your life and livelihood, you have to take care of that place or suffer the consequences, a lesson learned and relearned by many generations over time. As a result of those hard-earned lessons, ecological principles have been incorporated as metaphysical as well as practical rules for human conduct. In addition to responsibility, there is also celebration of life, a key element in seeking to understand how to live a good life.

Native science mirrors and celebrates the cycles of time, space, and being, in individual action, community action, ritual and ceremonial activities, and direct relationships with the land. The ubiquitous use of the circle and directional orientations both underpins Native science and is its result.

Ultimately, science is storytelling for understanding of the natural world. Indigenous science is also a process of understanding, a way of coming to know rightful relationships to the natural world that yields life. For example, peyote is regarded as a sacramental plant used in pilgrimages or for seeking understanding. The Huichol use peyote "to find our lives," and theirs is a journey back through time, landscape, and relationships. The pilgrims take on the role of their ancestors so they become players in their own mythological history. They recount the journey of their first shaman Watakame and the first people to go to the land of many colors of flowers called Wirikúta, a place of ultimate harmony and balance. The metaphor of the land where the Huichol originated is recounted in rituals and the oldest tales of human existence when humans, plants, animals, and natural phenomena could communicate.

Peyote for the Huichol and other Native peoples becomes the facilitator for the reenactment and reestablishment of conventions in this primal relationship. People can achieve this experience if the peyote is properly taken under the guidance of a shaman. Through these practices, Indigenous people reestablish primal connections and orientations that must be learned generation after generation. The purpose of ritual, myth, and story is to tell of important aspects of the continuity and flow of life, that is, a particular people's life and history.

"Coming-to-know" is the best translation for education in Native traditions. There is no word for education, or science, or art in most Indigenous languages. But, a coming-to-know, a coming-to-understand, metaphorically entails a journey, a process, a quest for knowledge and understanding. There is then a visionary tradition involved with these understandings that encompasses harmony, compassion, hunting, planting, technology, spirit, song, dance, color, number, cycle, balance, death, and renewal.

This is where a great deal of misunderstanding between Western objectified science and Indigenous traditions of knowledge has occurred. Knowledge among Indigenous people is acquired in a completely different way, but the coming-to-know process is nevertheless extremely systematic. For example, certain processes must occur in

a particular order, which in its way is similar to the precise ways that an experiment is executed within the Western scientific method. Coming-to-know is the goal of Indigenous science, a different goal from that of Western science.

Like Western science, Indigenous science is sequential and builds on previous knowledge. But in Native traditions, guides or teachers—individuals who have gone that way before—are necessary. Building on prior learning and traditions is never a direct or linear path. Instead, Indigenous science pursues a rather meandering path around things and over obstacles, a roundabout way. In the Western mind-set, getting from point A to B is a linear process, and in the Indigenous mind-set, arrival at B occurs through fields of relationships and establishment of a sense of meaning, a sense of territory, a sense of breadth of the context. The psychologies of thinking and approach differ.

A parallel in Western thought is the artist, as artists also do this kind of meandering. The value of the effort, the coming to know, is found in the journey, in addition to or rather than, the end result. Consequently, this is why Western artistic traditions find greater affinity with Indigenous thinking than does the scientific mind-set. There is a kind of natural connection between these processes, an intersection.

Traditionally, Indigenous peoples understood 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.

Ceremonies and rituals choreograph situations to bring people in contact with those compacts, the entities involved in relationships. The ceremonies themselves become ways of coming to know, of understanding. As compacts are never static and a cyclic process exists even in their making and evolution, there are traditions of communal and environmental renewal. Native science involves this making of

compacts and their continual renewal through the year, and through generations and broader time cycles. These guiding orientations of Native science hold promise for the forging of a new philosophy of nature that is so desperately needed to address the post-modern crisis of environmental perception.

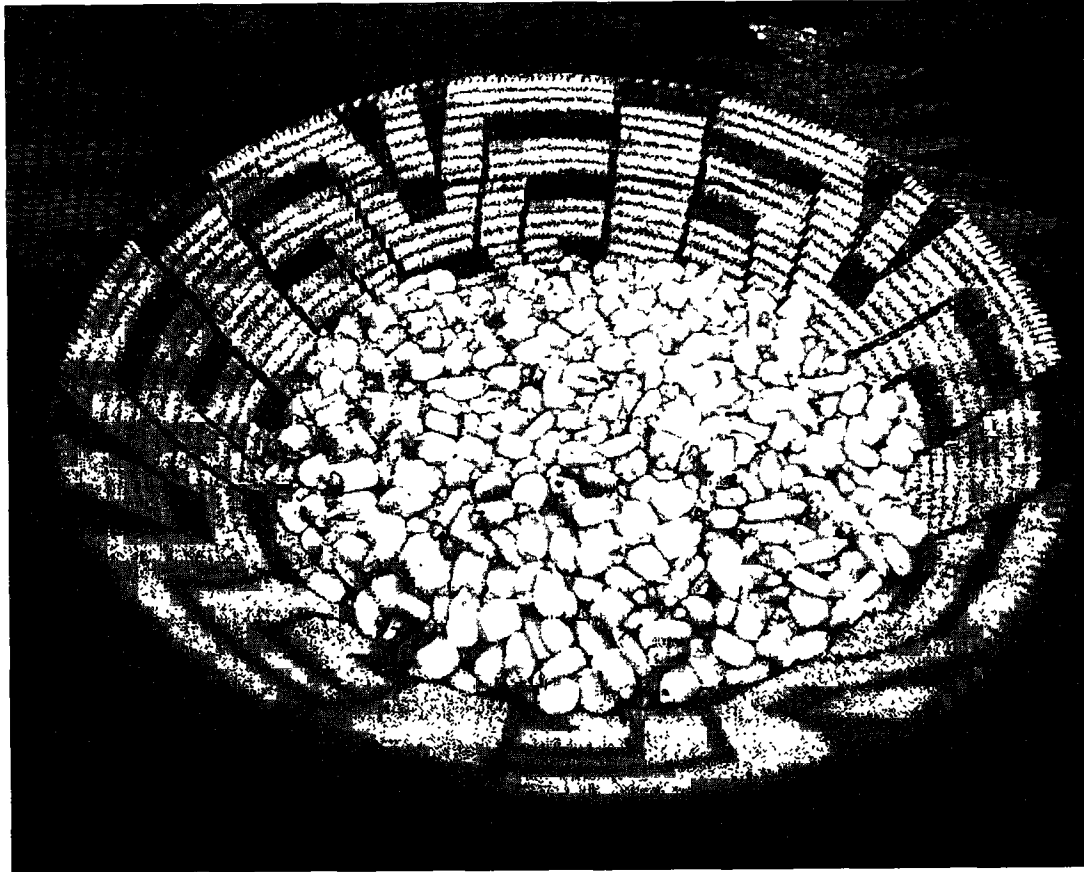
### Meanings and Possibilities

The story of Native relationships to the natural world is more than can be told in one story and more than a footnote to environmentalism. Rather, it is a story of complex human relationships in complex interaction with nature. In the final analysis, Native science as the outward expression of Native relationship to the natural world is a philosophical *ideal*. It is an ideal conveyed through Native cosmologies, community, relationships to plants, animals, landscape, and the cosmos. It is an ideal that must be sought. It is an ideal that must be remembered and re-remembered through art, ceremony, story, ways of community, and personal experience. We human beings are forgetful creatures, and we need cosmology, philosophy, and lived experience at a personal and communal level to remember our life-sustaining relationships. For traditional Native cultures the practice of Native science, along with its cosmological and philosophical orientations, provided the context for such remembering.

In their striving toward this ideal Native people have not been perfect in their personification or realization of it. As would be true of any other people, Native people are human and express all the diversity of human nature, including the saintly and the not so saintly, the pious and the not so pious, the wise and the not so wise. Despite such imperfection, Native people strive for a cultural ideal predicated upon dynamic relationship with nature based on participation. Striving for such an ideal is little different from, say, a medical doctor striving to be true to the Hippocratic oath, or a lawyer striving to be true to a standard of justice, or a teacher who strives to fulfill the highest standards of his or her profession. The point is that Native science is predicated on a cultural ideal centered on nature and which posits establishing an ongoing and dynamic relationship based on traditions of holistic participation.

It is the philosophical ideal that a society attempts to emulate that forms the focal point for its creative evolution and development. This philosophy stems from the worldview of culture that guides its prevailing thoughts and behaviors toward the environment. Native science and the worldviews and philosophies from which it is derived provide models, lessons, meanings, and possibilities for what it means to participate with rather than attempting to dominate nature. Yet, when detractors say that Native people have no science, that they do not “walk their talk,” that they are environmentalist by convenience, that they are not acting Native enough or the opposite, that they are environmental “saints,” and so on, they echo a stereotype that has been evolving for the past five hundred years and are denying the complex, dynamic, and diverse history and contemporary reality of Native cultures. They continue to reflect and perpetuate a stereotype that serves no one.

Native cultures traditionally engaged nature in order to survive. Their collective historical and cultural experience with the natural world is profound and sophisticated. But, it is also evolving as we now collectively face a global crisis of relationship with the natural world and with each other. The philosophical ideal of ethical *participation* with nature may be the only ideal what will afford all of us a sustainable future as we enter the first years of the twenty-first century.



Corn is sacred to many Indigenous peoples of Turtle Island (the Americas).  
Photograph © Marcia Keegan.

### CHAPTER THREE

## The Ecology of Native American Community

*“We are all kernels on the same corncob”*

Five things alone are necessary to the  
sustenance and comfort of the Indians  
among the children of the earth.  
The sun, who is the Father of all,  
The earth, who is the Mother of men,  
The water, who is the Grandfather,  
The fire, who is the Grandmother,  
Our brothers and sisters the Corn and seeds of  
growing things.

—Zuni



## We Are All Related

“Mitakuye oyasin.” As the Lakota say, “we are all related,” a metaphor that personifies what Indian people perceive as community. Understanding the inclusive nature of this perception is key to understanding the nature of the context in which Native science occurs. Context is essential in Native science and indeed determines both its meaning and application.

Relationship is the cornerstone of tribal community, and the nature and expression of community is the foundation of tribal identity. Through community Indian people come to understand their “personhood” and their connection to the “communal soul” of their people. The community is the place where the “forming of the heart and face” of the individual as one of the people is most fully expressed; it is the context in which the person comes to know relationship, responsibility, and participation in the life of one’s people.

Community is also the context in which each community member assimilates culture and its underlying philosophy. In its most basic sense, culture is the way in which a group of people have come to relate to a place and its natural processes. While Native peoples all over the world are diverse in their expressions of culture, their fundamental way of relating to the natural world is remarkably similar, a commonality of ways that allows for generalizations to be made regarding Native science.

The Native individual is spiritually interdependent with the language, folk history, rituals, and geographical sacredness of his or her people. Relationships between members of tribal groups are defined and intensified through relational and generational language rather than through personal names, which are considered sacred and private to the individual.

Native community is the context in which the “affective” dimension of traditional education unfolds, the place where one comes to know what it is to be related. It is the place of sharing life through everyday acts, through song, dance, story, and celebration, and of learning, making art, and sharing thoughts and feelings where each person can, metaphorically speaking, “become complete.” Community is “that place that Indian people talk about,” the place through which Indian people express their highest thought.

How does Native community work? How does it context learning? What happens in Indian community that makes traditional education what it is? What are the educational structures of Indian communities and how are their roles played out? How does the community link its members to the natural community? How is the “communal soul” linked to the expression of the individual’s role in a tribe’s spirituality? What are the implications of community for contemporary Native education? These are some of the questions touched on in this chapter. “Mitakuye oyasin,” we are all related, we are all *of community*, and in engendering the educational structures and processes to pass on to the next generation, we honor what is most human in each of us.

## A PERSONAL STORY

To remember is a way to re-know and re-claim a part of your life. The following is a personal recollection of my childhood growing up in Santa Clara Pueblo, New Mexico. Remembering these kinds of stories is a way of revitalizing the experience of Indigenous education in community.

I can remember swinging through the air wrapped up in something that I later came to know was a traditional cradle, which is suspended from the *vigas* (ceiling rafters) in Pueblo homes. I remember sounds I learned were called singing, and hearing and seeing many faces. What I remember most of all was that I was always with people. These were my first encounters with community—just sounds, sights, and the feeling of being warm and safe. I remember it was a good feeling!

When I was about five, I would go with my grandmother to visit her friends and relatives in the Pueblo. Each visit was an adventure, a break from the usual routine. I seem to remember every thing and every place we visited during that year. It was the year before I started first grade at the local elementary school.

My grandmother was in every sense a matriarch, well known and respected in the Pueblo as well as in the nearby Hispanic villages. Born before the turn of the century, her world and frame of reference were therefore of the “old” times, of old New Mexico, of a time when Pueblos

reflected more complete expressions of symbiotic relationships with their respective environments.

I remember helping the old people prepare, plant, and hoe their gardens. I would sit with those old ones during the hot lazy afternoons eating "Indian cookies" and listening to their stories. I spent days in the foothills and mountains near the Pueblo gathering plants that my grandmother and other old ones directed me to. I played with other children who came with their grandmas and grandpas. I remember eating native trout baked with wild peppermint, watermelon, and wild cherries, along with the old people and their children. Afterward, all the children would jump into the stream to play and try to catch tadpoles, and the old people laughed and laughed. I would walk with my grandmother, and at certain places she would stop and tell me that the plants and animals there were our relatives and we should always remember and respect them.

My grandmother told me that all older people were my aunts and uncles and their children were my cousins. Everyone, young and old, shared with one another. When we went to visit older people we would take gifts, usually some sort of food, cloth, or meat. We would return with fruit, vegetables, and other gifts. It was a form of reciprocal giving in which things were spread around. Community news, shiny marbles, comics, toy soldiers, baseball cards, and a hundred other things were traded too.

When my grandmother and I attended a feast day at a neighboring Pueblo, I remember the kindness with which we were received, especially by the other grandmas. During these visits, I came to know the differences between Pueblos and other Indians, as well as the sense of oneness of the greater Pueblo world. I felt that we were indeed all related.

I remember those times when I sat with my grandmother and other older men and women in what is called the "Saint's house," a small shelter lined with cottonwood leaves set up especially for feast days "so that the saints might also enjoy the dances." The old ones sat with the saints, praying the rosary, visiting and talking about community news and of course about the "old times." In this way, they reaffirmed their faith in a Christian god while simultaneously reaffirming the traditional sense of

Pueblo community, values, and way of life. Pueblo life has always revolved around tradition and age-old practices. Catholicism has been adapted to these ancient communal themes and thereby has been given a place in Pueblo community.

I remember watching my grandma and other women and men of the Pueblo replastering their houses with adobe mud, laughing and working as if they were "one body." We would visit people who were ill, and my grandmother gave them her special bundles of plants with instructions about their use and the proper prayers to say. My grandmother and other aunts baked bread in the special outdoor Pueblo ovens called *hornos*. My cousin and I would sneak around trying to be the first to taste the fresh bread, pies, and cookies they left cooling. I remember those special feasts when all my relatives would come to my grandmother's home, or those times when she would go to help others prepare feasts for weddings, baptisms, and even funerals.

There are many other memories, many other events of communal life that formed me. But those early memories still have the greatest vividness and remain with me even to this day as a good sense of community. Our sense of being and perceptions of community mature along with changes in our lives, and in this way form a foundation for personal history. These memories provide my sense of rootedness to place and people that I carry wherever I go. There were, of course, sad memories as well, memories of hardship and pain and of doubt and anger. Overall, however, I cannot remember a time when I didn't learn something through my participation in community; when I did not see something differently; or when I was not shared with in a direct and significant way. I do not remember a time when my community was not involved in teaching something, or when I was not impressed with the strength and continuity of Pueblo community.

The elders tell us, "Accept your particular life, the whole of it; then celebrate it with joy, your connection to it, so you can then give back, return through sharing, all that has been given to you." This is the continuum, the order we humans have been placed in. It is simple. It is what we hold onto, because it continues to work for us (Cajete 1994:169-71).

## FOR THE GOOD OF THE PEOPLE: Foundations for Leadership, Service, and Community Values

Individuals become intimately conditioned to the nature of "right" or successful relationship, and the integrity of each individual is found in the complete expression of community. This understanding of relationships in tribal communities traditionally formed the foundation for the development of extraordinary leaders. In Indigenous communities, individuals rose to positions of leadership based on their service to the people. Indeed, to be of service to one's people was a major goal of every adult member of a tribe.

Leadership in and of itself was never a goal of Indigenous education but rather a result of the way of living in community and striving toward becoming complete. Traditional community was predicated on the perception that all things can be useful, and the qualities of being useful and being beneficial intertwine and in turn imply reciprocity, support, benefit, purpose, and vision. These perspectives—combined with an ingrained love for one's people and orientation to act for the good of the people—formed the foundation for the expression and development of leaders. Leadership was a role that had to be earned and it was earned by achieving a level of integrity that was irreproachable.

Ultimately, Indigenous leadership was about commitment to the nurturing of a healthy community and enriching the cultural tradition of one's people. Leaders were predisposed to care deeply and imagine richly with regard to their people. They listened to their own visions and the visions of their people; they used their imaginations and creativity; and they gathered the people and moved them together to "find their life" (Cajete 1994:172-74).

### Workings of Native Community

In a universal sense, community may be said to be founded on "a set of timeless rules guiding individual and group identity within the web of all-interpenetrating symbolic culture" (Nollman 1990:15). Community is the natural context of human life and activity. We are, one and all, social beings living *in relation* to one another. Our physical and biologi-

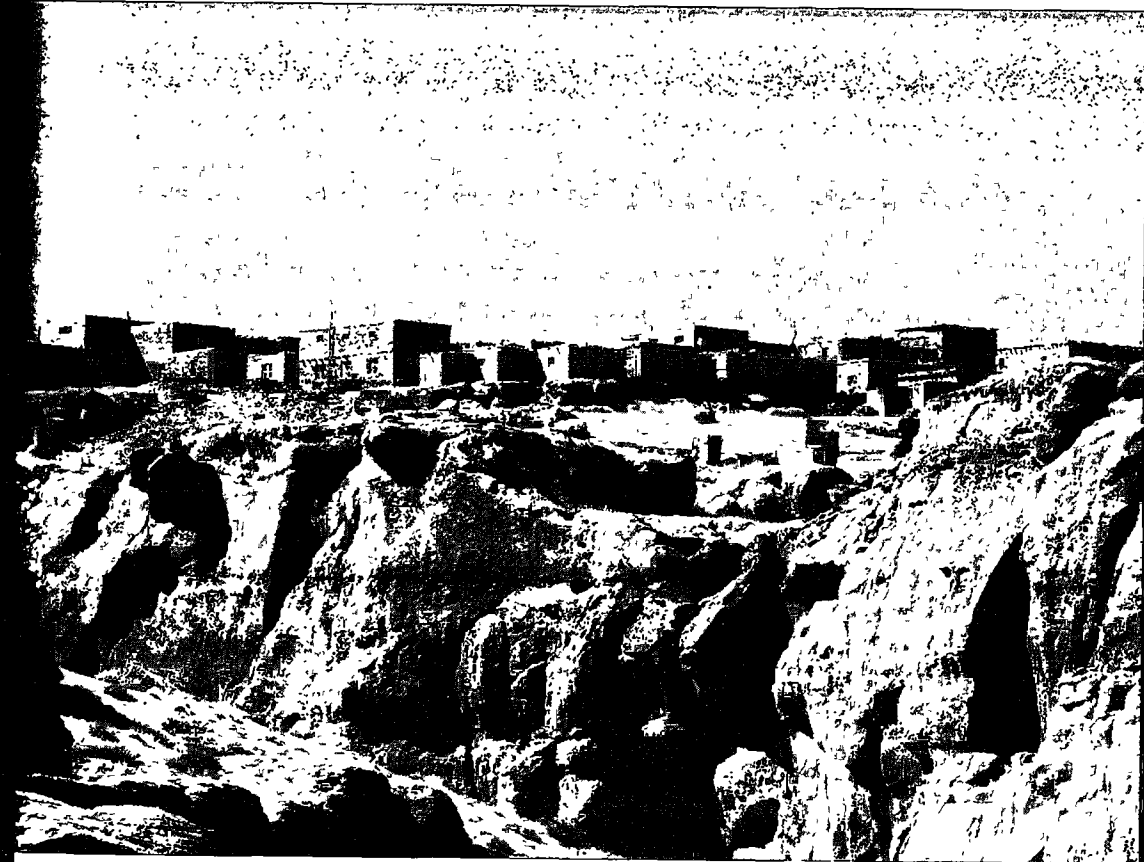
cal survival is intimately interwoven with the communities we create and that create us. The community is a complex of physical, social, and psychological relationships that change and evolve through time and the generations of people who identify with it. The community began in its first forms with the extended family, with shared lineages and ways of life. Until relatively recently in human history, all human communities were made up of people who were biologically related through family, clan, and tribal ties.

Human language, religion, art, technology, laws, ethics, values, forms of education, and other institutions all serve a particular expression of community. In the context of community, "the medium is the message." In other words, at conscious and unconscious levels, the community is each of us no matter who, when, or where we are. It is through community that each successive generation of people has expressed the "million faces of culture." In the final analysis, communities rather than civilizations are the enduring human systems!

Native communities mirror the earliest expressions of human culture. In some places they contain unbroken lines of ancestry originating thousands of years ago. 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. Simon Ortiz, Acoma Pueblo poet, relates the Acoma story of place in the following way (in Cajete 1994:166-68):

Acoma Pueblo people began to live atop  
its monumental sandstone pinnacle  
many, many centuries ago.  
Ancient stories of their existence speak of a journey on a  
Life Road  
from a time when All Things were in A Place Below  
and from where they Emerged.

Eventually for an era of time,  
 they lived in a wondrous place  
 where all living things, all people were together,  
 but from where they had to leave.  
 Guided by the Creator of All Things,  
 they had to make their way on the Life Road,  
 make decisions on how to live, what they should do,  
 and where they should go.  
 And they came to a Place That Was Prepared,  
 the tall, massive stone they know as Aacqu.  
 Like all the other Pueblo people, the Acoma  
 have always known where the Center is.  
 From the Center place of knowledge  
 within themselves they have learned  
 from the generations before them.  
 They have always known the Blue Mountains  
 and high places to the North, West, South, and East,  
 and they have known the Yellow and Red and White  
 hills and sandstone cliffs.  
 And upon the land they have seen  
 tall slender evergreens, the sagebrush  
 and yucca, sinewy grasses and brilliant flowers,  
 and they have seen and heard flying hawks, crows, and wrens,  
 and they have seen and hunted deer and rabbits,  
 and they have watched the tadpoles come alive after the rain.  
 All this and more they know about their place.  
 All this and more they know about the time that is now.  
 From the beginning, the story tells of who they are  
 and where they live and all the things that  
 relate to them and live with them in this world.  
 From the beginning to the present and into the  
 future, they know they must keep this Story alive!



Acoma Pueblo, the oldest continuously inhabited community in North America.  
 Photograph © Marcia Keegan.

Traditionally, harmonizing natural with human community was an ongoing process in Indigenous education, both a formal and an informal process that evolved around the day-to-day learning of how to survive in a given environment. This learning entailed involvement with ritual and ceremony; periods of being alone in an environment; service to one's community through participation in the "life-making" processes with others; and an engendering of a sense of enchantment about where the people lived. All combined toward realizing the goal of finding and honoring the "spirit of place."

The spirit of place was a deeply felt ecological relationship borne of intimate familiarity with a homeland, and the homeland became an extension of the "great holy" in the perceptions, heart, mind, and soul of the people. It is easy to understand why Indigenous people around the world lamented the loss of their land for it was a loss of part of themselves.

What then are Native communities, and what do they do? Indigenous communities are models of interconnectedness, the intimate human social structures through which we learn about basic human relationships. For instance, communities embody and harmonize the duality of maleness and femaleness. Understanding the biological and psychological nature of these complementary relationships ensured the survival of the group in the face of its most basic challenges. Mythic and spiritual qualities of maleness and femaleness, childhood, middle age, and old age are a dynamic of natural life, blended in ways that enhance the fullness of community, helping members to perceive connectedness and relationship as a way of life.

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 of 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.

Traditional Indigenous people have always expressed their symbolic culture through the continuous retelling of the myth-dreams that concern their deepest connections within nature. Totemism carries a

message about a human society interacting with non-human life in a neighborly world. In this sense, community itself becomes a story, a collection of individual stories that unfold through the lives of the people of that community. This large community of story becomes an animate entity vitalized through the special attention given it by its tellers and those who listen. And when a story's message is fully received, it induces a powerful understanding that becomes a real teaching. Cosmology, the lived story of place, kinship, and environmental knowledge, forms the foundation for the expression of Native science in Native communities.

People realized themselves by being of service to their community and by caring for their place. They sought the completion of themselves as tribal men and women, the communal and spiritual ideal, an ideal whose depth of expression is almost never achieved in contemporary communities. "Tribal man is hardly a personal 'self' in our modern sense of the word. He does not so much live in a tribe; the tribe lives in him. He is the tribe's subjective expression" (Deloria 1973:201).

Native peoples traditionally lived a kind of communal environmental ethics that stemmed from the broadest sense of kinship with all life. The underlying aim of the science of ecology, therefore, the understanding of the web of relationships within the "household" of Nature, is not modern science's sole property. Understanding the relationships scientifically is not enough—living and nurturing these relationships is the key. This is the ecology of Native community. An understanding of the ecology of community was achieved through the following key elements that structured and formed the experience of each Indigenous community member from birth to death (Cajete 1994:172-75).

*Environment.* Nature was the frame of reality that formed the learning experiences. The geographical and structural orientations of Indigenous communities to their natural place and the cosmos reflected a communal consciousness that extended to and included the natural world in an intimate and mutually reciprocal relationship. Through clan and societal symbolism, ritual, art, and visionary tradition, members connected themselves to the plants, animals, waters, mountains, sun, moon, stars, and planets of their world.

*Guidance.* Adult members of a child's extended family, clan, and tribe actively undertook parenting. All adults were considered teachers and any adult could guide, discipline, or otherwise play a direct role in educating a child. Adults were admonished to concern themselves with the development of each child into becoming a complete person, "for the good of the people."

*Kinship.* The network of extended family and clan provided a web of relationship that profoundly affected perception. Children learned early the significance of family, responsibility, respect, and the foundations of relationship and kinship. Father, mother, aunts, uncles, cousins, and grandparents, each in their turn and special way, influenced and formed children. Older children learned to care for younger ones. Through such experience they learned to share, nurture, and support others.

*Diversity.* In the close-knit, interdependent community, children were exposed to people of all ages, married and single, as well as varied personalities, the handicapped, and the "contraries." Children interacted with all types of people on a daily basis in the course of living in community.

*Special status.* In Indigenous communities, all children were considered to be special, sacred gifts from the Creator, and thus, were respected and prized. Children were believed to have a direct connection to spirits in nature, and so appear as players in the guiding myths of some tribes. They were bringers of light and good fortune to the community, the physical example of the vitality of a tribe. They were the carriers of the future.

*Ethical models.* Morals and ethics were modeled by the family and community. Respect for the elderly, honesty, care for the ill, appreciation of differences, respect for privacy, proper behavior during ceremonies, and proper treatment and respect for plants and animals were practiced and encouraged daily in direct and tangible ways.

*Clear roles.* Everyone knew his/her relationship to other people, nature, and the things of their society. Relationship was the basis of the community and therefore intimately understood in its various contexts for teaching, learning, and action. The role of each individual was clearly defined so that expectations could, in turn, be clearly understood. Traditional protocol and etiquette reinforced the significance of

certain relationships and responsibilities associated with major roles in the clan, society, or tribe.

*Customs and practices.* Customs associated with each community role or changes in role further defined specific relationships and reinforced key values and activities. Births, marriages, deaths, initiations, cyclical events based on a ceremonial calendar, and dances and other special celebrations combined to support and embellish values and relationships.

*Recognition.* Naming, rites of passage, gifting, feasting, and other social events honored achievements that benefited and enhanced individuals. These forms of special recognition were valued by each member of the community and provided motivation for many to seek ways to perform extraordinary acts of service.

*Unique ways of learning.* The unique qualities of each child as a learner were naturally accepted and honored. Indigenous teachers understood that people learn in many ways and that each person perceives, thinks, and then acts in individual ways. Given this understanding, most Indigenous learning was experiential and occurred in the course of "doing work." When the time came to learn specifics, general rules were given and a context was set up. However, ultimately each person chose the way and how much he or she would learn based on his or her own way of learning and doing.

*Community work.* Community interdependence characterized activity related to all major events and tasks. Organization through clan or society involved every member of the community in projects that were for the "good of the people." These activities ranged from agriculture to hunting, from building to art making, and from food gathering to ceremony. As a matter of common survival and tradition, people of a community came together for the common benefit of all. In work, play, and ceremony, community was constantly being reinforced and experienced. It is this daily practice that forged communal spirit and provided a foundation for learning and understanding of the nature of relationship.

*Spirit.* A sense of the sacred permeated all aspects of Indigenous community. Life, relationship, nature, and the tribe were "creations of the highest thought" tied to the people's guiding myths and religious expres-

sion. Among Indian people, as Vine Deloria (1973:200) so aptly states, "Religion is not conceived as a personal relationship between the deity and each individual. It is rather a covenant between a particular god and a community. The people of this community are the primary residue of the religion's legends, practices, and beliefs. Ceremonies of a community scope are the chief characteristic feature of religious activity. . . . Stories, songs, games and art were used to instill respect [for the sacred]. Life, as a whole, was tied to spirit." Therefore, the ultimate quest of both individual and community was "to find life," that is, to find that place that Indian people talk about.

### Native Science Practice in Native Communities

Native science builds on our innate sense of awe of nature's majesty, the core experience of spirituality. From this sense of awe flow the stories of creation, the philosophy of living, the foundation of community, and the "right" relationship with all aspects of nature. Native cosmology and philosophy, the truest reflections of Native science as a way of life, were the lived experience and practice within a community. Native science, both in its contemporary and historic sense, is contextual and relational knowledge: it attempts to model traditional ways of teaching, knowing, and understanding these relationships based on the existing makeup of the natural world.

Ecological communities revolved around practiced relationships at multiple levels of personal, family, and community life. The child born into this web of relationship first experienced the ecology of tribal community with the mother, father, and extended family; later, this learning extended to include clan and tribe. In the natural environment that formed the backdrop for all relational possibilities, the child learned the multiple roles of family, clan, plants, and animals, and the special place in which he lived. These roles were not haphazard; they mattered to the survival of the community and to continuation of the special relationships the community had established with its particular part of the natural world. The community was the common focus of

intention and attention in the social psychology of every Native person, young and old.

The natural principles observed in the working of relationships with the natural world were incorporated into the physical and social structure of a village. This might be metaphorically pictured as people huddled around something with rapt attention, or as people holding hands in a circle. Native science was an attempt to create closer and closer resonance with those aspects of the natural world that individuals and tribes felt to be important. This "resonance" is *relationship*, originally grounded on and inspired by people's feelings for the night sky and the cosmos. 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 as well as of the arts.

Through participation in the tribal community as well as in the greater community of nature, Native people experienced being at home with and in nature. Being in a community in natural places that brought forward this sensibility further engendered this connectedness. The concept of biophilia—the idea that human beings have an instinctual understanding and need for affiliation with other living things—reflects what Native people have always known: affiliation is a part of being human, as well as that which underlies the transfer of knowledge from one generation to the next.

Native life in community is a primal pathway to knowledge of relationships with the natural world. People establish and reestablish contacts with entities within nature, such as plants, animals, and natural forces.

Finding and growing food presented ecological principles that had to be reinforced. Native peoples constantly reminded themselves where their food came from. Every member of the community was responsible for gathering, hunting, or fishing, so each person came to know the intimate relationships humans had to maintain with the sources of their food. By following their traditional ways of food gathering, young and old came to understand that foods are prepared and must be respected in certain ways.

The entire realm of Native foods provides a context in which all dimensions of Native science are expressed. The preparation of food was itself an art in which all members of the community and family participated. Feasting and celebration formed the backdrop for the telling of stories, friendly interaction, trade, family and community bonding, learning, and giving thanks for life.

Native hunting and gathering at both the levels of process and experience placed Native people in constant participation with their sources of food. There are few other experiences that can develop empathy for the natural world in this way. Native hunting and gathering became both art and applied science and reinforced the sacred covenant that Native communities had long established with the places in which they lived.

Gardening provided another context for applied science through which people established and worked their special relationship with plants. Coming to know land entails coming to know, in very intimate ways, its plants. Similar to human communities in their diversity, plants prefer places based on their needs for certain soils, sunlight, water, and space. Reliance on readily available food sources forms the foundation for Native ethnobotany and the deep understanding that has evolved among Native people with regard to plants and their ecologies.

Native science is a people's science, a people's ecology. People come to know and understand their relationships to the physical environment in which they work by what they do to live in that environment. Native technologies are often elaborate and ingenious. These technologies were developed as ways of dealing with issues that come up in the process of living in a particular place, such as desert, ocean, forest, mountaintop, and so on.

Traditional Native architecture presents yet another example of applied science. Each traditional structure evolved from the special relationship people had evolved with their environments. Native structures were themselves reflections of the special features and available resources of the landscape of which they were a part. The stories, artistic forms, and technologies involved with the construction of these structures were a testament to the long-negotiated relationship with their land and resources. As people built, they learned stories behind the structures, materials used,

and construction techniques. Appropriate symbols and uses of various structures are all reflective of Native science, not to mention the lessons of cooperation, responsibility, and the role that each member of the community played in the construction of traditional shelters.

Mimicking the processes observed in nature, community involved learning how to be responsible in relationships. Everyone had their work, a place, and a purpose in the community. Everyone had something to share as well as something to learn, so young and old came to understand this mutual, reciprocal principle of Native science.

Close observation of plants, animals, landscape sights and sounds, changes in wind and humidity—everything surrounding people—is part of Native science, as it is in the Western scientific tradition. It is the Native emphasis on participation and experience that embeds the sense of kinship with all nature in the minds, hearts, and souls of all members of the community. Learning to be confident in one's ability to live within nature is a key motivation and feature of maturity.

Beginning with the most basic skills, children learned to live respectfully in their environment, in ways that would guarantee its sustainability. By first watching and then doing, Native children learned the nature of the sources of their food, community, and life relationship. They learned that everything in life was a matter of kinship with all of nature. Education involves a constant flow of information and is multigenerational and cross-generational: young teach old; old teach young; sister teaches younger sister; brother teaches younger brother; aunts, grandmas, and grandpas teach children. Mentoring relationships between the young and old are essential. Moreover, mentoring relationships do not have to be between people alone; they can also be between humans and plants and natural forces and spirits and all manner of things not usually recognized in Western science. Sometimes knowledge of self and new knowledge useful to the people as a whole occurs in the form of dreams.

Practical understanding develops in many ways. The key to learning was continual experience of the natural world through work, play, ritual, food gathering, hunting, and fishing. In some tribes young people had to plan long journeys to apply their knowledge. Skills of observation, seeing,



smelling, listening, tasting, healing, and intuition might someday be used for disciplines such as those of the herbalist, masseuse, hunter, maker of art, and animal tracker. These kinds of understandings were often based on practice during games, such as learning how to walk without the use of eyesight by depending on another. The latter, sometimes called "night walking," requires that the person set out in the dark and depend exclusively on balance, listening, and touch to move about.

Being provided the opportunity and time to reflect has always been an important aspect of Native education. It was understood that knowledge and creativity have their source in a person's inner being and in their personal journeying and thinking. Self-reliance, even in young children, is based on the belief that all persons have the ability to know and to share, to bring forward great strides in understanding and knowledge. Consequently, there are many myths revolving around the learning experiences of young people, as well as their roles in bringing new knowledge to the people.

Indigenous science and knowledge traditionally encouraged and directed curiosity, or the human instinct of learning. Children learn by doing and experiencing, such as in planting, hunting, preparing food, and helping to erect a traditional shelter. Indigenous education methodologies then include role playing, or learning relationships or roles that humans play, as well as the ways of animals. As children mature, they take on the ways of animals and remember to remember human roles in traditional dances that are artistic representations of relationships with all the things that matter affecting Native people's lives and traditions. Even traditional costumes reflect symbolic representations of their relationship to these entities, and the people dance and sing their relationships to revitalize their understanding.

Participating with nature through play, work, hunting, gathering, fishing, gardening, and traveling reinforces the innate "biophilia" or sense for affiliation with the natural that is so essential in the development of the mind, body, and spirit of children. They after all are the ultimate source of continuity for any culture. Larry Little Bird (1990), Laguna Pueblo storyteller, describes the process of such continuity as follows:

When we are children growing up, we are given stories. Words are sacred to a child. We have grandmothers and grandfathers who give words to us. They are elders in our households and in our communities. We grow up with elders always around us. Then one day it becomes our turn, and we in turn have children all about us, hungering for stories. What shall we say to them? What will we tell them? Maybe we will tell them how the world came into being. That listening is the first step to make this discovery that everything is connected to a movement begun with a first breath in that long ago beginning. Maybe we will point out a particular landscape, a real place on earth, and tell them that we are grounded to that place. And then we will point out how a person is always growing, and how we are blessed to watch our elders grow into becoming one with their world.

Native science has a mythic tradition and connection. Myths express relationships involved in building compacts with animals and natural forces in a particular place. Each traditional art form embodies the cosmology, philosophy, and mythic themes of a tribe. For example, in the Haida tradition of the American Northwest, dance and totemic art reenact the formation of clans and the relationships of those clans to bear, eagle, raven, and whale. Traditional art forms provide a context for remembering the important lessons of wise use and appropriate sources of materials, and for developing the skills of listening, close observation, patience, and memory.

Even gambling games were traditionally a part of the learning process because of their grounding in myth, but also because of the skills of mathematical reasoning and strategy that they develop. Now in Western science, evolving chaos theories reflect conceptual orientations related to gambling that Native people understand.

Personal relationships with plants, animals, and natural forces constitute a Native science orientation. Talking to trees, for instance, is an introspective exercise rooted in Native traditions. Scientists develop relationships or a feeling for the phenomena they study. Barbara McClint-

tock, a Western scientist famous for studying corn reproduction, is unusual in the sense that she wrote about her relationship with corn. In their dances and related traditions, Indigenous people celebrate relationships to the plant and animal world by effectively becoming one with their spirits or their world. Humans are not separated from their environments nor from the other creatures inhabiting those environments as they are in Western science. Knowledge must be both a source of joy as well as one of gravity or respect, because responsibility to the life that surrounds us is ignored only at great peril.

### Meanings and Possibilities

Traditionally, nature was the primary model for Native community. Plants, animals, natural phenomena, earth, sun, moon, and cosmos were used as symbols and models for emulating and natural "sense" of Native community. For example, corn was used a life symbol by many tribes, especially those of the U.S. Southwest. "Corn is who we are" or "We are all kernels on the same corn cob" are metaphors used by some Tewa Pueblos to embody Pueblo dependence on this plant for life, community, and well-being. Natural cycles are used as a model for social organization among Tewa-speaking Pueblos of north central New Mexico, as embodied in the traditional division of a community into Winter and Summer moieties. The Winnebago divisions of Sky and Earth clans is another example.

As is true with cosmology and philosophy, Native community mirrors the natural order of nature through its forms of organization and in its focus on knowing and cultivating key social and ecological relationships. Native communities evolved in response to the requirements of surviving in particular environments and maintaining sustainable relationships therein. While many Native communities were forced to adopt Western forms of community after being displaced from their ancestral lands, the spirit of Native community continues to be expressed in many ways among Native people. The few Native communities that have not been displaced continue traditions of participation with their landscape, and serve as examples of the meanings and possibilities of the conscious integration of human community with natural community. As we enter the

twenty-first century, Native cultures are attempting to reestablish their ancestral focus on relationship with a "homeland." Likewise, environmentalists advocate relationship with natural places through the concept of "bioregionalism." Yet, this concept does not go as deep as the Native expression of natural community. What traditional Native models have to offer is a perspective of community that goes beyond the social "isms" and theories of community. Native models of community get to the heart of social relationship as an expression of human biophilia, and of human society as a part of nature rather than separate from nature. This ancient idea of relationship must be allowed to rise in our collective consciousness once again. In the perilous world of the twenty-first century, it may well be a matter of our collective survival.



Navajo girl scattering cornmeal as an offering at sunrise.  
Photograph © Marcia Keegan.

CHAPTER FOUR

## Plants, Food, Medicine, and Gardening

*“The hair of the Earth Mother”*

The roots of all living things  
are tied together. When a mighty tree  
is felled, a star falls from the sky.  
Before you cut down a mahogany,  
you should ask permission  
of the keeper of the forest,  
and you should ask permission  
of the keeper of the star.

—Maya

## A Green Philosophy

Plants present the life energy of the universe in their roots, stems, leaves, and flowers. In their tenacity for living in every location on Earth, plants exemplify the operation of the natural laws of nature, that of "life seeking life." At every turn, in every mode, and at every opportunity, plants seek to live their lives, and in their seeking, support all other life, including humans. Plants are an integral part of the earth's system of respiration. Plants are the primary living mechanisms for transforming and storing energy in forms that can be used by animals. Plants have been essential partners in the evolution of life on Earth since their appearance as tiny one-celled members of living communities over two and a half billion years ago.

The intersection of plant and human nature is an integral consideration of Native science and Native societies for they realized that a sustainable relationship with plants is the foundation of all human and animal life. Why are plants so deeply embedded in the psychology of Native cultures? This deep relationship, it seems, is rooted in the inherent focus of Native cultures on participation with nature as the core thought and central dynamic Native philosophy. The Native relationship to plants is also an expression of a universal human instinct to relate to a "green" nature. Plants present an internalized image of natural life and energy that helps to form our perception of the living Earth. In reality, plants and humans have been biologically and energetically intertwined since the beginning of the human species. Our relationship to plants is a part of our body memory, conditioned by the oldest survival instinct of humans. Our collective relationship to plants provides insights into the very core of human nature. In contemporary society this instinctual relationship and part of our nature is largely submerged beneath our intellect. Yet, this does not diminish the profound importance of plants and their central place in our psyche and physical being. It is no accident that human hemoglobin and plant chlorophyll share similar biochemical structures or that humans breathe oxygen produced by plant respiration and that plants depend on the carbon dioxide produced by humans and other animals.

In many Native myths plants are acknowledged as the first life, or the grandparents of humans and animals and sources of life and wisdom, as

in the case of the Native mythic symbol of the Tree of Life. Through such an acknowledgment of plants, Native myths mirror the reality of human biological evolution in the context of relationship to plants. For example, in the creation myth of the Inuit, the first man is born fully formed from a pea pod with the help of Raven, the Inuit trickster god. It is not far-fetched to say that plants profoundly influenced the development of the earliest human cultures. Indeed, the earliest evidence of human ritual activity as reflected in the contents of burial sites indicate that plants were used as food and medicine and in ceremony.

The origins of our instinctual body of knowledge and its preferences for certain qualities of nature form the foundation for our ability to survive as a species. Human preference for relationship to plants and for certain kinds of landscapes have evolved from our natural sense for those aspects of nature that have helped the human species survive. "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. Green nature was the literal mother of our earliest human ancestors, providing food, clothing, shelter, and a library of environmental "cues" for the kinds of landscape that could best support their "seeking of life" (Lewis 1996:1-13).

The philosophy of Native cultures focuses on a direct relationship with the Earth as the source of knowledge and meaning for human life and community. In Earth-centered traditions, each part of the Earth is a manifestation of the spiritual center of the universe. Stones, trees, animals, or plants may be venerated as expressions of the sacred and representations of the greater family of life from which they come.

Because plants are rooted in the Earth and are intrinsically important to the life of humans, they are prime symbols for the life focus of Native science. Direct experience is the cornerstone of plant knowledge. Through experience, careful observation, and participation with plants, Native people came to possess a deep understanding of plant uses and relationship to humans, animals, and the landscape.

Plants were always viewed and utilized as a part of a greater context and were honored along with the sanctity of the natural place

in which they grew. The cosmology of Native traditions often mentions plants, especially those with mind-altering qualities, as having special spirits that must be respected. Sacred plants and trees are mentioned in the guiding stories of Native traditions. Tobacco, corn, beans, squash, gourds, bitter root, peyote, mescal beans, and coca have all played significant roles in the lives, cultural development, and well-being of Native American peoples.

In the intimate relationships with their plants, Native people became sensitive to the fact that each has its own energy. "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. This close relationship also leads to the realization that plants have their own destinies separate from humans, that is, Native people traditionally believed that plants have their own volition. Therefore, Native use of plants for food, medicine, clothing, shelter, art, and transportation, and as "spiritual partners," was predicated upon establishing both a personal and communal covenant with plants in general and with certain plants in particular.

Native uses of plants reflected their adaptation to varied environments. In the Southwest, plants grown were those adapted to arid environments, including corn, beans, squash, cotton, tobacco, and semi-wild plants such as devil's claw. In California, because of its diversity of environments, many varieties of plants were gathered, including acorns, pine nuts, and diverse seeds and grasses. In the Northwest, a rain forest ecology, the red cedar was by far the most important tree and a huge variety of plants species were used. Cultures of the Northeast gathered plants including nuts, pot herbs, seeds, tubers, and roots, and used maple sap as a seasonal source of sugar. In the Plains region, agriculture was seasonally practiced, and many plants were gathered, from the prairie turnip to the blue camas lily; crops included corn, beans, squash, tobacco, and sunflowers. In the Southeast coastal areas, while fishing was predominant, an equally large variety of plants were gathered and supplemented with corn, beans, and varieties of squash and tobacco.

Native tribes throughout California practiced a kind of "environmental bonsai" through their centuries of hunting and gathering activities in that region. That is, Native practices of selective gathering in their prescribed ancestral territories actually formed the flora and fauna of their landscape. The harvesting of acorns, wild potatoes, pine nuts, buckeyes, bunch grass, and other wild staples perpetuated these species and ensured their availability for people and animals (Martinez 1992).

Through the application of keen intellect, imagination, and a mythological sense of the diverse forms and functions of the plant world, Native cultures have evolved sophisticated ways of plant gathering, gardening, food preparation, and cooking that embody the essence of the participatory nature of Native science.

### PLANTS ARE THE HAIR OF MOTHER EARTH

If I were to go for medicines I would first burn tobacco and tell the plants I was about to gather medicines. Then, all the plants would be ready for me to come. . . . The tobacco is the medium of exchange that man has and with which he is able to procure the power of plants and animals; it is the vehicle of communication between men and all spiritual powers. This is *oye gwa owe*—the real tobacco of *ongwe'owe*, the real people (Jesse Cornplanter, in Herrick 1977:136-37).

Among some Indian herbalists, plants are referred to as "the hair of the Earth Mother." There is a widespread traditional Native belief that the Earth feels the pull every time a plant is taken from the soil. Therefore, humans must always make a proper offering and prayers. As one Navajo elder states, "You must ask permission of the plant or the medicine will not work. Plants are alive; you must give them a good talk" (Hughes 1983:64). Such offerings are made to ensure that the pulling of the "Earth Mother's hairs" does not hurt her too much and so that she understands that you comprehend your relationship to her and what she is giving you through a part of her body. In honoring and understanding this relationship, people also honor and understand their reciprocal relationship to all of life and nature.

The world of plants has spirit keepers. These might be the most frequently occurring types of trees in a particular environment, or they could be certain kinds of medicinal plants deemed important to a tribe. Indigenous people understood 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.

The concept of the Tree of Life as a metaphor for a foundation of the cosmic order was traditionally expressed in numerous ways in ceremony and philosophy throughout North America. Among the Pueblo people of the Southwest, the evergreen, which in most cases is the western fir or blue spruce, is a symbol of everlasting life and the connection of all life to the Earth and the Earth Mother. It is well understood that plants were the first kinds of living things and that both humans and animals depend on plant life for their existence. As the first living things, plants provided the most primal connection to the teeming life that is the most direct expression of Earth Mother's being.

Dependence on certain kinds of plants for the survival and maintenance of a people expressed itself in many ways. Among the Pueblo, corn, squash, pumpkin, and beans became the primary staple foods that gave rise to the social and community expressions. The relationship of the Pueblo farmer to corn is especially noteworthy. To Pueblo people, corn is a sacrament, a representation, and an embodiment of the essence of the Earth Mother's life. Corn provided not only food but also a symbolic entity that cradled the entire psyche and spiritual orientation of the Pueblo peoples. Hopi farmers, in their fields at the foot of their mesas, developed practical technology for growing corn in inhospitable soil and, through long experience and comprehension of the growth of corn, evolved a variety of strains that grew well in different kinds of soils and environmental circumstances. Through understanding "the life and

breath of corn," they established an elemental spiritual connection between themselves and this sacramental plant. That relationship extended not only into the technology of growing corn, but also into a variety of communal, artistic, and philosophical expressions.

Pueblo people evolved rituals and ceremonies that allowed them to express their partnership with those plants and animals. Among the Rio Grande Pueblos, Corn Dances performed during various times of the corn growing cycle reflect such communal expression. The community comes together—old and young, male and female—to celebrate and to provide occasion to "remember to remember" the connections that the community and individual have with such a sacramental plant.

This basic spiritual ecology, the Native peoples' understanding of their natural surroundings and the animals and plants upon which they depended, provided different occasions for expressing the relationship between themselves and the natural world. These expressions not only included the grand ceremonial representations of the plant and animal worlds, but were also reflected in engineering and other forms of practical agricultural and irrigation technologies. The great canals built in the Tucson Valley by the Hohokam people long before Europeans came provide an early American example. Numerous other examples of this integration of technology with the practicality required to maintain a lifeway revolving around key plants such as corn occurred among the ancient Anasazi in southern Colorado. In each instance, the ceremony or communal work associated with corn occasioned people coming together to celebrate and to learn the nature of being in community and needing one another for survival.

Such instances of communal interaction with nature reflect a basic idea of natural community, of human beings who are active participants along with all other entities and energies within an environment. Traditional art forms reflect the attempt to understand the human place within the natural community. The sense of natural community is expressed in the design motifs in forms such as pottery. The Zia Pueblo sun; the horned serpent in black Santa Clara Pueblo pottery; representations of clouds, and of animals associated with water, such as the frog,

water bird, dragonfly, tadpole, and butterfly, show the connection that Pueblo people have traditionally felt with their environment. Such design motifs, inspired by natural entities and forces and the Pueblo peoples' experience of them, formed the basis of their artistic expressions and aesthetics. The commonly used motif of Corn Mother and her Corn Children, two perfect ears of corn, each of a different color yet related through common ancestry, is another example of the metaphoric way that the intimate connections of plants, humans, animals, and all life are portrayed through Pueblo pottery.



Potter Rose Naranjo at work, Santa Clara Pueblo, New Mexico.  
Photograph © Marcia Keegan.

For Pueblos, the making of pottery is a ceremonial act, an act of faith, an act of understanding the significance of relationship to the Earth through bringing forth clay, as well as of reaffirming the basic connection that every human has to the Earth. This sentiment, called "right relationship," also extends to the collection, preparation, and eating of food and

foodstuffs from one's natural environment. What goes on or into the Pueblo pot is reflective of the realization that the food we eat must be appreciated—it is sacred and symbolic of that which gives us life and is a metaphor for our ultimate relationship with, and dependence upon, the natural world (Cajete 1994:100-01).

### Plants and the Foundations of Health and Wholeness

The food upon which Indigenous people around the world depended for life was also their medicine. The two were so intimately intertwined that many foods, under proper supervision and application, were components of a medical system based on the natural properties of plants and animals. Food, combined with physical lifestyle and spiritual orientation, formed an interactive triad that was the cornerstone of health. In short, it is food that best symbolizes the ecology of Indian health.

Since all food that people ate came from the land or animals, it had a direct symbolic relationship to the way they viewed themselves vis-a-vis nature. The place of food in ceremonies integrated their life experiences—intellectual, spiritual, and environmental. For instance, peoples of the Great Lakes domesticated and learned how to use the pond lily, wild rice, and other marsh-growing plants. These plants provided them not only with food but also a frame of reference for their existence and relationship to their place. Their knowledge and relationship with marshes was incorporated and reflected in their ability to make a living from their environment.

People learned how to use food plants occurring in their environment in the most productive, effective, and ecologically sound ways. In the Great Basin the Paiutes evolved numerous uses for naturally occurring pine nuts, a major source of protein. In the Northeast, the Algonquin peoples evolved a technology for using the sap of maple trees, which provided them not only with sugar, but also with a source of reflection and understanding of their connection to and dependence upon the trees.

Through long experience, people came to know a plant's properties for healing certain illnesses. This knowledge, which ensures survival in a given

environment, became an essential and basic foundation of Indigenous education. As with all knowledge, how to use plants and animals for medicine evolved along a kind of continuum that was addressed in an appropriate way for each stage of life. Young people were given their first experience in how to use plants through simple observation and the use of story.

This learning continuum evolved in a number of ways and incorporated into itself the full body of traditional philosophy and understanding of the human place within the greater natural world. Among all tribes, illness was associated with a kind of disharmony with some key element of the natural environment, so the healing rituals and ceremonies involved a reestablishment of harmony between the individual, family, or clan group and their immediate environment.

The teachers or mediators for the transfer of this knowledge of balance were primarily the healers or medicine people. Medicine people fulfilled a variety of roles. Herbalists, a principal group among the healers, were predominantly women, whose work in many tribes was to gather wild foods. Through their experience with plant communities came an understanding of individual plants that could be used for medicine. Another group of healers had more knowledge of the human body and muscular structure; they were adept at massage and repairing bones. The next group consisted of individuals who had, as a result of their position, clan initiation, or societal membership, access to special knowledge of plants and animals. Through ceremonies these individuals were empowered to address certain illnesses that they had learned to effectively treat (Cajete 1994:105-06). In the words of Stephen Buhner (1996:101), "To make the acquaintance of an herb, to understand the lowly weed, to hear its voice and that of the spirit teaching how to make it medicine and use it for healing, is the essence of earth relationship and earth healing—the essence of herbalism. . . . It belongs to the realm where the human and the sacred meet in the plant."

The most comprehensive role of Native healing was that of the shaman. The shaman's knowledge of uses of plants for medicine embodied the most complete understanding of the nature of relationship between humans and the natural entities around them. These teachers

provided a centering point for a teaching process that would result in establishing and maintaining balance between the community and the forces that acted upon it. Whether a singer in Navajo tradition, a tribal midwife, or a keeper of specific songs and dances among the Tlingit of the Northwest, the role of the shaman as First Doctor, First Visionary, First Dreamer, First Psychologist, First Teacher, and First Artist was focused on the spiritual ecology of the group in relation to its environment.

In the philosophy of healing, disease was always caused by improper relationship to the natural world, spirit world, community, and/or to one's own spirit and soul. Therefore, illness was always environmental. In one form or another, the environment provided the key context for illness, health, and the processes and expressions of healing that revolved around the reestablishment and maintenance of balance.

Breath was seen as being connected to the breath and the spirit of the Earth itself. We breathe the same air that the plants breathe; we breathe the same air as animals; and 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. Natural elements such as sun, fire, water, air, wind, snow, rain, mountains, lakes, rivers, trees, volcanoes, and a host of other entities played roles symbolically and physically in the expression and understanding of the ways of healing developed by Indigenous people.

Among Indigenous people, this understanding included all aspects of one's world and did not overlook the woven threads of the fabric of health. This is why Indian people honor their heritage of knowledge and deeply appreciate that balance and harmony with the natural environment has to be maintained at all cost. Failure to do so would result in a cataclysm of dysfunction and disease due to environmental negligence.

Communal ceremonies were tied directly into the guiding myth of a particular people and their self-understanding with the greater cosmos. Ceremonies were choreographed to help both individual and community come to terms one's relationship to other life. Among the Pueblos, the times of planting, growing, and harvesting of corn are commemorated by



the whole community. The Great Corn Dances of the Pueblos are timed according to the maturation of sacramental corn. The Great World Renewal ceremonies of the tribes of the Northwest and California, and the various Sun Dances of Plains peoples were and are renewal ceremonies in which the whole community participated.

Traditional dance represents the personification of natural forces and entities—plants and animals—and natural phenomena in another highly evolved and sophisticated ceremonial expression. The winter solstice ceremonies reflect constant vigilance in an annual cycle of celebration, ceremony, prayer, and teaching. The people represent their understanding of health and wholeness in metaphoric, symbolic, and ceremonial ways, a window through which to view the relationship they had established with the places in which they lived.

### THE ECOLOGY OF NATIVE HEALING

The use of plants and animals by Native North American tribes presents a diverse, yet universal expression of intimate bonding between a particular tribe and its place. Traditional Indian beliefs about health revolve around attempting to live in harmony with nature while developing the ability to survive under exceedingly difficult circumstances. The interrelated individual and communal process of "seeking life" plays a central role in the way that human beings are seen to interact with the natural world. Everything in nature reflects a balance between two creative energies, which can be viewed as male or female, light or heavy, and positive or negative, both within the natural processes of nature and the maintenance of a dynamic state of health and wholeness. Traditionally, balancing was primarily accomplished through spiritual means; therefore, the medicinal uses of plants for the curing of illness always contained a spiritual connotation.

The concept of two complementary forces was combined with a universal "life path" or purpose. Illness and health were understood as mirror images, each having a role in an individual's and/or community's life process. Illness played a distinct role in the perpetuation of the idea that life was indeed a process of creation *and* destruction. For life to exist,

there had to be death and illness. In order for us to grow and evolve as humans and community, there had to be times when a particular situation arose that caused dissension or illness, which in turn had to be addressed through restoring a level of harmony.

"Seeking life," a metaphor for life processes, represents this interplay of philosophy with practical medical knowledge and application. Illness and its association with the coming of death as natural parts of the life process are reflected in the origin myths of all Indigenous peoples. It was important to understand the role of these processes, to accept them, and to deal with them in Native science. Tribal origin myths contained the recipe or precedent for the development of ceremonies and rituals within the expression of a particular tribal way of life. 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.

There were differences among plants as to how and where they will grow which resonated with the perspectives people developed about themselves. Because plants hold the power to heal, they played essential roles as conduits or bridges to the spiritual world of nature. Herbs provided a metaphorical and practical physical example for understanding human relationship to the order of nature. Tobacco, corn, datura, peyote, and a number of other medicinal plants might act as intermediaries between humans and the spirit world of nature. Indian people established that intimate relationship with the natural world through the burning of sage or tobacco, the sprinkling of cornmeal, and the use of other such symbolic healing foods.

According to Donald Sanders (1979:117-46), scholar of Navajo healing practices, Navajo categories of disease to which plants were applied included displeasing the spirit entities; annoying the primordial elements of nature; disturbing or disrespecting animal or plant life; neglectful or disrespectful behavior to the celestial bodies; violation of taboo, misbehavior, or misconduct in the execution of rituals and sacred ceremonies; and diseases within the human heart, such as jealousy, envy,

hatred, and being in service to the ego without regard for one's actions and their effects upon others.

Each of these categories has much to reveal about how plants traditionally formed a focal point and a way of understanding this immensely elaborate process of human interaction that occurred within the healing process. Among the Navajo, displeasing the spirit entities, or holy people, could be one of numerous transgressions, but as the holy people represented dimensions that required understanding and proper behavior, this transgression reflected misconduct to oneself, one's collective community, or the natural world. Displeasure of the spirits of nature could take many forms, such as a stomach ailment, a rash, sores and boils, and/or psychological spiritual illness. All of these illnesses could be understood in relationship to the natural entity or spirit underlying a particular disease.

Elements of nature such as wind, fire, water, and air were considered primary medicines, but overexposure to or misuse of them could cause illness. Treatment would occur through an understanding of how these processes and primordial elements worked within the body. A more direct transgression was disturbing and/or disrespecting animal and/or plant life, because each represented the spirit world, and each was in direct contact with forces upon which human beings depended. Therefore, disrespect of an animal carcass after a hunt would bring about a reaction or retribution from that animal's spirit or spirit village. Similarly, the misuse of plants could result in illness.

The neglect of or disrespect to celestial bodies, such as the sun, moon, Pleiades, and Venus, also disturbed the balance and harmony between humans and the rest of the natural world. Finally, misapplications or misconduct during sacred ceremonies, which were expressions of ways to restore health and harmony, were all considered key elements of the propagation of disease and of disharmony.

Native healers as keepers of knowledge were keen observers of the natural world, with knowledge equivalent to today's naturalists, botanists, and ecologists. But, as keepers of a group's cultural mind-set, each needed qualities that set him or her apart from other people, includ-

ing a highly evolved intellectual and intuitive intelligence, necessary to understand and remember the complexities and social understandings of healing plants in the context of sacred guiding beliefs. Each needed an innate predisposition toward social service, a strong spiritual orientation, and great love for his or her people. Self-knowledge, that maturity achieved through the process of coming-to-know, and great natural wisdom were also needed.

The Navajo traditionally believed that the healing process moves through phases. First, there is diagnosis, an examination of past and present symptoms with attention to the ideas and actions preceding them, to determine what could be called the root cause of an illness. The emphasis in this healing phase is always on the causative factors and on coming to understand these factors in the way a particular tribe viewed itself in the natural world.

The diagnosis could take many forms, including direct observation and questioning of the patient, discussion of an individual's dream process, activities such as ceremonial preparations, meditation, encounters with natural forces, as in hunting—in short, anything that focused the life energy of the healer toward possible causes. Among certain tribes, a psychoactive agent such as peyote or other trance-inducing plant assisted in meditation. The Huichol, Aztec, Inca, and certain tribes in North America used such plant-induced meditations. Diagnosis could also include what was called divination, in which an individual, through self-hypnosis or other self-induced processes, became hypersensitive to signs, sights, and sounds that gave clues to the nature of the illness. Understanding of these methods of diagnosis goes beyond description and into comprehension of the human dynamic, mind, and spirit—all of which had to be understood to a much greater degree by traditional healers than other members of the community.

The treatment phase took many forms. The sing among the Navajo is a communal ritual involving a complex process of chants, combined with the creation of sand paintings and the application of a variety of plants, based on some of the illnesses reflected through the guiding myth of the Navajo. Other more common forms of treatment might include

massage and heat treatment, sweat baths and other forms of physiotherapy, and psychological and spiritual counseling. Treatments were combined in a systematic way and refined over generations. Through time certain systems were observed to succeed for certain illness patterns or patterns of disharmony experienced within the understanding and perspective of a particular people. These systems became the unique expression of a tribe's healing tradition.

The entire realm of healing—the application of plants, and the understanding of the roles played by the healer—exemplifies an ecological dynamic revolving around establishing and maintaining relationships not only to one's own natural healing process but also to spiritual, communal, and environmental healing processes. Healing traditions provide a benchmark in terms of expression of the intimate relationship that Native peoples established with their environments.

### THE QUEST FOR HEALING KNOWLEDGE

In the Huichol myth of creation of the New World, Watakame (the culture hero) finds the first land atop a mountain protruding from the flooded landscape. Watakame builds a mud house and then makes a fire to dry himself. He falls asleep and dreams of Tatewari (Grandfather Fire). After waking he decides to take a pilgrimage to the land of Wirikúta (the Land of the Ancestors) after having been instructed to do so by Tatewari in his dream. The following excerpt relates the journey of Watakame to the land of Wirikúta:

Watakame prepared for his pilgrimage by weaving a basket to store his special objects: the muviéri, the rock crystal souls of his parents, offerings of gourds, incense, and flowers, and several prayer arrows. He hiked across jagged mountain ridges, through parched desert where dry, cracked arroyos were the only remainders of streams. With each of his footsteps, the new land began to wake. The entrance to Wirikúta was guarded by coyotes. Watakame shrank back in fear when they howled at him, but then a pure song came out of him which charmed them into

opening the passageway. This mountain was home of Kauyumári, the deer spirit guide. On an offering mat Watakame placed the objects from his basket. He lit candles and incense. He took the rock crystals from the cloth and sprinkled them with water and corn. He kindled a sacred fire and circled it five times. In the flames he saw deer antlers, and Watakame held the long slender staff of his muviéri, and pointed it to the five directions. From deep inside Watakame came a chant that rose with the smoke of the flames. He first heard the chant from the gods, and then he repeated the chant out loud. In the freezing temperatures of the desert night, Watakame sang the chant over and over. Kauyumári sprung from the chant and relayed the gods' messages to Watakame. This is how it worked: Kauyumári went to the god realm and listened carefully to the gods' emanations. Then Kauyumári brought the gods' messages back to the mortal world, having translated the information.



Huichol yarn painting depicting the first shaman, Watakame.  
Courtesy of Hallie N. Love, *Watakame's Journey* (1999)

By the next morning Watakame knew how to leave the earth and travel to other worlds beyond the sky. He knew the formulas for negotiating with the gods to secure good rainfall and crops, healthy children, abundant animals, and protection from harm. He knew about objects the gods brought with them from the first world which they needed to maintain the new world. 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.

From that day forward, Watakame taught the people of the new world the rituals and ceremonies the gods required. He reminded his descendants to always step delicately on the earth. He instructed the Huichol race to take offerings to sacred places—to the cave where Nakawé lives, to the Pacific Ocean where the goddess Harámara lives, and to Wirikúta where Kauyumári lives. Watakame taught people with strong hearts how to become healers. He taught them how to heal sick people or animals or plants, and how it was also possible to heal sick weather when it rained too much or too little. He told stories—for they are Huichol history—and he taught the people chants so nothing would be forgotten, so the Huichols would always exist. Each time Watakame spoke, his voice soared into the heavens. The people attached luminous feathers and symbols to prayer arrows. The symbols were miniature shaman's chairs to help them learn sacred poetry, or paper cutout sandals to traipse the sacred countryside, or hearts to remember well, or drums for rituals, or *niérikas* to heal sickness. The spirits of unborn children in the sky lit candles that filled the sky with glistening light (adapted from Love 1999).

What is important about Watakame's journey is that he brings back to the Huichol the knowledge of the pilgrimage to Wirikúta. Through pilgrimage the Huichol find face, heart, and foundation, relational knowledge, and understanding. Watakame becomes a great leader and a

great teacher of his people. As time and the story evolve, it encompasses every aspect of life. Watakame's relationships extend not only to plants and animals, but to all natural phenomena, including the sun, moon, and stars. The universe as a whole is part of the grand play of relationship.

Watakame becomes a spiritual healer, and so a natural transition in the myth is the exploration of what he brought back to the Huichol and why it is important. The Watakame story is also the story of the making of a person of knowledge, and the trials and tribulations involved in the transformation of an ordinary person into a healer. The story of how a person becomes a healer opens a window into the world of relationships among health, wholeness, plants, and animals, as well as into what happens when proper relationships are lost and disease occurs.

Indigenous healers used songs and symbols, herbal medicines, and psychology (as we call it today) to restore balance in the patient. Each tribe evolved its own system of healing, and there are numerous differences and similarities from tribe to tribe. Today many of these practices continue, albeit in somewhat truncated forms, among traditional healers.

Unless the cultural/ecological context of relationship is understood, one cannot fully comprehend a particular Indigenous technology. The deeper levels of traditional tribal healing practices are still kept from outsiders, as invaders and others who wanted to exploit the land, resources, and labor of Indigenous peoples identified spiritual leaders and healers and executed them. Although the veil of secrecy has begun to lift with the publication of ethnobotany manuals by various tribes, the bare facts of herbology are only a small part of a much larger picture. These manuals relate simply that plant A is used for X condition in the context of Y tribe's history, and constitute both a sterilization and a reduction of something much more meaningful and complex.

A healer choreographs or facilitates a process in which the patient is the real leader. In any healing process, many things take place at various levels, and every healing process is unique. An herb used to cure a particular malady may be totally ineffective in another case of the same malady. Thus, the healer practices an art form that requires vast knowledge of practical botany, the energy fields of the human body, human psychol-

ogy, and much more. Healers spend decades learning what they do. They learn not only about subtle relationships, but they must also learn about themselves in order to master the art of healing.

Learning a Native science, whether it is the use of herbs or star watching, is a long and arduous journey, in some ways equivalent of attaining a Ph.D. in the university system of Western culture. The neophyte passes through various levels of knowledge and knowledge transfer, all the way to the doctorate. From there, the acolyte goes into research and other levels or rites of passage until he/she can be considered a master. Other masters must reach a consensus on bestowing such recognition. Western science is not as far removed as it imagines from the ancient practices of the Druids and other priests and shamans of Indigenous peoples throughout the world. Western cosmology, of course, is rooted in ancient European traditions.

Parallels between Western scientists and Indigenous healers break down, however, in the roles of intuition, vision, and other "internal" forces, which Indigenous science honors as essential aspects of any human endeavor. Western scientists refuse to acknowledge such elements of knowing, even though they are affected by them.

Experimentation with plants, such as their use to affect the mind, is a very ancient tradition. This tradition, along with others concerning relationship to the natural world as codified in art, language, and ceremony, fathered Western science. The intellectuals and experimenters of ancient Greece were influenced by the even more ancient experimenters in Egypt, Syria, Sumeria, and other lands. Indigenous science dates from humans' earliest attempts to understand their world and their place in the world.

Huichol shamans, for instance, practice traditions and art forms that are ten thousand years old. The connection between science and art is played out again and again in Indigenous contexts. Peyote is taken by a shaman and others after a lengthy process of cleansing and making offerings along the way. Peyote is hunted as though it were a sacred deer, and the quest is finally consummated when the peyote pilgrims partake of the peyote and begin a visionary quest within themselves.

The Huichol say their pilgrimage is "to find our life." Pilgrims go in search of their true selves and a glimpse of the whole, utilizing a psychoactive plant. In all religious traditions, practices like these exist for contacting the universal life force. In the Christian tradition, this has been called "touching the hand or the face of God." Even today's organized religions can be traced back to shamanic traditions of preparing oneself and participating in sacred rituals aimed at finding the source of life.

## Native Gardening

Each time a woman would cook anything, she would put some of it back in the fire and pray. "May we be taken care of good today and may my family live well and happy"—a prayer like that. And when she made corn meal mush she would stir it with a stick and she would say a prayer for more rain. "Today, may we have more rain so we'll have better crops, and may my family have good health." The women would say a prayer before each meal and then the men would say one after the meal. Indian people are very prayerful people. Here's one of our prayers:

"May my children have all things to eat  
and be happy;  
May the people of the outlying villages  
all laugh and be happy;  
May the growing children have all things to  
eat and be happy;  
May we have all kinds of seeds and all things good;  
May we inhale the sacred breath of life;  
May our fathers and our mothers bring us happy days."  
—Louva Dahozy, Navajo (in Keegan 1998)

The instinctual connection to plants enters human experience in numerous ways through the windows, mirrors, and memories of our lives. For myself, growing up on the Santa Clara Pueblo reservation in northern New Mexico, awareness of my personal connection to plants began at the

hands of a master Pueblo gardener, my grandmother. Time spent in my grandmother's garden, playing in the irrigation ditch, and eating green peas and melons while watching her lovingly care for each green plant instilled in me a special interest and relationship with plants. Hearing her talk to each plant as if it were a person and hearing her scold away crows and my cat Tom from her garden reflected her reverence for it. When I was older, she taught me how each plant needed certain things to encourage its growth. She told me how some plants like to grow in a family while others prefer to grow alone—just like people. And, just like people, she said each plant had its own personality.

Pueblo gardening involved direct experiential learning about plants and their natural relationships to humans, to each other, and to their habitat. Children were guided both formally and informally in the technology of Native gardening. They were taught to distinguish among food plants, useful herbs, and non-useful plants that could be pulled and used as mulch. Children's natural curiosity, intellect, and "biophilic" sensibility were developed simultaneously in their gardening activity. This early and direct involvement with the practical working of nature as reflected in gardening served to further develop Native children's capacity for participation with nature and the world of plants.

In most traditions of Pueblo gardening, cultivating domesticated food plants and promoting the growth of wild food plants were practiced simultaneously to maximize the availability of edible plants. Even insects that inhabited the garden might be used as added protein. The agricultural technologies of irrigation, soil preparation, fertilization, crop rotation, seed gathering, and storage were learned early by children.

Certain plants had to be thinned or transplanted to ensure greater productivity. Pueblo gardens were constantly cared for to ensure that the relationships among the Pueblo farmer, the plants, community, and land were mutually beneficial to all. The Pueblo garden was a collaborative enterprise involving not only the individual farmer but the entire community and the land itself. All community members shared the tasks of cleaning the extensive network of irrigation ditches and food preparation such as grinding corn and drying fruit.

Everyone in the community had a stake in their gardens. Every community member shared in the community garden's produce. Elders, women without spouses, and the disabled were provided for by the community. Sharing the produce of one's garden was a Pueblo virtue and an expression of the interdependence of community, plants, and land. Yet, all of this has changed. In the words of San Juan Pueblo elder Esther Martinez:

The spirit of farming and the connection to nature in our Native communities is disappearing. With the modern ways of farming, one does not realize the value of the land and crops. Farming used to be done by families, who were involved with nature. It was good to get your hands all muddy and dirty, feeling and smelling the earth. We knew which areas were good for planting vegetable gardens and where to plant wheat, corn, and alfalfa. . . . This absence of farming has affected our health in many ways. I don't remember our Indian people dying of cancer and a lot of the other problems that people have now. Working the fields kept us healthy and fit. It was a way of getting out to exercise. . . . Nature was not only used to nourish our bodies but was utilized in all aspects of our lives. When my little brother and I were growing up, we gathered branches, old corncobs, and such. These were our toys. Nature provided for us all the things we needed for our survival; all we needed was a little imagination (in Cajete, *Look to the Mountain*, 1994).

#### "NATIVE PEOPLE LOVED THEIR GARDENS"

Through a combination of gathering and gardening, many Native tribes produced not only enough to live on but also a surplus for trade. Native people loved their gardens. Their gardens provided a place to socialize, hold gatherings, and even a place to decorate. Gardens were an essential part of the ritual and ceremonial life of many communities as well. Plants such as corn, tobacco, aramant, and quinoa were spiritually symbolic and a part of Native myths and cosmologies. The belief that humans are a part of the

community of plants was widespread among many Native peoples. The following story of the Yuma Indians of the Sonoran desert relates how Brother Crow was responsible for bringing corn seeds to the people.

Near the beginning of time Kakh, Brother Crow, brought to the people seeds of all sorts, especially corn, to nourish and replenish them. And the people cultivated their gardens so that when game was scarce they did not go hungry. Because Sister Corn gives of herself that they might live, the people return thanks in song and ceremonies at planting time and harvest (Buchanan 1997:5).



Corn field at San Ildefonso Pueblo, New Mexico.  
Photograph © Marcia Keegan.

Stories of the coming of corn and its intimate relationship with people are numerous among the many Native groups who have cultivated it. Corn is after all a human-mediated plant, which means that it depends on humans for its cultivation and survival. This is an evolutionary relationship held in common with many domesticated plants and animals. The interdependence of humans and corn is a prime example of

biological synergism that is often described metaphorically and imaginatively in Native myth.

The idea that human life is maintained through constant work, sharing, and relationship with food and other sources of life underlies the Native relationship to corn and other plants with which they have formed special reciprocal compacts. The Native garden provides an exemplification of this idea in an environmental and communal context of participation. When people eat the vegetables that grow in their gardens, the substance of the plants joins with the substance of the person in a way that is more than physical—more than survival of the body. It is a survival of the spirit also. The people's spirits also meet the spirits of the Corn Mother, or the Three Sisters, who give of their flesh to ensure the survival of the people (Buchanan 1997:7).

The Native garden involved a deep understanding of "practiced" relationship. Therefore, Native gardens were as much a mythic-spiritual-cultural-aesthetic expression of tribal participation and relationship with nature as was Native art, architecture, and ceremonialism. The technology of Native farming was only one dimension of such practiced relationship. This practiced relationship and responsibility to care for food plants such as corn is related in the following story of the Tuscorora Corn Spirit.

In a time long past, the people of a village which had become known for its plentiful corn harvests became negligent of their compact with the Corn Spirit. The people had become used to the bountiful harvests and took corn for granted. They neglected to weed their gardens, store their seeds properly and give thanks to the Corn Spirit for their gardens. The people carelessly stored their corn and soon found that the mice had eaten their surplus. The men began to hunt but found that the game had also vanished. Soon the people began to starve. Only one man named Dayohagwenda kept to the covenant of respect for the Corn Spirit. His garden continued to produce rich harvests. One day when Dayohagwenda was gathering herbs he came upon an old

man dressed in rags and weeping. He asked the old man what had happened, to which the old man replied, "Your people have forgotten me. I am the Corn Spirit and I will soon die." Dayohagwenda returned to the village and warned the people that the Corn Spirit might die if they did not start to once again honor him through carefully planting, weeding, harvesting, and storing their corn. They immediately began to do this and their corn once again began to grow in abundance as they gave thanks to the Corn Spirit for his blessing of food (adapted from "The Corn Spirit" in Lowenstein and Vitebsky 1997).

Native cultures that practiced gardening evoked the spirits of plants and nature to ensure or otherwise perpetuate the proper attitude and intentions for the success of their gardens. They asked that their gardens be protected from the ravages of nature. In cultivating this attitude of reverence for their food plants, Native cultures expressed once again the central foundations of Native science—participation and relationship. Once planted, Native gardens were considered to have a life of their own and to be living expressions of the greater living community of the Earth. They became living embodiments of the Earth Mother filled with spirit and in possession of a unique personality.

Native gardens embodied skillful agricultural technology but also involved Native spiritualism. In a metaphoric sense, Native farmers "negotiated" with their gardens and with the spirits of nature on their gardens' behalf. They negotiated with the sun and rain for just the right amount of warmth and moisture to ensure their harvest. They negotiated with insects, birds, and other animals on behalf of their gardens. Prayers and ritual were applied to request the good will of various other living energies that comprised the greater community in which the gardens were placed. When gardens did fail the blame was placed on a loss of faith in them by the farmer, improper behavior during ceremonial observances, or errors in ritual practice.

When garden plants ripened in July and August, ceremonies of thanksgiving were held. These rites of thanksgiving ranged from the

Green Corn Dances of the Haida, Creeks, and Choctaw, to the Pueblo Corn Dances of the Southwest. Included in such ceremonial celebrations were countless other communal and personal acts of reverence that affirmed the connection to the greater dynamic of life at play in the Native garden. This awareness of connection did not exclude experimenting with the inherent possibilities of plants and the development of agricultural technologies. Native farmers were ingenious and practical scientists. Evidence of these traits are to be found in the domestication of dozens of plants and the use of over two thousand plants for food by the various tribes of the Americas. This made Native farming more productive and creative than farming in Europe during the time of Columbus, while at the same time Native farmers practiced reverence and piety in relation to green nature.

#### NATIVE FOOD CONTRIBUTIONS

Indigenous people around the world have developed extensive knowledge of the practical uses of thousands of plants. A portion of this knowledge has been transferred to modern chemists and the pharmaceutical industry. Examples of useful plants include foxglove for congestive heart failure; Madagascar periwinkle for childhood leukemia; licorice for various blood sugar imbalances, including diabetes; impecca, an effective purge; the Mexican yam from which the first modern contraceptives were derived and which also has beneficial hormonal balance effects if used properly; deadly nightshade, which is not so deadly in the right hands; opium poppy (the base of morphine); and the mayapple, which is being studied for its effects on certain types of cancers, AIDS, and heart disease.

The Western renaissance of interest in botanical medicine is both a plus and minus for Indigenous people. Others have finally recognized that Indigenous people possess a tremendous storehouse of knowledge. Much of this storehouse has been lost, but that which still exists is being explored as well as exploited. Indigenous people have not been given proper credit or patents for Western scientists' "discoveries" based on their traditional knowledge. These issues continue to plague the relationship between Indigenous science and Western science.



Indigenous healers have contributed a great deal to modern medicine. This type of exchange of knowledge has typically been ignored, dismissed, or even distorted. Thousands of plants have been used in remedies and preparations by the Indigenous peoples of this land. Upon including the Native peoples in Canada, Mexico, and Central and South America, the numbers expand the knowledge base by a factor of four or more. The study of Indigenous science, then, is also important to set straight the historical record. In the past four centuries, Western Europeans took and improved many agricultural products native to Americas, and today these products account for a large proportion of the world's agricultural wealth.

Indigenous people developed crops from wild plants (e.g., corn); transplanted from the wild into gardens and orchards (e.g., avocado); and used in their wild state, leaves, fiber, seeds, gums, and resins (e.g., rubber and copal). Described briefly below are certain important crops that were adapted from the Indigenous peoples of the Americas. This is hardly an exhaustive record, but only a sample.

*Potatoes.* The Taino people of the West Indies called the potato-like tuber *batata*, which Columbus found in use. Today, those tubers are called sweet potatoes. The sweet potato was developed from wild root-tubers, believed to be closely related to the vine of the morning glory family found in Brazil. Moist-fleshed sweet potatoes are sometimes called yams, derived from an Africa word "nyami" (to eat).

Upon their arrival in Peru, the Spaniards called the white tubers cultivated by the Indians, "batata," although the Incas of Peru called them *papas*; these are today's potatoes. As there are no longer any wild potatoes in Peru, botanists do not know from which plant the prehistoric Indians succeeded in developing potatoes. Potatoes were taken to Europe by Spanish explorers, and cultivation spread to other European countries, at first almost exclusively for its blossoms, and a century later, as a food staple. The date of the introduction of potatoes in Ireland is unknown, but it is known that they were a field crop before 1663. Irish immigrants then brought potato strains to the Americas (Walker 1943 in Whitman 1999).

According to Jack Weatherford (1988:62 in Whitman 1999), the Natives of the Andes had been cultivating the potato in their mountain slope gardens for four thousand years, and "were producing about three thousand different types of potatoes." Even before the Incas, these natives demonstrated how to produce extremely high yields of potatoes from small plots of land, and they developed different kinds of plants for every type of soil, sun, and moisture condition. Colors ranged from whites and yellows through purples, reds, oranges, and browns.

Some potatoes matured fast and some slowly, an important consideration in a landscape where the growing season varies according to altitude. Some potatoes required a lot of water and some required very little, which made one variety or another more adaptable to the highly variable rainfalls of different valleys. Some potatoes stored easily for long periods of time, while others, too bitter for humans, made excellent food for livestock.

Andean farmers also invented the first freeze-dry method of preserving potatoes by putting the potatoes out at night to freeze. The sun would thaw out the potatoes and the farmers squeezed out the melted moisture. Repeating this process would result in a white chunk of potato with the texture of plastic foam. In this form, the Incas easily stored large quantities of potatoes for five or six years. Cooking potatoes preserved in this way first required soaking them in water, and the preserved chunks could also be ground to make soups and other dishes (Weatherford 1988:64 in Whitman 1999).

*Corn.* One of the most remarkable achievements in agricultural history was the development of corn by prehistoric Indigenous people. The Tainos called corn "maize," and in some parts of the world it is still called maize. Some botanists believe it was developed in Middle America from the seed of a wild grass known as *teocentli*; others think that both *teocentli* and corn came from a common ancestor, long extinct. Of all the grains grown, "corn is the most completely domesticated, being the only one that cannot sow itself. It must be husked, shelled, planted, cultivated, and hulled, usually fertilized, sometimes irrigated, and finally harvested" (Walker 1943:4-5 in Whitman).

Native peoples grew corn in many varieties and adapted it to many diverse habitats, from wetland to desert. Varieties include dent corn, sweet corn, popcorn, flint corn, among many others; they range in color from yellow and red to blue and purple. Maturation time varied from a few months to several months (Weatherford 1988:84 in Whitman).

Natives learned how to roast, boil, or eat the corn raw. Drying corn meant that it could be stored for later consumption and future planting. The women ground dried kernels into meal or flour for bread, atole (cornmeal soup), and various other dishes. Early settlers in the United States acknowledged that the grain was the principal crop of the Natives, and so named it "Indian corn." In time corn became the principal crop of the United States, exceeding in production and value all other cereal crops combined. This fact is not easily recognized because most corn never leaves the farm where it is grown. Many contemporary farmers would be surprised to know that some of the productive methods that they advocate were known and practiced by the Indigenous peoples. Corn has become a centerpiece of North American tables through the rediscovery of ancient practices and processes of cross-pollination (Carter 1955).

Indigenous people developed an ingenious method of producing sugar from corn. Sugar could be made from corn through chewing fine cornmeal in the mouth, and adding it to a batter of meal and water. Saliva combined with the cornstarch to produce sugar. The ubiquitous processed sugar of today is a method refined by whites using a chemical process (Carter 1955).

*Cotton.* Cotton was developed by pre-Columbian Natives from small wild growths found in Mexico and South America. Prior to colonization of the Americas, people in Western Europe mainly wore linen, wool, or leather; the Spaniards introduced the fiber to Europe (Walker 1943 in Whitman).

*Tobacco.* *Tabaco*, the Taino word for tobacco, probably meant the pipe in which it was smoked or the tobacco leaves rolled for smoking. Tobacco is solely an Indigenous product and was used with great care. After the Europeans "discovered" tobacco, they spread its use throughout

the world. For many years, tobacco in Europe was regarded as a medicinal plant only (Walker 1943:6 in Whitman).

Many species of tobacco are grown and, of those, the Indians of South America mainly cultivated two. In pre-Columbian times, one or both of these grew over most of South America and as far north as Canada. Both types of tobacco are still grown, "one much more than the other, in the temperate and tropic zones of the world" (Walker 1943:7 in Whitman). Native peoples devised all known ways of using tobacco, including cigars, pipes, cigarettes, snuff, and chewing tobacco (Carter 1955).

*Rubber.* Centuries before the arrival of Columbus, people of the Americas had known and used rubber. They set up stone courts for their ball games, which were probably religious and played only at certain times of the year. Spanish *conquistadores* were astonished when they saw the remarkable way the rubber balls bounced. Treating the sap of several kinds of rubber trees, Indians from Middle America and the Amazon valley developed many articles, including waterproof bags and the original gum boots (Walker 1943:7 in Whitman).

*Beans.* Prehistoric peoples developed several varieties of beans from wild plants they found in Middle and South America. Lima beans come from the city in Peru from which they were shipped. The Spanish named the common Indian bean *frijoles*. Kidney beans are a variety of field beans.

*Squashes and pumpkins.* Squashes and pumpkins probably originated in Middle and South America and spread over both continents. Seeing an orange vegetable growing in the cornfields of Indigenous farmers, English settlers called it "pumpkin," a word from the Greek *pepon*, meaning mellow or ripe. The word "squash" is an abbreviation of *askutasquash*, meaning "eaten while green," a word from the language of the original peoples of what is now Massachusetts. Squashes and pumpkins belong to the gourd family, of which there were also representatives in Europe in pre-Columbian times (Walker 1943:8-9 in Whitman).

*Tomatoes.* The word tomato is derived from the Nahuatl *tomati*. The plant was probably developed in South America, and then distributed throughout South and Middle America in pre-Columbian times. There was controversy among Europeans about whether tomatoes were poisonous.

*Chocolate.* The Aztecs in Mexica drank their chocolate cold with a generous amount of chile pepper added to it, and they called the mixture *chocolatl*. The Spaniards added sugar in place of the fiery chile, and the English added milk (Walker 1943:9 in Whitman).

The Nahuatl called the chocolate tree *cacauatl* (kah-hah-o). The Aztecs, who used the seeds as the basis of a monetary system, treasured these trees. Spanish pronunciation changed the name to cacao (kah-kah-o), which became its first European scientific name; English pronunciation resulted in the word cocoa. After the word cocoa was adopted, "the trade-name of cocoa beans for the seeds, cocoa shells for the husks, cocoa nubs for the roasted seeds, cocoa butter for the oil, and cocoa for powdered chocolate, and also for the beverage made from that powder" followed (Walker 1943:9 in Whitman).

*Peanuts.* The peanut plant is sometimes called *groundnut*, because the flower stalk bends downward and plunges the pods into the earth to ripen. Indigenous people in Brazil were probably the first ones to develop the peanut, which is currently cultivated in all tropical and subtropical countries of the world. Another name for peanuts is *goobers*, derived from the language of African slaves brought to the Americas (Walker 1943:10 in Whitman).

*Strawberries.* Indigenous people developed strawberries from two varieties of wild berries native to this hemisphere. One grows along the Pacific coast of South and North America, and the other is common in the eastern and central parts of North America. The name *strawberry* probably came from the "runners of the plant that somewhat resemble straws; or possibly it came from the custom of strewing straw between the rows to keep the fruit from the ground."

*Pineapples.* The pineapple grew in tropical America, and the name probably came from the pinecone shape of the fruit. Today, pineapples are "grown so extensively in the Hawaiian Islands as to give the impression that they are native there."

*Avocados.* The name *avocado* came from the Aztec name *ahuacatl* (ah'-wah-cah-tl). Avocado trees were found growing from Mexico to Peru and Brazil. These trees were transplanted and cultivated in Native orchards (Walker 1943:10-11 in Whitman).

*Jerusalem artichokes.* Indigenous people planted the tuberous roots in their fields and cultivated them. The Europeans then raised the plant in considerable quantities and sometimes called it sunflower artichoke. The Italian word for sunflower is *girasole* (jeer-ah-so'-lay), which, by a surprising corruption of the term, resulted in the name Jerusalem.

*Tapioca (cassava).* The tapioca plant is poisonous, but Native peoples learned how to use it as a food source. Poisonous juice is pressed out of the roots, producing tapioca, cassava bread, and other foods. The Taino word *cassavi* became *cassava* in Spanish. Another name for the plant is *arrowroot*, which probably came about from seeing the plant used as a poultice to absorb poison from a wound inflicted by a poisoned arrow.

*Quinine.* The name comes from the Inca language, in which the tree was called *quinquina*. Quinine comes from the bark of the tree. The Spaniards called this tree *cinchona* after the Countess Ana of Chinchon, whose life was saved result of using quinine. Quinquina trees grew in the forests of Colombia, Ecuador, Peru, and Bolivia (Walker 1943:12 in Whitman).

*Maple tree.* Indigenous people of the Northeast made maple sugar from the sap of maple trees. They devised the methods that are continued today, boiling the sap in pottery kettles, wooden troughs, and containers made of bark into which they put hot stones.

*Chicle.* The word *chicle* derives from the Nahuatl term *chictli*. Chicle, the principal ingredient of chewing gum, comes from a tree, also named chicle, which "yields one of the finest white resins in the world." Indigenous people extracted the resin in a manner similar to the process of obtaining rubber. The Mayans carved the trees into logs, to be used as temple beams.

*Vanilla.* Vanilla derives from an orchid native to tropical America, but now cultivated extensively in Java. Indigenous people obtained vanilla extract by picking the pods before they were ripe, drying them, and then removing the crystals from outside the pods. The word vanilla originated from the Spanish word for the longer slender pod (*vaina*) containing the seed (Walker 1943:13 in Whitman).

*Tonka beans.* The beans are from a tree native to tropical America. Ancient people in Guiana used the beans for their fragrance of new

mown hay, and Europeans took the beans to Europe to aid in the perfumery business. Today tonka beans are used for flavoring smoking tobacco, perfuming snuff, and as a vanilla additive.

*Cashew nuts.* The tropical *caju* or *kashoo* tree family has spread so extensively in Africa and Asia that people mistakenly believe that cashew nuts originated in those continents. Long ago Indigenous peoples of the Americas developed a method of treating the nuts to counteract a highly corrosive poisonous juice, and the nuts were roasted in the shell. These methods are still used today to make the nuts palatable.

*Peppers.* Plants developed in tropical America supplied the world with all forms of red peppers known today, including cayenne, chiles, Tabasco, pimiento, and even Hungarian paprika (Walker 1943:14 in Whitman).

*Coca.* Indigenous people in the Andean region successfully performed difficult surgery with the aid of coca leaves, probably before Europeans knew of any anesthetic. The coca plant was grown extensively by the Incas in their terraced gardens.

Indigenous peoples of the Americas showed astounding ability in developing plant resources in difficult terrain and climatic conditions. The success of these early experiments remains visible today, not only in the variety of food crops but also in plant substances used in clothing, building materials, fragrances, and more.

## Native Permaculture and Agricultural Technology

People in the Americas are only now beginning to explore and rediscover a food heritage that is second to none in the world. The new science of permaculture, a system based on ecological principles of creating a sustainable Earth, is in reality applied Indigenous science.

Permaculture techniques ensured that plants needed and used for food, medicine, art production, and trade would be perpetuated. The Great Basin is characterized by hundreds of square miles of piñon pine, whose cones contain one of the most versatile of the wild gathered foods. For literally thousands of years, Native people planted and harvested piñons, ensuring that a favorable ecology was maintained and perpetu-

ated in these vast land areas. Little research has focused on how Indigenous people formed the pre-Columbian landscape of North America. The lush Eden-like vegetation of the Pacific Northwest and other areas of California is partly the result of hundreds of generations of Indigenous people practicing a form of permaculture extensively, effectively, and soundly based on a philosophy of mutual reciprocity.

Ways of propagating food plants are specific to region and society. Permaculture techniques were also applied to certain animals in order to help propagate animal populations. The estimated sixty million buffalo believed to have existed on the North American continent prior to their slaughter during European settlement were the result of techniques applied by Native people, including game management and bioregional horticulture.

Rediscovered permaculture techniques are being adapted to feed populations around the world. The cultivation of spirulina, a microalgae, one of the most nutritious foods anywhere on a per gram basis, was begun by the lake-dwelling Mesoamerican Indigenous peoples. People can eat it sprinkled on salad greens, but because it has a rather strong chlorophyll taste, it is commonly mixed with breads and other foods. The Aztecs mixed it with chile, peanut butter, and chocolate, as well as with corn to make small cakes.

The Ojibwe and other Great Lakes people learned how to cultivate such plants as wild pond lilies, cattails, and wild rice. Wild rice, currently a major cash crop in the northern Great Lakes region, is being introduced into other water-rich areas. Behind the cultivation of wild rice or any other important food plant is a relationship that is established, justified, and remembered in mythological traditions. The Hopi honor their relationship with corn via the myth of corn maidens descending from the sky to demonstrate how to care for corn plants. Here again is the connection between the sky and the earth. The Hopi corn maidens are also the stars of the Pleiades, who come to Earth at certain times of the year corresponding to ceremonies performed by the Hopi.

Corn then is part of a larger context. The uses of corn as a food and medicine by northern and southern Native tribes were extensive, and this

knowledge is being transformed into new applications today. Technologies currently being rediscovered and revitalized as traditions include numerous preparations of corn and its byproducts. Contemporary Indigenous foods are also being adapted to grow in certain places. For instance, muskmelons and honeydews were brought to the Americas from Africa and adapted to the Southwest, becoming Native foods.

Experimentation with food plants and the abundance that resulted in trade among the Indigenous peoples of the Americas parallel the uses of Western science and technology in modern society. This story is told, retold, and reflected in every part of this continent. The technologies involved growing corn were paralleled by the technologies for growing potatoes in the Andean highlands. Two hundred fifty-six varieties of potatoes, many used for trade among ancient people, are a direct result of genetic science originated by the Inca. Corn, chile peppers, beans, cotton, flax, and various squash varieties are also results of such experimentation.

Native Americans employed practical knowledge of the characteristics and interactions of soil, water, and plants. Many have underestimated the contributions of Indigenous peoples, showing disbelief in the notion that "uncivilized and primitive Indians" could influence "civilized Europe." The ancient cultures of South America were the greatest agricultural experimenters of their time and for centuries thereafter, building vast areas of plots where crops could be grown in different ways. Machu Picchu may have been such an area, with its neat rows of terraces along the face of the mountain. Terrace farming is a very effective way of using water in high-altitude areas.

Other agricultural peoples in Central and North America relied upon growing plants together in a small area called a *milpa*. Small mounds are created into which a mixture of plants were seeded. Such a system avoids soil disruption caused by linear plowing and reduces runoff erosion. European immigrant farmers in the eastern woodlands of North America adopted *milpa* techniques as they also had the advantage of allowing a good crop without the extra labor of digging out tree roots from cleared land.

The *milpa* technique was successful also because of synergistic effects. When soil was planted with the traditional "three sisters" of corn, beans,

and squash, with other native plants such as marigolds nearby, corn provided shade for the delicate beans and a stalk on which the vines of squash and beans could grow. The squash provided extensive ground cover, reducing weed habitat and weeding, and simultaneously shielding the soil from rain erosion while capturing a maximum of available rainfall. Beans fix nitrogen in the soil through their roots, and so improve fertility.

Plants like the marigolds planted in the *milpas*, often those thought of as weeds by non-Natives until recently, were planted because they were natural generators of chemical compounds that discouraged insect herbivores. Anthropologist Jack Weatherford noted that the three sisters combination also attracts predatory insects that eat harmful insects (Weatherford 1991:83). Euro-American farmers used the *milpa* mound system they had adopted from the Indians until the 1930s. It is generally accepted that the predominance of mechanized plowing techniques and crop monoculture from the 1930s to the present have resulted in severe problems of soil erosion, soil depletion, and a need to rely on artificial insecticides to control herbivorous insects whose populations boom when favored by a monoculture of food plants. Weatherford cites studies demonstrating that the traditional Indian technique used in modern Mexico provides corn yields per unit of land area as much as 50 percent higher than the Euro-American monoculture cropping technique (Weatherford 1991:82).

The Northeastern Indian agricultural practice of planting was superior in comparison to European techniques of sowing of seeds given the characteristics of that landscape. Europeans had customarily taken random handfuls of wheat, rye, or barley seed from a sack and strewn them upon the ground. This practice resulted in a limited range of self-hybridized grain types with little control possible over genetic qualities. Indigenous farmers, who planted corn kernels individually, learned that persistent selection of seeds for particular qualities enabled them to control the diversity of their crops. Indian farmers soon applied this technique to other plant species, resulting in a profusion of varieties of staple crops such as corn, chiles, beans, and squash. Indians also learned how to control pollination of plants in order to combine parent characteristics in desired ways. They thus became masters of plant hybridiza-

tion long before the nineteenth-century botanical researchers Gregor Mendel and Luther Burbank demonstrated the technique to the rest of the world (Landon 1993:9).

Along the shores of the Caribbean and in much of South America, agricultural techniques are different from the milpa system used in the north. The *conuco* system (from the Arawak language) is adapted to the year-long growing season in the tropics, with continuing planting and harvesting throughout the year. Conuco agriculture, a form of slash-and-burn or swidden field agriculture, features the propagation of plants through cuttings and roots rather than through seeding the soil. Some of the plants grown in this way have lost the ability to produce viable seeds or any seeds at all. Chris Landon cites the work of Robert Carneiro (1974:79) who has shown that manioc cultivation under the conuco system is capable of producing very high yields of calories per acre and per unit of cultivation time.

The selection and rooting of cuttings gave Indigenous plant breeders of the south greater control over the genetic qualities of crops than the northern methods of selection and planting of seeds. According to Weatherford, it is clear that Native peoples were the world's greatest plant breeders, and their knowledge rested largely on the techniques they used for planting seeds and cuttings. From this firm and practical base of plant manipulation, the modern sciences of genetics and plant breeding have developed. Without the treasure of diversity created by the trial-and-error methods of early Indigenous American farmers, modern science would have lacked the resources from which to develop modern techniques. The limited agricultural resources of the Eastern Hemisphere would have been far too meager and would have required additional centuries of research before science could achieve its present level (Weatherford 1991:42-46).

Yet another form of agricultural technology created by Native people can be found in the unique *chinampas* system practiced in the Valley of Mexico. A chinampa is an artificial island built up of cut reeds overlain with lake bottom mud and anchored with willows planted around its perimeter. Believed to have been invented in the city of Teotihuacán

nearly two thousand years ago, chinampas agriculture flourished in the cities on and around the Lake of the Moon in the Valley of Mexico, particularly Xochimilco and the capital, Tenochtitlán. Chinampas agriculture has also been practiced in the Andes at Lake Titicaca by the Uru people, although it is not known whether the technique was developed independently or was brought south from Mexico.

Planting and cultivation were done by hand in the chinampas. A profusion of plant varieties was developed in extraordinarily rich microenvironments that combined aspects of land agriculture with hydroponics. Flowers as well as produce were important components of chinampas agriculture; the Spaniards recorded marvels of gardening and floral display in the conquered city of Tenochtitlán (Schmidt in Lyon 1974:65).

Indigenous Americans first taught the world the value and uses of fertilizers. Incan guano (nitrogen-rich seabird droppings) and the fish fertilizers used by Native farmers in both North and South America rejuvenated the depleted soils of Europe in the eighteenth and nineteenth centuries, and pointed the way for Western science to later develop artificial fertilizers. Today, the guano deposits so carefully managed by the Incas are largely gone due to overexploitation, but fishmeal fertilizers continue to be used.

Based on his observations of Machu Picchu, Weatherford (1988:62) developed an interesting hypothesis about one possible use of the site. Machu Picchu is a small center, barely larger than a village, yet is endowed with a complex and extraordinarily durable stone architecture, surrounded by an extensive terrace system that is curiously unsuited to large-scale production of any one particular foodstuff. Many of the terraces are very small, and were constructed with great difficulty far above the Urubamba River, requiring an extensive canal system to support them. However, the enormous variation in elevation and sun orientation of the many terraces creates a diverse system of ecological niches (Landon 1993:13).

These facts suggest the possibility that Machu Picchu was built as a major agricultural research station run by the Incan state. Weatherford

believes it served the same function as other places in the Andes where plant experimentation was conducted, although Machu Picchu was more focused on intensive agricultural experimentation than were most of the other sites. Max Schmidt, a Paraguayan of German ancestry and a long-time student of South American cultures, reached a similar conclusion about the Peruvian site of Ollantaytambo in his last scientific journal article on South American Indigenous agricultural practices (Schmidt in Lyon 1974:65-66).



Machu Picchu. Photograph © Marcia Keegan.

### Meanings and Possibilities

“Whether this site [Machu Picchu] actually functioned as an ancient experimental agricultural station or not, the Indians of the Andes probably did more plant experiments than any other people anywhere in the world” (Weatherford 1988:62). But Native people lacked media exposure, and so their sophisticated agricultural techniques remained largely unknown until recently. These people experimented to improve crops with a vital purpose—in order to have enough to eat to survive, rather than in hopes of monetary profit or fame. Their careful scientific methods created very modern achievements that were remarkable on a

small scale, and are as applicable today as in their times.

Western science has been reluctant to recognize Native peoples' agricultural methods, much less to acknowledge its debt to them. Permaculture techniques are being introduced to our children in schools today as newly developed ideas. Only now, when serious problems have resulted from large-scale monoculture, from insect invasion and pollution of food products grown in soil ruined and poisoned by pesticides, are agriculturists and healers looking back to the practical methods, knowledge, and philosophies used by Native peoples for many generations. One might ask what Indigenous people today and of the recent past think about the contributions of their ancestors to the wealth and vitality of Western culture, which has spread throughout the world, while their own cultures have been undermined and their achievements ignored or treated with disdain.



Native peoples have traditionally perceived animals of all kinds as co-creators of life. © Pablita Velarde (from Pablita Velarde, *Old Father Story Teller*).

## CHAPTER FIVE

# Animals in Native Myth and Reality

*“The man who lived with the bears”*

Let a man decide upon his favorite animal and make a study of it—let him learn to understand its sounds and motions. The animals want to communicate with man, but Wakan-Tanka does not intend that they shall do so directly—man must do the greater part in securing an understanding.

—Brave Buffalo, Standing Rock Lakota  
(in Densmore 1894)



## Animals and the Native Worldview

Traditional Native perceptions of animal nature represent a type of thinking and attitude dramatically different from those of Western science. In the Native way, there is a fluid and inclusive perception of animal nature that makes less of a distinction between human, animal, and spiritual realities. These realities are seen as interpenetrating one another. This is a view held in common with evolving descriptions of reality in quantum physics.

To the Western mind, the associations that Native cultures may make regarding animals may seem illogical, but are indeed comprehensible and logical within the context of each Native cultural worldview. Among the Lakota, bison, elk, bear, dragonfly, moth, cocoon, and spider are all connected as expressions of the Lakota concept of the Sacred Winds. In turn, the Sacred Winds are one of the manifestations of "Wakan," the Lakota concept of the Great Mystery.

In Native science, associations and relationships of Native people to animals have their own internal logic. The way Native people traditionally classified animals had an "aptness" based on their value, their use as food, and their relative role in the reality of the natural environment that both Natives and animals inhabited.

The integration of these relationships was accomplished through the structures of the tribal worldview. For example, acknowledging the sacred directions recognized a conceptual and physical sphere of relationship to nature and its animals that formed the Native foundation for understanding. In all Native traditions, the sacred directions are a conceptual, mythic, and spiritual structure for reflecting upon the symbolic meaning of animals in the cosmology of Native cultures.

In the past, there has been a tendency to oversimplify Native spiritual expression and miss many of its inherent and subtle meanings. These subtle meanings are often presented in the way Native cultures relate to animals since animals are always associated with other Native concepts of power, dream, vision, guardian spirit, master or mother of game, and animal soul. The belief that animals have souls is deeply embedded in traditional Native views of animals. Each animal is seen to possess certain

special qualities and powers that they may share with humans if they are properly treated. In the Native view, animals were far from being considered inferior; rather, they were in many ways superior to humans. Given this view, animals inspired the lifeways of Native cultures.

In some Native traditions, such as the Iroquois, the Earth is considered to be a great living being—the Great Turtle and all living things ride her back. Among the Algonquin, the great creative spirit of the universe is said to be personified in the form of the Great Hare who pulls the sun across the sky each day. It is believed that animal nature helped to create humans and that animals have always served as humanity's mentors in coming to know the nature of the world. This first knowledge gained by humans from animals is said to have been lost in antiquity as a result of human misbehavior toward animals. However, it is believed that this ancient knowledge can be accessed through proper ritual, ceremony, dream, and vision. The wall that separates the human and animal worlds is thought to be thin. Consequently, it is believed possible for humans to transform themselves into animals and for animals to transform themselves into humans. Many Native myths talk about the marriage between humans and animals. When humans are drawn into such special unions with animals they learn important knowledge, which they pass on to future generations.

In the beginning of time, Native myth contends that humans and animals could communicate with each other. Animals cared for humans, helping them find food, water, and shelter. They even sacrificed themselves when needed to help humans survive. They would assist humans in knowing when to prepare for the change of seasons or the coming of storms. This intimacy with animals came to an end when humans began to be disrespectful to their animal relations. Humans, it is mythically related, began to abuse animals, kill them without need, steal the food they had stored for winter, and arrogantly mistreat them in various ways. In some Native myths, such as those of the Southeastern tribes, it is said that the animals had a grand council meeting in which it was decided to punish humans by leaving them to fend for themselves and by refusing to communicate with them through language. This early direct connection

to animals thereafter became submerged and could only be evoked through ritual, dream, and visioning.

Most Native languages do not have a specific word for "animals." Rather, when animals are referred to they are called by their specific names. The fact that there are no specific generic words for animals underlines the extent to which animals were considered to interpenetrate with human life. Animals were partners of humans even when humans were abusive. With this attitude of partnership and mutual participation with animals, Native cultures gained many important insights into the dynamics of animal nature and practiced their knowledge for human benefit and survival.

### Animal Nature

Humans' relationship to animals and our participation in their world bring forward our innermost instinctual selves, the highest in the order of our biological senses and being and the core element of our consciousness. Traditional peoples around the world have incorporated this sense into their relationship with animals, as they see all animal species as having equal rights to life and a place on Earth.

We who live in contemporary cultures have largely disassociated ourselves from our natural instinct for affiliation with other forms of life. The once sacred Earth community that nurtures human life has become "outside," a place filled with malevolent natural forces that must be controlled or otherwise guarded against. Fear, control, and exploitation of the "outside" or the other as enemy is deeply embedded in the psychology of Western society. To this end, much of modern science and technology has been mobilized to guard against or to war against the other, be it a mountain, a forest people, a religion, or the world of insects. From ideas in books and film, through education, government, and science, the message and therefore the practiced belief, has been one of fear and the need for domination and control of nature—its plants, animals, insects, and even its microorganisms.

Even the word "beneficial" is a judgment call based on modern conditioning with regard to the natural world. We love our pets as long

as they conform to deeply entrenched attitudes about animal nature. But usually we project upon animals the worst of who humans are. Anthropomorphic projections upon animals are reflected in everything from the cartoons children view to commercials for the latest tennis shoe. Animals must serve humanity or be done away with; after all, it says so in the Bible. We have been conditioned to act, think, and project prejudicially toward animals, and as for the insects, we lack both the emotional and intellectual appreciation that would bring forward any true appreciation for their role and importance in the natural order.

Animals raised for food (usually under horrendous conditions) are given little thought at all. They are certainly not the focus of prayers, dance, art, or ceremony as they were in earlier times. So-called "wild" animals are confined to lead desolate lives in zoos apart from their homes, the real sources of their natural being. We say we do this for their protection, their own good. We have simply become adept at rationalizing our "bio-phobia," our basic fear of nature.

Having divided all species into beneficial ones or pests, we are quick to ask "What good is it?" and "How can it further our plans?" (Lauck 1998:11). These questions and their underlying orientation form the basic foundation for the modern Western worldview of humanity as well as nature.

We have little awareness that globally there is the equivalent of a biological "holocaust" in play, and that every day the Earth experiences the extinction of hundreds of microbiota, plants, insects, and animal species. The biodiversity of life is dwindling and with its loss, we lose profound modes of natural spirit. In ignoring the health and viability of the biological web of life upon which we depend, we incur a real but largely hidden danger; in the life of the land on this planet lies our human lives. We ignore these relationships at our own peril.

In contrast, Native cultures usually look at all species as sharing a circle that is inclusive of all life, a circle that embraces science, art, community, and spirit.

Lakota Indian Black Elk experienced a moment when he saw the entire universe dancing together to the song of the stallion in the

heavens; the leaves on the trees, the grass, the waters in the creeks and in the rivers, the four-leggeds and the two-leggeds and the wingeds of the air "all dancing together to the music of the stallion's song." Throughout his work, Black Elk insists on this great unity of the entire world of the living. He tells us that "One should pay attention to even the smallest of crawling creatures for these too have a valuable lesson to teach us, and even the smallest ant may wish to communicate to a man" (Berry in Lauck 1998:xviii).

Native cultures have much to teach non-Native cultures from their inclusive view of life—about listening to the "noise of the infinite in the small." All animals including insects are necessary for the ecological functioning of the biosphere and the survival of all living things. The known benefits of the honeybee, earthworm, silkworm, ladybug, various beetles, ants, and spiders balance out their perceived harmfulness to humans. "We are missing fully half of nature when we eliminate insects from our world of interest. . . . Each of these . . . is, by definition, an animated being, a being with an anima, a soul; not a human soul, but a thing of marvelous beauty expressing some aspect of the divine" (Lauck 1998:xxi).

An entire species may be condemned to extinction if humans deem its behavior or appearance unacceptable. This is the prevailing modern Western cultural attitude toward animals. In many ways this attitude has also characterized Western attitudes toward Indigenous cultures that have traditionally afforded kinship to the entire animal world.

For Native people, knowledge of animals was important to all aspects of their lives. Learning about animals was a lifelong task integrated in every aspect of tribal life. Practical knowledge included characteristics of animal behavior, anatomy, feeding patterns, breeding, and migration. Techniques of hunting and fishing ranged from simple to complex and required long periods of teaching and learning, but these skills were always learned in the context of detailed understanding of the natural ecology of tribal homelands.

Native hunting combined great creativity and flexibility with complex rules of conduct and acts of spiritual significance. Through long apprenticeship and experience the hunter came to know his prey, where and when to hunt, and the topography and weather conditions most appropriate for hunting. He also knew the myths, songs, rituals, and history that were woven into the context. "In Native American myth, animals are regarded as holy because they have powerful souls. And though the souls of some species, such as bears, whales and elk, may be greater, more important or more dangerous to humans than those of, say, squirrels and lemmings, all animals share an honorable status in the spiritual universe" (Lowenstein and Vitebsky 1997:69).

The connection between humans and animals is exemplified in innumerable ways in Native traditions. In a story of the Skidi Pawnee, kinship with particular animal species is presented as a metaphor of interdependence and compassion.

A man out hunting once came upon an abandoned bear cub. Instead of killing the cub, he tied an offering of tobacco around its neck and blessed it saying: "May Tirawa (the Supreme Deity) protect you!" After returning to his camp, he described to his pregnant wife what had happened, and when she later gave birth, their son grew up feeling a great sense of kinship with the bears. So strongly did he identify with them that often, while alone, he would pray to the bears' souls.

When [the son] reached manhood, he was killed and dismembered in an enemy ambush. A male and female bear found his remains and revived him with the help of supernatural powers. The man was completely restored and lived for a long time with his benefactors. During this time, he came to revere bears as the greatest and wisest of all beings, with the most powerful souls. The bears, however, reminded him of their place in the order of things. Their wisdom, they said, was a gift from Tiwara.

Eventually, the time came for the man to return to his people. As he took his leave, the male bear embraced him, pressed

its mouth to the man's lips, and rubbed him with its paws and fur. The touch of the fur gave the man power, while the kiss gave him wisdom. He became a great warrior and established the Bear Dance among his people (Lowenstein and Vitebsky 1997:99).

### Our Relatives, the Animals

Evidence found at the Clovis site in southern New Mexico indicates that this part of the North American continent has been inhabited for at least ten thousand years and probably longer. Indeed, Indian elders say that we have always been here. There is an extended history of tribal groups of hunters in America following the deer, the bison, and the mastodon, and their relationship to the animals they hunted formed and engendered the first thoughts that today we call ecology and environmental philosophy.

The first hunters developed such an intimate relationship with the animals they hunted that they truly became resonant with the very spirit and essence of the life of animals. Early hunting cults depicted their relationships to the animals they hunted in the cave paintings of Spain and France. They enacted a variety of initiatory rites in caves like those of *Les Trois Frères* in southeastern France. Inside these caves, they created the symbols of their relationship and understanding of lives in nature. They created shrines for those animals upon which they depended for their well-being, and sculpted figures of entities that they believed allowed the game to exist. These figures were the game mothers, who in their archetypal fashion, represented Earth Mothers, those first mothers, the essence of the Earth upon whom human, and all life, depended.

In an attempt to develop and maintain a balance and harmony with the relationships they felt essential among themselves, the animals they hunted, and the environment in which they lived, these ancient hunters created a role for a person whom we call a "shaman," the first medicine person, first teacher, first artist, first doctor, first priest, and first psychologist. Indeed, it was these archetypal figures who laid down the frameworks for establishing and maintaining a direct relationship between human beings and the animals and plants that inhabited their environments.

This spiritual journey through relationship was the beginning of the first religion. Those first nature-centered religions evolved through abiding respect, an understanding that all natural entities had a spirit and shared breath with human beings. Art came into being as a tool to communicate, to express the nonverbal, innermost feelings for the natural world experienced by those first shamans and first hunters. Art documented the first attempts by human hunters to explain these relationships. As communities became more sedentary, this tradition of art and way of relating to nature was elaborated and expanded to form the expressions of sacred art we find worldwide today.

Those first tribes learned to build shelters from available materials, and to use, through trial and error, what grew near them for the betterment of their lives. All was undertaken with the realization that everything in nature was interrelated and that humans were indeed a part of the Earth and the Earth a part of them. In the U.S. Southwest, shelters were made from mud, stone, and wood, and clothing was made from the animals they hunted. They developed strains of corn and other foods, including squash, pumpkins, and beans, which became a dependable source of life for them and their families. They expressed themselves with natural materials around them, making baskets, pottery, and weavings decorated with plant substances and paints. They danced and sang in ceremony. Tribal arts continue today to powerfully express a people's interdependence on their natural community and understanding of their responsibility to other life and the Earth.

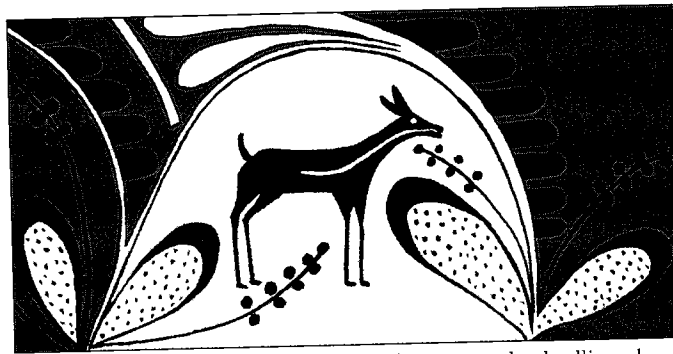
As time went by people lived in communities of increasingly greater density. They built towns and cities and evolved more complex societies, but they did not forget that everything came from nature and that nature was indeed the field of their being. Rituals also became more complex, as did conceptual frameworks and applications of appropriate technologies. The metaphysical concept that guided the development of these communities focused on the idea of "natural orientation." Natural orientation began with a symbolic center and radiated out of that center to include the entire cosmos, all plants and animals, the mountains, rivers, streams, lakes, and all of those natural entities comprising the reality of a community. The

concept of orientation was interpreted and expressed in numerous art forms, tools, jewelry, and architecture.

### THE HUNTER OF GOOD HEART

Every tribe incorporated a sense not only of the sacredness of nature but of the people's understanding of that sacredness in the symbols used to represent their relationships. Among the earliest symbols was the Hunter of Good Heart, a metaphor that evolved from the primal relationship of hunters to the animals they hunted. The Hunter of Good Heart is one of the oldest educational metaphors in existence and can be found in hunting cultures around the world. Among the Pueblo people of the Southwest, the Hunter of Good Heart represented a way of living, a way of relating, a way of ethics and proper behavior, the foundation for teaching and learning about the relationship to the animals the Pueblo depended on for life.

Some art, such as that made by the Anasazi and Mimbres peoples of the pre-Columbian Southwest, reflected an integration of the human being with the animal in the design motifs found in pottery. This is also represented in the petroglyphs found on rock faces throughout the Southwest. These petroglyphs communicate sacred relationships between hunters and the animals hunted and also symbolize the natural, spiritual, and other forces that combine to teach and to bring completeness.



Pottery design, called "the House of the Deer," meaning the dwelling place of the spirit deer. © Pablita Velarde (from Pablita Velarde, *Old Father Story Teller*).

The deer, for example, is a metaphoric icon, as well as a living entity, around which many Native peoples expressed philosophical and environmental ideas. Among the Huichol, the five-pointed deer epitomizes the mythical energy of nature and is woven in traditional yarn paintings to represent the spiritual essence of their peyote sacrament. In whatever habitat the deer was found, it became an important food source and was venerated for its spiritual qualities. Tracking deer was a metaphoric representation of the hunter and his sense of self, for the deer at once represented a source and a meaningful representation of life itself.

During the ten-thousand-year tradition of hunting among Indigenous tribes in America, songs, ceremonies, rituals, and art forms evolved that ensured the success 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.

The Hunter of Good Heart, in a direct and literal way, symbolized oral tradition and teaching at its best. It was the foundation of a complex and profound teaching process that began in childhood and extended into old age. As the successful Pueblo hunter gathered his extended family to tell the story of the hunt, people listened, and meaning passed from generation to generation as to the way that human beings should conduct themselves with animals, plants, and each other. These lessons were also encoded in art, such as in the hunter's canteen, created among the Pueblos from clay and decorated with a deer with a spirit arrow stretching from its mouth into the heart. Through such symbolic art, Native people focused on principles that emanated from their guiding myth. Traditional symbols reflected profound relationships with the environment, offering a context in which to "remember to remember" the relationship.

Through ceremonial dances such as the Deer Dance among Pueblo peoples, the deer were danced, and the community witnessed in dance, ceremony, and ritual the story of the relationship that human beings must honor with the animals they hunted. The “dancing of the deer” occurred not only in the Rio Grande Pueblos but also among the tribes of California, the Northwest, the Southeast, and Indigenous groups around the world who depended on the deer and/or other game animals of similar nature for their livelihood and existence.



Deer Dancers on kiva steps, Nambé Pueblo, New Mexico.  
Photograph © Marcia Keegan.

In every place that hunting occurred—and it occurred everywhere—the act brought the individual and community in direct interface with the magical reality of animals and the life of the natural environment.

Whether the hunter was a Cheyenne brave coming home with a buck to share with his grandparents, or an Abenaki hunting moose in the Maine forests and calling his extended family to come help him carry his catch back to their village, or two Inuit hunters battling for their lives and those of their families with a polar bear mother, the act of hunting brought people, tribes, and societies into direct contact with the reality of life and death, and the need to establish and maintain proper relationships with animals of their environments for the sake of survival.

The hunting rituals and the act of hunting itself prepared individuals for the important matters of life, by teaching the nature of courage and sacrifice, the importance of sharing, and the special power from the animals hunted that was gained through vision and spiritual questing. Individuals learned that we have within us an “animal spirit” and that coming to understand that spirit through the process of hunting was one of the most important lessons of self-knowledge. Preparing for the hunt was also preparing for life, a preparation of body, mind, and spirit. It involved an ethic of conservation and ecologically sound approaches for maintaining the life of the animals hunted. There was a widespread belief that each animal had a spirit village to which they returned and reported their treatment by humans, which henceforth directly affected whether that animal species would in the future give its life for humans. Such beliefs were a part of the way in which Native American people related to their environment and to the animals therein. 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 animal nature.

Hunting rituals reflected perpetuation of a covenant between the hunter and hunted. This covenant was often symbolized through the ceremonial use of talismans, which embodied the qualities of the animals hunted or other animals such as wolves, mountain lions, and killer whales that were themselves hunters. Among Aleutian hunters, talisman amulets provided a spiritual connection between themselves and the animals they hunted to sustain their lives and those of their families.

Hunting and its rituals empowered not only the individuals but also the communities from which they came. Rituals before, during, and after hunting celebrated the appropriate use of technology that was an extension of human abilities to provide for their communities. Even the tools used—spears, the atlatl, snares, various types of traps, the bow and arrow—were sanctified in relationship to their use. Thus, even hunting technology had an important and sacred relationship to the overall interaction of human to animals and the natural world.

Hunting itself spread far beyond the actual act to include the entire community in celebration, sharing, and commemoration of the life that animals shared with the people. The rituals performed for hunting were thought to attract animals and to cultivate a proper attitude and respect, but also allowed human beings to reconnect with those mythic times in which humans, animals, and plants shared a relationship with each other that was intimate and interactive. The atmosphere in which individuals were conditioned evolved around a concept of education viewed as a process of “coming into being.” Each step along that pathway of knowledge of animals, self, community, and environment formed the foundation for the concept of completeness that underlies traditional tribal education. Many tribes have preserved contemporary expressions of this ethic through traditional tenets of education.

The process of hunting and all it entailed allowed hunters to understand the nature of self-effacement and humility, and to honor the greater family of animals of which they were a part. It helped them to understand that dancing, offering prayers of thanksgiving, and asking for life for one’s family and community all added to the development of the individual hunter as a complete expression of human nature and being.

In many tribes, there was such identification with animals that not only were hunters’ personal names derived from animal experiences or expressions, but entire clans and societies also traced their lineage and their essence of power and social place to animal totems. The animals they hunted personified their sense of themselves as a particular group within the greater community of nature. Therefore, the way Native

people viewed their relationship to animals formed an infrastructure for social organization.

Hunting tribes evolved a kind of game management system predicated upon the eco/spiritual ethics of the community. Modern conservation principles, such as taking only one kind of game during a particular season and leaving others alone—the single-prey principle—were in widespread use among Indian hunters. The maintenance of a hunting territory, considered both sacred and practical, became another practice widely applied in Indian hunting. In some cases the taking of animals within a particular territory was strictly controlled by a particular society within a tribe. The Cheyenne Dog Society, for instance, played the role of not only policing the community, but also maintaining and ensuring adherence to the proper respect of a particular hunting area and its animals.

Indian hunters sought to establish a direct and intimate resonance with the animals hunted. They focused not only on animals considered important for their survival but also those embodying a spiritual quality whose habits, character, and lifeways provided models for human behavior. Animals such as the bear, dog, salmon, deer, coyote, wolf, mountain lion, turtle, great eagle, raven, snake, hare, fox, badger, hummingbird, elk, moose, and a host of other smaller animals and birds were recognized for their characteristics and ability to teach through their behavior and what they represented in the overall fabric of an environment.

All of these expressions of relationship to the animal world provided rich teaching in a variety of experiences that Indigenous people understood in both practical and philosophical ways. They applied these in a direct process to help each individual “become fully human.”

The richness and vibrancy that one finds in traditional art forms and stories is due in part to the application of the metaphoric understanding of human relationships to the animal world. The transformations that occur throughout Native ritual, myth, dance, and performance reflect that interaction. Stories abound in which human beings become certain animal beings or vice versa, interacting with each other in an intimate way. Animals as living entities with a particular and powerful kind of spirit appear in shamanistic practices in the northern latitudes of

America and Asia, established by hunter-gatherer ancestors thousands of years ago. In that dim past, when a resonance in both form and function between humans and the animals upon which they depended existed, humans truly bonded with animals.

The world renewal ceremonies practiced by all tribes are specific expressions of the human responsibility to preserve, protect, and perpetuate the life of animals and all other life. For the Yurok of California, performance of the White Deerskin Dance symbolized a renewal of the world's creation. The White Deerskin Dance was performed in a ceremonial cycle associated with the solstice and renewal of ties to the world's life-giving spirits. One of the life-giving spirits was the deer, that fleet, delicate creature who symbolized the renewal and continuity of relationship with all animals in so many Native cultures. Many groups also held ceremonies for the first fish taken, the first deer, the first berries, or even the first acorn in the southern regions. In the Northwest, the salmon ceremonies traditionally reflected this responsibility of honoring animals.

The salmon (or first four salmon) received the most elaborate rites, though this varied from place to place. Usually the salmon were laid with their heads pointing upstream on a newly woven mat or cedar board, often under a special shelter and sprinkled with down feathers of birds. A formal speech or prayer of welcome was intoned as in this particular example: "Old friends, thank you that we meet alive. We have lived until this time when you came this year. Now we pray you, supernatural ones, to protect us from danger, that nothing evil may happen to us when we eat you, supernatural ones, for that is the reason why you have come here, that we may catch you for food. We know that only your bodies are dead here, but your souls come to watch over us when we are going to eat what you have given us to eat now."

The salmon were offered fresh water symbolically after their long journey through the salt sea. The first salmon were then cooked and divided in small pieces among all the people present at a communion. The celebration, often seven days in length,

included feasting, gift-giving, torch-bearing processions, dancing and singing. During all the ceremonies of welcome, countless salmon were allowed to pass upstream to the spawning grounds and thus the ritual actually helped to assure the continuation of the salmon runs (Hughes 1983:46).

Participating in ceremonies in their honor created empathy for an animal or animals, as well as a context for relationship. The various animal dances of Native cultures provide an understanding of the evolution of the culture and remind people they must work on their relationships with animals. Relational psychology (ecology) must be "worked," or constantly renewed. Another way of working this relational psychology was to create a clan totem, a symbol that commemorated a people's links with an animal. Each totem had a story and emerged as a way to entreat the animal spirits for their protection and intercession with other worlds.

## Animals in Myth

The ensouled land in which a people lived generated other types of knowledge. The Anasazi of Pueblo Bonito in Chaco Canyon, New Mexico, for instance, hunted certain kinds of animals for ceremonial purposes tied to greater empathy with larger cosmic cycles in which they became deeply interested because they could observe a vast exposed dome of sky. In some tribes myths involved animals that helped establish relationships between human beings and the first creations of the world. According to the Eskimo version of the creation of the first man and woman, a raven participates. In other cultures animal characters have guiding roles in the emergence of human beings and the formation of the landscape of the world that we know today.

Other myths involving animals are stories about ethical or moral behavior. One such story focuses on human frailties. In this tale, the possum has a bushy, elegant tail, and makes every effort to ensure that everyone around him knows how beautiful he is. Suffering from ego inflation, he is easily tricked by the hare and the cricket into shaving his



tail when they tell him that an even more magnificent, beautiful tail will grow in its place. And of course, possums have "bald" tails.

It is estimated that over seventy-five percent of Native American myths contain animal characters, evidence of the intimate relationship with animals felt by Native people. A tale deriving from the Haida of the Northwest talks about human relationships between families, within families between husband and wife, and also between humans and other animal families. It is a popular myth called "The Woman Who Married a Bear," based on the idea that humans are not terribly different from bears and may even share a common heritage. In the tale a woman marries a bear and has his offspring. When her brothers finally locate her, her bear husband goes to meet them and is killed. The brothers take their sister back to the village, but she finds that she can no longer live as a human because she has lived as a bear for so much of her life. And of course, her children are half human and half bear.

The tale reflects love between a man and a woman, or in this case a bear and a woman. It also talks about family love and respect for another animal's kingdom. These stories are actually very elegant and complex, and contain great wisdom. Most stories are told during the wintertime because bad weather forces people too to "hibernate," and the tales take a long time to tell and commit to memory.

Another type of story revolves around the consequences of transgressions, such as lack of respect for other living things. A Blackfoot myth tells of a vain, egotistical young man who is also cruel, evidenced by his propensity for making fun of the mice people by crushing their homes. The mice people, with Rabbit's help, convince the man that if he sticks his head into a buffalo skull, he will emerge with the power of the buffalo and also with more beautiful facial features. Of course, what happens is that the vain young man runs around with a buffalo skull on his head, and the mice people make fun of him. This is a tale about care for even small things because they also have a life that must be respected.

Consider also the Havasupai myth of a couple who transgress certain kinds of cultural and social morals of the tribe; that is, they have an affair. Butterflies attack the couple as they are running for their lives.

This myth is a reminder that there are repercussions for immoral acts of various types.

The Paiute myth about Coyote stealing fire from the shamans is very ancient. When the Earth was still dark and very cold, animals were cold, forlorn, and looking for a way out. Coyote knew of a village on the top of an obsidian mountain where light could be found, and Raven informed him that the light was called fire, and that it was being held captive. Fire, said Raven, was the way to light the world and keep oneself warm. Coyote and his animal allies challenge the shamans of the village to a grand dance contest.

According to the myth, Coyote then dances with his allies, and the shamans and warriors look on. They dance every one of the warriors to sleep, and as the last one falls asleep, Coyote grabs the last burning ember from the fire. The shamans chase him, but as he runs through the landscape, he tosses the ember to his allies in a relay race around the world. And as Coyote, Eagle, Bull, Hare, and others run, light enters each land, and the great ice melts. Just as the shamans are about to catch him, Coyote makes one last dash and throws the ember into the sky with all his might and it forms the sun. The results are night and day, color and warmth, a balance of energies, and the formation of the sun. It is a tale of transformation, and of the coming of fire, a very important part of human cultural life. The tale is believed to be between ten thousand and fifteen thousand years old because it relates the receding of ice long ago.

The Great Turtle myth of the Iroquois is the archetypal ecology myth. According to the myth, everyone rides on Great Turtle's back, the island we live on. All things done on Earth, all things that happen on Earth, are felt by the Great Turtle, who is the Earth Mother; she knows everything that occurs. In contemporary ecological studies, the Gaia hypothesis is a popular concept that describes the Earth as a living, breathing entity who registers all that we do and all that we are.

## Animals and Spirituality

Two quintessential interdependent issues face people in the twenty-first century, and both are fundamentally about relationship. The first is how we are going to deal with the environmental crisis, or how will we

relate in a proper, sustainable way to plants, animals, and the earth. The second is how we are going to deal with each other in a proper, respectful way that acknowledges our common interdependence. Biological diversity and cultural diversity are both issues of relationship. These problems are recognized by Indigenous peoples and are portrayed in many myths.

Relationships with animals have always been an important part of Native American spirituality. These relationships (often called the "worship" of animals) are considered a "primitive" stage of human intellectual development by Western science. But the core idea is being rediscovered through the environmental movement or eco-philosophy; that is, the idea that we are all related, that humans have a responsibility to animals. The whole concept of animal rights is not new: among Native people animals have always been considered to have rights, and were equal to human beings in terms of rights to their lives and to their perpetuation as species. One could describe these beliefs as a type of natural democracy.

Councils of animals that must give their blessing to human undertakings are alluded to in many ways in Indigenous mythologies. Humans rightfully and respectfully ask the permission of animals for doing things with them and to them. This is the meaning of the dances, rituals, and ceremonies Western scientists sometimes call "animism."

### American Indian Animal Husbandry

Using deer and other animals as world renewing entities was a common ancient practice among Indigenous peoples in North America and elsewhere. Many Indigenous technologies evolved from or were informed by such relationships with animals. Consequently, these technologies were usually ecologically sound, having a minimum impact on the environments in which they were used. They were often elegantly designed, such as the Iroquois tribes' fish traps, which were constructed to take fish of only a certain size, thereby allowing smaller fish to grow. While people needed permission from councils of animals for certain undertakings, they also learned to tame and use individual animals (Landon 1993:17-24).

Relatively few large animals in the Western Hemisphere survived the late Pleistocene extinctions. Of these, ancient people domesticated only llamas and alpacas of the Andes as beasts of burden and for wool, milk, and meat. Natives in North and South America tamed a few small animal species, including dogs, Muscovy ducks, and turkeys, the latter so valued that Southwestern Pueblos had systems of stone pens for these birds. South American Natives used the feathers, skins, and meat of the ostrich-like rhea and raised guinea pigs for food.

Prior to the Spanish reintroduction of horses in the Americas, dogs hauled loads for many Plains tribes of North America. They were hitched to what the French called a travois, two poles lashed together in an elongated X or V shape, with a platform lashed on the longer, dragged part of the travois, and the short forward part anchored to the dog's body. The animal trailed its mistress as she walked to new hunting and camping areas. Travois would later be tied to horses, and perhaps for this reason, one people, the Lakota Sioux, called the horse *snka wakan*, "holy dog" (pp. 17-18).

Nearly all hunting and gathering cultures developed very sophisticated understandings of animal lifeways, which were as beneficial as domestication, because such deep knowledge of natural environmental factors and the ways in which these can be subtly altered reward both animals and people by increasing the long-term carrying capacity and stability of a landscape or river. People sometimes managed "wild" game in ways that increased their availability to hunters and fishermen (p. 19).

Among the Pueblos rabbit hunting was and continues to be a community event. Rabbits were a ready source of protein, and knowledge among the Plains tribes of how rabbits behave under certain conditions was well developed. The ethic of hunting rabbits dictated that one would not take more than one could carry, which ensured that the rabbits would continue to propagate. Moreover, because rabbits tend to multiply quickly, the Pueblo ethic of hunting rabbits also provided a way for other plants and animals to survive in competition with rabbits for food sources. Thus, desert ecology was actually balanced so that more and healthier rabbits would grow with more foliage, and that the diversity of animal species inhabiting the territory would be adequate.

Hunting, then, may fundamentally enhance a local ecology if performed under certain conditions. And Indigenous people—from the Pueblos of the Southwest to the African Bushmen—knew their land and the animals who lived thereon so well that they could establish a kind of stewardship of their lands that maintained an ideal balance. These traditional ecological principles are now being “rediscovered” in contemporary environmental sciences (pp. 19-20).

Among Native Americans environmental management was resorted to in traditional times in a limited manner. In some woodland and mountainous areas of the continent, Native peoples burned the undergrowth of forest floors and created clearings by killing trees via girdling. This benefited plants and animals such as deer, elk, rabbits, and seed-eating birds that require more open grazing. Even bears like burned-over clearings because burning encourages growth of berry bushes. Useful, shade-intolerant trees, such as Douglas firs, also propagate much better in burned-over forests.

In the buffalo country in pre-horse days, numerous tribes, among them the Blackfeet, developed a managed hunting technique based upon characteristics of herd animals. Buffalo avoid trying to run through or over anything that appears to be a solid barrier. The Blackfeet and other tribes directed entire herds over cliff edges or along natural draws by constructing brush or rock fences. At the base of the draw they might construct a corral, called a *piskin*, into which a herd could be driven by hunters or their wives and children jumping up from hiding, yelling, and waving blankets or skins.

If things went well for the hunters, the buffalo “gave” themselves to the people, unable to turn around because of their own group momentum and their reluctance to attempt to break through a fence or line of hunters. Other hunters waiting with spears could butcher the animals at the foot of a cliff or in a *piskin*. Canadian sub-Arctic bands used a similar technique for caribou, using brush corrals and bound-brush human effigies.

The hunters were very careful about how many buffalo they would take in this way, and would try to avoid capturing young female buffalo

and buffalo calves. Through careful observation the Blackfeet and some other tribes became even more sophisticated. It was noticed that some buffalo approached a hunter who waved a blanket, wing, or skin. “Calling” buffalo could sometimes be used more effectively than attempting to drive a herd into a *piskin* or jump.



Buffalo maintained by Taos Pueblo, New Mexico.  
Photograph © Marcia Keegan.

A few Native people acquired strong spiritual connections to the buffalo, which might occur as a result of finding a small stone shaped like a buffalo, or through dreaming, or in a trance during the Sun Dance. Some of these callers gained power to attract buffalo through a sacred song, in the nature of an agreement between the man and the animals which brought gifts of food, clothing, and shelter in exchange for appropriate respect and treatment of buffalo. Among the Cheyenne, some spiritually powerful people hunted the shy, fleet-footed pronghorn antelope using a similar calling technique (Landon 1993:20-21).

Techniques among Native Americans where fishing was an economic mainstay also show sophisticated adaptive understanding of the fishes' lives and environment. In the Northwest, techniques for taking whales and seals, salmon, halibut, shellfish, sea urchins, herring, and Dolaclian (or “eulachon,” a small, littoral fish rich in oils, used as a condiment for many dishes and also dried for use as candles) made use of what the people had learned of the ways of life of each species.

For example, Pacific salmon that return to the freshwater streams of their birth to spawn each new generation were not hunted in the open ocean at great expense of time and equipment as they are now. Instead, the tribes awaited the annual return of the salmon to the rivers, where the catch could be most economically made using fish weirs, dip nets, and spears, all methods that minimized the risk of overfishing the resource. In the Amazon River drainage of South America, some tribes fished the often muddy waters of streams and flooded areas using a plant drug called *barbasco*, which causes fish to float to the surface for a time, where they may be more easily found and harvested by canoe.



Horses exercising, Taos Pueblo, New Mexico Photograph © Marcia Keegan.

Natives quickly adopted the domesticated animals European conquerors brought. Horses revolutionized ways of life and transport throughout North and South America. Some tribes became not only expert users of horses but also renowned as horse breeders. The Palouse and Nimipu (Nez Perce) of the Columbia Plateau created the beautiful and strong Appaloosa breed from Arabian stocks traded and captured from the Shoshone. Their neighbors the Cayuse developed a breed of fast, sturdy ponies that bear their tribal name.

In South America, the Native adoption of the combination of horse culture and ranch work for European owners came sooner than in North America. One result was the development of a *mestizo* and Native social class of professional cowboys. Tribes in the grasslands of Venezuela, Argentina, Uruguay, Paraguay, and Chile became expert horsemen and breeders, giving rise to the *gaucho* culture. Similarly, Native peoples in Mexico helped develop *vaquero* traditions, which would influence the Anglo-American cowboy culture. These peoples learned the techniques of selective breeding and used them to maintain the quality of horse breeds as well as to adapt Eurasian stocks to Western conditions and needs. Knowledge of stockbreeding and management was passed from tribe to tribe and between assimilated and independent Natives throughout seventeenth- and eighteenth-century America.

Of the bovine species introduced by Europeans in the sixteenth century, goats and sheep became favorite animals of tribal people, particularly the Navajos in the American Southwest. Herding remains a mainstay of the modern Navajo economy, despite several disastrous attempts by the U.S. government beginning in the 1930s to enforce livestock reduction programs.

On the American Great Plains, most tribes did not at first favor beef cattle, preferring buffalo for meat and materials. After the destruction of the herds in the 1870s and 1880s, some tribes ranched beef on their reservations, but the U.S. and the Canadian governments often interfered, trying to acculturate Natives as farmers, a policy driven by ethnocentric and Christian assumptions about the role and sequence of farming in "the march of civilization." These notions were actually contrary to the historical development of certain tribes of the western margins of the Northeast woodlands and the river valleys of the Great Plains. These cultures had traditionally lived by farming and hunting, but had reduced their dependence on agriculture with the coming of the horse in the seventeenth and eighteenth centuries. After their subjugation in the nineteenth century, they were reluctant to return to farming as a way of life. Pushed out onto the Plains into reservations, many adopted cattle ranching as reminiscent of buffalo hunting (Landon 1993:22-24).

Their efforts created difficulties between neighbors over range rights. Theft from tribal herds as well as from non-Native herds led to demands for the curtailment of Native ranching, and the Bureau of Indian Affairs confiscated or reduced the size of herds Natives could own. Some continued to raise small herds or to work for other ranchers as cattle hands.

### Meanings and Possibilities

Eighteenth-century Native people must have been shocked by Western hunters' appalling slaughter and maiming of Plains buffalo, not only because they depended so heavily upon the great beasts, but also because they had never experienced an entire culture with no respect for the equality and spirit of animals. But now, little by little, the lessons their natural lifestyle taught by example are being learned by their subjugators. Where Euro-Americans once lacked basic respect for the equality of all life on Earth, they have had to pass strict laws establishing punishment for taking specific animals' lives. Animals like white egrets with their sweeping head feathers were almost exterminated when a fashion designer encouraged women to desire long feathers on their hats. Birds darkened the skies on flyways between their summer and winter homes until so many were killed that entire species were wiped out. Animal species had to be labeled "endangered" by the federal government to give them the right to live.

There is irony here. Now a Native American can be legally punished for shooting an eagle to acquire ceremonial feathers. An Alaskan Indian tribe is forbidden to harpoon whales it believes will symbolically regenerate tribal ways because whales have become scarce and are an admired species. The people who subjugated Native Americans and Indigenous people everywhere in the world are only now understanding the value of their lifeways.

But what is threatened is much more than a few species' extinction and an ironic reversal of a cultural viewpoint. At stake is the land we live on, the planet Earth. Life on Earth is woven into a vast web, the food chain's intricacies on which all life depends. When a mangrove swamp is bulldozed for an apartment complex in Florida, for example, not only do

gnarled trees and egrets die, so do millions of tiny shrimp and fish that an entire industry with its thousands of employees depends upon. Wiping out the Earth's rainforests for their wood or simply because they're in the way actually threatens the oxygen in the very air we breathe so automatically. All life on our planet is greatly endangered because of accidental or wanton destruction of the habitats of animals and plants. Now we are all learning these natural facts. The irony is that Indigenous people the world over knew many of them, although we moderns have belittled them for their dependence on nature.

Indigenous people are not entirely free from blame for ecological mistakes. Herd management or animal husbandry by both Native and non-Native farmers may cause overgrazing, soil damage due to concentration of hoof impacts, water contamination, unbalanced predator-prey relationships, and the spread of disease among large, concentrated populations of similar stock. In some areas of the world, like that in Africa where the Sahel has turned to desert Sahara, herd use has caused rapid deterioration in the land's ability to support life. At the edges of deserts everywhere, sheep and goats overgrazed, and the land degenerated, unable to support life. Hungry Inuit Arctic people have killed huge numbers of whale and seal, which have not regenerated. What must occur is a kind of compromise, some way we humans of all cultures may save our Earth's lands. An urgent need for an eco-philosophy, and for its first step—joint explorations of the ways of both Native and Western science—is upon us.



Black Mesa, located on San Ildefonso Pueblo land in New Mexico, is considered the center of the Tewa-speaking Pueblos' homeland. Photograph © Marcia Keegan.

## CHAPTER SIX

# A Sense of Place

*"That place that Indian people talk about"*

Land, then, is not merely soil; it is the foundation of energy flowing through a circuit of soils, plants, and animals. . . . An ethic to supplement and guide economic relation to land presupposes the existence of some mental image of land as a biotic mechanism. We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in.

—Aldo Leopold, *A Sand County Almanac*

## Living in Relationship

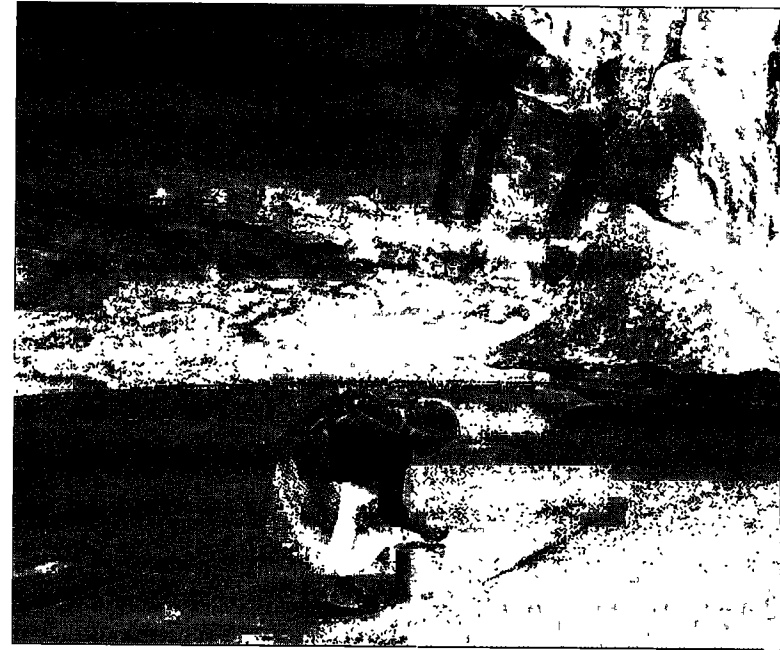
Key questions for traditional Native Americans included how individuals and the tribal community could ecologically respect the place in which they lived, and how a direct dialogue among the individual, the community, and the natural world could be established and maintained. Wherever Indigenous people lived, they found ways to address these questions of survival and sustainability in profoundly elegant ways. They thought of their environments “richly,” and in each environment, they thought of themselves as truly alive and related.

The meaning of the Lakota aphorism, “mitakuye oyasin” (we are all related), is shared by all Indigenous people. Its shared meaning stems from the fact that it is a guiding principle of the “spiritual ecology” held by every tribe in its perception of nature. Guided by this metaphysical principle, people understood that all entities of nature—plants, animals, stones, trees, mountains, rivers, lakes, and a host of other living entities—embodied relationships that must be honored. Through the seeking, making, sharing, and celebrating of these natural relationships, they came to perceive themselves as living in a sea of relationships. In each place they lived, they learned the subtle, but all important, language of relationship. It was through such a mind-set, tempered by intimate relationships with various environments over thousands of years, that Indigenous people accumulated ecological knowledge.

In contrast to the relatively one-dimensional Newtonian-Cartesian view of nature, Native people perceived multiple realities, of which the reality experienced by our five senses was only one of many possibilities. In such a perceived multiverse, knowledge could be received directly from living and non-living entities. Animals and plants have ritual ways of interacting with one another, and each has a personhood, a sense of purpose, and inherent meaning expressed in many ways. In short, Native cultures understood and reflected in profound and elegant ways that “we are all related.”

Over the past five hundred years, changes to the land and the environment of the Americas have been dramatic. At one time the American continent may well have been the most pristine and richest natural

environment on Earth. The first Europeans saw America as wilderness, an obstacle to be overcome through settlement and the use of living and non-living resources. The land was a material object, a commodity, something from which they could gain economically. For the most part, they viewed the people they encountered as another resource that they would either use or abuse in accord with their agenda for material gain (Hughes 1983:2-3).



Water pool, Acoma Pueblo, New Mexico. Photograph © Marcia Keegan.

For the Indigenous people the land and the place in which they lived were in a perfect state. The real test of living was to be able to establish a harmonious relationship with that perfect nature—to understand it, to see it as the source of one’s life and livelihood, and the source of one’s essential spiritual being. But in the minds of many Europeans, Natives were “the other”—either savage and heathen, or noble and good. The people indigenous to this land were never truly understood for who they were and are: a people who, in a variety of ways and with all their heart

and being, tried to establish a direct relationship with nature, which they understood as the essence of the Great Mystery that guides and breathes life into all things. The land was full of spirit, full of life energy. Each entity—a rock, a tree, a plant, a mountain, an animal, a bird, an insect—had its own expression of life and way of the Spirit. Indigenous peoples coded this understanding into a philosophical orientation that helped individuals live with their environment in a holistic way (Hughes 1983:2-3). Oren Lyons (1984:91-93) reflects this understanding in a contemporary voice in the following:

And each generation was to raise its chiefs and to look out for the welfare of the seventh generation to come. We were to understand the principles of living together. We were to protect the life that surrounds us and we were to give what we had to the elders and to the children. The men were to provide and the women were to care for the family and be the center, the heart of the home. . . . And so our nation was built on the spiritual family and we were given clans . . . the Turtle, the Eagle, the Beaver, the Wolf, the Bear, the Snipe, the Hawk, all of whom were symbols of freedom. Our brothers the Bears, the Wolves, and the Eagles are Indians, they are natives, as we are.

We went to Geneva, the six nations, the great Lakota nation, as representatives of indigenous people of the Western Hemisphere, and what was the message that we gave? There is a hue and a cry for human rights, they said, for all people; and the indigenous people said, what of the rights of the natural world? Where is the seat for the Buffalo or the Eagle? Who is representing them here in this forum? Who is speaking for the waters of the earth? Who is speaking for the trees and the forests? Who is speaking for the Fish, for the Whales, for the Beavers, for our children?

We are indigenous people to this land. We are like a conscience; we are small, but we are not a minority; we are the landholders, we are the land keepers; we are not a minority, for

our brothers are the entire natural world and we are by far the majority. It is no time to be afraid. There is no time for fear. It is only time to be strong, only a time to think of the future and to challenge the destruction of your grandchildren.

The concept of place is often taken for granted. In contemporary Western societies the notion of place is a given in that when most Western people speak about a place they assume that everyone has the same reference to that place. In the Western scientific perspective, maps of places are drawn to symbolically represent a place based on previously agreed upon criteria that are logical and measurable with regard to the discipline of cartography. But a map is always just a kind of symbol for a place, it is not the place it is meant to describe. Indeed, to know any kind of physical landscape you have to experience it directly; that is, to truly know any place you have to live in it and be a part of its life process. Maps also imply a history, and the political and cultural background of its makers (Pine 1999:2).

The creative act of naming a place has subtle yet complex dimensions that remain hidden because the underlying cultural assumptions upon which a name is based are presumed to be shared by others. There can, of course, be different kinds of maps. Ultimately, all perceptions of place are a matter of our personal and cultural subjectivity. This is as true for the scientifically standardized U.S. Geological Survey map as it is for the mythic/spiritual map of a Native culture. The scientific map, despite its claim of objectivity, has behind it a relatively subjective history and cultural worldview. Our vision of place is invariably tied to our worldview and our worldview in all its shades of subjectivity drives our various personal and cultural campaigns to impose our vision upon others, even to the extent of dispossessing others inhabiting the places we wish to make our own. Understanding and accepting the complexity of the vision and the living reality of the place is integral to the process and perception of Native science. In contrast, in Western arts, sciences, and humanities the perception of the Earth and its places as living presences has been largely absent. Even in the practice of environmental science,



“places” are encountered and described by their physical features and not as a reflection of a creative living force.



Window Rock, Arizona, site of the Navajo Nation government headquarters, an example of the mythic landscape of Navajoland. Photograph © Marcia Keegan.

In contrast, Native cultures describe their place as a living presence in the context of its mythic and spiritual meaning. The storied and living homeland of Native cultures provide a holistic foundational context for Native life and participation with the universe and illustrates the primacy of space and place in Native cosmology. An example of the way a Native culture perceives a specific place that reveals the Native perception of place is the way the Navajo (Diné) bound their homeland with sacred mountains (Pine 1999:7, 9-10).

The Navajo view their Fifth World as a pattern of physical landmarks that are imbued with mind and vital force. The basic model consists of four outer sacred mountains. These are called (ESWN): *Sisnaa jini* (Blanca Peak), *Tsoo dzil* (Mount Taylor), *Dook o oosliid* (San Francisco Peaks), and *Dibenitsaa* (Hesperus Peak). They are positioned cardinally around a Navajo world axis whose earthly form is considered to be Huerfano Mesa in northern New Mexico. Its Navajo name, *Dzilna'oodilii*, meaning

Mountain Around Which Moving Was Done (Encircled Mountain), refers to the early movement of the clans during the settlement of the Fifth World (Gold 1994).

These sacred mountains are the boundaries of the special place the Navajo consider their homeland. The stories, experiences, and rituals associated with each of these mountains and other physical places within this geophysical universe constitute the context for Navajo participation with plants, animals, earth, and sky. The character of this homeland has profoundly affected Navajos and their way of life, and the Navajo have significantly influenced and formed their landscape. The land nurtures humans and humans nurture the land, the foundation of a reciprocal compact of care and responsibility, which is continually reaffirmed through the various expressions of Native technology. Given this special relationship, the separation of culture and nature would be considered unnatural. Likewise, the separation of humankind from nature and the creation of discrete categories for viewing nature inherent in the disciplines of Western science would be viewed as equally unnatural and arbitrary (Pine 1999:3-4).

Native cultures have indeed amassed an enormous knowledge base related to the natural characteristics and processes of their lands through direct experience and participation. However, all Native cultures have readily used their landscape in ways that benefited them and ensured their survival. Native cultures have applied their technology to make roads, to cut timber, to fish, to hunt, to farm, and to engineer the landscape in order to survive. The difference between Native and non-Native use of the land and its resources is that Native cultures have traditionally aspired to live in accordance with an ideal of reciprocity with the landscape, guided by cultural values, ethics, and spiritual practice. Living a life of relationship through ethical participation with nature is the ideal behind the practice of Native science and its orientation to place.

#### THE ROLE OF LANGUAGE

Native languages are intimately tied to the landscape that has inspired their development. The word *ho'zho'*, for example, encompasses the

whole essence of the Navajo concept of balance and beauty. Ho'zho' represents the Navajo ideal of natural beauty, which, in turn, is intimately related to the Navajo orientation to their landscape. Implied in this ideal is the Navajo notion of proper relationship between humans, nature, and each other. Similar words evoking similar sentiments toward nature are to be found in every Native language (Pine 1999:5).

Native cultures talk, pray, and chant the landscape into their being. This is the animating power of language inherent in the spoken word that connects the breath of each person to the breath of the world. Native languages invest their homeland with their presence through the active verb-based process of "talking the land," that is, naming its places, singing its virtues, and telling its stories. Native languages are highly descriptive of natural places and pay special attention to the way the event or place they are describing is in a perpetual state of motion. The verb-based nature of Native languages is also connected to the Native cosmological assumption that we live in an interrelated living world in perpetual creative motion. Native languages echo the natural reality of a universe that is alive and creative. Gary Witherspoon (1977), a scholar of the Navajo language, makes the following observation:

Dominance of verbs in Navajo corresponds to the Navajo emphasis on a world in motion. . . . A Navajo premise that is significant and relevant to the powers of thought and speech is that all matter and all living beings have a dualistic nature: static and active. The assumption that underlies this dualistic aspect of all being and existence is that the world is in motion, that things are constantly undergoing processes of transformation, deformation, and restoration, and that the essence of life and being is movement.

The perception that the universe is in constant motion is also verifiable through Western science. Movement is associated with life and the creative processing of the universe. When something becomes static, whether it be human, animal, or the ecological processes of an environment, atrophy and death usually follow.

### THE HUMAN BODY AS METAPHOR FOR LANDSCAPE

In the perception of many Native cultures, their landscapes are seen as metaphoric extensions of their bodies. In many Native cosmologies, the sphere of the sky and earth are metaphorically viewed as coming together to form a cosmic couple, a male and a female quality, which causes things to be born. In other words, the body of the sky unites with the body of the earth to create the life we see in nature.

The Earth Mother uniting with the Sky Father is an archetypal mythic theme found in the creation myths of many cultures throughout the world. There is, however, a major difference in how this cosmic coupling is viewed by Indo-European cultures and Native cultures of America. For Native cultures the most influential role in the creation of life on Earth is naturally the procreative power of the Earth Mother. Life and divinity in the Native view are experienced through the feminine, life-giving principle of the Earth. Native perceptions of the land and its qualities are primarily Earth-centered rather than sky-centered as perceived in many Indo-European cultures. For the Navajo, the active feminine principle perceived in nature is named Changing Woman, and like many Native tribes, they view themselves as children of an Earth-based mother. The following example illustrates this fundamental Native view.

The Navajo Earth is experienced as a living female entity, while the atmosphere and heavens are experienced as a living male entity. His male body lies atop her female body, the enormous weight of his being supported by the four corner posts of the sacred mountains, and by several other "invisible" pillars that the Holy People put in place when they created the present world . . . (Savino 1997 in Pine 1999:25).

Changing Woman created the four original Diné' clans rubbed from her own body. . . . For this reason, all Navajos can be said to have been made from this Earth Mother, and to be directly or indirectly descended from the four original clans that

Changing Woman created with her body. White Shell Woman (another of her names) is also a feminine metaphor for the traditional Navajo vision of a dynamic, cyclical, self-renewing, and fundamentally ordered universe. . . (Pine 1999:31).

Ultimately, in the traditional Native perspective place is a part of a larger order of a living Earth. Native languages, stories, and rituals give meaning to Indigenous peoples' participation with their homelands. The Native view of the landscape is a metaphoric map of place that is humanistic, sacred, feminine, in motion, creative, nurturing, and the source of all their kinship. This is "that place that Indian people talk about."

### The Psychology of Place

Native people expressed a relationship to the natural world that could only be called "ensoulment." The ensoulment of nature is one of the most ancient foundations of human psychology. This projection of the human sense of soul with its archetypes has been called the "participation mystique," which for Native people represented the deepest level of psychological involvement with their land and which provided a kind of map of the soul. The psychology and spiritual qualities of Indigenous people's behavior reflected in symbolism were thoroughly "in-formed" by the depth and power of their participation mystique with the Earth as a living soul. It was from this orientation that Indian people developed "responsibilities" to the land and all living things, similar to those that they had to each other. In the Native mind, spirit and matter were not separate; they were one and the same.

Indigenous people projected the archetypes that they perceived in themselves into the entities, phenomena, and places that were a part of the natural environment they encountered. They understood the roots of human meaning as grounded in the same order that they perceived in nature. They experienced nature as a part of themselves and themselves as a part of nature. They were born of the earth of their place. A widespread belief was that children were bestowed on a mother and her community through direct participation of "earth spirits," as children

come from springs, lakes, mountains, or caves where they existed as spirits before birth. This is the ultimate definition of being "indigenous" and forms the basis for a fully internalized bonding with that place. It is also a perception that is found in one variation or another among the traditions of Indigenous people throughout the world, including the archaic rural folk traditions of Europe.

Indeed, this perception is reflected throughout myth, ritual, art, and spiritual traditions of Indigenous people everywhere because in it is a biological reality. All human development is predicated on our interaction with the soil, the air, the climate, the plants, and the animals of the places in which we live. The inner archetypes in a place formed the spiritually based ecological mind-set required to establish and maintain a correct and sustainable relationship with place. This orientation was, in turn, reinforced by a kind of physical "mimicry," a "geopsyche," or that interaction between the inner and outer realities that often takes place when a group of people live in a particular place for a long period of time. Our physical makeup and the nature of our psyche are formed to some extent by the distinct climate, soil, geography, and living things of a place. Over a few generations, physical and psychological traits begin to self-select, and the development of mountain people became distinct from that of desert people and from plains people. Although it is not as apparent now as it was in the past, Native Americans of the Northwest, Southwest, Plains, Great Lakes, and Southeast reflect physical and psychological characteristics that are directly the result of their generations of interaction with the geographies and ecologies of their respective regions.

But people make a place as much as a place makes them. Native people interacted with the places in which they lived for such a long time that their landscapes became reflections of their very souls. Phrases such as "Land of the Hopi," or "Land of the Sioux," or "Land of the Iroquois," have a literal dimension of meaning because there was a co-creative relationship between Native people and their lands. We know that all Native groups managed their territories in what today can only be termed ecologically viable ways. Through the practical knowledge that such

long-term experience brings, they interceded in the creation of habitat and the perpetuation of plant and animal life toward optimum levels of biodiversity and biological vitality.

Relationships between Native peoples and their environments became so deep that separation by forced relocation in the last century constituted, literally, the loss of part of an entire generation's soul. Indian people had been joined with their lands with such intensity that many of those who were forced to live on reservations suffered a form of "soul death." The major consequence was the loss of a sense of home and the expression of profound homesickness with all its accompanying psychological and physical maladies. They withered like mountain flowers pulled from their mother soil (Cajete 1994:85).

The connection of Indian people to their land was a symbol of their connection to the spirit of life itself. The loss of such a foundational symbol led to a tremendous loss of meaning and identity; only in the most recent generations has revitalization begun. Inner kinship with the Earth is an ancient and natural extension of the human psyche and its severance can lead to a deep split in the consciousness of the individual and the group, in addition to social and psychological problems that can ultimately be healed only through reestablishing meaningful ties. Reconnecting with nature and its inherent meaning is an essential healing and transformational process for Indian people.

### Applied Technologies on Land, River, and Sea

In the places they lived and with their awareness of the Earth as a living organism, Native people developed sophisticated technologies to make their lives easier and more efficient. In the Americas, people learned to use water, established transportation systems, used minerals they mined from the Earth, and created the art needed to express their intimate relationships with the Earth's products they used.

The use Native peoples of the Americas made of their land is seldom documented. These people did more than simply survive, they developed methods for agriculture, mining, water channeling, road building, and land management, many of which are now being studied with a view to

enhancing sustainability. Not only has their sophisticated land use and management been little known, it was little acknowledged by their Euro-American subjugators, who dismissed nature-centered people as primitive and made few or no attempts to investigate their accomplishments. While no one would suggest repeating the arduous methods of development required, what does need to be acknowledged is that these first Americans were extremely capable human beings, adept at living in and preserving the natural world of their homelands.

### MINING

Native Americans made use of a wide range of minerals for tools, building materials, and pigments. While some cultures made relatively greater use of horn or bone implements, particularly in the earliest centuries about which we have any knowledge, it is generally true that most Indigenous cultures were fully expert in lithic technology. This technology included both surface mining and quarrying skills and, in certain parts of the Americas, metal mining knowledge.

Stone quarrying for building materials was practiced chiefly in Mexico and in the urban regions of South America. Basalts appear to have been the most commonly quarried building stone, to judge from the remaining buildings and the materials salvaged from them by the Spanish to build colonial-era structures. These basalt building stones, sometimes of several tons each, were split by use of stone and wood wedges, drills, and hammers, and then shaped and dressed by hammering, pecking, and grinding with other stone tools. In the north, some quarrying of stones used for art and ceremonial purposes (for example, catlinite for pipe bowls, and soapstone for pipes, lamps, and small carvings) took place at the few locations where these relatively soft minerals could be reached by surface mining techniques.

Native peoples in Mexico and the mountainous regions of South America were the major groups to develop metal mining skills. They principally mined for copper and tin, used to make bronze for tools and ornaments. It is thought that they and the copper-using cultures of Alaska and the upper Midwest obtained most of their ores by working

stream deposits, only resorting to laborious cutting into surface veins of ore in hard rock if stream deposits were inadequate or unavailable. Most gold, where it was gathered by Natives at all, was obtained in similar ways.

After the Conquest, Native South Americans contributed their metallurgical knowledge by providing smelting technology that worked at high elevations where the imported Spanish technology did not. These Indigenous master metalworkers and miners also improved the European mercury amalgamation techniques so as to raise the efficiency of silver extraction from ore.

Native mining technicians and metalworkers further improved imported European technology by creating ore-crushing machines and automated coin-minting machines that were unprecedented in Europe. The interaction of Indian and European cultures resulted in a great development of mining technology, which was the requisite precursor of the later metallurgical developments of the modern industrial era.

Jack Weatherford (1988, 1991) and other authors have recorded the contribution of Native Americans to establishing uses for asphalt and other petroleum products. Their oil pits in Pennsylvania became the birthplace of the modern U.S. oil industry. There and elsewhere, surface seeps of petroleum were developed and exploited for medicinal purposes. In Pennsylvania alone, over two thousand oil pits were dug by various tribes to promote the collection of petroleum.

Native Americans developed petroleum jelly from these sources by combining olefin-bearing hydrocarbons with methane (natural gas) to make a salve for treating burns and open wounds. After obtaining metal tools in trade from Europeans, Indians used petroleum jelly as a superior lubricant, in contrast to the animal fats employed as a grease by the Europeans. The Chumash in California also developed the use of asphalt (the heaviest part of petroleum) as a waterproofing material for their plank-hulled boats.

## HYDRAULICS

Techniques for the collection, transport, and management of water as a resource for agricultural and urban use were well developed by pre-

Contact Native Americans in three separate regions of the Americas. In the American Southwest, the Hohokam culture centered on the Gila and San Juan Rivers near modern Phoenix built extensive irrigation systems that are thought to have inspired imitation by a number of neighboring cultures. In Mesoamerica, various groups developed agricultural and urban water systems that display a high degree of ingenuity and technical skill in adapting to local conditions and needs. The Peruvian peoples of pre-Inca and Inca times also mastered agricultural and urban water supply problems in the mountainous river valleys and highland centers of their cultures.

Archaeological evidence suggests that the development of technical skill in building and controlling water supply systems developed in these three regions around 300 B.C. Some scientists believe that coastal valley farmers in Peru may have begun developing irrigation systems as much as five hundred years earlier, although the evidence remaining is largely circumstantial.

Because of a lack of surviving records, we do not know for certain how the technical knowledge for the construction of canals, pipelines, aqueducts, dams, reservoirs, and check valves was maintained and passed along from generation to generation in these cultures. It is likely that the knowledge of controllable canal grades and the canal construction materials and techniques needed for these gravity-fed systems was the province of master technicians who passed the information on orally. It is thought that the Hohokam especially relied on skilled technicians who handed down their hydraulic knowledge.

It seems possible that the Mesoamerican engineers of the Nahuatl-speaking cultures of the Valley of Mexico, those of the Zapotecs of the Oaxaca region, and the Maya of the Yucatán-Guatemala areas may have recorded technical information about their water systems in their written languages, but so far we know only of a few descriptive images from wall paintings and lack more specialized texts on Native hydraulic engineering. Similarly, any records (if any were ever made) about the engineering of the canal systems in Peru failed to survive the destruction of the coded *quipu* string libraries of the Incas. Thus, nearly all of what we know of the

engineering of pre-Contact Native American water systems comes from the archaeological record.

Contemporary Indian hydraulic engineering still uses some of the techniques of the past for some small irrigation systems in Peru and in the American Southwest. It also uses the modern techniques adapted from Euro-American engineers, as can be seen in the fully modern, tribally built and operated hydroelectric dam on the Warm Springs reservation in Oregon or in the municipal water and liquid waste systems operated by many tribal communities on larger reservations in the United States. The fish hatchery systems that numerous tribes have established can also be thought of as part of contemporary Native hydraulic engineering (as well as part of contemporary tribal wildlife management) (Landon 1993:34-58).

### *Hohokam Irrigation and Water Systems*

The Hohokam peoples, thought to be the ancestors of the Pima and Tono O'odham (Papago) tribes, established themselves on the Gila River near modern Phoenix sometime around 300 B.C. Many archaeologists believe them to have been migrants from Mexico. Hohokam culture, divided between desert and river groups, went through several phases of development before dissolving sometime around 1400 A.D. Their cultural center was a rambling village of about one square kilometer, the remains of which are now called Snaketown, south of Phoenix. This center and more than twenty other significant villages have been identified in the Gila, Salt, Santa Cruz, and Verde river basins in Arizona.

The riverine Hohokam began to build systems of irrigation canals shortly after they established their village sites. These were usually unlined earthen canals cut by hand tools, the soil being removed by the basket load. By the time the culture reached its high point between about 1000 and 1400 A.D., the Hohokam farmers were able to settle considerable distances away from the rivers due to the extent and complexity of the canal systems. According to the text of a recent advertisement that appeared in the journal of the Native American Science and Engineering Society, one of the Hohokam systems was able to supply the irrigation

needs of over fourteen thousand acres of cropland. Some examples follow to give a sense of the hydraulic engineering accomplishments of the Hohokam peoples.

The main canal serving Snaketown was four to five feet in depth and about eight feet in width. The two canals providing water to the village and fields at what scientists call Pueblo Grande, also near Phoenix, range from ten to fourteen feet in depth and twenty to thirty-three feet in width. One of these canals was lined with clay to prevent water loss into a layer of gravel through which the canal was cut.

One village, called "Los Muertos" by Frank Cushing, the Smithsonian scientist who excavated it in the 1880s, was supplied by canal with water from the Salt River over six miles away. The fourteenth-century Hohokam trading center now called Casa Grande, midway between Phoenix and Tucson, was served by a canal sixteen miles in length.

The canal system within any given river drainage often served several Hohokam villages, leading scholars to suppose that close cooperation and planning took place among village leaders to coordinate use and movement of the water through the system. The Hohokam canals were valved by the use of closely-woven mats that were moved in and out of place on gateway frames at the junctions of the feeder canals and the irrigation ditches (Landon 1993:34-58).

### *Pre-Incan and Incan Irrigation and Water Systems*

Sometime in the period between 800 B.C. and 300 B.C., the Chavin culture on the coast of Peru began to expand inland, moving from earlier river mouth settlements into the mountainous river valleys. Chavin farmers began to terrace the valley slopes to raise maize, greatly expanding the agricultural base of their economy. The eroded remains of these terraces have not retained clear evidence of irrigation, but scholars suspect that the terrace fields required irrigation to be productive.

One large terraced Chavin site, that of the Casma Valley on Peru's central coast, was thought by Alfred Kidder, an early American archaeologist known for his excavation of an ancient North American Pueblo, to imply the early presence of irrigation systems since, in Kidder's analysis,

the population known to have lived at the site "could hardly have been supported without irrigation on a fairly large scale."

Later, between 300 B.C. and 200 A.D., other valleys such as the Vim and Chicama on the north coast show some surviving signs of canal irrigation of the terraces. By 200 A.D., clear archaeological evidence shows that the Mochica and Nazca cultures of the Peruvian coast were making extensive use of canal irrigation and fertilizers in the terrace farms, and Kidder believed that the river valleys were used to their full agricultural potential. The limits of irrigation supplies of water became a chief constraint on the further expansion of these cultures. Artistic records, Kidder reported, clearly show that state militarism developed in these cultures at this time. A program of conquest of others' agricultural land and water supplies became the only way to support further growth of the populations of these vigorous cultures.

Around the time of the last great pre-Conquest Peruvian cultures, those of the Chimu and the Inca, the final technological innovations of the valley and highland irrigation and civic water systems were developed. Irrigation systems between river valleys were linked by long systems of canals and, where necessary, aqueducts. This linkage was made possible by the growth of "kingdoms" capable of uniting and controlling entire regions rather than just specific locales.

The Inca in particular elevated hydraulic engineering to great heights just prior to the arrival of the Spanish in 1532 A.D. Under Inca Roca, the first lord of Upper Cuzco, they built extensive systems of flood control dams and used heavy masonry levees to channel the rivers supplying water to the agricultural terraces and to the fields below their capital of Cuzco.

Other streams and springs that supplied drinking water to the capital were similarly controlled. The Inca deepened natural pools and cut artificial ones to heighten the aesthetic qualities of the streams, along which the royalty and nobility built villas. Engineers led these sources into huge masonry reservoirs from which underground pipes or open masonry trenches supplied both private and public fountains and ritual bathing pools, each identified with its own *huaca*, or "distinctive spirit."

In the Intihuasi, or fortress of Sacsahuaman, which overlooked Cuzco, Incan engineers reached the high point of their sophistication. They created a system of underground, piped, pressurized water for use in the apartments of the royalty, apartments that included extensive bath facilities. While the available records do not indicate that any valve mechanisms for this pressurized water system have survived, it is likely that such valves existed, for the Inca were masters of bronze casting and could readily have produced excellent valves with bronze, a material which is still widely used by plumbers for this purpose (Landon 1993:34-58).

### *Mesoamerican Irrigation and Water Systems*

As in the American Southwest and Peru, archaeological evidence places the inception of hydraulic engineering technology in Mexico and Central America at around 300 B.C. The Zapotec-speaking peoples of the Monte Albán culture in the Valley of Oaxaca in Mexico are known to have created artificial terraces on a hillside site. The irrigation canals the Zapotecs cut to supply these farming terraces with water from nearby springs have been preserved by hard calcium deposits laid down by the mineral-rich waters of the springs.

The major urban center of Teotihuacán, which began to develop at about the start of the Christian era, reaching substantial size by about 300 A.D., presents an interesting puzzle for archaeologists. It had a large population and is located in a relatively dry highland valley offshoot of the Valley of Mexico. These factors suggest that irrigation was needed if agriculture were to yield sufficient produce to support the population. Yet there has been no discovery of any physical evidence of coexisting Indian irrigation systems in the valley around the ancient city.

William Sanders has shown that the Teotihuacán farmers practiced terracing on hillsides to control erosion and has long argued that irrigation must have existed on the terraces. Irrigated gardens are shown in wall paintings at the Tepantitla palace in the city, so it is evident that the Teotihuacanos knew of hydraulic technology.

Michael Coe, professor of archaeology at Yale University, has suggested that the city may have relied on other means for feeding its people. He notes that there is evidence that the Teotihuacanos practiced *chinampa* agriculture within the city itself. He also points out that the city dominated an extensive trade network and may not have needed to rely much on local produce.

In the core area of the Valley of Mexico, the numerous city-states that rose to prominence after the fall of Teotihuacán in the eighth century continued to practice chinampa agriculture in lakes Texcoco, Xaltocan, Zumpango, and especially the Chalco.

The Alcohua also created a system of canals and aqueducts from the mountains into their cities and to the terraced agricultural fields on the hills they farmed. From the Alcohuan capital of Texcoco, the fifteenth-century poet-king Nezahualcoyotl engineered and directed the construction of this system and assisted his allies, the Aztecs, in solving one of their water supply problems as well. He is credited with the creation of the ten-mile long dike in Lake Texcoco that held brackish flood waters away from the chinampa plots of the Aztec capital of Tenochtitlán.

The Aztecs themselves were accomplished hydraulic engineers, and the eighth *hueg-tlatoani*, or Great Speaker, of the Aztecs, Ahuitzotl, constructed an aqueduct over eight miles in length to supply his capital city with drinking water in the latter part of the fifteenth century. A portion of this aqueduct is currently being uncovered in archaeological excavations in Mexico City, and has been shown to be a carefully crafted, stone-lined structure. The twin island-cities of the Aztec capital were served by several such aqueducts, carried across the waters of Lake Texcoco on earthen dikes, as were the causeway roads that connected the cities to the mainland on the north, south, and west.

In the southern part of Mesoamerica, the Mayan people faced a variety of engineering challenges in obtaining and transporting water in the widely differing circumstances of their cities and farming settlements. In the highland regions of Guatemala and in the Mexican state of

Chiapas, terraced farming was practiced and irrigation may also have existed; the remaining physical evidence is inconclusive.

In the lowlands of the Yucatán peninsula and neighboring coastal regions where the Maya settled, much of the land is underlain with an extensive, porous limestone layer that contains a huge underground aquifer. The rains quickly percolate down to this aquifer. As a result, surface water is scarce despite heavy tropical precipitation. Few rivers or streams exist in this region. However, numerous natural sinkholes, or *cenotes*, allow access to the underground water supplies, and the Maya sometimes enlarged these to provide easier access when required.

Elsewhere, they cut cisterns called *chultuns* into the rock under buildings and ceremonial plazas. The Mayan engineers devised drainage systems from the buildings and courtyards to divert rain runoff into the chultuns to provide year-round water supplies in areas where cenotes did not exist, such as the Puuc region of the northwestern Yucatán. The chultuns were lined with plaster to prevent seepage, and average about 7,500 gallons in capacity. This is enough water to supply about twenty-five people year-round. Sylvanus Morley, a noted researcher of Mayan civilization, reported that the capacity available to some of the Yucatán towns from these artificial water systems could support between two thousand and six thousand people.

Mayan hydraulic engineers and architects also created elaborate systems for using water in some public buildings, temples, and palaces. Among their creations were steam baths with troughs for delivering water to heated rocks in order to generate steam for these saunas. At Palenque, a major city in what is now the Mexican state of Chiapas, Mayan engineers developed toilets with running water and supplied the city's water system from an aqueduct (Landon 1993:34-58).

## TRANSPORTATION SYSTEMS

On the American continent, large animals suitable for use as draft animals had become extinct by the close of the last ice age. As a consequence, wheeled transport vehicles were not developed, although the



principle of the wheel was known to at least two Native American cultures. The artists of Remojadas (northwest of Tres Zapotes in Veracruz) and Panuco (also on the Gulf Coast) in Mexico put the wheel to use in childrens' toys during the Classic Era, ca. 600-900 A.D. These toys are the only known application of the principle of the wheel by Native Americans. Other forms of transport and transportation systems were well developed by Native Americans, however.

### *Trails and Roads in North America*

The American continents were laced with a well-developed system of trails and even hard-surfaced roads in some areas. One such trail ran along the eastern edge of the Rocky Mountains from far north in the subarctic regions of present-day Alberta to Mexico in the south, well over three thousand miles. The road system built by the Anasazi people among and outward from their Chaco Canyon complex of villages in the Four Corners area of the United States covers an area nearly equal to that of Ireland, according to Jack Weatherford. Accompanying this road system were mesa-top smoke and reflected-light signaling stations that could communicate a message over dozens of miles in very little time.

Among the northern Native American trails that were later used by Euro-American immigrants as roads and highways (even into our own times) are those now called the Oregon Trail, the Central and Southern Overland Trails, the Cumberland Gap-Wilderness Road, the Natchez Trace, and the Santa Fe Trail.

Describing the extent of the network of trading and traveling routes used by northern Native Americans, one historian has said that because so many modern roads were originally important Native paths of transportation, one can get a sense of the intricate network of historical Indian trails crisscrossing the continent by looking at current road maps. And one can assume with near certainty, when taking a walk in any part of North America, that Native peoples previously walked the same path (Landon 1993:34-58). Two of the most technically remarkable road systems developed by Native Americans are examined in some detail below.

### *Inca Roads and Bridges*

From the center of Cuzco, the capital of the Inca Tawantinsuyu (the "Four Corners" or what Europeans referred to as the "Inca Empire"), four remarkable roads radiated from the symbolic square called the Haucagpata, now known as the Plaza de Armas. These main roads of the Tawantinsuyu, hard paved with fitted stone surfaces, ran northwest to Ecuador (the Camino Real or Royal Road), southeast to Bolivia (the Collasuyo Road), southwest to the coast and Chile (the Contisuyo Road), and the north-northwestern road over the Andes toward the trading routes into the Amazon Basin (the Antisuyo Road).

These roads thus formed the semi-cardinal axes of a great medicine wheel. The Inca showed by this arrangement that they thought of Cuzco as an especially sacred place. In addition to being a capital city, Cuzco was the spiritual center of their world and the home of some of the greatest of their *huacas*, or sacred beings.

Parallel to the main northwest-southeast axis of the Inca highland roads, a coastal road was also built, and the two were interconnected by lateral roads through the major valleys. The two main parallel roads each ran for approximately 2,250 miles. The total known length of the Incan road system is about fourteen thousand miles.

In the mountainous regions, Inca engineers cut road tunnels through granite prominences to avoid dangerously steep slopes. They built suspension bridges of ropes, some with up to twenty-two thousand feet of handmade rope, using the same construction techniques used in modern steel suspension bridges. They built solid bridges of stone piers and wooden decking to cross gorges or pulley-operated gondola bridges. Inca engineers raised their roads over marshes or flood-prone areas on causeways that were built with culverts to pass water under the roads without danger of undermining.

All along the network of roads there were garrisons, lookout posts, stations for the system of *chasqui* runners (official carriers of messages and royal delicacies), toll booths at the bridges, and huaca shrines at all spiritually important points. As a system, the construction, maintenance, and administration of the Inca roads must be considered one of

the great feats of human engineering in the pre-industrial era, especially considering the incredibly demanding terrain of the Andean highlands (Landon 1993:34-58).

### *Mayan Roads*

While not as extensive or spectacular a system as the Inca roads, those of the Maya in the Yucatán are of considerable technical interest in a historical sense. This is because the Maya mastered and extensively used the relatively advanced technique of concrete surfacing in building many of the major arterials connecting important cities and ceremonial centers in the Yucatán. Mayan engineers and architects also eventually learned how to use concrete prepared from crushed limestone mixed with gravel and sand fill as a building construction material.

Notable examples of these concrete roads are found in a network centered on the early Yucatán center of Cobá, established around 623 A.D. The Mayan road builders created their roadways from the center to outlying sites and villages by raising rubble-filled causeways from two to eight feet above the surrounding ground, covering the sides with dressed stone blocks and the tops with their limestone cement. Widths at the road surface averaged about fifteen feet and ranged from twelve to thirty-two feet. Evidence shows that they were planned and surveyed, running straight for distances from less than one to as much as 62.3 miles and deviating where necessary to connect to the outlying locations. On one of these roads, archaeologists found a five-ton, cylindrical stone road roller, used for packing the roadbed prior to paving, much as is done in building roads today (Landon 1993:34-58).

### *Land Transport Technology*

In the northern parts of North America, where climatic conditions keep snow on the trails for long periods each year, Native Americans invented a number of unique aids to winter travel. Snowshoes are the best known and most distinctive of these Native inventions, but several forms of toboggans, sleds, and travois frames also originated among the Natives of the north. These devices played important roles in Inuit and Sub-Arctic

Indian trade and travel and also served in the international era of polar exploration early in the twentieth century.

Two other Native American contributions to land transportation should be mentioned here. Both have had lasting influence on the design of modern footwear. The moccasin used by Native Americans in much of North America set a pattern for comfortably shaped, lightweight, flexible, and breathable uppers that has come to dominate the international market for shoes. The South American rubber-soled shoe similarly inspired a radical transformation of the materials and techniques of shoe sole making. The combination of these ideas and their elaboration by modern shoemakers has resulted in one of the most popular forms of footwear in the world today, the sneaker, and its more expensive brother, the athletic shoe. Even more directly related is the modern boating shoe, which often explicitly takes the form of a rubber-soled moccasin (Landon 1993:34-58).

### *Water Navigation and Vessels*

Coastal, riverine, and lake-dwelling tribes on both American continents created a variety of types of water craft. The ocean-going vessels were principally large dugout canoes in many styles, but others included such ingenious vessels as the plank-hulled boats of the Chumash in California as well as the skin-covered kayaks and *umiaks* of the Inuit and the similar *bidarki* of their relatives, the Aleuts.

Inland waters were home to smaller, shallow-draft dugouts and several other kinds of boats as well. Bark-covered canoes were popular in the Northeast for their easy portability between lakes and rivers. Hide-covered, round-bottomed "bull boats" were favored on the Missouri River. Most of these craft were driven by single-bladed paddles. In the lakes and marshes of places as distant from one another as California and highland Peru, a number of tribes built canoe-shaped craft of dried reeds lashed together and usually propelled by poling.

The northeastern woodlands birchbark canoe and the Inuit kayak, recreated in modern materials, have become immensely popular as models for contemporary recreational and sporting vessels around the

world. Naval architects who create modern sailing yachts also frequently employ the forms of canoe bodies and especially the rounded "canoe stern" in their contemporary designs, a tribute to the efficiency and sea-kindly manners of these Native American designs.

We have learned from studies of trade artifacts that there were extensive networks of coastal and trans-Caribbean trade carried out by the Arawaks, Caribs, and the Putun Maya in large dugout canoes with as many as twenty-five paddlers. Sea lanes extended throughout the Greater and Lesser Antilles islands of the Caribbean and touched the northern coasts of South America and the southeastern United States.

The Putun Maya, in particular, were very active sea traders in the ninth and tenth centuries along the coasts of the Yucatán and what are now the Mexican states of Tabasco, Campeche, and Veracruz. From their center on Cozumel Island, the Putun Maya mixed militarism, mass production, marketing techniques, and their skill with boats to become immensely influential in the power vacuum that resulted following the fall of the major Maya and Toltec centers after 900 to 1156 A.D. They are known to have established themselves in the Valley of Mexico and in the highland Maya regions. The Putun Maya are thought to have carried Toltec cultural elements (and perhaps some of the Toltec survivors, possibly including the exiled leader Ouetzabtial Topiitzin himself) into the Mayan homeland.

On the western coast of South America, and probably extending up to the shores of Mesoamerica, Ecuadoran traders carried on a similar function between the economies and cultures of the region. Some cultural traits thought to be of Olmec origin appear on the northern coast of Peru as early as 1500 to 700 B.C., although it is not certain that they arrived by boat-borne coastal trade.

Between 500 B.C. and 500 A.D., a culture known as the Bahia appeared on the Ecuadoran coast. These people possessed considerable mastery of water craft and offshore travel, to judge from cultural remains found on islands twenty-five miles off the coast and along the coast as far as southern Peru. There is also evidence from pottery and masks that the Bahia culture had established extensive maritime contacts with Mexico, apparently by direct sailing in the open ocean

and not through coastal voyaging. It is thought that later water-borne contacts from Ecuador introduced metallurgy skills into Mesoamerica through the Zapotec homeland of Oaxaca, probably around 800 to 900 A.D. We know little about the craft used by the Ecuadoran navigators, although the Mochica culture to the south is known to have used reed boats by around 200 A.D.

On the southern California coast, the Chumash built a type of boat that was distinctive by Native American standards. Formed of planks that were drilled to accept lashings of sinew or plant fibers, the boats were waterproofed by a coating of naturally occurring asphalt. These vessels were capable of voyages between the mainland and the Chumash settlements on three of the Santa Barbara Channel Islands lying twenty-five miles and more off the coast.

Further north, several styles of dugout canoes of great size were carved by craftsmen on the coasts of northern California, Oregon, Washington, British Columbia, and Alaska. It is recorded that some of these craft reached sixty feet in length. Their craftsmanship was of a remarkably high standard.

Variations in the use, style, and size favored by different tribes make most of these Northwest canoes distinctive. Some are small, relatively flat, "shovel-nosed" river canoes, others are high-prowed, large, whaling canoes for use on the open seas. Still others, with substantial beam and freeboard, were freighters; one example is known to have a displacement capacity of five tons.

The Aleuts of Alaska and their relatives, the Inuit of the circumpolar regions of Canada, Greenland, Alaska, and Siberia, built extremely seaworthy vessels from waterproofed hides of marine mammals stitched tightly over bent and lashed driftwood frames. The decked and sealed kayak design was generally used by a single hunter, who would hunt seals and sea otters from the small vessel. The design enabled the craft to withstand an inadvertent or deliberate capsizing (the so-called "Eskimo roll") and right itself with the aid of the paddler's double-ended paddle. The larger, open *umiak* design was used to move a family from place to place, to hunt whales, or to engage in long-distance freight trading. Inuit from

Alaska regularly paddled umiaks across the Bering Sea to attend the great trade fairs of their Siberian relatives.

In the northeastern woodlands of what would become the United States and Canada, Native Americans formed extremely lightweight canoes out of birchbark. This thin, water-resistant material could be peeled from the trees in wide strips. These panels of bark were sewn to lashed wooden frames in a variety of shapes, including the oft-depicted high-prowed, double-ender form. Overlapping ends of panels and stitch holes for the lashings were often sealed with a glue of tree resins. The Beothuk people of Newfoundland and the neighboring coasts near the Gulf of St. Lawrence used birchbark canoes of a more seaworthy design to move across their more exposed Atlantic waters.

While somewhat prone to puncture damage, these canoes served well on the numerous portages between the rivers and lakes of the region; these made up a great waterway network that supported an equally extensive trade network. The canoes could be readily repaired from the widely available birch trees, so the light weight of this material more than offset its fragility. The trade networks supported by these canoes, as well as the Indians' knowledge of the routes, were later of inestimable value to the early European fur traders and explorers of the Northeast. In particular, the French quickly adopted the Indian techniques of travel, although not without trepidation, as the historian James Axtell reports. Finally, Indians on the rivers of the Western Plains made occasional use of skin-covered bull boats, of a circular design similar to the Welsh and Irish coracles, as a means to cross rivers too deep and broad to swim (Landon 1993:34-58).

### Sacred Space

Creative use of the environment guaranteed its continuity, and Indigenous people understood the importance of allowing their land its rich life because they believed their land understood the value of using humans. If humans could use the land, the land would also use them to enrich it and to keep it alive. They and the place they lived were equal partners in life.

Certain sites in their landscape are sacred to Native cultures because of particular life-giving natural qualities they possess. As a source of life and tribal meaning, sacred sites reflected in myth often represent the metaphoric and ecological characteristics of the places Natives describe. In myths of the landscape humans and places interact to create new life and harmonious relationship. Along with song, dance, and prayer, myth helps set the tone for the human role of caring for and perpetuating the life of place. Experience with the land integrated with myth, ritual, and practiced belief over generations gave rise to a true Native connection to place, its animals, plants, and geography.

There is great diversity of cultural "dress" to be found in the expression of the sense of place. Yet, each expression flows from common principles and sentiments. The reverence with which Native cultures hold their landscape is particularly reflected in sacred sites. Each sacred site in a Native homeland is a place for "remembering to remember" to care for life-sustaining places.

In the same fashion as myth, land becomes an extension of the Native mind, for it is the place that holds memory. Hence, it becomes one of the major roles of totemic clans to define the kinds of expressions of reverence to be given to each sacred site. Sacred sites contain the compact of kinship to certain plants, animals, or natural phenomena with which a clan group identifies. It is the landscape that contains the memories, the bones of the ancestors, the earth, air, fire, water, and spirit from which a Native culture has come and to which it continually returns. It is the land that ultimately defines a Native people.

Native sacred spaces include places of healing and purification, such as springs and waterfalls; places where special plants or animals may be found; quarries where certain stones or minerals such as pipestone, crystals or turquoise may be found; places for astronomical observation; places where shrines are erected; mythic and legendary places; places of fertility; places where petroglyphs are etched; and places for dreaming and visioning. Places may also be constructed for special use. These constructed forms of sacred space might include structures such as medicine wheels, an earth lodge, a hogan, a longhouse, or even portable sacred space such as the

Plains sweat lodge, the tipi, or the Sun Dance grounds. The structure, story, symbol, and meaning of traditional dwellings also embody the view of and compassion for the natural world. Indeed, it may be said that a traditional Native structure is a sacred package of memory, feeling, and relationship to the land. This package is woven through guiding stories that relate the events of the creation of the earth, plants, animals, and the first people. In the special time and space of the creation, the landscape and all living things are in a perpetual process of transformation.

### THE MYTHIC BODY OF THE LANDSCAPE

Studying Native science apart from the culture that gave rise to it is impossible, because Native science is about context and relationship. This feature constitutes yet another major difference between Indigenous science and the conventional philosophy of Western science. In the latter, one can theorize while largely ignoring factors that might relate to a social or a cultural context other than the subculture of science itself.

Metaphoric expression is very common in Indigenous creation stories, particularly in those of the North American Indigenous cultures. What is included is really an ecological explanation of how things have come to be. The stories utilize characters, particularly animals and supernatural beings, and interactions between forces of nature, animals, plants, and human beings.

Among the Huichol, the wolf people acquired knowledge of the creative process and the responsibility for sharing the knowledge learned at the time of creation. Acquiring knowledge about relationships to symbolic animals and plants, of how to live a good and proper life, how key relationships are established and maintained, and how knowledge comes to a people are common themes of creation stories.

For the Huichol, a great flood is said to have happened many eons ago after which things were recreated in a new form in a new way. The Huichol great flood story is similar to the Pueblo emergence story. Humans journey through various stages or worlds, and in each world they learn something new and important to carry on to the next world that evolves.

The Huichol myth relates how after the flood the first living things, particularly plants and animals, were created by the Earth Mother. Any Indigenous creation story is a collective conjecture of ideas and perspectives of how things may have been formed. In creation stories, an Earth Mother, a feminine energy, is responsible for creating all living things.

Fire, as well as earth, wind, and water are archetypal elements of human interaction with the natural world. Fire holds a central place in Huichol tradition because Grandfather Fire represents the sun (source of life-giving heat and light) who cleanses and distributes knowledge and enlightenment. However, a careful relationship with fire is necessary because fire can also burn and destroy. For artists and others, the creative fire must be acknowledged in personal and even ritual ways, because there are two sides to creativity.

Wherever volcanic activity has occurred, fire is represented in its Indigenous mythology. In Hawaii, for example, Pele is the goddess of fire and of creation as well as of destruction. People living near oceans emphasize water. People living in mountainous terrain look to the mountains. Desert people understand the desert and its flora and fauna.

Indigenous science cannot be understood through a focus on the usual—anthropology and archaeology—which are really just the material expressions of technology. Without its context, the ideas of the people or the environments in which those ideas have arisen, the science of a society remains mysterious. Here again is the notion that Native people were the first ecologists, as the mythologies, understandings, and technical knowledge were always directly tied to specific ecologies, or specific regions, plants, and animals. The knowledge base itself becomes one of maintaining a thoughtful, proper relationship to those natural forces.

The Mexica (Aztec) built a great mythological complex around the sacred twins Quetzalcoatl and Tezcatlipoca. Ancient Chinese philosophy is also grounded on a duality. Both are based on an understanding of the forces that move, create, or destroy reality, as are the two brothers, good and evil in the Judeo/Christian tradition, and the mythic twins in many other mythological traditions. The lesson behind the ubiquity of the dual symbols is that there is a dark dimension, an underside, to everything in the world.

Every time something is created, something else is "dis-created," and other kinds of relationships then move in other directions. Within Western science, the creative process has moved consistently in the direction of rationality and the reductionist breaking down of things into elemental parts. Within the Indigenous paradigm, elemental parts have different meanings and different relationships depending on the context.

Creation always engenders synthesis, and that synthesis is at a new level and becomes an entity unto itself once it is fully formed. A new worldview may emerge if traditions join, as when the East informs the West and vice versa. We are in the early phases of a synthesis between Indigenous science and certain aspects of Western science. Results of such convergence will likely be seen in the fields of medicine and physics of the twenty-first century.

The new synthesis is coming from very deep within the collective consciousness of human beings. Metaphorically, this is like the process that created our world and landmasses, a result of continual activity deep within the Earth. Such activity eventually reaches the point where it erupts, and new terrain, waterways, plants, and animals result.

The counterpart to this creative fire deep within the Earth in mythic tradition is the sun. High above the Earth, the sun is often viewed as the inseminator. In Indigenous traditions, the sun gives life, warmth, and light. This myth also details ecological relationships, and how people became human and came to understand and maintain these interactions through generations. Relationships are established via very direct connections with sources of life, a process known in the Huichol tradition as "People Learn the Ways of Nature." Proper relationships are grounded on a variety of responsibilities. Like ripples in a pond, relationships affect subrelationships that evolve and may be categorized as social ecology; that is how Indigenous communities traditionally have organized themselves. Indigenous communities reflect organic models of the Earth and relationships established over time with the places in which they live. Indigenous organization or social structure mirrors basic natural principles that the people have come to know and understand after millennia (in some cases) of being "of a place."

Every group, including the Huichol, focuses on particular plants and animals that have acted as communicative bridges between the worlds of humans, plants, and animals, and the supernatural. Huichol tradition has been greatly influenced by the use of one particular plant, peyote. Peyote has played a central role in creation myths and also as a messenger, a life-giving form, or representation of the life-giving connection that people have to the Earth Mother. For the Huichol, peyote is a sacramental plant, a plant used for medicine, health, abundance, and for increasing endurance. However, what is most important is that it allows the people to connect to the spirit of the universe, a greater consciousness. In the ritual taking of peyote, as the Huichol say, "to find their life," a bond forms between the Huichol and their mythical and spiritual selves, an understanding and illumination of the key relationships that have been part of their traditions and ecological psychology.

The effects of a psychoactive drug are dependent on the state of mind, preparations made by the individual, and the individual's cultural context. When in the 1960s, Westerners "discovered" the Huichol and their use of peyote, and began journeying to Mexico, the objective of most of the "pilgrims" was to get high on peyote, without any cultural or physical kinds of preparation. Misunderstanding was rampant. This ritual knowledge has been misused in the Western context.

*Mara'akames* (shamans) in the Huichol tradition can be either male or female. Shamans become conduits or intermediaries between this reality or world and the spirit world (that of the cosmos) or reality. These individuals are keepers of knowledge and how learning is passed from one generation to the next. The role of shamans may not be terribly different from the roles that scientists or medical doctors play, although it is more comprehensive and entails much more responsibility.

Medicine is one of the first fields of Western learning in which the recognition of important ancient wisdom has occurred. Many medical practitioners today realize that relationships with patients, and patients' relationships with people and their world are extremely important in understanding the disease process, and thus, how people can return to wellness. At first, conflict and skepticism prevailed, particularly among

physicians trained in the context of advanced machine technologies. This conflict continues. One of the major issues among Indigenous peoples is whether and under what conditions they share their traditional knowledge. Whatever form discussion may take—political, social, economic, cultural—Indigenous people are always aware of past and present instances of sharing with Western peoples when such relationships benefited the latter far more than the Indigenous people.

Witness the huge growth of medical alternatives or health maintenance alternatives, herbal treatment, and nutrition, many of Native American origin. Western doctors now sometimes take courses in alternative medicine traditions and nutrition, evidence that attitudes are beginning to change in some quite dramatic ways. A synthesis will occur first at the alternative or so-called margins of the system. This is how creative movements evolve.

### ORIENTING TO PLACE AND SPACE

The four (or more) cardinal directions generally serve as allegories for sacred orientations to places in Indigenous traditions. Each has associated plants, animals, and natural phenomena. And each of the plants and animals represents a perspective, a way of looking at something in the center that humans are trying to know.

The idea of moving around to look from a different perspective, from the north, the south, the east, and the west, and sometimes from above, below, or from within, is contained in the creative process. Everything is like a hologram; you have to look from different vantage points to understand it. In the Indigenous causational paradigm, movement is relational, or back and forth in a field of relationships, in contrast to Western science's linearity (A to B to C and so on). Indigenous logic moves between relationships, revisiting, moving to where it is necessary to learn or to bring understandings together. Eventually this process, a synthesis, leads to a higher reflective level of thinking.

This might be called the sacred dimension of Indigenous science. Western science has struggled mightily to remove the role of spirit from understanding of the world. Indigenous science works from the other

side, continually infusing relationships with spirit through its discovery and rediscovery. Indigenous systems are organic, ecologically inspired systems of established relationships vital to the sustainability of people in a place. Consequently, when an Indigenous worldview is forcibly changed, the tightly woven fabric of relationship unravels, and people lose their understanding of themselves with their sense of place and are subsequently destroyed.

### Meanings and Possibilities

In the face of the rapid transformation of the Earth by science and technology and the ecological crisis that has begun to unfold, leading thinkers are exploring alternative cosmologies, paradigms, and philosophies in search of models that may sustain nature rather than destroy it. Many of these thinkers have found that Native cosmologies offer some of the most profound insights for the kind of sustainable relationship to place and spiritually integrated perception of nature needed to address what has now become a global crisis of ecological relationship.

Native American peoples' identification with their place includes elegant alternative paradigms for practicing the "art" of relationship to the natural world. Native Americans have consistently attempted to maintain a harmonious relationship with their lands in the face of tremendous pressures to assimilate. They have expressed in multiple ways that their land and the maintenance of its ecological integrity are key to their physical and cultural survival. The importance Native Americans traditionally place on "connecting" with their place is not a romantic notion that is out of step with the times. Instead, it is the quintessential ecological mandate of our time.

Much of what Native people have to offer has been ignored or trivialized. Western culture, through its own unique play of history, disconnected itself from the natural world in order to conquer it. In doing so, Western culture also disconnected itself from the wellspring of the unconscious and ancient primal orientations to spiritual ecology and a deeply internalized sense of place. The symbolic unity of the inner and outer dimensions of the human psyche had to be denied in order for the

rationalistic Newtonian-Cartesian paradigm of science to take hold. Through such a denial, the natural world was objectified so that it might be controlled and subsequently exploited for economic gain and for the greater glory of the Western ego writ large. During the Age of Enlightenment, Western culture broke with the ancient human "participation mystique" as the basis for its relationship with nature and substituted a relationship based purely on objective scientific/rationalist thought, which viewed the universe from a purely materialistic standpoint. Nature became a mass of "dead" matter ripe for manipulation and material gain. Animals became "dumb" and Indigenous peoples became "savage primitives." All had to be controlled and developed for their own, and Western society's, good.

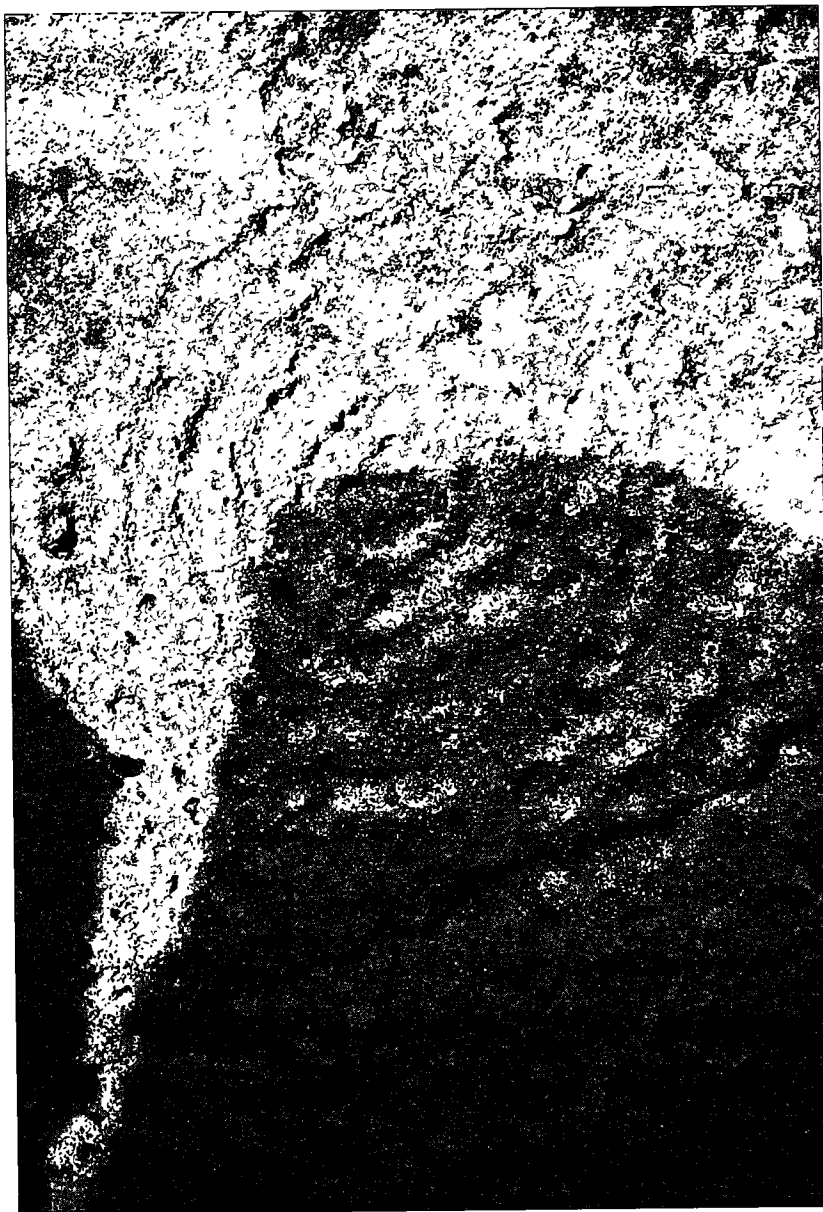
Modern governments, businesses, mass media, institutions, and organizations are still driven in greatest measure by this mechanistic paradigm with its emphasis on profit, economic development, standardization, command, and control. Many of these entities continue to operate from a perspective in which other living things, natural resources, land, and even Indigenous people matter only in proportion to their material worth and their political clout. Indigenous people have become as endangered as Indigenous places. Nonetheless, harmonizing with their place remains a matter of spiritual, psychological, and cultural survival. This is why Native people struggle so tenaciously to hold onto or regain their ancestral lands.

Harmonizing involves the integration of mind, body, and spirit through a dynamic and complex set of activities. For Native people, living in harmonious and sustainable relationship with the land was a sacred responsibility, tempered with the realization that neglect of this responsibility would bring dire results and retribution from the Earth. The perpetuation of this sacred and survival-oriented responsibility from one generation to the next was accomplished through myth, ritual, art, traditional education, and an honoring of the psychology of place.

In our Earth's history, some have lived with the land more efficiently than others. Many created small societies built around living with their place. With the wonders and ramifications of larger, more complex soci-

eties and technology, we have lost touch with our place—living with it has become complicated. The Earth is not getting back at us; it is simply failing to work properly. Perhaps for the first time in modern history, we are looking at the ways people native to the Earth for many centuries or millennia coped with planetary difficulties and gloried in its benefits. These people considered ahead of time the possibility that resources might fail and worked out practical and spiritual ways to ensure life. If a creative synthesis can result from combining cultural ideas about our Earth's ecology, then clearly such a synthesis is greatly to be desired.





A large spiral petroglyph on a southwest-facing cliff on Tsankawi Mesa in northern New Mexico. The petroglyph, which probably dates from the 1300s, was used as an autumnal and vernal equinox marker. Photograph © Robert W. Parker.

## CHAPTER SEVEN

# Native Astronomy: A Skyward View

*“Living the heavens . . .”*

We live in an ordered world of observable natural phenomena whose constancy and consistency are typified by events in the sky, whether the event be a sunset, a close encounter between two planetary wanderers, an eclipse, or a shower of shooting stars. Nowhere else in nature—not in the comings and goings of the birds, the blooming of trees, nor the arrival of the rains—do we find a more reliable environmental reality in which to frame the drama of life than the celestial backdrop.

—Anthony F. Aveni, *Ancient Astronomers*

## Living the Heavens: An Introduction

Over the past five thousand years, astronomy, the oldest human science, has taken many forms. In both ancient and modern times, astronomy has been vital in the ordering of life. Astronomical observations were used to guide food gathering activities and ceremonies, and formed the context for participation with the Great Mystery of the Universe. Ancient and contemporary astronomers have always explored areas such as the creation of the universe, the nature and fabric of time and space, and the relationship of human beings to the cosmos.

Native astronomies were predicated upon a participation-resonance-creative imagination-relational orientation that characterized the participatory nature of Native interaction with other aspects of the natural world. In other words, Native cultures applied a participatory consciousness to their conception of the heavens, whose goal was to establish a kind of resonance with what they perceived in the night sky and their activities on Earth. They approached the stars with their creative imaginations as well as with their skills of observation and astronomical technology.

Each expression of Native astronomy reflected the mind-set and spirit of the cultures from which they came, and therefore served the social, economic, and spiritual needs of its creators. Everywhere Native astronomers used ingenious and creative ways to preserve and transfer their knowledge of astronomy through stories, ritual, art, symbolic architecture, song, dance, and communal ceremonies. People attempted to establish a deep communion with their "star relatives," expressed through myth and ritual, the social organization of communities, and formal educational structures that were used in somewhat the same way modern astronomers use the structures of universities, research centers, observatories, and professional meetings.

Native astronomies helped to make sense of Native life and relationship and reaffirm the belief in the interrelationship and interdependence of all things in an animate and living universe. In brief, like the Earth, plants, and animals, 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.

In many Native creation stories, human and celestial beings interact in numerous ways. In these stories sky beings come to Earth and humans and animals visit the sky realm and participate in the course of each other's lives. The stars are seen in some creation stories as the creators of the Earth and humankind. The stars are also involved in the moral development of humans through the examples, values, and behavior they present. The stars provide important ritual symbols and at other times can be personifications of the Trickster, the reflection of the cosmic principle of chaos.

The Pawnee Bright Star gives Great Star a pebble, which he drops into the water to create the Earth. The daughter of Bright Star and Great Star joins the son of the Sun and Moon, and together they populate the Earth. . . . [T]he 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 the girls' puberty ceremony. . . . [T]rickster and culture heroes may create or arrange the stars. Gluskap names the constellations. Coyote scatters 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 (Miller 1997:2).

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. By watching and trying to understand the order of the cosmos, Native cultures derived important lessons, laws, and principles to live by. Star watching and star stories provided valuable insight and inspiration for their personal and collective participation in the greater order of the universe.

Why did Native cultures place so much emphasis, spend such time, and expend such thought in taking measures to align themselves and their societies with what they perceived was the cosmic order? Native astronomers were driven not only by their own awe and curiosity, but were also serving the innermost needs of their societies—to resonate

with the cosmos and to be the power brokers of their worlds. 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. Indeed, Native cultures recognized no clear dividing lines between nature and the cosmos on the one hand, and human spirituality and affairs on the other.

This chapter reintroduces themes of the previous chapters by reflecting on the practice of Native astronomy from the orientations of cosmology, philosophy, community, plants, animals, sense of place, and the cosmic journey. A few examples of particular Native peoples' cosmology and astronomy are explored to illustrate the key thematic ideals of participation, creative imagination, relationship, and the attempt to establish resonance with the creative process of the universe.

### A NAVAJO PERSPECTIVE ON COSMOLOGY AND ASTRONOMY

The following description of the Navajo creation myth represents the kind of mythic relationship other tribes relate about their connection to the heavens. In this myth the characteristic pattern of creative imagination, participation, relationship, and resonance is evoked. Cultural and practical understanding of the stars is conveyed metaphorically, and it is in the telling and retelling of stories and performance of associated rituals that the knowledge of Native astronomy is transferred and applied in the traditional life of Native cultures. The description relies heavily on Sean MaCallan's work on Navajo astronomy (1999).

For Navajos, the purpose of life is to live in harmony with all forces, entities, and beings. All beliefs and understandings of life are predicated on creation stories, and creation stories are the key to defining and unlocking the mysteries of life. According to Navajo perceptions, there is an order to the universe, and the actions of people are deliberate to maintain harmony and balance. When harmony and balance are interfered

with, ceremonies are held to reestablish them. Taboos are used to educate and inform people of their roles and responsibilities to affect *ho'zho'*, or balance and harmony.

The Navajo recognize certain elements of the order of the universe, such as the Earth spinning on its axis and revolving around the sun, phases of moon within the Earth's orbit, solar and lunar eclipses, and stars and constellations as distant suns. However, they have special understandings and stories for these phenomena. The sacred nature of the Navajo interpretation of life recognizes the stars as having human qualities with supernatural force or powers. Like their European counterparts, the Navajo used their understanding of the celestial bodies to predict dates of astronomical phenomena, such as eclipses. They also used this information to plan changes according to seasons with accompanying ceremonies or cultural practices. The rhythm of the seasons directed by the sky became the rhythm of the people.

Pair and gender orientations for celestial bodies support the idea of balance and an orderly universe that is simultaneously holistic, rational (explainable), and spiritual. The stories associated with the constellations are reflective of life, children, leaders, elders, and animals, among other things. The value of the constellations is essentially spiritual. Heavenly bodies have the capacity to communicate with each other as well as with the people and beings of the earth. The constellations are closely associated with the creation stories, which are used as tools to understand, comprehend, and put things into the proper cultural perspective. All celestial bodies are associated with particular ceremonies, life lessons, and meanings of agricultural cycles and other ways of how the world works. The stories and interpretations appearing below are not intended to be representative of all Navajo, nor are they detailed reproductions of what some Navajos believe. Certain clans and people within clans have somewhat different interpretations (Zolbrod 1984).

*Creation of the Universe, Solar System, and Earth.* Navajo people believe in a very orderly beginning of the universe. Male and female characteristics are attributed to all forces in the natural world, according to the Navajo philosophy of harmonious balance. The Creator or Supreme Being

created First Man, First Woman, Coyote, and all other beings. These first beings, known as the Holy People or the Deities, had great powers that were used to assist in forming the universe in accordance with the design of the Creator. All elements of the universe were created and arranged in a such a way as to realize balance. Fire, water, air, and earth are sacred elements, and, of course, each contains male and female qualities.

Two different ways of bringing about balance were used in the creation of everything that is. The first is known as the Blessing Way, the female role, used to orient the earth and sky. Its qualities are beauty, wonder, happiness, and harmony. Corn or corn pollen is typically used to symbolize this quality. The second is the male counterpart, the Protection Shield Way, bearer of weapons and protector of life against danger and evil. Today this way can be symbolized with arrowheads.

The Navajo creation story describes how the Holy People formed the earth and sky in a meaningful and deliberate way to consecrate the life givers (including all substances and elements) on Earth. Earth, the Mother, and Sky, the Father, were, after great discussion by the Holy People, clad in appropriate symbolism. The materials used to adorn the Mother were said to have unique feminine qualities. White limestone became her bones, yellow limestone her bone marrow, red stone her blood, and gray stone her intestines. Crystalline limestone was used for the Mother's fat, black stone represented her hair, and brown limestone signified her skin. White shell beads adorned her from the soles of her feet to the plumes in her hair. Many other elements, such as turquoise, abalone, and jet, were used to decorate and therefore, clothe the Earth. The Mother was given vegetation, other minerals, and sacred elements.

To quicken the Mother's life, the Holy Ones decided to provide wind, accompanied by certain prayers and songs. A light wind (female) and a strong wind (male) would give life to the Mother. Wind is depicted via four degrees of air and six colors. The four parts of the day are the different interactions of the wind and are produced in the colors of dawn, blue twilight, yellow twilight, and darkness. The Holy Ones oriented the Mother toward the east, and dawn became her plume.

Father Sky was the next to be prepared. The Holy Ones adorned the Father in turquoise stone, white shell beads, abalone shell, and black jet. Male and female characteristics were given to the clouds and the patterns of rain. Black clouds, jagged lightning, and loud thunder with heavy rain are male. Misty fog that produces light rain and gentle lightning that does not touch the Earth are female. When male and female rain combine, rainbows result. Water was created to keep the mind and body of Earth and the Sky moist. Atmosphere was placed between Sky and Earth to bond their relationship.

The Holy Ones then realized that the universe needed light. They also realized there was no order, direction, or sense of time or measurement. The Holy Ones again collaborated to address these needs (Zolbrod 1984).

*Sun and Moon.* First Man and First Woman brought the energy of the sun, moon, and a crystal star from the first world. In the second world, Coyote, First Boy, and First Girl were created, and together they brought the knowledge of heat and light from the clear crystal to the fourth world (the world as we know it), all of which was eventually used to produce the sun. The Holy Ones decided that the sun, considered to have male characteristics, would provide order to the days and seasons. The seasons are recognized by the location of the sunrise (Scott and Mitchell 1992).

Referred to as the Day Traveler, the sun is used to determine time in a general sense as well as to determine the cardinal directions. The equinoxes and solstices are considered sacred times of the year, the end of the sun's journey marking the passage of time and the seasons. Blessing Way ceremonies are held to ensure that the actions of the people and the Earth are in harmony. At these times, it is said that for thousands of years, the sun, moon, planets, air, water, and electrical forces have aligned themselves at these times, a universal alignment where energy is shared.

The moon, referred to as the Night Traveler, was created to provide another source of light at night and to provide another measuring tool. The Navajo recognize that the moon has shorter cycles compared to the sun. Because of the twenty-eight to thirty-day range of the moon phases, the moon provides thirteen months. Nature and human activities on

Earth were used to name the months. Because of its gentle character and direct correlation with women's menstrual cycles, the moon is considered female (Scott and Mitchell 1992).

The moon provides guidance and knowledge that complement the sun. Day, night, months, and seasons are signaled by the phases of the moon. The Holy People agreed that the moon would be both grandmother and grandfather, dominate old age, and act as the precursor of the unborn child. Each day of the month is named with regard to the phase of the moon.

Particular offerings, colors, and stones were assigned by the Holy Ones to the four directions, times of the day, and the seasons. For the east, the offering is white cornmeal. East is adorned with white shell, its color is white, and it is associated with dawn and spring. For the south, these elements in the same order are corn pollen, turquoise, blue, midday, and summer; for the west, yellow cornmeal, abalone, yellow, sunset, and autumn; and for the north, corn pollen, jet, black, night, and winter.

Taboos are associated with the sun and moon. When the sun is in eclipse, this period is monitored and observed. Ceremonies are held to renew the sun at the time of eclipses, and pregnant women and their mates are not to watch or look at the sun during this time, because doing so may be harmful to fetuses. In addition, all activities are to cease during this time as an expression of respect to the sun and solar eclipse. Likewise, it is taboo to look directly at the sun or it will harm the eyes. Next, sleeping while the sun is rising or setting is not appropriate. The Navajo believe, in reverence to the sun, that the sun is too busy to be waking the people; therefore, the people should wake before the sun. It is also taboo to sleep while the sun is setting. It is said that if people sleep while the sun is setting they will be cranky, irritable, emotionally upset, and mean when awakened. This places them temporarily out of harmony (MaCallan 1999).

A lunar eclipse is viewed as a recognizable change in energy, heat, and strength of light. Similar reverence is practiced when all activities should be stopped until the moon reverts to its normal shape. If a ceremony is underway, it will be stopped and specific prayers and songs are said or sung. The parents of an unborn child have similar obligations not

to gaze at the eclipse. If the parents of an unborn child see the moon in eclipse, ceremonies should be held to correct potential dangers (Scott and Mitchell 1992).

*Morning and Evening Stars.* The morning and evening stars are the planets Mercury (female) and Venus (male), respectively. To the Navajo, Mercury and Venus are referred to as So'Tsoh or Big Stars. The Big Stars are revered and believed to hold knowledge placed there by the Holy People. The knowledge would be revealed to the people, or the Morning Star would help them regain balance, if a time came when the people of Earth forgot their cultural ways.

The role of the Crystal Gazer, who is a Navajo medicine man or spiritualist, is to lead a ceremonial process used by the Navajo people on Earth to maintain balance. It is said that the Stars can hear what is said and that is the reason they are spoken to. The Morning Star is female, and the Evening Star is the male counterpart. The Evening Star travels first and the Morning Star follows. Male songs and prayers are said and sung first and female songs and prayers follow.

*Male and Female Revolvers (Ursa Major and Minor) and Central Fire (Polaris).* In the Western astronomical view, the Big Dipper (Ursa Major) is complemented by the Little Dipper (Ursa Minor). The Navajo do not see dippers, but rather the Male and Female Revolvers. The Male Revolver's body consists of seven stars, and two stars represent the warrior's feathers. The Female Revolver's body also consists of seven stars. The Male and Female Revolvers are viewed as a paired constellation, rather than as separate constellations. The Male Revolver lies next to the Fire between him and the Female Revolver. The First (Central) Fire is known in Western culture as Polaris or the North Star. Four stars surrounding the Fire guarded by the Revolvers extend to the four cardinal directions.

To the Navajo, the Fire is sacred and represents home, and a strong fire means a strong home life. The Revolver pair serve as guides to other constellations as well as to the people of Earth. Their cycles measure the seasons, and they appear in the sky at different locations depending on the season. Thus, the Revolvers rotate clockwise around the Fire, while the Earth rotates counterclockwise. The Revolvers help the people iden-

tify seasons and the time of night. For instance, when dawn approaches the Male Revolver is standing. People are expected to rise at dawn, face the east, make their offerings, and begin their daily activities.

In the Protection Way ceremonies, the Male Revolver is key to helping restore balance and harmony to the lives of the family. The disharmonious elements that have infiltrated the family are cast far away, past the Revolvers and the Fire. The Revolvers are there to protect the family from the dangers that may try to return to them.

*Planter (Pleiades).* The Pleiades or Seven Sisters are known as the Planter, and the Planter is part of a constellation consisting of hundreds of stars. During its nine months of visibility, the Planter can be seen in the fall following sunset in the eastern horizon. By mid-winter the Planter is overhead after sunset, and it slowly disappears into the western horizon in spring. Timing of planting and cultivating are determined by the disappearance of the Planter in late spring/early summer.

The Navajo see the role of the Planter as not only symbolic of agricultural practices, but also as the natural order, or law of nature. Taboos are associated with thoughtless planting while the Planter is still visible in the night sky. Frosts, freezes, and poor crops are the inevitable effects of not following the signs.

*First Slender One (Orion).* The First Slender One (male) is often paired with the Planter (female). Considered to be a kind and gentle presence, First Slender One is also referred to as "keeper of the months," because he keeps the other constellations in line by making sure they appear in the night sky at the proper times. Similar to Orion, this constellation is composed primarily of a quadrangle of bright stars bisected by three stars that form a belt. Sometimes First Slim One is female and paired with First Big One (Scorpius). This is an interesting duality that reflects the need for balance and shared qualities. All stars are really Holy People who communicate with each other and with Earth people.

*Man with Legs Ajar (Corvus).* Corvus, visible during the fall, winter, and spring months, is a four-star (somewhat lopsided) square, which generally follows Orion rising on the eastern horizon. The Navajo view eight stars in this grouping, said to be a man standing and gesturing with

his arms while explaining. Man With Legs Ajar tells his people, children, and grandchildren how to live with one another so that people can plan and think for themselves. Man With Legs Ajar wears a single feather on the left side of his head, which symbolizes the purpose for conducting a meeting, and is used to denote significance and respect.

*First Large One (Scorpius).* The First Large One, considered to have male characteristics, represents everything that is of great and overpowering strength. Like all stars (although not always visible), he has an eagle tail feather. He also has a cane, representing stability in every aspect of life. When Changing Woman (Navajo deity) created the four original clans, each was given a cane. The canes were made from turquoise, white shell, abalone shell, and black jet. Canes also provide stability for aged, injured, or weak persons when moving around. Canes are used in ceremonies, representing opportunities for people to redirect themselves to their chosen life paths.

The story goes that when a cane is needed, an offering of cornmeal must be placed in the tree for use of one of its branches before the branch is cut. It must be remembered in preparing a cane that the part used for the bottom must be the end that was nearest the roots of the tree. The tip where the leaves grew must be the handle. In this way, the cane remains standing, just as when the branch was growing on the tree. The elders' teachings say this is so because life must continue to grow in its original direction.

*Rabbit Tracks (Tail of Scorpius).* The Tail of Scorpius, referred to as Rabbit Tracks, is seen as distinct from First Large One. It is said that these tracks have been there since the creation of the universe. This constellation is related to the (male) Hunting Way ceremony. The Rabbit Tracks remain on the southeastern horizon, traveling west. The stars are traveling west, but the rabbit is said to be running in a northeasterly direction. The hunting season begins when the tracks tip to the east, when the young deer and antelope are no longer dependent on their mothers.

Another ceremony related to the Rabbit Tracks is the Feather ceremony for curing an individual who has had contact with an animal. Certain animals are to be pets and others not. Sometimes a person may become ill if they try and make a pet of an animal not intended to be one.

The Tracks are also symbolic of the paths all humans must walk in their lives. Everything has tracks or footprints, including all constellations. In certain ceremonies, corn pollen or yellow cornmeal is used to make footprints on the ground. This is to make certain that the order of creation, with all its purpose and significance, is maintained.

*One That Awaits Dawn (Milky Way).* One That Awaits Dawn is a brightly glowing mass appearing in the east, which becomes brighter as dawn approaches. It is considered to be the guardian and steward of dawn, responsible for ending night and beginning another day. As One That Awaits Dawn positions itself horizontal to Earth in the eastern sky, people make offerings of white cornmeal and pray. It is said that at this time, when people ask for blessings, the Creator makes the most abundant and sacred blessings (MaCallan 1999).

### A Relational Philosophy: The Stars Are Our Relatives

Many Indigenous cultures developed a resonance with heavenly bodies in the night sky, which they considered to be their relatives. Indigenous versions of astronomy reflect their cosmologies, or stories of the creation of the Earth and the evolution of human beings. After myths about animals and human relationships with animals, the second largest group of Native myths are those about the stars. In all of these stories, there is the deeply felt sense that humans do have a direct and ancient relationship with the heavens. Humans are also seen to benefit in terms of moral understanding and ethical behavior through their interaction with the heavens.

In a Pueblo myth related by the famed Santa Clara Pueblo artist Pablita Velarde in her book, *Old Father Story Teller* (1989), the Pueblo culture hero Long Sash leads his people on a journey to find the lands that the Pueblos currently inhabit. Before the journey begins, Long Sash instructs the people in ways of hunting, and how to make clothing and shelter. The journey is difficult and the people must overcome many obstacles, the most difficult of which are their own selfishness and intolerance and internal quarrels. They travel and stop in many places, and in each place they must overcome their doubts and decide whether to go on

with the difficult journey. As Long Sash shows them through his kindness, they can complete the journey only through cooperation and caring for one another. In showing each other care and respect, they are able to finish the difficult journey and arrive at their present homelands. The evidence of the journey of Long Sash and his people is written in the stars, for Long Sash is Orion, the never-ending trail is the Milky Way, and places that the people stopped are Castor and Pollux and the constellations of Cancer and Leo (Miller 1997:176-77).



Old Father sits in the plaza as he points to the Long Sash (Orion) constellation in the Endless Trail (Milky Way). © Pablita Velarde (from Pablita Velarde, *Old Father Story Teller*).

Because of their fascination with the heavens and strong sense of relatedness, astronomical systems developed by Native Americans are extensive. Western archaeologists have begun only recently to investigate star mythologies under the rubric of a new branch of science called "archaeoastronomy." Many Native American and other sites around the world are being reevaluated. A recent exploration yielded

the recognition that the great pyramids of Egypt may have been star aligned and used in a way to communicate with and find resonance with certain stars, especially in the Pleiades. New evidence indicates that the three main pyramids were aligned in order to be able to view the three central stars of Orion. Moreover, the three pyramids were spaced in a geometric ratio to the stars in the Orion belt. Holes in the pyramids that were previously believed to be for ventilation purposes were likely viewing ports. Archaeoastronomers made the calculations to determine the positions of stars two thousand and three thousand years ago. They find that the viewing holes were directly aligned with various stars and constellations.

The Egyptian pyramids are just one example among many as archaeologists return to ancient sites with this new understanding of astronomy, that is, of the importance of the stars and star beings to Indigenous peoples. Much of the current revitalized interest in the astronomy of ancient peoples commenced in the U.S. Southwest with the discovery related to the Sun Dagger in Chaco Canyon. Many sites in Central and South America are also being reevaluated. As these discoveries continue to evolve, it is likely that people will learn that every ancient culture in the world had a deeply embedded sense of, or relationship, to the stars. This relationship is actually a very old part of human psychology.

The story of Scar Face discussed later in the chapter is an example of the kinds of things that Native people incorporated into their stories about these relationships. These stories frequently involved a journey to the stars; a meeting with star beings; a compact, which is typically made with star beings and results in some kind of gift of new knowledge bequeathed to the hero or heroine; and the return of the hero to Earth with the knowledge to share in particular ways with the tribe. In the case of Scar Face, after he journeys to the land of the Star People, he finds a sense of his identity and he makes a new compact with the people that he encounters. Scar Face helps them, and in turn, they help him, and he returns to Earth with new knowledge that he shares with his people.

Another myth derived from the Blackfoot people is the story of a young warrior who hears beautiful music and women singing and laugh-

ing as he is hunting. The hunter is enchanted, follows the sounds to their source, and discovers seven women walking around in a circle. He notices a large basket nearby. As he watches and listens, he is especially enchanted by a particular young woman, whom he immediately falls in love with. When he begins to walk toward the girls, they are startled. The girls run and jump into the basket, which shoots up into the sky.

The hunter then plans to catch the young woman he is in love with the next time the women dance. Because this event occurred around the solstice, the hunter believes he knows when the women will return. Indeed, a short time later, the young women do return. The hunter is hidden in place. This time he sneaks up on them, and just as he is about to get near them, they start running. He runs after the girl he has fallen in love with and catches her just before the girls leave in their basket again. The young woman falls in love with the hunter, and she decides to stay with him for a period of time. She eventually decides that she wants to ask her father for permission to marry the hunter, and then takes her young lover with her in the star basket to request permission from her father, the Sun (Wood 1982:80).

Of course, there is also an immediately practical dimension to Indigenous astronomy. A hunters' camping area in the Chihuahuan Desert in Nuevo León, Mexico, is believed to be at least fifteen thousand years old. At this site, one of the oldest known records of keeping track of the days between the solstices, there are 365 markings, which seem to signify the number of days between winter and summer solstice, as well as to indicate the equinoxes. At one time, this area was a very lush savanna, and evidence of extensive hunting has been found around the site. The very dry climate and the fact that the markings were deeply etched into the stone are likely the main reasons explaining how the markings were preserved. This camping site demonstrates that Indigenous knowledge of astronomy had evolved over thousands of years, and was a part of the first Native cultures and traditions in the Americas. It is quite likely that as the discipline of archaeoastronomy matures and studies are extended into the Paleolithic era, evidence of Paleolithic peoples' involvement with the stars will accumulate (Hadingham 1984:91).



It is also known that the Mound Builder or Mississippian traditions were grounded on astronomy. The star priest, a very important figure in Mound Builder culture, set the calendars and presided over ceremonial activities. The mounds themselves probably had particular functions, such as observation sites that provided a better view of the horizon as well as being closer to the sun. Vestiges of certain solstice ceremonies continue into the present by the Choctaw, Cherokee, Cree, and other Southeastern Indigenous groups, all of whom are descendants of the Mound Builder cultures (Aveni 1993:125-26).

A common activity among the Plains peoples is called the wintercount, prepared by a person who was both tribal historian and astronomer. It is likely that a social and political leader was given the task of depicting the key events from one solstice to the next using pictographs. In many instances, the star priests were actually a kind of medicine person. In some instances, the star priest was also a healer, but just as often, the star priest was a specialist, a particular kind of shaman.

Many devices were developed by Native peoples to keep track of key events, such as drawings and pictographs on animal hides, the wintercount, and markings on canes (used by the Cree) to represent events in the night sky in order to know when to arrange ceremonies. The canes were also emblems of authority given to political leaders. Examples of key astronomical events are full moon to full moon, one position of a star to another position of a star, one position of the sun to another position of the sun, and so on.

Many people believe that a large portion of the petroglyphs scattered throughout the Southwest are star related, depicting a star story or in some cases documenting a celestial event. One example is a well-known petroglyph in Chaco Canyon, consisting of a crescent moon, a star object, and a person's hand. Some have suggested that the painting represents the supernova of 1054, which would have been visible from the desert Southwest in Chaco Canyon. A supernova was certainly a celestial event that would have drawn everyone's attention because it was visible during the daytime for weeks (Williamson 1984:115).

Celestial phenomena affected social organization and architecture. The Navajo octagonal hogan is a traditional structure incorporating alignments with astronomical phenomena. The hogan, like the Skidi Pawnee earth lodge and Mound Builder structures, was built to face the rising sun. Inside these structures, narrow windows were cut so that one could see the Pleiades and the movement of the sun or the moon during certain times of the year.

Like the Navajo hogan, the Lakota tipi was built in reference to the sun. A first step in building a tipi was to make a star with the first three poles as the Lakota people believe that the true inner shape of the world resembles a three-pointed star. Once the star is centered, the next seven poles are added, representing the seven directions (the four cardinal directions, and above, below, and within). The total number of poles at this point is ten, representing respect for the universe. Two more poles are added, which serve as "ears" controlling the air flow throughout the tipi. Proper positioning of these poles allows the people to communicate with the spirit world.

The twelve poles of the tipi represent the twelve months of the year. Once a year the people participate in the Sun Dance, and their prayers are offered to the Holy Tree of Life. There are also twelve stars: the morning star, the evening star, seven stars of the Big Dipper, and the three stars on Orion's Belt.

Wherever they were, the Lakota observed the sun's relationships to the constellations and performed the appropriate ceremonies. Generally speaking, as the sun moved counterclockwise through the constellations, the Lakota people moved counterclockwise through the Black Hills from one ceremonial site to the other, and each site was correlated to a different constellation. In this way, the Lakota people mirrored the sun's path (Goodman 1990:12-14).

There are stories among Indigenous peoples that suggest visitations by extraterrestrial beings, that the stars are their ancestors or carry the spirit of their ancestors, and that when people die they become the stars or go among the stars. For instance, the Milky Way is described by certain peoples as the land of people who have gone on. There are stories that people come

to the Earth for a certain period of time, and then return to the heavens to become star beings. The following Lakota story is an example.

A long time ago two Lakota girls went out one night to watch the stars. One of the girls said she wished she could marry that one big beautiful star. The other girl said she wished the same about the other beautiful star. Suddenly they were taken into the star world, and it was there that the two stars became their husbands. Later the girls become pregnant. They are told that the star world was theirs but they were warned not to dig any wild turnips.

Eventually one of the girls pulled a turnip from the ground. A hole in the star world opened, and the Lakota woman was able to look down to see the earth and her village. Because she became homesick and wanted to return to the Earth, she braided turnips to make a rope. The braided rope she made did not quite reach and she fell to her death, although her child was born. The Meadowlark raised her son since they too speak Lakota. The baby boy was named Fallen Star.

Fallen Star reached manhood in days rather than years. He was very tall and light was always around him. The Meadowlark grew old and decided to take him to a Lakota band where he could settle. Fallen Star traveled from band to band. Everywhere he was recognized for being the protector and the bringer of light.

A Lakota band was camped near Hamey Peak in the Black Hills. Every day a red eagle swooped down and stole a little girl, who was carried away to the top of the mountain and killed. All of the warriors tried to kill the red eagle but they failed. All Lakota people prayed for the help of Fallen Star. He arrived after seven days and after seven girls had been killed. Fallen Star killed the red eagle and placed the spirits of the seven girls in the sky as a constellation. This constellation is known as the Pleiades in the Western world, and in Lakota, Wicincala Sakowin (the Seven Little Girls).

Another constellation is called Nape, which means "hand" in Lakota. To locate this constellation, one must first find Orion. The Orion Belt comprises the wrist, Rigel the pointer finger, and Eradanus Beta the pinky. A story related to this constellation begins long ago when Fallen Star told everyone that he planned to marry the daughter of a chief in a

nearby village. She told Fallen Star that the Thunder Beings had taken away her father's arm. She agreed to marry Fallen Star if he could get the chief's arm back.

Fallen Star went in search of the arm, and he obtained special powers as he traveled through different villages. Fallen Star obtained sinew, a wren feather, a swallow feather, a live coal, an eagle plume, and many words of power. All of these things helped Fallen Star change his shape and escape the Thunder Beings. As Fallen Star traveled, he was in the Black Hills, but at the same time he was traveling through the star world. He visited three villages of star peoples, and it is said that his son would have to visit the other four.

Finally, Fallen Star reached the Wakinyan (Thunder Beings). By changing into a wren and then into a man, he was able to outwit the Thunder Beings and the Iktomis (Trickster). Fallen Star recovered the chief's arm, and using the other powers he was given, he was able to flee. Fallen Star gave the arm to the chief, married his daughter, and later they had a son. The purpose of this story is to provide certain teachings. The chief represents selfishness for wanting his arm back. The Thunder Beings represent the annual disappearance of fertility, as well as the masculine power to refertilize. The arm symbolizes the earth. The power of life is lost and regained each year, but not without sacrifice.

People who argue that such stories are wholly unscientific are begging the question of probabilities and possibilities. We know that life on Earth likely resulted from supernova activity, that is, a combination of certain types of electromagnetic radiation and bombardment by particles of matter. Thus, the notion that we are star people or stardust is quite reasonable. Currently Western science says that yes, all life on Earth is stardust, or comprised of the same elements as stars. Some of the necessary elements that made life possible on Earth could not have come from anywhere else but bombardment by asteroids. And of course, if it happened in this solar system, it most certainly happened in other solar systems.

A belief in reincarnation is shared by many Indigenous cultures around the world, such as the myth of Isis and Osiris among the peoples who built the pyramids in northern Africa. The ancient Pueblo myth

about star people, that we return to the Milky Way after we die, is about reincarnation. According to a Chumash myth, the stars control everything on Earth. It is said that the Earth is part of a great celestial being in the sky—Star Coyote is on one side, and Old Man Sun is on the other side, and that the cosmic battle between creation and destruction is continuous. This is a fundamental concept in astrophysics. The universe cannot expand forever; there has to be an opposite force.

Ancient Indigenous peoples had very sophisticated understandings of how things work, how things move, and how things happen in the universe. They used the coded form of mythology to try and convey their understanding, because in some ways it is understanding beyond words. Incidentally, this is why physics is heavily dependent on mathematics. There are certain things that cannot be explained in words, and the relationship is not transparent unless you quantify it into some symbolic form. Indigenous people are doing the same thing in another form by coding their knowledge, understanding, and insights into the rituals that they perform, the mythologies they have created, and the stories that they pass down.

#### COMMUNITY: The Skidi Pawnee, Star People of the Plains

The Skidi band of the Pawnee considered themselves people of the stars and were devoted and skillful star watchers. Before the tribe was moved to the Oklahoma Indian Territory in the 1880s they lived along the Platte and Loupe rivers in Nebraska. The Skidi were farmers and buffalo hunters living both a sedentary and nomadic life, depending on the season. Skidi Pawnee social and ceremonial life was structured around their star knowledge and mythology to the extent that their related ritual practice was one of the most elaborate of any Plains Indian tribe. The Skidi believed that all events on Earth were in some way connected to celestial events and that stars were sacred beings who actively sought relationship with their human relatives. Given this view, the Skidi sought to emulate all aspects of their society in relation to the entities and the events that they perceived among the stars.

The Skidi categorized their star relations in a hierarchy of cosmic levels. At the first and highest order of the universe was Tirawahat, the great

mystery or the great void that held the heavens together. Tirawahat was the great cosmic field in which the stars lived and moved about in their dance of life. At the second level in the Skidi pantheon was the Chief of the Stars (the North Star or Polaris) and a constellation they called the Circle of Chiefs through which the chiefs of the Skidi sanctified their authority. Also at this first level were Red Morning Star (Mars, considered male), viewed as being married to Evening Star (Venus, considered female). In Skidi mythology, it was this marriage that produced the first humans, the ancestors of the Skidi. At the next level of this star hierarchy were the four principal stars, located in the semi-cardinal directions of the heavens, and which held up the heavens. Next in order of importance were the Sun and Moon because they were perceived as being closer to Earth and less powerful than the stars located at higher levels or greater distances.

In Skidi myth it is related that Tirawahat is the source of the special star medicine bundles that are planted in the western shrine of the Evening Star. The other star beings planted special bundles in the other semi-cardinal and cardinal directions to mark the physical boundaries of the Skidi Pawnee territory. It is through these bundles that the star beings of the Skidi universe endowed the Earth and all living things with life, and gave knowledge and order to Skidi life and community.

This is the blueprint that the Skidi Pawnee followed to organize and guide their life on Earth. The original Skidi villages even followed the pattern of the stars and constellations that were most important to them. Indeed, everything for the Skidi Pawnee, from their sociopolitical organization, to the ways in which they laid out their villages, to their art, dance, music, and perception of themselves, mirrored their view of their stars. It is this mirroring of star order on Earth order that defines the way the Skidi and other tribes “resonated” their life with the cosmos.

The Skidi placed their villages in the order of the four principal stars they recognized as the chiefs of the semi-cardinal directions. Each village according to Skidi mythology was said to have been given the knowledge of ritual and artifacts of power to communicate with their patron star in the form of a sacred star bundle. The care and ritual associated with each bundle when combined and performed in the proper order and sequence

in accordance with the Skidi ceremonial calendar ensured the life and continuity of the Earth and the Skidi Pawnee. The other villages of the Skidi Pawnee also had their patron stars or constellations and were arranged accordingly around the four semi-cardinally situated villages.

The Skidi ceremonial calendar began with an "Earth reawakening" ceremony held near the spring equinox. This new year ceremony was timed to the return in the heavens of a constellation they called the "swimming ducks" (Pleiades). Prior to this ceremony, the chiefs of the Skidi would meet in council, as did the constellation in the sky called the Circle of Chiefs, to determine the beginning of the new year and the number of months it would contain.

Astronomy also had many practical applications in Skidi lives. The traditional Skidi Pawnee dwelling was also a practical kind of sky dome, called the earth lodge. Built of sod, its opening was always to the east; it was cool in summer and warm in the winter. The earth lodge was also a very convenient place for people to sit on hot summer afternoons and tell the stories of the stars. The interior of the lodge replicated the universe as the Skidi Pawnee perceived it.

For Native peoples, the cardinal and semi-cardinal directions have both cosmological and metaphorical meanings. Particular plants are associated with each of the semi-cardinal directions. For the Skidi Pawnee, southwest was associated with box elder; northwest, cottonwood; northeast, elm; and southeast, willow. Animals are associated with the cardinal directions. Natural phenomena (winds, lightning, thunder, clouds) and colors (white, yellow, black, and red) were associated with the four directions as well.

This schema refers not only to directions on Earth but also directions projected into the night sky. Thus, for each of the semi-cardinal directions, the night sky was divided into quadrants. To represent these quadrants, the Skidi made star maps on buffalo rawhide containing the key constellations that could be found in the sky during the summer solstice. The Skidi Pawnee depicted every visible star on their star maps and emphasized certain constellations and stars that they recognized as their ancestors. They also utilized the star maps to predict the comings and

goings of summer and winter solstice. A Skidi elder or star priest could position himself and observe the movement of key stars overhead from within the lodge through strategically located portals in the earth lodge dome. Members of the entire extended family inhabiting an earth lodge would also rearrange themselves in each of the semi-cardinal directions in accordance with the change of seasons.

Skidi astronomy reflected a very sophisticated knowledge of the heavens inspired by the night sky of the Great Plains, similar to that of the Polynesian view of sea and sky—there are few mountains on the plains just as there are few mountains on the oceans to obstruct the view. Whether oceans of grass or of water, the night sky and the stars become the best navigational tools available in the absence of landmarks such as mountains, hills, and buttes.

Skidi traditions exemplify the interface of Native science with community, environment, cosmology, and creative imagination in ways that are typical of Indigenous peoples. The night sky became the model for the community on Earth. Indeed, the Skidi Pawnee thought of themselves as citizens of the universe (Hadingham 1984:105-09).

## STAR VISIONS AND THE ROLE OF PLANTS

Plant cultivation was one of the primary reasons for the development of accurate Native calendars. Agricultural systems based on celestial observations and the seasons are numerous throughout the history of humankind. In Egypt and Greece, as well as in many other areas of Africa and in North and South America, it is known that the First Peoples established resonance with the cosmos and its connection with the Earth. The performance of ceremonial and agricultural tasks in accordance with celestial cycles was fundamental in order to survive.

For centuries Native communities in the northeastern United States worked with an agricultural system based on celestial observations. By studying the constellations, mainly the Seven Sisters (Pleiades), they created a calendar that determined the proper times for planting important crops, such as corn, beans, and squash. In southern New England, planting was timed with the disappearance of the Pleiades from the

western horizon, and harvesting with its reappearance in the east, a period that marked the length of the frost-free season.

The closeness of these seven sister stars made the constellation particularly important to some Native peoples, for they considered the number seven to have ritual or sacred significance. In addition, seven represented the total number of possible directions—south, west, north, east, up, down, and center (or within).

Throughout the Northeastern tribal communities, the role of farming and the planting of the seeds was a ritual traditionally carried out by women. They were the gatherers of the crops and herbs, and along the coast, shellfish. When the Pleiades vanished beneath the western horizon in early May, the women planted corn. When the Pleiades, their sisters, reappeared in the early eastern dawns of mid-June, the women knew that the last of the seeds should be planted immediately, or crops would not mature before a killing frost.

Rituals were performed around the growth of plants. The Iroquois hold a four-day festival in late August or early September called the Green Corn Ceremony, when the corn is at the proper state of ripeness. Tribal women on Long Island still participate in their corn planting ceremony, which occurs in the beginning of June. The Seneca say a "Thank-You Prayer" before and after ceremonies in major longhouse gatherings, a reminder that the cosmos is marked by patterns people used in planting, harvesting, and fall hunting (Williamson 1984:256; Buchanan 1997:70-71).

People and plants also related to the heavens in a more integrally symbolic way. In Plains Indian Sun Dance traditions, the Tree of Life connects the earth and sky, and among the Huichol in Mexico, the spirit of peyote guides vision questing. In both tribes plants symbolize relationships between people on Earth and the universe.

The Chumash are probably among the least well known of Native Americans. Yet, the first encounter of the Spanish on October 10, 1542, with the Chumash along California's Santa Barbara Channel records a sophisticated Native society numbering more than ten thousand and governed by an old woman. Victims of disease and wholesale cultural disruption, by the early 1800s the Chumash population had been

reduced to less than three thousand. Today, a small remnant of Chumash numbering around two hundred hold title to a small reservation in the vicinity of the Santa Ynez mission near Santa Barbara.

Very little research or attention was paid to this California tribe from the ceding of California to the United States in 1848 until the late 1950s. For all intents and purposes, the Chumash were an extinct tribe or had assimilated into the melting pot of America in the minds of most Americans. Then in the late 1950s, an artist rediscovered complexes of caves in the interior of the Santa Barbara coast in what were the traditional homelands of the Chumash. The caves were decorated with multicolored pictographs of fantastic geometric, circular, and star-like shapes, and with animal and insect forms that seemed to be layered one atop the other, indicating generations of use. With the rediscovery in 1965 of the "Chumash papers" of John Peabody Harrington in a storage vault at the Smithsonian Institute, the meaning of the painted caves of the Chumash came to light. Harrington was an eccentric anthropologist who had dedicated his last years to comprehensively documenting the cultural history of the Chumash with the help of a few Chumash elders.

Harrington's papers revealed the echo of one of the most sophisticated Native astronomical traditions in North America. The painted caves and the star cosmology they visually evoked were part of a Chumash visionary tradition of astronomy inspired in part by the use of *datura*, a psychoactive plant long used in Native traditions of shamanism. The use of *datura* and the painted caves were associated with the vision questing and initiatory rites of the astronomer-priests who governed Chumash society.

For the Chumash, a foundational cosmological belief is that a primal energy permeates the universe and affects all its aspects and expressions. This force is essentially neutral and can be used for human purposes if properly approached. The Chumash believe that there are three worlds of existence in the universe: the underworld, the middle world, and the sky world, and each is occupied by various energies and beings. Humans live in the middle world and can act as mediators between the worlds through properly enacted ritual. The forces of all

three realms interact with one another to create a dynamic balance. This balance is always precarious and may become destructive if humans are not vigilant in their ritual activity, which the Chumash believe preserves the dynamic balance.

In the traditional Chumash view, the most powerful and important beings were the sky beings whose actions they traditionally attempted to interpret through daily ritual and close observations. Like the Skidi Pawnee, the Chumash see an order in the sky that they modeled in their political social organization. To the Chumash, the Sun is an old man whose lived in a quartz crystal house of light that traveled across the sky every day. The Moon is a woman, associated with *datura*, the vision plant, whose flowers open in moonlight. The Morning and Evening Stars are the two phases of Venus, with the Morning Star being a helper of humankind and the Evening Star, a giant golden eagle who devours human bones. The planets of Mars, Jupiter, and Saturn, along with the North Star and the Big Dipper are considered the other principal beings of the sky world, each with its own personality and temperament.

The Chumash traditionally followed every change of the heavens through the year and commemorated the key events of solstice and equinox with communal ceremonies. These ceremonies were presided over by an astronomer-priest called an *alchuklash*, who was a member of the *antap*, the elite caste of astronomer-priests who spoke their own esoteric language and from which Chumash chiefs were chosen. The most important ceremonies were the winter solstice ceremonies that reenacted the climax of the nightly ball game of the sky people. The Chumash believed that every night two teams of sky beings would play a cosmic ball game in which the very life of the universe hung in the balance. This sky game expressed the cosmic play of creation and destruction that underlies the primordial dynamic of the universe as the Chumash perceived its unfolding in the night sky.

The team headed by Sky Coyote (Polaris) was comprised of the sky beings, who represented the creative forces of the universe, while the team of Old Man Sun represented the forces of destruction and entropy. So it was that on the evening of the winter solstice the future of all life

could be lost if the forces of Old Man Sun were to defeat those of Sky Coyote by pushing the forces of creation from the heavens, allowing the Sun to leave the plane of the heavens and no longer rise to warm the Earth. In order to ensure the success of Sky Coyote, Chumash astronomers would pull the Sun back every year to perform through their highest ritual of "pulling back the sun," and thereby assisted Sky Coyote and his forces to prevail for one more year.

The ceremony of "pulling back the sun" had practical as well as cosmic dimensions for the Chumash in that the various Chumash chiefs from throughout the Chumash kingdom would assemble in the village of the *paha*, the high chief of the *antap*, with food, goods, and shell money that they had collected throughout the year. These goods, a form of tax revenue, would then be redistributed to people who had been widowed or orphaned during the year, the elderly, the handicapped, and even to other villages who had suffered a poor harvest or poor fishing during the year. This redistribution of wealth among the Chumash helped to restore and maintain the social balance and welfare of the Chumash kingdom. It also ensured that the *antap*, the society of astronomer-priests, remained in the good graces of the Chumash people and had their support for this cosmically inspired sociopolitical order.

As for the painted caves and the symbols they contained, it has been postulated that they were used for initiation and instruction of young Chumash men by the *alchuklash* through the imbibing of *datura* for the purpose of visioning. The fantastic and colorful rock paintings in the caves depicted symbols of the initiates' guiding visions as well as sky mythology in visual form. The *datura*-mediated vision quests, corresponding star mythology, star-inspired sociopolitical system, extensive practical knowledge of heavenly body movements, combined with other astronomically related ritual tools—feathered poles set against the horizon to site solstice rising and setting points, star maps of shells placed on cedar planks covered with tar, and notched moon-counting sticks, among others—define Chumash astronomy as one of the most sophisticated of Native America (Hadingham 1984:110-23).

### THE NAZCA ANIMAL GEOGLYPHS OF PERU

The Nazca culture of Peru evolved from about 300 B.C. to 700 A.D. in what is one of the driest places in the Americas. They were farmers, fishermen, and master potters. Indeed, it is through their pottery that the Nazca have been identified as a distinctive cultural group of this region of Peru. The "geoglyphs" (giant proportionally-drawn forms placed directly on the ground) found on the Nazca desert plateau on the south coast of Peru were probably among the largest and most sophisticated created by any culture in the world at that time. Until recently, the geoglyphs were one of the greatest mysteries of Nazca culture. Indeed, they were not even discovered by modern Peruvians until planes began to fly over the Nazca Plain in the 1920s. The full extent of the Nazca Plain geoglyphs is not visible except from a bird's eye view of over a thousand feet.



Aerial view of Nazca lines in the shape of a hummingbird.  
Photo © Eva Lewitus (Spencer 1983:6).

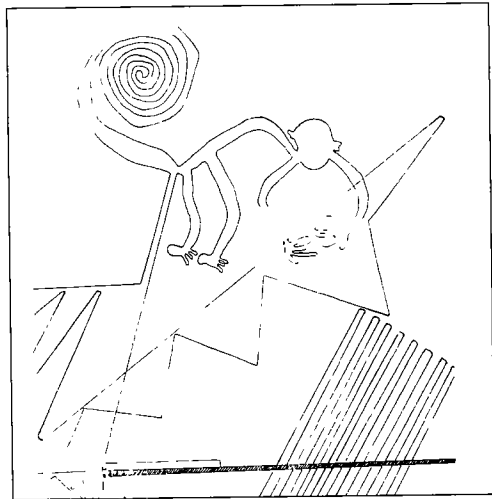
The layout of the geoglyphs appears similar in concept to medicine wheels in the northern plains of the United States, with certain sight lines aligned with the horizons and the solstice sun. Many of the giant figures are of animals, such as the hummingbird, spider monkey, and llama. These and human effigy figures are also represented in many design motifs of Nazca pottery and textiles. These giant drawn forms, many measuring over a hundred feet across, were part of a complex, agriculturally inspired form of astronomy that predates most of the known astronomical traditions of North America.

The geoglyphs were made by making proportionally measured lines (a form of Nazca geometry and mathematics) and then clearing the loose rock and dirt along each line to reveal the light colored soil and rock underneath. Given the exceptionally arid conditions of the Nazca Plain (about two inches of rain every two years), marks made on the ground in this way will last for hundreds, and even thousands, of years. The Nazca lines are similar to the *ceques* lines created by the Inca radiating out of Cuzco, the Inca imperial city, which were a part of their geographically situated calendar of astronomically aligned sight lines and shrines that formed "avenues" to the horizon and the heavens. These avenues were walked and the shrines visited by the Inca elite at various times during the year to commemorate important sky events such as equinoxes and solstices. It is speculated that the Nazca lines were walked in a similar way since many of the lines associated with the geoglyphs trail off to the horizon (Hadingham 1984:173-76).

The Nazca lines are likely a giant visual calendar with which the Nazca, like other Native cultures, entered into a dialogue with the stars. In the Nazca region the need for an accurate calendar to time harvesting and planting in such a difficult environment would have been enough motivation to create the lines. But, motivations for creating the geoglyphs probably went beyond just the need for planting to include the attempt of the Nazca to commune with the stars that glisten so beautifully in the arid and clear sky of the region. It was toward this end that the Nazca lines were used generation after generation as earthly pathways to the stars. Some lines trail to points on the horizon where the sun

rises and sets during the solstices and equinoxes. Other lines point in numerous other directions on the horizon that seem to have no pattern until you see them in relationship to the procession of constellation groups in the night sky.

The Nazca lines and their astronomical significance were unknown in the modern era until 1941, when Paul Kosok, an American historian who pioneered the study of the ancient Peruvian canals, took special notice of the "lines" that consistently appeared in many of his aerial photographs of the region while in search of canal routes. Upon closer examination, he realized that these were not canal lines but giant drawings of animals, geometric shapes, and other symbolic forms. Upon investigating one of these drawings near sunset in June on the shortest day of the year in the Southern Hemisphere, Kosok observed that one of the lines associated with a spider monkey was pointing directly to the solstice sunset, thus confirming that the glyphs and lines were associated with the rising and setting sun.



Drawing of Nazca Plain geoglyph of spider monkey and geometric shapes (Spencer, 1983:cover).

The glyphs, then, were understood to be a giant calendar, but how to read them as a calendar remained a mystery until Maria Reiche, an asso-

ciate of Kosok's, took up the task of comprehensive study of the glyphs in 1946. After years of painstaking work of measuring, documenting, drawing, and then sweeping each figure as she found them, Reiche had uncovered a giant spider, a huge monkey, fish resembling killer whales, a dog, a pair of lizards, a pair of llamas, a flower and other plants resembling seaweed, a pair of hand-like forms, a few other human-like figures, and another eighteen bird forms, ranging from hummingbirds to the frigate bird common to the Pacific coastal areas. Each figure consists of a single, solid unbroken line without a crossing of lines. This suggests that each figure may have been walked like a pathway by tracing the outline of the figure as a way of ceremonially acknowledging or otherwise symbolically resonating with the figures (Hadingham 1987:74-76).

There are a few animal forms relative to the geometric forms that are set apart or at times associated with the figures. The most numerous forms are spiral shapes of various sizes, many of which are coupled together and scattered in almost every part of the plain. It is speculated that the Nazca may have associated such spirals with snakes or the sun (Hadingham 1987:82). The Nazca Plain is a confusing complex of sporadic animal forms interlaced in a field of more numerous geometric forms, spirals, and lines, some of which seem to be superimposed upon another. It is not until some of the lines associated with the animals figures are followed into the night sky that the outline of constellation forms similar to the animal forms that appear on Nazca pottery begins to take shape.

Each of the Nazca figures seems to correspond to a constellation pattern in the sky. Such correspondence has been confirmed by computer simulated research, which has matched three points associated with the spider to the constellation Orion. Other figures are now being matched to star patterns recognized today. In addition, certain figures are being matched to patterns that are recognized by modern astronomers. The Nazca appear to have recognized the "dark space between star patterns" as well as the stars themselves. The Nazca Plain may in fact be a giant visual zodiac of animal forms that were probably associated with Nazca mythology and star lore. The lines that pass through each figure were



made over the course of generations to adjust the sighting of key stars in constellations. Adjustments were necessary due to the Earth's precession, or wobbling on its axis, which changes the way stars are positioned in the night sky over time (Kurtis Productions and WTTD 1990).

The geographic Nazca calendar may well be the most sophisticated "book" of astronomy ever produced in ancient times. Yet, much about the Nazca plain animal drawings remains a mystery. The Nazca, like other Native tribes, participated with the heavens through the daily and ceremonial acts of their lives. For them the practical and spiritual connections among themselves, the sky, and the animals were related through ritual and mythic compacts that they evoked through their creative imaginations and the form of astronomy they practiced.

#### PLACE AND ASTRONOMICAL ORIENTATION

In recent years, Western scientists have identified and explored ancient astronomical observatory sites and techniques used by Indigenous cultures throughout the world. The discovery in the late 1970s by artist Anna Sofaer of an ingenious twelfth-century Anasazi astronomical



Sun Dagger, Chaco Canyon, New Mexico. Photograph © Anna Sofaer.

marker, now called the Sun Dagger, revolutionized the discipline of archaeoastronomy. Near the top of Fajada Butte in Chaco Canyon, New Mexico, while surveying rock art, Sofaer found three sandstone slabs precisely situated in front of a small and a large spiral carved into the face of the butte. She discovered that sunlight, passing through the slabs, creates a dagger of light that bisects the larger spiral at midday near the time of the summer solstice. Her later investigations showed that during the spring and fall equinoxes, a light dagger falls on the right side of the larger spiral while another slender light dagger pierces the center of the smaller spiral. At the winter solstice, Sofaer found that daggers of light frame both the left and right sides of the larger spiral. Archaeologists also speculate that this site marks cycles of the moon as well, including major and minor lunar standstills. The Anasazi, careful and creative pre-Columbian builders, may also have constructed other observatories at Hovenweep in Utah, Mesa Verde and Chimney Rock in southern Colorado, and in other places in the Southwest. The Anasazi culture probably used natural site alignments to determine the date of the winter solstice. Alignments of windows, doorways, and niches in the walls of the circular ceremonial structures, Casa Rinconada and the Great Kiva at Pueblo Bonito in Chaco Canyon, suggest such use.



Grand Kiva at Casa Rinconada, Chaco Canyon, New Mexico, aligned to the winter solstice. Photograph © Marcia Keegan

Until Sofaer's work became known, archaeoastronomical studies had been focused on structures of the Mesoamerican cultures of Mexico and Central America, the best known of which is the ninth-century Toltec-Mayan structure at Chichén Itzá in the Yucatán called the Caracol. Western scientists believe the windows in the upper story enabled the Mayan astronomers to make precise observations of the settings and risings of the planet Venus, the celestial embodiment of the god Quetzalcoatl. These data shaped the Mayan calendars, the basis of the predictions that guided the life of their culture.

In Mesoamerican literary sources that survived the Conquest, there are illustrations of an astronomical instrument, the so-called "crossed sticks," that appears to have been used to determine the ascension of stars and planets above the local horizons from fixed locations in temple observatories. Astronomical tables appearing in the Dresden Codex (predicting the precise moments of the disappearance and reappearance of Quetzalcoatl) are known to have been developed at Chichén Itzá. Anthony Aveni, a leading American archaeoastronomer, believes that observations from the Caracol and other similar towers nearby probably helped the Toltec and Mayan astronomers refine their predictive tables (Aveni 1993). Among the Incas in Peru, Ecuador, and Chile, particular shrines (*huacas*) called *sucanas* were used as observational points in astronomy. Archaeoastronomers suspect also that the sighting tube chamber in "Structure P" at the ancient center of Zapotec culture in Monte Albán, Mexico, was used as a solar observatory.

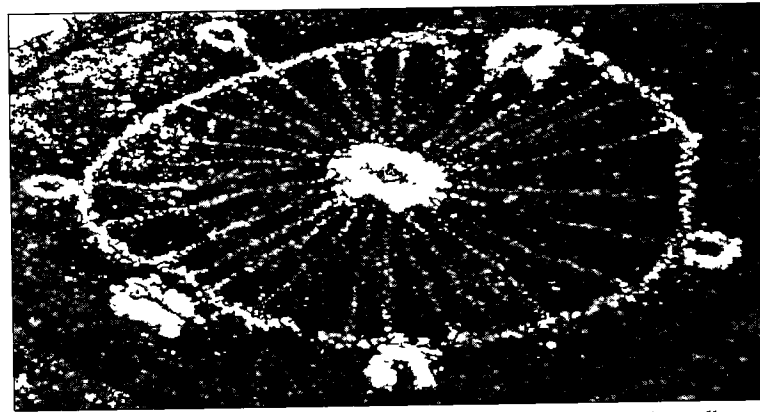
Archaeologists have noted that many groupings of buildings, plazas, stelae, and natural objects on the horizon suggest their deliberate alignment to enable astronomical observations by astronomers of earlier times. Examples noted by various researchers include the "Group E" buildings at Uaxactún in the upland Petén region of the Yucatán peninsula. The arrangement enabled observers to note the solstices and equinoxes, and apparently was reproduced in about a dozen other towns within about one hundred miles of Uaxactún. "Building J" at Monte Albán similarly has alignments with key points

on other nearby structures that point to the spot where the star Capella arose on the morning of the equinoxes.

In Colombia, the Kogi build pole-and-thatch temples of a rounded conical form, the height of which is equal to the diameter of the base of the structure. The hole in the roof of each temple is ordinarily covered by a piece of pottery. Inside are four ceremonial hearths arranged along nearly semi-cardinal lines (northwest to southeast and northeast to southwest). The first light of the sun strikes a hearth in the floor at the southwest on the morning of the summer solstice, traces a line to the east throughout the day, and stops in the southeast hearth. On the December solstice, the light first strikes the northwest hearth, then moves across to the northeast hearth during the day, where it gradually disappears. This temple pattern of light and hearths, "weaving the sun," has ritual significance in this South American culture where weaving is a metaphor for the structures of life and the cosmos.

Circles and similar formations of stones, called *megaliths*, were constructed in Ireland, England, and other locations in Europe. In Peru, and in the northwestern part of the U.S. and Canadian Great Plains, Native peoples constructed formations of stone now called *medicine wheels*. Over fifty such circles have been discovered in the Canadian provinces of Alberta and Saskatchewan and the states of Colorado, Montana, North Dakota, and Wyoming, and many were undoubtedly destroyed when settlers gathered the stones because they were readily and easily available to make foundations for their sod homes.

Medicine wheels are generally features of cooler climates. The most common form of medicine wheel follows a pattern similar to the spokes of a wheel. The spokes are made of loaf-sized stones that meet in the middle at a central cairn, or pile of rocks. Most wheels include from one to twenty-eight spokes, but some have no spokes, only cairns. The diameter of the medicine wheels may be as large as sixty yards with a central cairn three to four feet high and ten yards wide (Williamson 1984:200-01). Cairns and occasionally one or more concentric circles can also make up a medicine wheel (Aveni 1993:149).



Aerial view of Bighorn Medicine Wheel between Sheridan and Lovell, Wyoming, on Medicine Mountain.

Among the most likely observatory medicine wheels are the Bighorn Medicine Wheel (believed to be about three thousand years old) near Sheridan, Wyoming; the Fort Smith Medicine Wheel on the Crow Reservation in Montana; and the Moose Mountain Medicine Wheel in Saskatchewan. Cairns of stone on some of their radial lines and at the centers of the circles mark key points, which, when used as points on a sight line, provide an accurate determination even today of the summer solstice (Landon 1993:27-34).

### A Cosmic Journey

The Blackfoot legend of Scar Face presents another archetypal hero's journey of spirit. The story of Scar Face is a teaching story that reflects not only the courage of an individual in overcoming obstacles of cosmic proportions, but also the nature of the way Indigenous people viewed relationships with all things, people, animals, the earth, and the sky. The story is about "face," that is, the spiritual nature of character and learning how to develop our true selves. The story is also about journeying to the center, to "that place that Indian people talk about," the place of spirit both within ourselves and in the world as a whole. It is in "that place" that knowledge and gifts of spirit can be obtained. It is a place of spiritual vision, a place that one must learn how to seek, a place whose inherent

message is to be found in the landscape of our souls and that of the wondrous multiverse in which we live.

Scar Face lived with his grandmother, because his mother and father had died shortly after his birth. His face had a birthmark that set him apart from all others and became a source of ridicule and shame. Because he was different, he was taunted by the other children and whispered about by others in the tribe. As Scar Face grew older he withdrew into himself and spent much of his time alone in the forest befriendng and learning the ways of the animals he encountered. It is said that he learned to speak with them, and through them he learned how to be related with all things.

As Scar Face grew older he experienced all the things of life with humility and great reverence. He even fell in love, as young boys do, when they come of that age and express that facet of their "face." The focus of Scar Face's affection was a young woman, Singing Rain, the chief's daughter. Singing Rain was also a special person, kind and with a gift of insight. Although all the other young men competed for her affection, it was Scar Face whom she came to respect and love because of his honesty and good heart. However, when Scar Face asked her to marry, she revealed her sacred vow to the Sun to never marry as a pledge of spiritual piety in the way of the Blackfoot. The only way she could marry was if the Sun were to release her from her pledge. On hearing this, Scar Face determined to undertake a journey to the place where the Sun dwells to ask the Sun to release Singing Rain from her pledge. And so, it is said that Scar Face began his visionary journey to the land of the Star People.

Scar Face did not know where the Star People lived, only that they must live in the direction of where the Sun set every evening, beyond the Great Water in the West. So Scar Face prepared himself with help from his grandmother, and when he was ready he set forth on his journey, a journey to the land of spirit. He first traveled familiar territory, but then began to enter into lands that neither he nor other members of his tribe had ever seen.

As the snow of winter began to fall, a hundred paths became open to him and he became confused; he did not know which way to go. He met a wolf on one path and with great humility asked for help and direction.

Knowing the goodness of his heart, the wolf spoke to him and guided him to the right path. He traveled that path for a great distance until he came to another series of paths, and again he became confused. He stopped, set his camp, and prayed. Soon a mother bear and her cubs appeared on the path in front of him. Again, with great humility he asked for guidance from the mother bear. The bear spoke with great kindness and pointed out to him to the right path. Scar Face followed the bears' path for many days until the path ended. Now there were no longer any paths in front of him to follow, only the vast expanse of the great forest.

As he stood and pondered in front of the forest, two white snow owls approached him. He called to the owls and they landed in a pine tree above him. Again, he asked for direction and help from the owls. Knowing his heart and the nobility of his quest, they responded with great kindness. They guided him through the forest to the edge of the Great Water, where, exhausted, he made camp. He thanked the birds and he thanked each of the animals who had helped him by offering them a gift of song and tobacco. He could see a twinkling of lights across the Great Water and he knew that that was the land of the Star People.

Scar Face did not know how to cross the water to "that place that his people talked about." But he was determined to find a way. He made camp and then fasted and prayed for three days and nights. On the fourth day, a path of sunlight began to form in front of him leading toward "that place." He leaped onto the path and followed it as it took him higher and higher into the sky. When he reached the end of this path of sunlight he came to a beautiful forest and another path, a path of great width as if made by thousands of people traveling on it for a very long time. As he followed the path he came upon a richly decorated quiver of arrows leaning against a tree. He wondered to whom it must belong, so he waited to see. On the path coming from the other direction an extraordinary-looking warrior dressed in richly decorated white buckskin soon appeared. As the warrior approached, Scar Face could see that this man was an image of perfection. He asked Scar Face if he had seen a quiver of arrows. In response, Scar Face showed him where the arrows were. Grateful and curious, the stranger introduced himself, "I am Morning Star." Then he asked Scar Face his name

and where he was going. "I am called Scar Face and I seek the lodge of the Sun." Morning Star responded, "Then come with me. Sun is my father and I live with my mother Moon in his lodge."

When Scar Face arrived at the lodge of the Sun, he saw that the walls were painted with the history of all people of the world. Morning Star introduced Scar Face to his mother the Moon, and as his father the Sun entered the lodge a great light entered with him. Morning Star introduced Scar Face to Sun, the greatest chief. Scar Face was so impressed that he could not bring himself to reveal his reasons for coming to the land of the Star People. Sun and Moon treated Scar Face with great hospitality and asked Scar Face to stay with them as long as he wished. Over the next few days, Morning Star showed Scar Face the many paths in the beautiful land of the Star People. There was one path to a distant mountain that Sun had warned Morning Star and Scar Face never to go near. At the top of the mountain lived a flock of seven giant birds that the Star People greatly feared.

One morning, Scar Face woke to find Morning Star gone. Scar Face arose and quietly left the lodge of the Sun to take a walk and decide how he might ask the Sun to release Singing Rain from her vow. He thought he might meet Morning Star and ask him for advice. As he walked, he began to feel that something was wrong, and the nearer he came to the mountain where the giant birds lived, the stronger his feeling became. He knew that for some reason Morning Star had gone to the forbidden mountain.

Scar Face set out in search of Morning Star. As he climbed to the top of the mountain of the giant birds he found Morning Star engaged in a ferocious battle with the birds. These birds were indeed savage and extremely large. They were about to overcome Morning Star when Scar Face joined the battle. Scar Face fought valiantly and soon turned the tide of battle. One by one, Scar Face and Morning Star began to kill the giant birds until all seven were slain and their tail feathers taken by the two warriors.

Tired, yet proud of their accomplishment, Scar Face and Morning Star descended the mountain and returned to the Sun lodge to inform Sun and Moon of the defeat of the Star People's most feared enemies. Sun and Moon were very impressed by the courage shown by both young men and were especially grateful to Scar Face for saving the life of

Morning Star. In honor of the courage of Scar Face, Sun offered to fulfill any desire that he would request. Yet, Scar Face still could not speak his greatest desire and remained silent until Moon, who knew his heart, spoke of Scar Face's love for Singing Rain and her vow to the Sun that prevented them from being together. Sun immediately responded by saying to Scar Face that he would release her from her vow. Sun touched the cheek of Scar Face and the scar that he had borne all his life disappeared. Morning Star in turn gave him special personal gifts and revealed to him that he was his "spirit" father, confirming the feeling that Scar Face had felt all along.

Then Sun and Moon began to sing songs in praise of Scar Face and Morning Star. Sun and Moon gave Scar Face many gifts, including rich clothes and a special shirt. In addition, Sun renamed Scar Face "Mistaken Morning Star" because now without the scar on his face he looked like Morning Star. Sun taught Mistaken Morning Star his own special dance, the Sun Dance. He said that if Earth people wished to honor him and bring health and well-being to their tribe they should dance the Sun Dance each year when he had reached the highest place in the sky. Then Morning Star led his Earth son to the path called the Wolf's Trail (Milky Way) and placed a wreath of juniper on his head. In an instant, Mistaken Morning Star was back on Earth and on a path leading to his own village.

Singing Rain was the first to meet Mistaken Morning Star as he approached the village. He told her that Sun had released her from her vow, and she knew in her heart from seeing and feeling the magnificence of him that they could now be together always. Mistaken Morning Star called the people together and taught them the rituals of the Sun Dance. He showed the women how to build the Sun Dance lodge, and he taught the men how to conduct the sweat lodge ceremony and raise the Sun Dance pole. He taught them about the sanctity of their individual spirits and the nature of sacred visioning. He taught them from "that place that Indian people talk about."

There are profound lessons to be learned from stories like that of Scar Face. Traditional versions of such tales told in Native languages have a richness and depth of meaning that are difficult to express in English

translation. Such richness and depth of meaning are equally true of other similar tales among Indigenous people around the world. Like the mythical spirit deer, they leave tracks beckoning us, if we would but follow (Grinnell 1962:93-103 and Wood in Cajete 1994:64-67).

## Meanings and Possibilities

In many ways Native American astronomy embodies all that Indigenous science is about, and is therefore, the composite Native science, as it includes all components that one finds in any particular tribal culture or tradition. In other words, astronomy incorporates all areas of Indigenous science. Native astronomies reflect on a particular people's cosmology, or their stories of creation of the Earth and the evolution of human beings. Indeed, many Native origin myths are about the sky or cosmos rather than the Earth.

The cosmological concepts that underpinned the astronomical practices of Native cultures were and are profoundly sophisticated and spiritual. These ancient, widely separated peoples traditionally sought meaning and order for their lives in the heavens with perhaps more intensity than Western scientists, for their very survival depended on these observations. They conducted their everyday lives based on these observations. They exchanged no letters, and television did not reveal to one tribe what another believed. While some ideas may have been shared via trade, each tribal group spoke its own language. Many of these ideas arose from within the spirit of an individual tribe, which was deeply integrated with their homeland. Given this spiritual/cultural interior focus, astronomy as a conceptual framework pervaded the lives of Native cultures until relatively recent times.

Much of the richness and use of Native astronomy has been lost to the forces of cultural disintegration, acculturation, and neglect, result of the deaths of tribal elders and the consequent loss of their knowledge. What remains is but an echo of what once was the premier Native science with an extraordinary focus on participation with all aspects of nature and the cosmos. In such an echo is to be found a lament and an invitation to once again "live the sky" as a guiding metaphor for ethical

conduct and a contemporary expression of life lived in sustainable and reverent interrelationship with nature.

The historic efforts of Native cultures to resonate with the heavens also represent their attempts to live up to an ideal ecological relationship with the Earth. This knowledge must now be transferred to others and studied seriously by Native and non-Native people the world over for the models and lessons that it can provide as we collectively search for an environmentally sustainable future. Today, a new generation of scientists, scholars, historians, philosophers, and artists have become fascinated in their own intense ways with the skies above Earth. Millions of dollars are being spent on efforts to conduct research in space and to observe celestial bodies more closely than ever before. Western scholars are now attempting to reconstruct the philosophical and historical record of Native astronomy, and contemporary Native people have begun to innovate creatively on the legacy of this grand tradition and bring its spirit to life once again in their art, music, dance, and story. This is particularly notable, because until recently, Western science scoffed at the notion that Native cultures could have any form of sophisticated astronomical ideas or associated technologies, and assimilated Native Americans appeared to agree. With the discovery of sites such as the Sun Dagger on Fajada Butte in Chaco Canyon, and the alignment of portals in Anasazi and ancient Egyptian structures, however, archaeoastronomers have begun to alter their perceptions of Native astronomy.

Characteristics of the cosmos that modern science is now describing through the application of quantum physics theories, and as a result of deep space observation made possible by new computer-enhanced technologies and the Hubble Telescope, exhibit striking metaphoric parallels with the creation stories and descriptions of a "living" interconnected universe that inform Native science. The self-ordering yet paradoxical nature of the universe as reflected in descriptions of chaos theory are also echoed in many Native creation stories and trickster myths. The second law of thermodynamics, which describes the physical dynamics of the creative process as it moves from an ordered state to disordered and back again, is metaphorically echoed in the Aztec calendric construct of the

"thirteen heavens and nine hells" and the Chumash myth of Sky Coyote and the celestial ball game. The concepts of biological evolution are likewise metaphorically represented in the Hopi story of emergence. The physical parallel worlds referred to in quantum physics also form the foundation for Native shamanism and its view that our various physical and non-physical "worlds are constantly interacting, coming together and flying apart in dimensions we cannot experience, every time anyone makes a single observation" (Wolf 1992:293).



Solstice markers on a cliff top along the eastern high plains of New Mexico, these two standing stones are aligned almost exactly NW 300° and SE 120°, marking summer solstice sunset and winter solstice sunrise. Nearby are two stone structures whose doorways precisely frame the winter solstice sunset. Some fifteen tons of rock were used to build the structures, making it unlikely that the doorways are aligned by accident. Photograph © Robert W. Parker.

Native astronomies are expressions of the universal process of human inquiry into the nature of nature in order to make human life both possible and more meaningful. By attempting to see the cosmos through the eyes of Native skywatchers, we can allow ourselves a perspective that may better equip us as we search for a more sustainable future, and as we attempt to address the quintessential question of relationship and interdependence of our time: how will we be able to once again relate to nature and then to each other in an ecological and life-sustaining way?



Faces of the seventh generation. Photograph © Marcia Keegan.

## CHAPTER EIGHT

# Creating New Minds and Worlds

*“Finding our face, finding our heart, finding  
our foundation . . .”*

. . . Everything an Indian does is in a circle, and that is because the power of the World always works in circles, and everything tries to be round. . . . This knowledge came to us from the outer world without religion. Everything the power of the World does is done in a circle. The sky is round, and I have heard that the earth is round like a ball, and so are the stars. The wind, in its greatest power, whirls. Birds make their nests in circles, for theirs is the same religion as ours. The sun comes forth and goes down again in a circle. The moon does the same and both are round. Even the seasons form a great circle from childhood to childhood, and so it is in everything where power moves. Our teepees were round like the nests of birds, and these were always set in a circle, the nation's hoop, a nest of many nests, where the Great Spirit meant for us to hatch our children.

—Black Elk, *Black Elk Speaks* (Neihardt 1995)

## A New Sun

Like Indigenous people elsewhere, the First Peoples of Mesoamerica venerated the physical forces of nature and the spirit of the cosmos, especially as they were reflected in the presence and movement of the sun, moon, Earth, planets, and constellations. They found the Earth and the cosmos to be imbued through and through with life and energy. They named the flowers, plants, places, animals, mountains, rivers, lakes, springs, and trees in accordance with the qualities they perceived in them.

Even in the midst of the mystery they saw in nature on the Earth, these people reserved a special place in their imaginations for the heavens. They wondered about the grand movements of heavenly bodies. They observed the appearance and disappearance of heavenly bodies and their cycles of movement through time and space. They measured time and space as a function of the sacred circle of life. From their observations a great calendar evolved, which embodied in thought, form, and principle the creation and nature of the universe. Around this great calendar arose the idea that the sun fought the stars from the sky only to die at night and be reborn each new day to repeat this sacred cycle. The sun came to be viewed as a supernatural being, a great and immensely powerful warrior.

So it was, then, that these great cycles of light and dark, sun and moon, came to guide the mind and spirit of Indigenous Mesoamerica. Mythic understandings developed around the symbols and workings of the great calendar in light of the birth, death, and rebirth of the sacred time of the sun. The symbolic Great Tree of Life grew in this rich imaginative soil, rooting stories of the creation of the universe, the birth of the sacred twins, and the first plants, animals, and human beings. At the core of these stories is the essence of "spiritual ecology," or the cornerstone of human intention. In poetic story the mythic origins, purpose, and vision of the great calendar have been carried through hundreds of generations.

Among the Aztec (Mexico), one of the most recent carriers of the calendar, the goal of an authentic life was to "find one's face, find one's heart," and to search for a "foundation," a truth that one works through to express one's life. The Aztec developed schools of Native science, called

the *calmecac* in which the *tlamatinimine* (astronomer-philosopher poets) taught the calendar, medicine, astronomy, religion, mathematics, and architecture, using poetic chants called "flower and song" (Portillo 1993:140). The *tlamatinimine* explored with their students the heavenly bodies, the cycles of space and time, the mystery of life after death, and the nature of life and relationship. They studied people as creators of a way of life and of educational, ethical, legal, and aesthetic principles within the context of proper relationship to earth and sky. They explored the spiritual, communal, and personal ideals that gave rise to the divine spark that transformed humans into artists, poets, sages, and keepers of the great calendar.

According to the Aztec great calendar, 1,144 years comprised an epoch of time. The epoch consisted of twenty-two cycles of fifty-two years each. Thirteen of the cycles were described as "heavens of decreasing choice," and the remaining nine as "hells of increasing doom." In Aztec mythology, an epoch denotes the cosmic cycle of creation and dissolution, or of birth, growth, development, maturity, old age, and death. This metaphor is reflective of a "fatalistic" perspective said to characterize Aztec prophetic poetry, a perspective that would play a pivotal role in their demise. The Aztec imagined Hernán Cortés as a reincarnated Quetzalcoatl, their great cultural hero whose return had been prophesied. Their perspective reflected also the constant cycling of the creation and dissolution of matter mythically related in that hero's story and the transcendental quality of nature and human societies.

Quetzalcoatl, "Lord of the Dawn," continually battles with his sacred twin Tezcatlipoca, "Dark Lord of the North." The story of Quetzalcoatl, the hero, is one of transcendence and deep change, an embodiment of eternal creation and dissolution. Quetzalcoatl was to return near the beginning of the fifth sun, the epoch of calendar time that began in 843 A.D. It is said that priests of the Quetzalcoatl cult awaited his coming for two "heavens," or two cycles of fifty-two years. His birth is said to have occurred at the dawning of the day, "one reed in the year one reed," the beginning of the third fifty-two-year cycle, as the morning star Venus shone brightly in the early morning sky.



As the story goes, the child was named in accordance with the great calendar, "Ce Acatl Topiltzin Quetzalcoatl" ("Our Lord One Reed Feathered Serpent"). His mother died at his birth, and he was raised in the temples of Xochicalco. According to the council of priests and elders, as a child he came to know and commune with living and spiritual beings, including the little spirits of nature known as *tlaloques*, who taught him the ways of the living Earth. As he grew, he performed many divine deeds, teaching his people the ways of divine laws and arts, building great cities, and creating a context for compassionate living and relationship to the Earth.

Alas, it is told that he was tricked into drinking *hikuli*, the milk of peyotl used in the ritual of human sacrifice by the jealous followers of Tezcatlipoca, thus forever compromising his position as ruler of his people. In this way the followers of Tezcatlipoca gained control of the minds and hearts of the people and drove Quetzalcoatl into exile. The new order then became one of the pursuit of power and glory through war and human sacrifice.

Quetzalcoatl and his followers made a pilgrimage through the sacred landscape of Mexico to the valley of the Tree of Life, in Oaxaca. It is told that he and his followers prayed at the shores of Lake Tezcoco, which would later become the Aztec capital city of Tenochtitlán. They stopped at the foot of Popocatepetl, the great volcano, where it is said Quetzalcoatl renewed his boyhood ties with the spirits of nature. Then they climbed the great volcano, where more than two-thirds of his group were lost. As Quetzalcoatl mourned his companions, he was visited by a sage from each of the four directions. He gave four words to each sage to carry to their peoples for ceremonies and guiding stories. The common word given to each was the word "tree," the Tree of Life, symbol of Quetzalcoatl's teachings. He turned over leadership of his group to one of the sages and went on alone for the last part of the journey to the valley of the Tree, meeting and talking with many people on the way.

It is said that Quetzalcoatl was forty-six, an old man with gray hair, when he finally reached the valley of the Tree. There he had a vision of the events to come, and he wept. He spent the last years of his life under

the great Tree designing Milia, the sacred city of books, which would be a place for the seers, artists, philosophers, and poets to work and to learn the philosophy of the Tree.

Quetzalcoatl died when he was fifty-two years old. One short cycle of the sacred calendar, one of the Lord of Life's thirteen heavens was all he was given. The date of his birth by the Christian calendar was 947 A.D., and of his departure, 999 A.D. His death marked the beginning of the fourth cycle, or heaven. Before his death, Quetzalcoatl promised to return to close the thirteen heavens and to open the nine hells. Hernán Cortés reached the shores of Mexico on April 21, 1519, on the day one reed, the year one reed, which was the birth date of Quetzalcoatl and the first year of the first fifty-two-year cycle of the nine hells.

The fifth sun, as commemorated in the great stone calendar of the Aztecs, ended on August 16, 1987. Thus, we have entered the first heaven of the "sixth sun" of the great Mesoamerican calendar. What will be the guiding nature of this "new sun," this new epoch of 1,144 years? What will be the nature of the choices we will make in the next fifty-two years?

If we believe that the eternal cycle of creation and dissolution repeats itself, then the new fifty-two-year period of the first heaven can be the foundation for new hope for Indigenous people in the Americas and for all people everywhere. In certain ways, this new flowering of the living philosophy of the Tree may be connected to the resurgence of pride in Indigenous identity, and of the evolution of global consciousness and environmental philosophy. This new flowering is also a reflection of a way of education for life's sake that must be nurtured once again.

The Tree of Life is reflected among Indigenous people of the Americas as a metaphor for life, healing, vision, and transformation. The Tree is symbolically interwoven with another metaphor that orients its central teachings. Called the pecked cross, the life circle, or the medicine wheel, its roots are deep in the soil of Native American consciousness. This circle of life holds archetypal elements of earth, wind, fire, and water, and all the physical, mental, spiritual, and emotional aspects of human nature. At the center of this circle is potential realized through the interplay of volition, vision, sense of identity, values, growth, and

change. Four great human developmental stages give meaning and value to each human being throughout life—protection, nourishment, growth, and wholeness. These stages bring forth the key meanings and teachings of the Tree.

Through an understanding of “protection” (the shade of the Tree), we come to see how the Earth provides for human life and well-being. In understanding the nature of “nourishment” (the fruit of the Tree), we come to see what we need to grow, to live a good life. We come to understand how we are nourished through the relationships we have at all levels of our nature and from all other sources that share life with us. We also come to know that as we are nourished, so must we nourish others in turn. As a tree grows through different stages—from seed to sapling, to mature tree, and to old tree—we see that growth and change are the key dynamics of life. We also learn that growth and change reflect self-determination, movement toward our true potential through the trials and tribulations, the “weather” of our lives. “Wholeness” is the finding and reflection of the face, heart, and foundation through which our lives become a conscious part of a greater whole, or part of a life process rooted to a larger past, present, and future ecology of mind and spirit.

When we reflect in this way on the Tree of Life, we perceive that this way of learning and “coming to know” is tied to deep environmental awareness and reaffirmation of responsibility for the care of the Earth. As Vaclav Havel (1994:31-35) states:

Something is being born. . . . [W]e are in a phase when one age is succeeding another, when everything is possible. . . . The only real hope of people today is probably a renewal of our certainty that we are rooted to the earth and at the same time to the cosmos. . . . [I]t logically follows that in today’s multicultural world, the truly reliable path to coexistence, to peaceful coexistence and creative cooperation, must start from what is at the root of all cultures and what lies infinitely deeper in human hearts and minds than political opinion, convictions,

antipathies, or sympathies: It must be rooted in self-transcendence. Transcendence as a hand reached out to those close to us, to foreigners, to the human community, to all living creatures, to nature, to the universe; transcendence as a deeply and joyously experienced need to be in harmony, even with what we ourselves are not, what we do not understand, what seems distant from us in time and space, but with which we are nevertheless mysteriously linked because, together with us, all this constitutes a single world. Transcendence is the only real alternative to extinction. Something is being born.

### FINDING FACE

What is the “face” of the new sun? What new perspectives must be formed to define its characteristics? What new types of “coming to know” will such a new face require? The learning that will transform the current state of affairs must be transcendent, multidimensional, cultural, and powerfully effective and sustainable if we are to survive the next 1,144 years, the sixth world of the Mesoamerican calendar. In reality, we must learn how to teach new generations a new worldview, from cosmology to consciousness, from the “inside to the outside.” This new worldview must not only engender a different lifestyle but also a different and deeper way of human knowing.

This new face must reflect meaning in life that is not the result of economic calculation, nor of microanalysis in any one discipline. The new face will not result from more, or more clever, political, technological, and scientific interventions, because these systems are founded on an inherently flawed understanding and practice of interaction with nature. It can only result from a life-sustaining cosmology, an eco-cosmology that gives rise to an eco-philosophy, the foundation for a new ecology of thought and purpose for education, economics, social life, organizations, government, and politics. Creating this will be a tremendous challenge, but the potential negative consequences of not creating a life-sustaining cosmology are equally tremendous.

## FINDING HEART

In Mesoamerican philosophy, the human heart housed the soul, the place where our highest form of compassion resides. The spirit, feelings, emotions, and passions that move us to act, speak, and know reside in the "body" of our heart. For the Mesoamerican poet-philosophers, developing heart was the reason for verses of flower and song that could transcend time and place and resonate for all people who would see and hear their truth.

Finding heart is a metaphor that captures the impassioned purpose and spirit essential in sustaining the effort needed to transform our lives. What are some of the ways this heartfelt motivation can be fostered? How can heartfelt thought and energy be mobilized to engender knowledge and values, reorient power and intent, move from arrogant humanism to the development of the ecological human, and create a modern cultural base for ecological ethics and a reverential consciousness toward all life? These are the foundational questions.

One of the most crucial dynamics that must be engineered and facilitated if transformational learning is to take place involves a fervor for evolving a true eco-cosmology in contemporary lives. We need an impassioned "mistica"—mission, passionate desire, and empowered need—to strive for "ecological personhood." The thinking about an evolving eco-cosmology can be likened to spawning colonies of "menomes," viruses that prepare a host for its survival and ultimate replication. Colonies of conceptual menomes preparing the birth of this essential eco-cosmology have been incubating for quite some time.

Very simply, our very survival as a species depends on our ability to make such a transformation. Every generation must develop and add a social ecological imperative to perennial truths; these are the foundations of life we pass down to subsequent generations. This "seventh generation principle" of the great law of the Iroquois Confederacy is well understood by most Indigenous people as a prime directive of human and cultural sustainability.

Cultures that violate this directive gradually cease to be viable and vanish over a period of time as a result of cumulative degeneration. Therefore, the impassioned mission must evolve around issues that affect

the survival and viability of all cultures. Indigenous cultures still hold to the rudiments of the eco-cosmologies of former times. The preservation, reinterpretation, and reintroduction of "foundational" cultural ethics must constitute one of the first goals of such a mission.

An impassioned explosion of directed action results from critically discussing issues and approaches that affect people in their "gut," or "where they live." A first strategy for making a truly multicultural, environmentally based educational process work is to enlist people with talent for teaching about the ecological/cosmological crisis of modern society. A second strategy is to identify those issues that elicit impassioned responses and to focus on them.

One of these issues is the preservation of cultural diversity, and in turn, contemporary revitalization of cultural ecological philosophies worldwide. We must begin with our own communities and bioregions.

Ultimately, finding face and finding heart are dependent on discovering our essential relationships with ourselves and with the natural world. The work of Michael Cohen in helping young people "regenerate" their connections to nature and in the process to reconnect to themselves and their community is exemplary of the "re-learning" that must occur if this transformation of education is to take hold. Cohen introduces students to Gaia, the Earth Mother of ancient Greek culture, through the direct experience of feeling the pulse of the clouds, rain, snow, mountain, lake, river, canyon, plants, and animals (1974, 1987, 1997).

Learning from nature directly moves us beyond the everyday, socially conditioned flow of life in which we are immersed in our homes and malls. The "mediated pulse," that window through which we know nature today, is largely only a fantasy created through words and images describing nature. Only by truly touching the Earth can we honor and enable the vision and action necessary to recapture the feeling and understanding that we have always been a part of a living and "conscious" Earth.

## FINDING A FOUNDATION

"Foundation"—the metaphorical truth that one works through to express one's life—reflects the evolution of ways of "coming to know"

and of living based on a life-sustaining cosmology. Miriam McGillis, a Dominican nun, has eloquently spoken on "the fate of the earth," of the need for stewardship, and of the necessity to create a transforming vision for our future. McGillis (n.d.) believes that the environmental crisis is of a magnitude never before faced, and that we are living in a time of "supreme crisis." That is the reality of our time, but it is no accident that we are born in these times, with our lives unfolding now, with our particular histories, and our particular gifts, experiences, and wisdom.

The transforming vision of which she speaks must be deep enough to encompass all that we have become, along with all that we must now become as participants in the healing and regeneration of the earth. That vision must open up our future to hope and recreate us as "people of hope." The education engendered from such a vision must be all-inclusive. Each person must feel that his or her life and work are significant in making such a global reality come into being. The new kind of education, work, and play must embody hope. Hope is, after all, a choice. We have to teach ourselves and others that we can make a difference. Choosing a life of seeking life is the central message of Indigenous cosmologies, and also reflects the deepest aspects of human nature.

Hope for an education toward sustainable Earth culture has been evolving for some time. In a 1993 study of a remote Yupiaq village school system in southwestern Alaska, utilizing participant-observer research methods, A. Oscar Kawagley (1994) studied the practices of a traditional fish camp that attempt a balance between human, natural, and spiritual realms, and how these relate to children's science education. In *Look to the Mountain* (1994), I presented a curriculum developmental plan already in use in New Mexico incorporating Indigenous philosophical concepts into the study of science. The 1995 Ahkwesahsne Science and Math Pilot Project, conducted on the reserve in Ontario, Quebec, and New York state has incorporated creation stories, history, geography, and language arts, studies of birds, Indian medicines, and edible plants, and the impact of industrial pollution and its projected effect on the seventh generation. This project uses elders and spiritual leaders in the classroom, and no other textbook provides as much information about the alteration of the

environment along the St. Lawrence River. As a result of the use of cultural values and concepts in this project, an amazing increase in self-esteem has occurred among Native students (Martin 1995).

Native science's view on environmental sustainability has at long last also begun to affect Western scientists' opinions. After many years as a distinguished physicist, F. David Peat, author of thirteen books about science, studied the cultural and educational implications of the merging of Western and Native science. Peat wrote in 1994 that Native science conforms in many ways to the definition of Western science, but that it is not possible to separate it from ethics, spirituality, metaphysics, ceremony, and social order. In Western society, science and technology have come to have a kind of life of their own. The splitting of the atom, creation of the computer, advances in genetics and microbiology, among other developments, have given science and technology an aura of invincibility. But with the developing prominence of the theories of quantum mechanics and nonlocality, theoretical physicists like Peat have sensed that the universe has a nonmaterial, deep spiritual dimension, even an elegant guiding intelligence that has already been recognized within Native science. As they have probed the universe and the Earth, Western scientists have begun to sense their magnitude and complexity. They have begun to understand the universe as a "creation in grand process," in which our Earth and its inhabitants are a moment in an unfolding cosmic process. Our universe and planetary system are but small eddies in an ocean of creative process that began more than fifteen billion years ago.

The survival of planet Earth may be dependent on Western science's ability to acknowledge and utilize the principles of Indigenous science. Cross-cultural exchange and collaboration through participatory research might ensure such utilization (Colorado 1988). Indigenous science, then, would be recognized as an equal but different source of knowledge, not measurable through a Western worldview.

Some scientists have begun to appreciate how much was accomplished and passed down to Western science by Indigenous peoples. Agricultural knowledge may actually have been first developed as a science among African people at least seven millennia before it appeared on any

other continent. A numerization system found in Zaire, dating back an estimated eight thousand years, shows that mathematics was also highly developed (Harding 1991).

While it is indisputable that Indigenous science predates and forms the basis of much Western contemporary science, little recognition has been given these accomplishments. However, with the resurgence of interest in cultural heritage among Indigenous peoples, Native sciences are now being preserved and honored in some communities. For instance, in Hay River, Northwest Territories, Canada, the Déné Cultural Institute began in 1989 to document and promote Déné knowledge and to integrate it with Western science to aid in future resource management. Research began with the ecological study of four animals: moose and barren-ground caribou, which are major sources of food, and beaver and marten, the most economically important fur-bearing animals. Information examined included interspecies relationships, habitat and habitat relationships, life cycles, reproduction, migration, population dynamics, parasites and disease, and traditional and modern management.

Initially, the community was not interested, and in its first phase, the project had to conclude that it was unclear to what extent Western science and Déné ideas about ecosystems concurred. Many Déné people recognize complex ecological linkages and have as much understanding of some fish species, ecology, and wildlife as do Western ecologists. But the Dénés and Western scientists differ in their explanations of ecological processes and environmental management. "Traditional Déné ideology consists of a spiritually based moral code or ethic that governs the interaction between the human, natural, and spiritual worlds" (Johnson 1992:59). Like Indigenous people the world over, the Déné consider the land and its resources to belong to future generations. The Earth is a living organism; all its elements, maintained in balance, have a reason for being—to ensure continued life on Earth. Humans have no special authority over the natural world.

In the past decade an increasing number of projects based on Indigenous knowledge have been established as people feel an urgency about the natural Earth and want to communicate this to the public.

Much of the current effort to preserve traditions is related to Western science's attempts to usurp, even to patent, plants used by Native peoples. All over the world, Indigenous communities are creating organizations that promote, conserve, and protect traditional medicinal plants and knowledge. Through these organizations, they have been trying to affect decisions about dams, forest clear cutting, fishing rights, mining, low-level airplane flights, and water pollution. To revitalize themselves and to preserve their traditional knowledge, communities enlist the help of their own people, particularly their elders, whose knowledge of Native science sustained communities long before contact with European societies.

In the Andes of Peru, identified by Western science as one of eight centers where cultivated plants originated, farmers have the potential and the resources to regenerate their traditions without breaking from their ten-thousand-year history. "With the collapse of the formal economy of Peru, the spectacular failure of most development projects, the rapidly deteriorating environment and the chaotic political situation in the country, the only vibrant, non-destructive and dynamic sector of the country is the Andean peasantry" (Apffel-Marglin 1997:222). An organization called PRATEC (Andean Project of Technological Campesinos) includes academics and ex-government bureaucrats who research, teach, and write from the Andean worldview, while rejecting any claims to universality or absolute truth.

In Fiji in the South Pacific Ocean, the Women's Association for Natural Medicine Therapy (WAINIMATE) has been promoting use of safe and effective rainforest medicinal plants in Fiji and other Pacific islands. WAINIMATE organizes community workshops and creates demonstration gardens, as well as provides resource people to train others in plant recognition and use. Members prepared a traditional medicine handbook and are in contact with other organizations working on similar issues and concerns (WAINIMATE n.d.).

Zuni elders in New Mexico advise the Conservation Project, which is modeled on those in use in Ghana, Nepal, Bolivia, and Mexico, facilitating a harmonious integration of traditional and mainstream resource

management practices begun in 1994 (Thorpe 1996). Zuni customs provide guiding principles for the project's approach to training and work on sustainable agriculture, forestry, hydrology, freshwater resources, fish and wildlife, range conservation, and watershed restoration. In only a few years the group has attracted tribal hunters, farmers, youth, elders, ranchers, and religious liaisons, and as a result of their successes, more than forty nations have sent delegates to visit.

In Canada, the Aboriginal Science and Technology Society works to ensure scientific responsibility on Indigenous lands and the recognition of Native science, and to encourage Native people to join the scientific community (Settee 1998). Conferences have been held in Vancouver, British Columbia; Winnipeg, Manitoba; and Edmonton, Alberta. In September 1998, a Saskatchewan conference featured presentations on seed projects, the preservation of biodiversity, scientific responsibility, and environmental issues. Academics were recognized for their efforts to preserve Indigenous plant practice by combining it with Western agricultural knowledge in new agrarian projects.

These campaigns need money to attract attention to Native science. The Honor the Earth Campaign, spearheaded by the Indigenous Women's Network, the Indigenous Environmental Network, and the Seventh Generation Fund, as well as the Indigo Girls and other musicians, have been raising public awareness and financial support for grassroots environmental initiatives through concerts and speaking tours. As part of their educational campaign, they distribute postcards to key politicians and decision makers on specific issues. Advertised on the Web, their first event raised \$250,000 and helped finance thirty-eight community environmental projects.

Scientists have come to see the plant and animal wealth that continues to exist in their natural habitats within Indigenous homelands as rare and desirable. Communities have been besieged by outsiders as their unspoiled land is recognized as a new form of wealth. The exploratory search for rights to Native land and concern about patents for plant use have created tremendous strain and tension within these communities.

Vandana Shiva, ecologist and director of the Research Foundation for Science, Technology, and Natural Resource Policy in India, has been an outspoken advocate and leader in the preservation of biodiversity within Indigenous communities. He calls attempts to acquire Native people's knowledge and land without compensation "biopiracy," and Western science "the new conquistador." Shiva believes that the world's biodiversity is endangered because of international building and mining projects and exploitation of the oceans. The erosion of biodiversity causes a chain reaction resulting in unforeseen problems. According to Shiva (1997:66), "The crisis of biodiversity . . . is not just a crisis of the disappearance of species which serve as industrial raw material and have the potential of spinning dollars for corporate enterprises. It is, more basically, a crisis that threatens the life-support systems and livelihoods of millions of people in Third World countries."

At the root of biopiracy lies the concept of intellectual property rights. Western scientists see natural resources such as plants as valuable only because of their commercial worth, while Indigenous communities hold such resources as communal, and have little concept of private property concerning biological and medicinal knowledge. Privatization of plant knowledge is a serious matter for people who rely on their backyards for food and healing. Indigenous healing practitioners themselves seldom use knowledge to amass private wealth; in fact, they frequently *give* their knowledge, a practice called in India, *gyan daan*, the "gifting of knowledge." While it is difficult to attach a dollar figure to the useful plant life in Indigenous peoples' communities, "by one estimate the market value of plant-based medicines alone sold in developed countries amounted to \$43 billion in 1985" (Posey 1996:34). Much less than one percent of that is ever returned to the source community (Posey 1996; Simpson 1997).

Associated with the issue of the ownership of plant knowledge is compensation for ancestral Indigenous knowledge and how to recognize such contributions in building the foundations of modern scientific knowledge. When Western scientists find a plant useful for healing or for manufacturing, they attempt to patent it. That practice undermines a

central Indigenous community value, as it is granted by a government to a person or firm who "made" the innovation or invention, and therefore, becomes a "right to prevent, to restrain, to limit others from imitating, adapting, improving, producing, or using, even for public welfare and development, the patented produce or process. . ." (Brush and Stabinsky 1996:310). Clearly the "discovering" scientist did not *make* what she or he found, an innovative use of a plant; Native people had understood that use for generations. "Instead of promoting self-reliant national development, they [patents] serve private interests of foreign corporations . . . [and] universalize the U.S. system of intellectual property rights, thereby constraining the national interests of developing countries. . ." (p. 315).

Arguments about rights have swung back and forth. In the Uruguay Agreement of 1993 developing countries were obliged to extend patent protection to processes as well as to products. Then, at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, the Convention of Biological Diversity (CBD) included in their objectives a historic milestone—the possibility of compensating Indigenous communities for their pre-industrial knowledge, as well as promise of a fair and equitable share in "the sustainable use of its components . . . arising from the use of genetic resources. . ." But at the International Alliance of Indigenous Tribal Peoples of the Tropical Rainforest, representing thirty-one Indigenous organizations in Latin America, Africa, Asia, and the Pacific, concerns were expressed about the CBD's objectives becoming a tool of governments to increase the control of nation-states over Indigenous land and resources.

The CBD promotes development of "protected" areas, but the term "Indigenous" applies only to local settlements living in isolated environments. "The CBD reaffirms a unilateral state sovereignty, which could easily be used by states to deny indigenous sovereign rights to our territories, lands, and resources" (International Alliance 1996:12). The Draft Declaration on the Rights of Indigenous Peoples being created by the Working Group on Indigenous Populations, which is comprised of Indigenous peoples, experts, governments, and intergovernmental institutions, expresses the spectrum of rights, the importance of self-determi-

nation, and stresses individual and collective rights to the ownership, use, and control of homelands, territories, and natural resources. It emphasizes participation, consultation, and prior informed consent to activities that will have an impact on Indigenous people and their lands, and addresses the issue of just and fair compensation. This Draft Declaration has yet to be fully endorsed by governments and the United Nations (Simpson 1997:49).

These documents also need to be considered within the context of international trade agreements, such as the General Agreement on Tariffs and Trade (GATT), which actually threatens Indigenous peoples' rights to their own resources by allowing transnational corporations to price products below local prices to compete on global markets, thereby underselling traditional farmers and local industries. The Trade Related Intellectual Property Rights (TRIPS) obliges signatory countries to pass intellectual property legislation, establishing patent protection for "biotechnological innovation [which] threatens to commercialize Indigenous knowledge and genetic resources worldwide" (Rothschild 1997:60).

Native knowledge of science is challenged at every turn. The current legal and ethical ways of dealing with questions of economics and ownership have been inadequate toward providing shared benefits with users of plants and knowledgeable Native scientists. Of great importance to traditional people, for example, is the assurance that ethical practices concerning use of plants embody the spirit of traditional values and ethical exchange. "In contrast to Western legal systems, indigenous cultural heritage cannot be owned or monopolized by an individual, just as it cannot be alienated, surrendered, or sold on an unconditional basis. Rather, the cultural heritage of indigenous peoples is a collective right, and as such the responsibility for its use and management in accordance with indigenous laws and traditions is borne by the community as a whole" (Simpson 1997:54). A disproportionate focus at both domestic and international levels reflects the financial interests of businesses and governments; pharmaceutical, agricultural, and cosmetic industries acquire enormous economic power from dealing with these products.

Worldwide, Native peoples' use of their own resources is also threatened by the impact of recently developed seed alteration techniques. In March 1998, the Delta and Pine Land Company, a cotton seed company, received a U.S. patent on a technique that genetically alters seed so that it will not germinate unless a particular agricultural chemical is applied. This technology, now spreading to other seed suppliers, would prevent farmers from harvesting seed from plants grown from seed originally sold by U.S. corporations, thus requiring them to purchase new seed each season. Patents have been applied for in nearly eighty countries. Should this new technology be used, the multinational seed and agro-chemical industry would acquire unprecedented control of the global food supply.

Soy products, found in almost sixty percent of the processed foods on the market, may soon be under the control of a huge chemical conglomerate, Monsanto, which has hired Pinkerton private detectives to identify "unauthorized" soybean seed saving by farmers in the United States. Soybean seeds are now being genetically altered to prevent them from being damaged by herbicide use.

In India, the Karnataka State Farmers Association, representing ten million Indigenous peasant farmers, has fought for resource use, forcing Kentucky Fried Chicken and Cargill Seed Company from India because they threatened small-scale farming autonomy as well as biodiversity throughout India. Indigenous farmers everywhere are attempting to establish and protect sovereign rights by organizing through international forums.

Western science appears to have no limits, no ways to be held accountable even to the people they propose to benefit. Planned projects sometimes threaten Native people in unusual ways and clearly require careful watching. In 1996, the *Indigenous Women's Network Magazine* of Rapid City, South Dakota, reported that through a multi-million-dollar initiative called the Human Genome Diversity Project (HGDP), over 700 "endangered" Indigenous communities the world over will be visited by scientists who plan to take blood, tissue (cheek scrapings or saliva), and hair samples in order to map and sequence genetic diversity through DNA.

DNA is the defining interest of an international consortium of scientists with universities, governments, and other entities in North America and Europe. The HGDP seeks to map the genetic differences of groups from a monotype genome that will be identified by the Human Genome Organization, founded in 1994. It has identified many Native peoples as "isolates of historic interest," and these people find it reprehensible that the scientists' interest is purely to document rather than to preserve tribal groups. This so-called scientific attitude reflects long outdated and oppressive ethics, as well as initiating a possibly self-fulfilling pessimism. Blood samples taken from these peoples will be immortalized for future study, and certain cells of an organism can be kept alive and capable of multiplying with a technique called "cell conservation." Unlimited amounts of the organism's DNA will be stored in gene banks, mostly in the United States (Settee 1998:85).

Coined the "Vampire Project" by the World Congress of Indigenous Peoples, the HDGP has been condemned by communities all over the world. The North American Committee of the HDGP has secured a grant to develop a model protocol for the collection of samples, but Indigenous people feel that this will be used primarily to acquire project cooperation. "The HDGP states that the research will help reconstruct the history of the world's populations, address questions about the history of human evolution and migration patterns, and identify the origins of existing populations. [But] while the HGDP is looking for answers about human evolution, Indigenous peoples already possess strong beliefs and knowledge regarding their creation and histories" (Dukepoo 1998:1).

In 1994 the Guayami Indians of Panama and citizens of Papua New Guinea and of the Solomon Islands discovered that the U.S. government had taken out patent claims on the cell lines from some of their people. That August, the International Academy of the Environment along with the World Wildlife Federation and the United Nations Center for Human Rights, declared, "This practice of collecting samples without our approval (for purposes that are not clear) . . . not only violates ethics and human rights, but also violates nature, our spirituality, and our knowledge of creation that connects us with all forms of life. . ." Indigenous



leaders from the United States, Canada, Panama, Ecuador, Peru, Bolivia, and Argentina used even stronger words: "We hold that life cannot be bought, owned, sold, discovered, or patented, even in its smallest forms" (Dukepoo 1998:7).

The HGDP is on conference agendas and is opposed in declarations worldwide. In a recent document, the Indigenous Peoples Coalition on Biopiracy demanded an immediate moratorium on the collection of blood, hair, and skin samples; return of all genetic materials, cell lines, and data; and support from the scientific community in the improvement of social, economic, and environmental conditions of Indigenous peoples (*Indigenous Women's Network Magazine* 1996:38).

Organizations worldwide support the protection of Indigenous peoples' rights. The Council for Responsible Genetics in Cambridge, Massachusetts, whose board of directors includes internationally recognized scholars, engages in public education and lobbies governments to ensure that genetic privacy is protected. The Rural Advancement Foundation International (RAFI), an international non-governmental organization in Canada and the United States, supports farmers' rights. This principle was endorsed in 1989 by the UN Food and Agricultural Organization, which stated that the world's farmers have contributed greatly to the creation, exchange, conservation, and knowledge of genetic resources and should be recognized and rewarded for their contributions. For Indigenous peoples, farmers' rights are a critical concept because they include not only the idea of compensation but also rights to land. Specifically, the concept refers to the right to harvest seed and exchange germ plasm, secure land tenure, and to decide whether to make knowledge available (RAFI 1997).

The Indigenous view of the sanctity of all life requires that all efforts of corporations to exploit the natural world for profit be challenged and supervised—in other words, that Western science be held accountable. No one questions that Western science has brought a level of advancement from which all societies have benefited. Yet, some scientific research and practices have had negative effects, particularly upon ecosystems and Indigenous communities. Education programs seldom include Native

science knowledge, and most never look critically at the impact of Western science on Indigenous communities. In most countries, science is taught in a moral and social vacuum unrelated to the outside world (Solomon and Aikenhead 1994).

The reality that is not being taught is that the Earth is dying. The oceans are dying. If degradation of the world's oceans continues, they will soon lose the capacity to support life, to exchange and replenish oxygen. The massive injection of toxins into the oceans is overwhelming the capacity of the oceans' natural systems to purify themselves. Rainforests, the Earth's other great organ of mineral, water, and gaseous exchange, are also being cut down. Hundreds of species of microorganisms that have not evolved the capacity to withstand this acute onslaught are becoming extinct. In the ocean these organisms in the past filtered toxins and maintained the margin of chemical gradients necessary to the web of life. As toxins enter the food chain in greater and greater quantity, all parts of the food chain become more toxic. The clouds become toxic, the rain becomes toxic, the corn becomes toxic, and even our tears and our bodies become toxic.

The Earth is indeed a water-clothed planet; oceans are the context, the medium, and the primordial soup from which life emerged. It is no accident that they are becoming the barometers of global environmental sustainability and levels of degradation. The oceans are the living fluid of the planet, and every living thing has this vital fluid within it. There is one single water system and it flows through every living thing. The waters of the earth animate, connect, and encompass all organic and inorganic processes.

Human beings consist of seventy percent salt water and thirty percent minerals of the Earth. We are the earth and her waters made more animate. Our understanding of this essential natural connection is one of understanding our relationships to all things of the Earth. The water of which we are made is the same primordial water that circulates through the clouds, rivers, lakes, springs, and the great oceans. The water that nourishes the corn plants becomes the water that nourishes us when we eat that corn. When we pollute these waters, we ultimately pollute ourselves. There is no escape—we cry the oceans, we excrete the oceans,

we eat the oceans, and we become the oceans. The oceans teem with life interwoven and interdependent in levels too complex to understand except at the most rudimentary levels.

When we pollute the waters of the Earth to the degree that we have, the complex matrix of life develops gaps. In other words, we puncture this intricate fabric of life. And since we were not the weavers of this tapestry of life, we do not know how to repair the damage we have caused. As the effects of disrepair and toxins accumulate, they eventually affect all parts of the intricate web, including us. What is amazing is that *we know that this is the case* intellectually. We have the scientific, objectified data that indicate without much doubt that we have severely damaged and are continuing to damage the Earth, its waters, and other living things. Yet, we have not changed our lifestyles, attitudes, or habits of thought and action in substantial ways. As a society we are in total denial of the reality we have created. Our institutions, economics, values, beliefs, and worldview continue to be based on the same values as our Western cosmologically conditioned parents and grandparents. Our educational systems continue to propagate the same cosmology, including its principles of competition, individualism, and narcissism that have led to this crisis. In spite of mounting evidence that the cosmology of modernism is not sustainable, we continue to be bombarded by messages from institutions and the media that somehow everything is going to be fine: just keep on supporting your governments, businesses, and educational institutions, keep consuming, and everything will be all right.

The ambiguity, conflict, and tension that we are experiencing at all levels of modern life reflect our inability to come to terms with a dysfunctional cosmology, a cosmology that can no longer sustain us at any level. Although there are differences in the stories that contributed to the current dominant cosmology, all espouse essentially the same root paradigm. God the Creator was seen to live outside the universe, transcendent and greater than the universe, with dominion over the universe and all inhabitants. Humans had a connection to this divinity, but in order to fully consummate this union, they had to transcend the material world and exercise dominion over it in God's name. This orientation led

to a perception of the world in purely material terms; hence, the objectification, secularization, and scientific orientation of the world. The non-human world (often including tribal Indigenous peoples) was the property of the transcendent God and his chosen people. Although it was holy, it was also material, without spirit, and therefore eligible for use or exploitation by God's chosen. This conception of the world as spiritless (dead/lifeless) material allowed Western peoples to have a sense of detachment that was religiously justifiable. Therefore Western people could decide how they applied this God-given dominion over nature.

Human domination has not sustained the life of our Earth, and we must learn what will. The above description is only superficial. It is a bare outline of obvious patterns that are emerging as the symptoms of the Earth dis-ease become apparent and acute. The effect of such a dire description is to bring home the point that the Earth and all its inhabitants are in deep trouble. The cosmology of human progress and dominion over nature is no longer viable, sustainable, or ultimately, desirable. In the final analysis, we must change/transform our consciousness, which has for several centuries been steeped in an orientation of itself as superior, objective, and scientific. We are the Earth consciousness at a new place realizing the consequences of choices made by only a small portion of the human race. Thomas Berry and Miriam McGillis advocate renewing our faith in a sustainable future in tune with the truth of nature's primal laws, as images of the future can be self-fulfilling. The images we create, the languages we speak, the economics we manifest, the learning systems we espouse, and the spiritual, political, and social order we profess must all reflect and honor interdependence and sustainability.

The accumulated knowledge of the remaining Indigenous groups around the world represents an ancient body of thought, experience, and action that, if honored and preserved as a vital storehouse of environmental wisdom, can form the basis for evolving the kind of cosmological reorientation that is so desperately needed. A starting point for putting Native and Western sciences into perspective might be a review and recognition of the contribution of Indigenous people to world development. Such recognition would include the inventions of pottery and

weaving; the taming of fire; the domestication of animals; agriculture, irrigation, land selection and conservation of seeds, which led to biodiversity in plant life; metal mining; the wheel, road building, the development of land and sea transportation; directional technology, including the compass and astronomical observation; arithmetic and geometry; city planning, architecture; systems of administration; preservation of vital water supplies and drainage systems; and the inventions of paper, printing, and glass and its etching (Brush and Stabinsky 1996).

Our willingness and ability to change in the midst of the all-encompassing environmental crisis will test every fiber of our collective and individual beings. It is akin to laying the track as the train is coming; we must work as if our lives depend on it, because this is exactly the case; we cannot be neutral observers. The consciousness of the Earth is us. The choice through Earth's natural selective process is us. We are totally relevant and significant to the future life of the Earth. The earth must think through us, you and I. But our Earth is, must be, primary and humans remain derivative. This is a difficult concept for most people to accept. The primary sacred community is the Earth, a community in which humans are but one dimension. It is this reality that must guide the behavior of every nation, culture, institution, and community. We have to think first of the Earth and then ourselves. Can we accept such a monumental change of perspective?

### Meanings and Possibilities

In the Western view land is lifeless, a commodity to be bought or sold, an economic resource, an inert landscape to be shaped to the need and will of those who own it. The word "sacred" has no meaning or place in the modern Western concept of land. Rather, land is "real estate," territories, counties, states, and nations. All such concepts and entities are defined through the legal, intellectual, political, and cultural exigencies of Western society, which long ago replaced innate affiliation for places with a social intellectual credo of scientific and social progress based on the exploitation of land and resources for economic gain. The existence of an inherent sanctity of the land became the stuff of fairy tales and "primi-

tive" Native peoples. Although many Westerners declare they love their land, their feeling for the mythic and spiritual qualities of the land have become subsumed by the modern conditioning of land as commodity.

Meanwhile, however, the notion of land as sacred has lived on in the secular notions of conservation and stewardship. After the U.S. West was "won" in the late 1800s, a few enlightened Westerners such as John Muir began to lobby publicly for the protection of certain pristine tracts of land such as Yellowstone by setting them aside as national parks. This was the beginning of the conservation movement in the United States.

Even in a science whose official philosophical position is to subjugate nature to humanity's desires, practitioners have experienced "intuitions of the sacred" and describe their sense of awe and reverence for the exquisite ecological unity of nature as revealed in micro and macro manifestations of the inner and outer processes of the living landscape.

Even under science's unflinching gaze, the land itself reveals qualities that can only be described, if metaphorically, as "sacred." Science's extraordinary images of the earth reveal landscapes to be vast, artful visual fusions of time and space. By pinpointing processes by which the world's ecosystems evolved and by educating our eyes and minds, science can make our natural surroundings speak to us in ways that can render them deeply meaningful to us. By elevating our understanding of the natural world and its myriad, intertwined lives, science can even be said to, in some sense, sanctify nature for us (Suzuki and Knudson 1992:153).

The Earth is filled with ecologically significant places that reflect biological and geological diversity, creativity, and transformation. Places such as the Grand Canyon, the Andes, the Amazon rainforests, the Black Hills, and a host of other natural places of the Americas resound with the memory of the intimate connection between land and life. Science provides the empirical information and rational insight from which we fashion our sense for affiliation with and sanctity of the land, yet it is our

personal and cultural cosmology that guide both our perception and our response. If science uses its own reflection as its primary frame of reference for rendering the natural world meaningful, then the view of the natural world becomes skewed to only a physical description and the abstracted intellectual vision that is largely mute to the "sacred songs" that emanate from the land. Western science in its official capacity presents a kind of "freeze-dried" description of the natural, bereft of the water of life and the breath of the human spirit that animates knowledge toward meaning and ecological consciousness.

The Earth and the places on it have a story and a language through which that story may be told and remembered. Native peoples through long experience and participation with their landscapes have come to know the language of their places. In learning this language of the subtle signs, qualities, cycles, and patterns of their immediate environments and communicating with their landscapes, Native people also come to know intimately the "nature" of the places which they inhabit. Learning the language of place and the "dialects" of its plants, animals, and natural phenomena in the context of a "homeland" is an underlying foundation of Native science.

Metaphorically, learning the language of place and using that language to talk that place into being in both the individual and collective consciousness of the community is one of the essential functions of Native languages. It is for this reason that Native languages are predominantly verb based and are filled with metaphors about nature that celebrate and remember participation and relationship and make up the body of Native song, prayer, and everyday conversation. Native identity and hence Native science are wrapped in a blanket of the place that has formed Native tribal life through the generations. Indeed, it may be said that Native cultures are the earth, air, fire, water, and spirit of the place from which they evolved. "From this attitude of respect, gratitude and humility, aboriginal people have acquired an understanding of their 'relatives' that is far more extensive than the unidimensional kind of information that is gleaned by scientists" (Suzuki and Knudson 1992:xxxv).

Because traditional Native peoples understand the language of their environment, they are able to communicate with it in ways that few Westerners can imagine. They are able to talk about place in ways that few scientists are able to appreciate much less validate through the unidimensional lens of science. The lack of Western models that validate or otherwise parallel the Native sense of place does not mean that they do not exist. With each generation of assimilation and the loss of entire Native communities, however, these "other" models of "living in place" become fewer and more marginalized.

The implicit message of this book is that Western science *needs* Native science to examine its prevailing worldview and culture. Western science has often been caught up in an almost fanatic drive to objectify and fragment all of human experience so that it could somehow be better or more clearly understood or controlled. But these methodologies often forget to recontextualize data bits, or to recycle that knowledge into a meaningful expression for human life and human situations. Indigenous science is a process of thinking and relating that refuses to decontextualize.

Western science seems unable to move beyond its own bias, its history from its earliest inception and conflict with the Catholic Church, and its turn away from the spiritual orientations of its birth. Western science is like an orphaned child determined to deny any connection with its parents. As the child matures, however, he or she finds that whether wished for or not, whether believed or not, the parent lived and may even have been able to transmit value.

Until Western science rejects its bias, dialogue with another culture will be problematic. Individual scientists can sometimes see beyond, but as an institution, Western science is caught behind institutional blinkers. That the Western scientific worldview is insecure and may feel threatened is evidenced by a total dismissal of the Indigenous worldview. A study of psychology would suggest that when Western science is threatened, its practitioners become defensive and unwilling to reconsider their point of view.

Bridge building is underway, and both sides stand to gain from dialogue. Like any system of human knowledge, Indigenous science as structure and paradigm can get caught in its own web. Any cultural or reli-

gious tradition always walks a tightrope between dogmatism, fanaticism, fundamentalism, and new creative movements that renew and revitalize that tradition, and Indigenous traditions have not been immune. But Indigenous traditions have little power. Because Western science is in a position of dominance, its biases, insecurities, and unwillingness to consider other ways of knowing and understanding, become the order of the day.

It is natural for an older institution or tradition to resist attack on its infrastructure. A revitalization process is necessary on both sides. However, given contemporary political realities, the playing field is unequal when practitioners or spokespersons of the two traditions come together. A crucial first step in making the dialogue and its effects truly authentic and practical would be for the Western scientific establishment to validate the study of Indigenous science. The latter does not need validation, but wants it for a dialogue that will benefit both sides. In the same vein, parity is necessary in building a mutually reciprocal and beneficial relationship.

Indigenous people fear revealing traditions and practices as they believe others have taken far, far more than has ever been given to the First Peoples and the lands held sacred for eons. A prime example of cultural expropriation that Indigenous people wish to avoid occurred when pharmaceutical companies and their governments patented medicinal plants shown them along the Amazon River without compensating the Native sources of the knowledge.

Cultural appropriation issues must be considered in the bridge building process. Thus, in the spirit of the golden rule of conflict mediation, this book is a beginning of a dialogue based on mutual respect and reciprocity. Indigenous science can help Western science in developing or evolving a more expansive way of thinking and understanding. There are two concessions Western scientists must make to open up the parameters of debate: (1) they must recognize that what is considered to be scientific common sense is actually relative, and (2) they must concede that the verb orientations and highly metaphorical nature of Indigenous languages may be better suited than European-based scientific language for expressing quantum reality. To describe what is now being under-

stood about quantum reality requires a whole different way of looking, one that is made difficult by Indo-European languages themselves.

The debates surrounding quantum knowledge and quantum physics bring up all manner of orientation questions. The Western science paradigm is predicated on individualism, of which capitalism is also an expression. In contrast, Indigenous science has always been predicated on mutually reciprocal relationships, or on the communal sensibility expressed in the notion that "we are all kernels on the same corn cob." What happens to one happens to all. The concept of individualism, separateness, must give way or be subsumed in the concept of interconnect- edness. Another area in which change is necessary is the system of logic used in Western science by which everything ends up being categorized in an either/or, black-or-white fashion. The language of Western science itself is part of this logic.

Western and Native science traditions are very different in terms of the ways in which people come to know, the ways in which knowledge or understanding is shared, how knowledge is transferred from one generation to another, and how knowledge is handled legally, economically, and spiritually. Traditional Indigenous law is geared toward restitution and restoration. If traditional laws, and especially laws that deal with relationships to nature, are transgressed, restoration and restitution must occur. If the latter are ignored or mishandled, people suffer the consequences.

What Indigenous people will need to participate fully in a compact with Western science is for their laws regarding restitution and restoration to be honored. In some cases, it may be impossible to restore the rights to or wealth of lands, but restitution of past and present transgressions must occur as a matter of course for a mutually reciprocal relationship to develop.

Of course, the old order resists the new, as in the cosmic battle of the sacred twins mentioned in the story of Quetzacoatl. This cosmic conflict represents the two sides of human nature played through the cycles of time and human history. A new sun, a new cosmology is being born. How we will collectively greet it is up to us. We may embrace it, we may ignore it, we may cringe in fear, but it will rise to take its rightful place in time.

## Land and Stars, The Only Knowledge

North, West, South, and East.  
 Above and Below and All Around.  
 Within knowledge of the land,  
 We are existent.  
 Within knowledge of the stars,  
 We are existent.

Coldness and wind and the snow, northward.  
 Mildness and mountain and the rain, westward.  
 Hotness and desert and the hail, southward.  
 Warmness and mesa and the sun, eastward.  
 Starshine and sky and the darkness, upward.  
 Earthsource and stone and the light, downward.

By this Northern Mountain, we live.  
 On this Western Peak, we live.  
 In this Southern Canyon, we live.  
 Upon this Eastern Mesa, we live.  
 Under this Sky Above, we live.  
 Above this Earth Below, we live.

We are Existent within knowledge of land.  
 We are Existent within knowledge of stars.  
 All Around and Below and Above.  
 East, South, West, and North.  
 This is our prayer. This is our knowledge.  
 This is our source. This is our existence.

Always the land is with us.  
 Always the stars are with us.  
 With our hands, we know the sacred earth.  
 With our spirits, we know the sacred sky.  
 We are with the land and stars.  
 We are with the stars and land.

With offering, all around outside.  
 With offering, all around inside.  
 This is the knowledge we have.  
 This is the existence we have.  
 In thankfulness, we give and we know.  
 In thankfulness, we receive and we know.

—Simon Ortiz, 1993 (in Cajete 1995)

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# Index

- Aboriginal peoples, Australia 74  
 Aboriginal Science and Technology Society 272  
 abstraction, as trap 22  
 Acoma Pueblo 91–93  
 adoption/adaptation of knowledge 75  
 Africa 269–70  
 agricultural methods 269–70  
   farmers' rights 278  
   genetically altered seeds 276  
 agricultural technologies 132, 142–46  
 agriculture 127–40  
 Ahkwesahsne Science and Math Pilot project 268  
 Alcohua people 196  
 Aleut people 44, 201  
 Algonquin people 115, 151  
 alternative medicine 210  
 Amazon River 172  
 Anasazi people 113, 165  
   culture 246–47  
 Andean Project of Technological Campesinos (PRATEC) 271  
 animal geoglyphs of Peru 242–46  
 animal husbandry 168–71, 175  
 animal rights 168  
 animals  
   disrespect of 119–20  
   draft animals 197–98  
   hunting 40  
   origin myths 33, 35  
   raised for food 153  
   relationship to 156  
   research on 270  
   spirituality and 167–68  
   transformation 40  
   Western Hemisphere 169  
 animism 27, 168  
 antelope hunting 171  
 anthropocentric philosophy 29–30  
 anthropomorphic projections 153  
 apprenticeship 66  
 appropriate technology 69  
 archetypes 186, 207  
 architecture 100–01  
   sky dome (Skidi Pawnee) 236  
 art 103  
   “aliveness” or spirit 46  
   animals 163–64  
   ceremonial art, steps 48–51  
   sacred hunting motifs 158  
   as shaman/hunter expressions 157  
   as way of “seeing” 46  
 artists, process of 81  
 asphalt and other petroleum products 190  
 associative empathy 24  
 astronomy  
   Chumash cosmology 239–41  
   geoglyphs 242–46  
   living the heavens 216–18  
   loss of tradition 254  
   Navajo creation myth 218–26  
   Navajo myths 218–26  
   participatory nature 216  
   preserving knowledge of 216  
 astrophysics 234  
 Athabascan people 44  
 authority 69–70  
 avocados 138  
 Aztec (Mexica) people 196, 207, 260–63  
 Bahia culture 202–03  
 balancing  
   Chumash 239–40  
   and harmony, Navajo view 218–20  
   life energies 119  
   promoting health 118  
 beans 137  
 Bear Dance 156  
 beef cattle 173–74  
 bifurcation point 18  
 biodiversity 153, 276  
 biological synergism 131  
 biophilia 24, 99, 127  
 biophobia 153  
 bioregionalism 105  
 birth 21  
 birthing, origin myths 35–36  
 Black Elk 153–54  
 Blackfeet/Blackfoot people 166, 170  
   myths 42–43  
   myths, enchanted hunter 228–29  
   myths, legend of Scar Face 228, 250–55  
 blindness of modern perception 22–23  
 boats and water craft 201–04  
 body 21  
 body sense 25–27  
 botanical medicine. *See* medicinal plants  
 breath, importance of 117  
 buffalo hunting 170–71, 174  
 bull boats 204  
 business values 59  
 calendars 237–38, 243–44  
   Aztec 261, 263  
   Mayan 248  
 Mesoamerican 260  
 California Indigenous traditions 111  
 Canada 272  
 canes 225  
 canoes 203–04  
 Caracol 248  
 cardinal directions 210  
   Navajo view 222  
   Skidi Pawnee view 235–36  
 cartography 181–82  
 cashew nuts 139  
 cassava 139  
 Catholicism 89  
 cattle 173–74  
 causality 69  
 Cayuse people 172  
 celebration of life 79  
 celestial bodies 120  
   in myth 217  
   Navajo view 219  
 Central Fire (Polaris) 223–24  
 ceremonial art, steps of creation 48–51  
 ceremonies 45, 65, 70–71, 81–82, 117–18  
   animal 165  
   of art 46, 52  
   corn 113  
   food in 115  
   plants 129  
   pottery making 114–15

- Chaco Canyon 230, 247  
 chaos theory 16–20, 256  
   butterfly effect 18  
   gambling 103  
 Cheyenne Dog Society 163  
 Chuchén Itzá 248  
 chicle 139  
 children  
   as earth spirits 186–87  
   environment, learning about 101  
   experiential learning 102  
   gardening 127  
   guiding 96  
   learning and community 97–99  
   status of 96  
   stories 102–03  
*chinampas* agriculture 144–45, 196  
 Chinese mythology 17  
 Chinese philosophy 207  
 chocolate 137–38  
 Chumash people 201, 203  
   traditions 190  
   *datura* use 239  
   described 238–239  
   painted caves 239, 241  
   star myths 234  
 cisterns (*chultuns*) 196  
 Clovis site 156  
 co-creators 38  
 “coming to know” plants 110  
 communal participation 131  
 community/ies  
   defined 90–91  
   ecology, key elements 95  
   expressions of 91  
   gardening 127–28  
   hunting 162  
   Native science practice 98–104  
   natural 113–14  
   nature of 86  
   resonance with nature 99  
   work 97  
   workings of 90–98  
 consciousness 67  
 conservation movement 283  
 context 86  
 control, being in 16, 18–19  
 control/dominance over nature 152,  
   211–12, 280–81  
*conuco* agriculture 144  
 corn 104, 112, 113, 130, 135–36  
   Hopi traditions 141  
   uses 141–42  
 Corn Dances 113, 118, 132–33  
 Corn Mother and Corn Children 114  
 Corn Mother, or Three Sisters 131  
 Corn Spirit, Tuscorora 131–32  
 Cortés, Hernán 261, 263  
 Corvus 224–25  
 cosmic journeys 250–55  
 cosmology/ies 52–53  
   defined 58  
   eco-cosmology 60–61, 265  
   ecological 59  
   as lived story of place 94–95  
   Native science 70  
   Navajo creation myth 218–26  
   reorientation necessary 281–82  
   Western religious paradigm  
     280–81  
 cotton 136  
 cowboys, professional social class of 173  
 creation myths 13, 75  
   animals 154–55  
   celestial beings 217  
   chaos, role of 17  
   dynamic balance, maintaining 119  
   ecological explanations 206  
   as guiding stories 74–75  
   Huichol 122–25, 206–07  
   Inuit 44, 109, 165  
   male-female principle 185–86  
   Mayan 40–41  
 creative body 26  
 creative participation 19–22  
   in nature 23  
   products of 26  
 creativity 19  
   art creation 47–48  
   human 19  
   in nature 17  
   nature of 15  
   out of chaos 18  
   sacred dimension of art 46  
   teaching 45  
   three basic concepts 15–16  
 cultural appropriation issues  
   286–87  
 cultural heroes 38–39, 43–44  
   Huichol 122–25  
   Long Sash 226–27  
 cultural relativism 24  
 culture, community, sense of 86  
 customs and practices 97  
 dance, traditional 102  
 Dayohagwenda 131–32  
 death 21  
 deer as metaphoric icon 159  
 Deer Dance 160  
 Déné Cultural Institute 270  
 directions  
   plants associated with 236  
   sacred 150  
 diversity, within communities 96  
 divination 121  
 dogs 169  
 domesticated animals 172–73  
 dominion over nature 54  
 dream time 73–74  
 dreams and visions 71  
 dual male-female, in nature 118  
 Earth Mother, plants as hair 111–15  
 earth re-awakening ceremony 236  
 Earth-centered traditions 109  
 eclipses 222–23  
 eco-cosmology 266  
 eco-education 63  
 ecological awareness 14  
   metaphoric mind 30  
 ecological compact 38  
 ecological empathy 40  
 ecological ethic 159  
 ecological person/individual 59, 63  
 ecology of community, key elements  
   95  
 ecology of Native healing 118–22  
 eco-philosophy 58–63, 265  
 ecology of community, key elements  
   animals, responsibility to 168  
   values of 61  
   values vis-à-vis worldview 63  
 ecosophy 60  
 Ecuador 202–03

- education 101–02  
 action, realm of 63  
 affective dimension 86  
 all-inclusive 268–69  
 animals, learning about 154  
 astronomy 216  
 “coming into being” 162  
 “coming-to-know” 80  
 healers 125–26  
 hunting 162  
 hunting as metaphor 159  
 mainstream values 62  
 medicinal plants 116  
 “new” paradigm 46  
 pilot programs in Native 268–69  
 re-learning 267  
 science in a moral vacuum 278–79  
 spirit of place 93  
 tree of life 263  
 values of consumption 280
- Egypt, pyramids 228  
 Egyptian mythology 17  
 elders 71  
 emergence stories 13  
 endangered species. *See* extinct  
 animals  
 energy, transformation of 73  
 engineering 199  
 ensoulment 186  
 environment/al 95  
 “bonsai” 111  
 challenges 23  
 degradation 279–80  
 management 170  
 plants and 110  
 equinox ceremonies 236
- ethical models, in communities 96  
 ethics 72  
 environmental 95  
 Europe 186  
 European encounter 178–79  
 evening star 223  
 evergreen, as symbol 112  
 evolution, plants 109  
 evolution and consciousness 36, 37, 77  
 experimentation, practical 67  
 explanation 69  
 extinct animals/species 153, 154, 174,  
 175
- face, concept of 250  
 face, finding 265  
 Fallen Star myth 232–233  
 Faustian individual 59  
 fertilizers 145  
 Fiji 271  
 fire myths 43, 167, 207, 223  
 First Large One (Scorpius) 225  
 First Slender One (Orion) 224  
 fish hatchery systems 192
- food  
 ecology of Indian health 115  
 gardening 129, 131  
 Native contributions 133–40  
 plants, spiritual connection 112–13  
 preparation of 99–100  
 right relationship 114–15  
 forest management 170  
 foundation 267  
 foundational cultural ethics 267  
 fruit 138  
 fur trade 204
- Gaia hypothesis 167  
 Gaia mythology 41  
 gambling games 103  
 game management system 163  
 gardening 100, 127–40  
 significance 129–30  
 gathering 99–100  
 genetically altered seeds 276  
 genomes, DNA 276–77  
 geoglyphs of Peru 242–46  
 geopsyche 187  
 gift-giving 88  
 give-aways 51  
 Great Basin 115, 140  
 Great Hare 151  
 Great Lakes people 141  
 traditions 115  
 Great Turtle 151, 167  
 Great World Renewal ceremonies 118  
 Green Corn Dances 74  
 green philosophy 108–15  
 guano 145  
 Guayami Indians 277  
 guidance, of children 96  
 guiding stories 74–75  
 guiding thoughts 75–77
- Haida people, traditions 103  
 harmonizing 212  
 Havasupai people 166–67  
 Hawaiian people 207  
 healers, keepers of knowledge 120–21  
 healing process, phases of 121–22  
 health and wholeness, plants and  
 115–27  
 health, gardening and 129
- heart, finding 266–67  
 herbalism 115–16, 119; *See also*  
 medicinal plants  
 herbalists 89  
 herding 173–74, 175  
 hero with a thousand faces 42  
 Hohokam people 113, 192–93  
 culture 191  
 irrigation and water systems 192–93  
 Holy People or Dentities, Navajo  
 creation myth 220  
 homelands 94, 105  
 Honor the Earth Campaign 272  
 Hopi traditions 141  
 horses 169, 172–73  
 Huichol people 80  
 creation myth 206–07  
 five-pointed deer 159  
 peyote rituals 209  
 traditions 122–25, 126, 208  
 human body, metaphor for landscape  
 185–86  
 human consciousness 19  
 human evolution and consciousness 35  
 Human Genome Diversity Project  
 (HGDP) 276  
 human nature, plant nature and 108  
 Hunter of Good Heart 39–40, 158–63  
 hunting 99–100, 158–63  
 animals, regard for 154  
 buffalo 170–71  
 cults 156  
 ecology, local 170  
 give-and-take 73  
 rabbits 169  
 rituals 73

- hunting, *continued*  
 values expressed 161  
*See also* Hunter of Good Heart
- hydraulics 190–97
- ice age 43
- identity, tribal 86
- illness  
 balance and 118, 125  
 as disharmony 116  
 environmental 117  
 role of 118
- Incan people  
 culture 193–95  
*huacas* (shrines) 248  
 roads and bridges 199–200  
 traditions 191–92
- India 276
- individualism 86, 287
- information, from nature, as gifts 21
- initiation, and pathways to knowledge 70
- in-scape 71
- insects 153, 154
- instrumentation 69
- intellectual property rights 273–76
- interpretation 69
- Inuit people 175, 201–02  
 myths 44, 109  
 traditions 165
- Iroquois people 151, 167  
 myth, Great Turtle Island 41  
 traditions 266
- irrigation 190–94  
 technologies 113
- Jerusalem artichokes 138–39
- journeying 42
- Karnataka State Farmers Association 276
- kinship 96
- knowledge  
 animals 151  
 astronomy 216  
 coming-to-know process 80  
 community benefits 72  
 community life 99  
 high contexts 66  
 through relationship 178  
 ways of knowing 178
- Kogi people of Colombia 21–22, 29  
 astronomy 249
- Kokopelli 31, 50
- Lakota (Sioux) people 150, 153–54, 169  
 Fallen Star story 232–33  
 traditions 178  
 wheel 76
- land issues 94, 177, 282–84  
 body as metaphor 185–86  
 complexity and 212–13  
 European perspective 178–79  
 land use 183, 188–89  
 profit motive 212  
 relocations, forced 188  
 sacred space, importance of 204–11
- language/s  
 active, verb-based 27  
 animals, referring to 152  
 animating landscapes 183–84  
 metaphoric mind versus 28  
 nature, relationship 72, 178

- of place 284–85  
 power to condition 28–29  
 quantum reality 286–87  
 Western science 287
- law, traditional 287
- leadership 90
- learning  
 children's uniqueness 97  
 high context models 68–69  
 pathways to knowledge 71  
 practical 101–02  
 processes of 65–66
- life, as creative activity 15
- life energy 71
- linear thinking 29, 81
- Long Sash 226–27
- Machu Picchu 142, 145–46
- male and female characteristics,  
 Navajo creation myth 219–20
- Male and Female Revolvers (astronomy) 223–24
- male-female principle  
 Skidi Pawnee 235  
 sky-earth 185–86
- Man with Legs Ajar (*Corvus*) 224–25
- maple tree 139
- maps 181–82
- mathematics 270
- Mayan people  
 boats 202  
 cosmology 17  
 cultures 191  
 irrigation and water systems 196–197  
 roads 200
- “mediated pulse” of nature 267
- medicinal plants 112, 115–16, 118, 133, 271  
 biopiracy 273–76  
 coca 139  
 ethics of use 275  
 intellectual property rights 286  
 quinine 139
- medicine 209–10  
 medicine bundles 235  
 medicine people 116–17  
 star priests 230  
 medicine wheels 73, 76, 249–50  
 medicine women 89
- meditation 121
- menomes 266
- mentoring relationships 101
- Mescalero Apache people 217
- Mesoamerica/n 191, 260  
 astronomy 248–49  
 irrigation and water systems 195–97
- metal mining 189–90
- metaphoric mind 28–31  
 foundations 71–72
- metaphoric thinking, creativity and 45
- methodological elements, Native science 67–71
- Mexica (Aztec) people 196, 207, 260–63
- middle world 40–41
- Milky Way 226, 231
- milpa* agriculture 142–44
- Mimbres pottery 39
- mind-body 25  
 dissociation 26
- mining 189–90



- moccasins 201  
 Monte Albán 248–49  
 moon 221  
 moral framework of understanding 76  
 morning star 223  
 Mound Builder or Mississippian traditions 230  
 mountaintop perspective 45  
 mutual reciprocity 79  
 myth/s  
   animals as holy 154  
   animals in 165–67  
   animals, unions with 151  
   calendars 260  
   ceremony and 117–18  
   councils of animals 168  
   creative center 15  
   creative fire 208  
   functions 103  
   mythic body of landscape 206–10  
   Native 13  
   origin 37–39  
   plants 108–09  
   sacred sites 205  
   star myths 228  
   sun 208  
   two minds 29  
   worldview and 62  
   *See also* creation myths
- Native philosophy  
   nature of 64  
   tenets 64–66
- Native science  
   cognitive and linguistic “maps” 65  
   concept of 14  
   expressions 42  
   guiding thoughts listed 64–65  
   holistic aspects 66  
   human capacities 14  
   methodological elements and tools 67–71  
   origins and history 14  
   paradigm 77–82  
   as philosophical ideal 82  
   process of 66–71  
   as “science of the subtle” 17
- natural community 113–14  
 natural democracy 33, 35, 77  
   animal rights 168  
 natural orientation 157  
 nature mind of humans 28–31  
 nature  
   awareness of 20–21  
   “being alive” 21  
   categorizing 72  
   as chaotic system 16  
   control of 16  
   as creative center 15–16  
   creativity in 15  
   dominion over 53–54  
   ecology of community 95  
   ensoulment of 186  
   give-and-take relationships 73
- Native cosmology 98  
 Navajo people  
   categories of disease 119–20  
   creation myth 218–26  
   hogan 231  
   language 183–84  
   male-female creation principle 185–86

- perspective on cosmology and  
   astronomy 218–26  
 philosophy 64  
 sing, for illness 121  
 star myths 217  
 traditions 182–84
- navigation, water 201–04  
 Nazca culture of Peru 242–46  
 Neanderthal lunar record 29  
 night walking 102  
 Nimipu (Nez Perce) people 172  
 Northeastern Indigenous peoples 110  
 Northwestern Indigenous peoples 81  
   canoes 203  
   hydraulics 192  
   fishing techniques 171–72  
   potlatch give-aways 51  
   traditions 110, 164, 166
- objectivity 67–68  
 observation 67  
   astronomical 246–50  
   celestial bodies 217–18  
 oceans 279–80  
 Ojibwe people 70, 141  
 One That Awaits Dawn (Milky Way) 226  
 oral tradition 43, 94, 159  
 organizations, Native resource management 270–72  
 orientation, concept of 158  
 Orion 224  
 “other” 179  
 Paiute people 115, 167  
   myth 43  
 Paleolithic era 29  
 Palouse people 172  
 Panama 277  
 Papua New Guinea 277  
 paradigm clash 75  
 participation mystique 27, 186  
 participation with nature 83, 108  
 Pawnee people  
   celestial myths 217  
   Skidi band, star people of the plains 234–37
- peanuts 138  
 peppers 139  
 perceptual blindness 22  
 perceptual engagement 27  
 permaculture 140–46  
 personal story, of author 87–89  
 perspective and orientation 36  
 Peru 191–92  
   agricultural methods 271  
   pre-Incan and Incan irrigation and water systems 193–95
- petroglyphs 230  
 pets, animals as 152–53  
 peyote rituals 80, 126, 209  
 phenomenology 23–26  
 physical mimicry 187  
 physics 234  
 pineapples 138  
 Pipe ceremony 45  
 piskin corral 170  
 place of creation 49  
 place, importance of 70, 74, 77, 89, 91, 93–94  
   constructed for sacred purposes 205–06  
   as ecological mandate 210–24

- place, importance of, *continued*  
 language of place 284–85  
 psychology 186–88  
 sacred orientations 210–24  
 spiritual meaning 179–80, 182–83
- Plains people 118  
 traditions 72, 73, 76, 110  
 wintercount 230  
*See also* Pawnee people and Skidi  
 Pawnee people
- Planter (Pleiades) 224
- plants 108  
 conduits to spiritual world of  
 nature 119  
 disrespect of 119–20  
 as hair of Earth Mother 111–15  
 Pueblo gardening 127–29  
 as symbolizing relationships 238
- Pleiades 224
- potatoes 134–35
- potlatch “coppers” 51
- pottery 113–14
- practice, of Native science 71–82  
 guiding stories 74–75  
 guiding thoughts 75–77
- Protection Shield Way 220, 224
- psychoactive agents 121, 126, 209,  
 239
- Pueblo people 117, 169  
 creation myth 31–33, 37–38  
 design motifs 113–14  
 gardening 127–29  
 hunting 159  
 metaphoric symbols 50–51  
 myths 226–27, 233–34  
 plants as symbols 112–13  
 traditions 87–89  
 pumpkins 137
- quantum mechanics 54  
 quantum physics 60, 287  
 Quetzalcoatl 261–63  
 quinine 139
- rabbit hunting 169  
 Rabbit Tracks (Tail of Scorpius) 225
- rainforest organizations 274
- ranching 173–74
- rational mind 29
- recognition of community members 97
- redistribution of wealth 241
- reincarnation 233–34
- relational philosophy, astronomy  
 226–34
- relational psychology 165
- relationship/s  
 community 101  
 community and nature 105  
 issues 167–68  
 language of 178  
 natural world 178–84, 211  
 personal, with plants, animals,  
 natural forces 103  
 place and 208  
 practiced 131  
 responsibility 208  
 tribal community 86
- religion 78, 98  
 nature-centered 157
- relocation, forced 188
- renewal ceremonies 79, 118
- representations 70

- research, data gathering 44  
 resource management 270–72
- responsibility 79  
 learning 44
- right relationships, healing 117
- Rights of Indigenous Peoples, Draft  
 Declaration 274
- ritual/s 65, 81–82  
 gardening 132  
 hunting 159, 161–62  
 plants in 109
- roles, in communities 96–97
- rubber 137
- rubber-soled moccasins 201
- rubber-soled shoes 201
- Rural Advancement Foundation Inter-  
 national (RAFI) 278
- sacred  
 places, plants 109–10  
 plants and trees 109–10  
 sites 91, 204–11, 282–84  
 space 65  
 tree 58  
 Winds 150
- Sant’s house 88
- salmon ceremonies 164–65
- salmon fishing 172
- Santa Clara Pueblo, New Mexico 87
- Scar Face myth 42–43, 250–55
- science  
 alternative views 79  
 art vis-à-vis 78  
 concept of 14  
 defined 78  
 as evolutionary 14  
 as a story 13  
 uses of term 78
- scientific rationalism 88
- Scorpius 225
- secrecy, about healers 125
- “seeking life” 109, 118  
 medical knowledge 119
- self-reliance 102
- semi-cardinal directions, night sky 236
- service to community 90, 93, 95
- shamans 116–17, 126, 156, 209; *See also* medicine people
- shrines (*huacas*) 248
- single-prey principle 163
- sinkholes (*cenotes*) 196
- Sioux 50
- sixth world of Mesoamerican calendar  
 263, 265
- Skidi Pawnee people 231, 234–37  
 traditions 155–56
- Snaketown 192–93
- Solomon Islands 277
- solstice  
 ceremonies 230  
 Chumash ceremonies 240–41  
 geoglyphs 243  
 medicine wheels 249–50  
 myths 228–29
- soul death 188
- South America 172–73
- Southeastern Indigenous people 151  
 traditions 110
- Southwestern Indigenous traditions  
 110, 157
- soy products 276
- spirit of place 93–94

- spiritual ecology 38, 113, 178  
 spiritual partners, plants as 110, 112  
 spiritual process 69  
 spirituality  
   animals and 167-68  
   core beliefs 14  
 squashes 137  
 star relatives 216  
 star watching. *See* astronomy  
 stereotypes 82  
 stewardship 70, 170  
   place, connection to 187-88  
 stone quarrying 189  
 stories 30-31  
   animals 155, 163-64, 165-67  
   children 102-03  
   community 94-95  
   creation and emergence 31-45  
   as culture transmission 94  
   ethical or moral behavior 165  
   guiding stories 74-75  
   understanding through 44  
 strawberries 138  
 sun 221  
 Sun Dagger 228, 247  
 Sun Dance 72, 74, 118, 171, 238, 254  
 supernovas 230, 233  
 sustainability 189, 281  
   issues 269  
 symbols 36, 94  
   "abiding stone" or dream time  
     73-74  
   animals as 163  
   cardinal directions 222  
   ceremonial art 50-51  
   corn 104, 112-13  
   creation and entropy 207  
   Hunter of Good Heart as 158  
   Navajo 221-22  
   plants as 109-10, 112  
   synthesis, creative 208, 210, 213  
 taboos 222  
 Tail of Scorpius 225  
 talismans 161  
 tapioca 139  
 teachers 81  
 technology/ies  
   applied, hydraulics (irrigation)  
     190-97  
   applied, mining 189-90  
   applied, transportation 188-204  
   relationships with animals 168  
   land transport 200-01  
 Teotihuacán 195  
 terrace farming 142, 145, 193-95  
 territories, hunting 163  
 Tewa Pueblos 104  
 time and place 49  
 Tirawahat 234-35  
*tlatinimime* (astronomer  
   philosopher poets) 261  
 tobacco 111, 119, 136-37  
 tomatoes 137  
 tonka beans 139  
 totemism 94-95  
 totems 162, 165  
 traditional dance 118, 160  
 traditional dwellings 206  
 trails and roads, North America 198  
 transcendence 265

- transportation systems 197-204  
   Incan roads and bridges 199-200  
   land transport technology 200-01  
   Mayan roads 200  
   trails and roads 198-200  
   water navigation and vessels 201-04  
 travois 169  
 tree of life 58, 109, 112, 238, 263-64  
   Mesoamerica 260  
   Quetzalcoat's teachings 262  
 tribal members, relationships 86  
 trickster/s 38-39, 43-44, 66, 109, 217  
   in celestial myths 217  
 truth, ever-evolving point of balance  
   19  
 Turtle Island 40  
 Tuscorora Corn Spirit 131-32  
 United Nations 274  
 unity 68  
 vanilla 139  
 vigil, in ceremonial art 51  
 vision quest/experience 43, 45, 80, 90  
 vortices, pattern of 18, 19  
 Watakame 122-25  
 water navigation 201-04  
 water spirit (*huaca*) 194  
 water, as resource 190-94  
 Western science  
   detached view 24-25  
   human mastery over nature 16  
   perpetual trap 24-25  
   wheel, invention of 197-98  
   White Deerskin Dance 164  
   wild rice 141  
   Winnebago Indigenous traditions 104  
   wintercount 230  
   winter solstice ceremonies 118  
   winter travel 200-01  
   Woman Who Married a Bear myth  
     166  
   Women's Association for Natural  
     Medicine Therapy (WAINI-  
     MATE) 271  
   world renewal ceremonies 164  
   worldview/s 62, 208  
     animals and 150-52  
     foundational premises 77  
     new 265  
   Western scientific 285  
 Yucatán, Mayan roads 200  
 Yuma people 130  
 Yuptaq people  
   philosophy 66  
   traditions 268  
 Yurok people 164  
   White Deer Skin Dance 74  
 Zapotec-speaking peoples 195  
 Zuni people 271-72  
   myth 35-36

“Cajete makes a major step forward in articulating an Indigenous epistemology that moves beyond anything now in print. A superb pleasure to read—all Indian college students should immerse themselves in this book and learn from it.”

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Associate Professor, Science & Technology Studies, Deakin University, Geelong, Australia

In *Native Science*, Gregory Cajete initiates the reader into a timeless tradition of understanding, experiencing, and feeling the natural world. He explores and documents the Indigenous view of reality—delving into art, myth, ceremony, and symbol, as well as the practice of Native science in the physical sphere. He examines the multiple levels of meaning that inform Native astronomy, cosmology, psychology, agriculture, and the healing arts.

Unlike the Western scientific method, Native thinking does not isolate an object or phenomenon in order to understand and work with it, but perceives it in terms of relationship. An understanding of the relationships that bind together natural forces and all forms of life has been fundamental to the ability of Indigenous peoples to live for millennia in spiritual and physical harmony with the land. It is clear that the First Peoples offer perspectives that can help us work toward solutions at this time of global environmental crisis.



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