An Analysis of Western, Feminist and Aboriginal Science Using the Medicine Wheel of the Plains Indians

Lillian E. Dyck

What is science? What underlies our belief in the objectivity of the scientific method? How does being a woman or an Aboriginal affect a scientist's work? The following paper explores these questions and shows that science as we know it in the modern Western hemisphere does not acknowledge openly the influence of the scientist on her/his scientific work in terms of personal or cultural beliefs, nor does it openly allow for the gaining of scientific knowledge through methods other than the so-called scientific method, such as gut hunches or creative insights.

Qu'est-ce que c'est que la science? Sur quoi notre croyance dans l'objectivité de la méthode scientifique est-elle basée? Être femme or Autochtone, comment cela affecte-t-il le travail d'un scientifique? Cet article examine ces questions et démontre que la science, telle que nous la connaissons dans l'Hémisphère occidental moderne, ne reconnaît pas ouvertement l'influence des croyances personnelles ou culturelles du scientifique sur son travail. De plus, la science ne permet pas ouvertement l'acquisition des connaissances scientifiques par des méthodes autres que celle appellée la méthode scientifique, tels que par une conviction profonde ou des aperçus créatifs.

This paper was originally titled "Putting the Woman and the Aboriginal into the Scientist: A Female Urban Indian Scientist's Perspective." This is rather masculinist language; now, I think the more appropriate title is "Honouring the Aboriginal Woman in the Scientist."

While preparing this paper for the Women and Other Faces in Science Conference, Saskatoon, Saskatchewan, September 1996, I had difficulties organizing and focusing my thoughts and realized that this was because I was not sure which style of language to use: The language of the scientist,

the feminist or the Aboriginal. I speak all three languages.[1] Neuroscience is my area of science: I have researched how the brain uses chemical transmitters and how drugs, particularly antidepressants, affect neurotransmission; I have also investigated alcohol metabolism and most recently the biodistribution and metabolism of new aliphatic propargylamine drugs that hold the promise of being neuronal rescue drugs. I am a feminist, knowledgeable about feminist and other critiques of Western or Eurocentric science.[2] I was raised in mainstream Canadian prairie culture and have recently begun to incorporate Aboriginal ideology into my thinking and practice. As chair of Women and Other Faces in Science, I built in a session devoted to Aboriginal voices that provided an atmosphere of safety where I began to speak from an integrated place – as an Aboriginal woman – not just as a scientist who normally speaks as an objective authority and removes herself from the spoken or written word.

Mainstream North American culture maintains stereotypical images about what a scientist looks like and how a scientist conducts research. What springs to mind are images of a man in a white lab coat pursuing research rationally and objectively and whose findings lead to an elucidation of universal truths. The public usually assumes that scientific enquiry is not affected by the scientist's preconceptions (scientists are considered selfless and objective) and the scientific method itself is thought to be immune from bias, so scientific experiments are thought to lead inevitably to indisputable results.

As a result, the identity of the scientist is considered unimportant. Thus, the underrepresentation of women or racial minorities is not seen to be a problem in terms of the kinds of research conducted. To illustrate how holding feminist or Aboriginal world views can, in fact, affect scientific practice, this paper will briefly describe the traditional Western scientific method, examine assumptions inherent in it and highlight the influence of the investigator or scientist on research. Then it will describe how feminist and Aboriginal beliefs change the traditional view. Finally, science will be examined using the medicine wheel of the Plains Indians.

The traditional or textbook concept of Western science[3] is as follows:

- The scientist is completely separate from her object of investigation (e.g., rats, subatomic particles).
- The scientific method is infallible, exact and accurate.
- The scientist is unbiased, objective and impartial.
- Scientific knowledge is value-free.

Is this concept an illusion? A delusion? The truth?

The Oxford English Dictionary defines science and scientists as follows: Science is the "physical or natural sciences, collectively"; natural science is "one dealing with material phenomena and based mainly on observation, experiment and induction – as chemistry, biology, physical science." A scientist is a "person with expert knowledge of a (usually physical or natural) science" or a "person using scientific methods." The definition of a scientist is embedded in the definition of natural science. This creates the illusion that natural science exists independently from the scientist. The scientist who makes the material phenomena known to herself and to us by observation and experimentation is not acknowledged. Similarly, we scientists use communication styles that create an illusion that we are separate from our science. We render ourselves invisible by using eliminating the first person: instead of "I observed that the rats treated with drug 'x' were startled more easily than those treated with drug 'y' . . . ," we say "Drug 'x' resulted in . . . ."

Some definitions of the scientific method do not even mention the scientist as the agent carrying out the various steps:

> Steps in the Scientific method:
> 1. the formulation of a hypothesis.
> 2. the design of an experiment to test the hypothesis – method to observe, measure, identifying variables, random sampling.
> 3. execution of the experiment.
> 4. analysis of the data.
> 5. judgement of the hypothesis.
> 6. generalization – conclusion, involving inductive reasoning.[4]

Clearly, a person is involved in every step, so an alternative view of Western science exposes the scientist and points out that the scientific method is subject to the scientist's biases; the scientist is imbedded in the research; the scientist has whatever biases pervade her culture. Scientific knowledge, by this view, is not value-free but a product limited by and tainted with the values of the culture that produces it.

Thus, scientists help present science as static through our acceptance of the belief in the infallibility of the scientific method and through our style of communication. Kuhn would describe this behaviour as part of our informal training as scientists: we and we alone learn the unwritten rules of our enterprise.

This simple introduction has focused on the roles of individual scientists, but Kuhn examines in depth the practice of science by the scientific community as a whole. He points out with clarity and eloquence how the

ever-changing face of science, our constantly evolving knowledge of nature, is hidden or made invisible in the way textbooks are written and the way in which scientists are trained.[5] Science textbooks, which he claims are the main pedagogic instrument for training in science, are written from the perspective of the currently accepted theories; in rewriting or revising, the perspective of the old knowledge is removed as though it did not exist. For example, before Copernicus, the earth's moon was regarded as a planet and any observations of it were interpreted from that perspective; after Copernicus was accepted, the moon was regarded as a satellite orbiting Earth, and all subsequent observations were interpreted and all previous observations reinterpreted from the new perspective.[6] In this way, the perspective of science is presented to the public as having always been as it is; as a *fait accompli*; as static, unchanging, immune to error.

According to Kuhn, studies of the history of science show that the scientific method is not sufficient to produce "unique, substantive conclusion." In fact, a number of incompatible conclusions may be reached by using the same method but asking different questions.[7] Furthermore, he notes that sufficient accumulation of these inconsistencies eventually leads to the overthrow of accepted scientific theory, usually via another type of science, which he calls revolutionary or creative science.[8] Scientists whose perspective is grounded in the old paradigm or theory think one way; those whose data are inconsistent with the old paradigm think differently because they view the problem while being immersed in the process of generating a new paradigm. In other words, revolutionary science occurs when anomalous findings (findings that are not consistent with accepted theory) are discovered and consensus (about rejecting the current theory) within the scientific community has not been reached. Kuhn states that, when the old beliefs are rejected, a new set of problems and standards to judge validity are adopted by the science community as a whole.[9] Normal science then resumes once again, until new anomalies are discovered. The process of science, then, is a continual cycle of normal science interspersed with revolutionary science.

Perhaps the greatest blow to the textbook view of Western science in modern times has come from physics, a science thought to be the gold standard of linear, reductionist science. The discovery that subatomic particles behave unpredictably, or with uncertainty, and that they appear to influence one another's behaviour (i.e., they behave neither predictably nor independently as single units whose properties can be studied and characterized in isolation from each other) make it evident that traditional concepts of science need to be modified to include such observations.

Feminist scholars have also challenged traditional concepts of Western

science.[10] Feminist scientists "acknowledge that they, like everyone else, have values and beliefs and that these affect how they practice their science."[11] Feminist scientists openly acknowledge that they have biases affecting the research questions they propose, interpretation of their results and the conclusions they reach. Feminist science is seen in the context of the society – the social or cultural environment – in which it is carried out. They make their values and beliefs known; they do not adopt a stance of neutrality. Moreover, they have as a goal the use of their research to obtain women's equality. Women in the (social) community are seen to be an integral part of the research team, as collaborators in proposing projects and carrying out research. Feminist scientists are accountable to the community. Feminist science is non-hierarchic – a science "with the people, by the people and for the people," according to Margaret Benston.[12] The goal is to create knowledge grounded in women's experiences – virtually all Western science has been grounded in men's experiences.[13]

The question, "What is Aboriginal science?" is more difficult; little is written on the topic.[14] One way to answer it would be to talk about what was known by our ancestors in fields such as astronomy, agriculture and medicine. However, my intent here is to focus on the process of Aboriginal science. What were the traditional (ancestral) ways of knowing? Having been raised in White society, I am not schooled in traditional Aboriginal ways. Furthermore, some aspects of Aboriginal knowledge are sacred and learned by an extensive process of training with an Elder; this knowledge is not shared with others publicly unless Elders from that community decide it is right to do so. What I will do in this paper is to examine the way I as a Western trained scientist do science using the medicine wheel of the Plains Indians as a framework for analysis.

The concepts embraced by the medicine wheel are an integral part of Plains cultures. It can be used to understand ideas, to show how all things are living and interconnected.[15] Everything is considered to have four aspects: spiritual, emotional, physical and mental. For example, a person is considered to be in balance or in harmony when each of these four aspects is equally developed. A person is whole when the opposite yet related aspects of the wheel are in balance (physical in balance with spiritual, mental in balance with emotional).

Tables 1 through 3 summarize the learning processes, the thinking processes and vision of Western science, feminist science and Aboriginal science as I see them with respect to their location in the medicine wheel. Differences among these three can be seen by comparing the characteristics listed.

Table 1: Analysis of Western Science

East (physical aspect)	
Learning	A process of acquiring scientific knowledge in terms of: the language – written or published material the methods – what they are and the physical carrying out of experiments use of the physical senses, tools, pieces of equipment to observe and conduct supervised experiements; hands-on science.
Vision	Focused like the mouse – vision is limited to what is nearby, but able to see clearly separate objects in a complex environment
Thinking	Atomistic, reductionistic, linear, step by step
South (emotional aspect)	
Learning	By experimentation – the active stage of producing scientific knowledge. Able to design own experiments, speculate, solve problems, analyze. Passionate involvement in the practice of science. Science is fun. Enmeshment with research possible, biases unacknowledged.
Vision	Ability to see a bigger picture than from the perspective of the East; still coloured with personal perspective.
Thinking	Authoritarian, linear, logical, black and white. Opposites are in conflict with each other. I'm right, you're wrong (judgemental). Dualistic thinking – all-or-none thinking.
West (spiritual-creative aspect)	
Non-existent.	
North (mental/intellectual aspect)	
Learning	At the wisdom stage – acquired with experience. Learning integrates knowledge from the physical and emotional aspects but not the other two aspects of the wheel. The scientist works alone or as a separate individual in group work.
Vision	Limited, not detached from personal investments.
Thinking	No integration of reason and intuition. Authoritarian, judgemental. Ethical and moral aspects of scientific practices considered to be of little or no relevance.

Traditional Western science displays many attributes that can be designated as the mental, physical and emotional aspects of the medicine wheel (Figure 1), and many scientists like myself were attracted to research careers because of an intense curiosity (emotional and intellectual aspects) to understand how the material world operates from a reductionist perspective (physical aspect) and an ability to master the methods (tools, equipment) (physical aspect) used in research. We isolate and take things apart and selectively manipulate single variables to figure out how something works (physical aspect). The intellectual or mental aspects of science in terms of linear, reductionist thinking are well developed, but in terms of integrated logical and intuitive thinking or in terms of postulating interconnected models rather than linear models, they are not well developed. In traditional Western science, there is no spiritual domain.

Table 2: Analysis of Feminist and Other Alternative Sciences

East	
Same as Western science.	
South	
Same as Western science.	
West	
Non-existent, same as Western science.	
North (mental/intellectual aspect)	
Learning is at the wisdom stage – acquired with experience.	
	Learning by integration of knowledge acquired from the emotional, physical and intellectual aspects of the wheel.
	Balanced learning – seeing that things are connected non-linearly.[16]
	The scientist works synergistically in group or collaborative work, with diverse perspectives on a problem and diverse ways of thinking leading to new insights.
	Awareness of the need for community input and the impact of science on the community (persons and environment).[17]
Vision	Broad perspective, detached from personal opinion, set in the social context.
Thinking	Combining diverse elements or perception (accepting, non-judgemental).
	Can see that all things fit together, are interconnected.[18]
	Ethical and moral aspects of scientific practices considered to be crucial.

Feminist science (as well as ecological and environmental sciences), in contrast to traditional Western science, is more conscious of the complexity of the material world. It could be said that feminist science and these other scientific disciplines are more balanced in that their intellectual aspect has

Table 3: Analysis of Aboriginal Science

East
Same as Western and feminist science.

South
Same as Western and feminist science.

West (spiritual-creative aspect)

Learning By use of intuition – an openly advocated, accepted way of knowing.
- Going within stage, a time of inner contemplation (hibernation of the bear).
- Accessing information from the subconscious realm of our beings.
- Active listening to our gut hunches, intuition, dreams and spirit helpers to provide insights into problem-solving in the physical realm.

Vision Far-seeing as the eagle; intuitive insight developed.

Thinking Creative, open to intuitive insights.
Flexible – non-perfectionist, balance rather than dualism.
Opposites define or compliment each other.
Ability to see patterns of relationships that are non-linear.

North
Same as for Western and feminist science, plus:

Learning At the wisdom stage – acquired with experience.
- Learning by integration of knowledge acquired from all aspects of the wheel, including the spiritual aspect.
- Balanced learning – seeing that all things are connected[20]
  to imagine, to interpret
  to see the connections
  to use intuition (hunches, insight) consciously.

Vision Broad perspective, detached from personal opinion and informed by spiritual insight.

Thinking Active integration of intuition and reason.

been developed to include non-linearity,[20] plus a patent awareness of the biases and influence of the scientist on the research itself (see Table 2).

Aboriginal science (see Table 3) openly advocates a spiritual aspect; none of the alternative ways of doing science (feminist, ecological or environmental sciences) do so.

How does one cultivate the creative or spiritual aspects of doing science? This is the interesting question that I leave with you. All I can offer now as an answer is that it requires a scientist who incorporates spiritual practices into her/his personal life and thus has the tools to apply to her/his professional scientific life.

The creative aspect of Western science is largely undefined and invisible. Western science is thought to have no creative domain. However, Kuhn

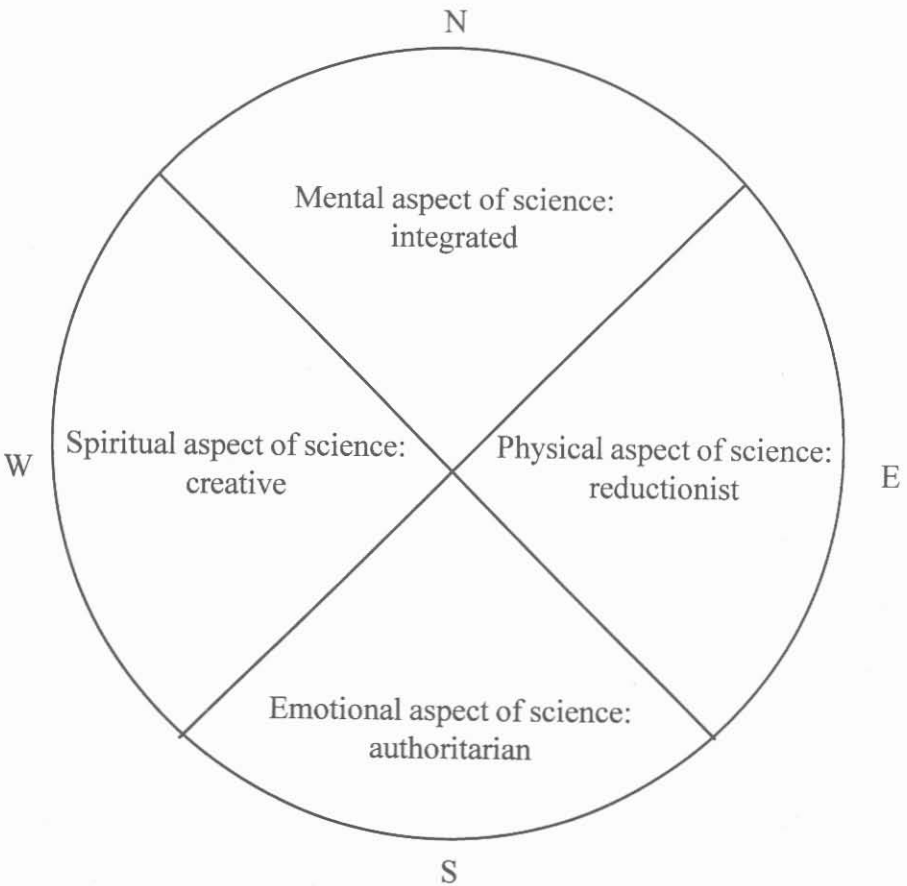

Figure 1: Placing the Thinking Processes of Western Science into the Medicine Wheel

considers revolutionary or creative science to be essential to the growth or development of new scientific theories; leaps forward do not occur by the linear, reductionist methods of Western science.[21] In my opinion, it is the methods of creative science that have been made invisible to the scientific and non-scientific communities. I was happy to see that Kuhn mentioned, albeit briefly, that intuition and illumination during sleep were the methods of problem-solving employed in creative science.[22] What was of paramount significance for me on reading his essay was the recognition that the big leaps in scientific thinking occurred via revolutionary science – through dreams, intuition, sudden insight from out of the blue.

Two examples of these creative methods, which were mere asides during my undergraduate chemistry lectures, have stuck in my brain to this day. Kekulé dreamt of a snake swallowing its tail when he was trying to figure out the chemical structure of benzene – the dream gave him the insight to look at a ring structure. Similarly, Mendeleyev used playing cards to sort out the relationship between the chemical properties of elements and their atomic weights, and came up with the periodic table.

The individual scientist plays a role in hiding the existence of these other "scientific" methods. For instance, the solution to a problem might come in the form of a night-time dream to a scientist, but that insight alone is not acceptable scientific proof or evidence. What happens is that the insight from the dream gives the scientist the perspective from which to design an appropriate experiment to provide scientifically acceptable evidence. When the research is completed and written up for publication, the insight of the dream is not described in the methods or the discussion. There may be reluctance in revealing publicly the "unscientific" process of creative insight. What is clear to me as a scientist, though, is that this type of science – the big leaps forward in thinking – is what is most exciting and what many of us strive to attain.

If we call these unusual methods of problem solving *creative*, they likely will be acceptable to every scientist; however, the adjective *spiritual* would be rejected. For centuries, philosophers have debated the existence of a spiritual world; in Aboriginal culture, there is no debate. The spiritual and physical worlds both exist, and it is from the former that our creative insights and dream messages originate.

This analysis of Western, feminist and Aboriginal science using the medicine wheel comes from my limited understanding as an urban Indian raised outside of my Plains Cree culture. I am relatively young with respect to my journey of learning about my Cree heritage from various Teachers, so when it was pointed out to me that I had erred in placing the spiritual

aspect of the medicine wheel in the west rather than the east, I was not surprised. The east is the place of entry into the medicine wheel – it is the spiritual beginning. We are born into this world as pure spirits. My upbringing in Eurocentric society and training in Western science have conditioned me to think of the physical domain as the logical starting place, so I placed the physical aspect of science in the east. I was aware of this anomaly, since the diagram in the Sacred Tree shows the spiritual aspect in the east of the wheel, but my mind was not able to accept this placement – yet.

Perhaps in time, as I begin to understand the spiritual aspect of science and its practitioners better, I will be able to place it in the east. Undoubtedly, those people who choose to go into science because they wish to understand the mysteries and complexities of the universe would have no difficulty placing the spiritual aspect of science in the east position (Figure 2). Those

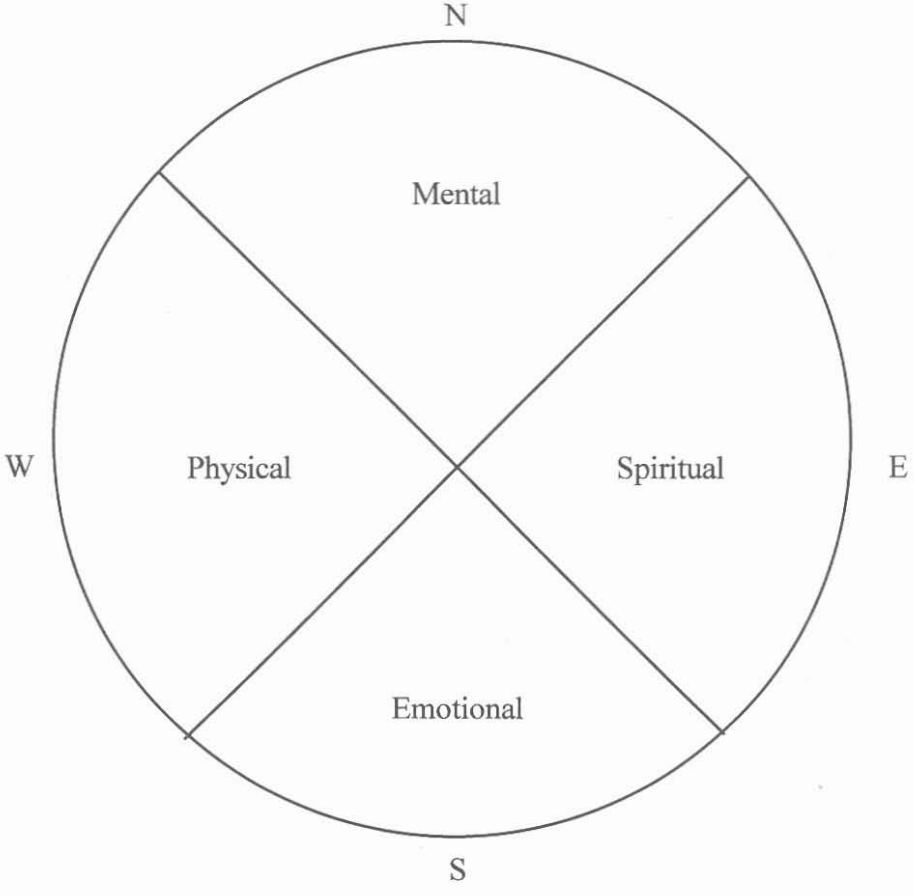

Figure 2: The Medicine Wheel of the Plains Indians

who were attracted to science by a deep love of nature and the desire to do something soulful rather than mundane – who study astronomy or biology to gain a glimpse of the interconnectedness and mysteries of life – clearly have spiritual and not simply intellectual reasons for their scientific enquiries. When I was in grade school, that was what intrigued me about science; however, as I grew older and adapted to the education system, I developed my intellectual abilities intensively, but that other part of me, the spiritual-creative part, was shut away and is only now slowly resurfacing.

Acknowledgements

This paper is dedicated to my mother, Eva Muriel McNab (1920–1956). She was a Cree Indian from the Gordon's Reserve near Punnichy, Saskatchewan. Provincial laws, federal laws and racism prevented her from living as a traditional Cree woman. She left the reserve and married Yok Leen Quan, my father. In her own time, in her own way, she was a feminist from whom I received courage and determination. In 1981, I obtained a Ph.D., and then, at age 36, I began the search for my Cree heritage. I thank my Teachers and Helpers on this path.

Notes

1 The styles, vocabulary and meanings of certain words, written or spoken, may vary between specialized subgroups. Thomas Kuhn also used the metaphor of language to describe the communication gap between "men who hold incommensurable viewpoints" who are like "members of different language communities"; *The Structure of Scientific Revolutions*, 2nd ed. (Chicago, University of Chicago Press, 1970), p. 175.

2 Many articles, from Kuhn's classic treatise cited above to a range of feminist scholars (philosophers, historians of science and scientists) criticize science, especially its stance on being objective and value-free. It is not my intention to review these papers, but I found several to be especially helpful: Ruth Bleier, "Introduction," in *Feminist Approaches to Science*, edited by R. Bleier (New York: Pergamon Press, 1988), pp. 1–17; Ursula Franklin, "Letter to a Graduate Student," *Canadian Woman Studies* 13 (1993): 12–15; Sue V. Rosser, "The Relationship between Women's Studies and Women in Science," in *Feminist Approaches to Science*, edited by R. Bleier (New York: Pergamon Press, 1988), pp. 165–80; M.H. Whatley, "Taking Feminist Science to the Class Room: Where Do We Go from Here?" in *Feminist Approaches to Science*, edited by R. Bleier (New York: Pergamon Press, 1988), pp. 181–90; Linda Christiansen-Ruffman, "Community Base and Feminist Vision – The Essential Grounding of Science in Women's Community," *Canadian Woman Studies* 13 (1993): 16–20; Roberta Mura, "Searching for Subjectivity in the World of the Sciences: Feminist Viewpoints," Canadian Research Institute for the Advancement of Women Papers no. 25; Evelyn Fox Keller, "Introduction," *Secrets of Life, Secrets of Death* (New York: Routledge, Chapman and Hall, Inc., 1992).

3 Kuhn, *The Structure of Scientific Revolutions*, describes the process of scientific discovery over time as a process of normal science punctuated intermittently with revolutionary science. Normal science is undertaken using methods and knowledge that are accepted by all members of the particular science community. This normal science is equivalent to what others have termed Western or Eurocentric science, and I have adopted the latter terms in this paper.

4 J.M. Little, *An Introduction to the Experimental Method* (Minnesota: Burgess Publishing Co., 1961).

5 Kuhn, "The Invisibility of Revolutions," *The Structure of Scientific Revolutions*, pp. 136–43.

6 Kuhn, "Revolutions as Changes of World View," *The Structure of Scientific Revolutions*, pp. 111–35.

7 Kuhn, "Introduction: A Role for History," *The Structure of Scientific Revolutions*, p. 3.

8 Kuhn, "Revolutions as Changes of World View," *The Structure of Scientific Revolutions*, pp. 111–35.

9 Kuhn, "Introduction: A Role for History," *The Structure of Scientific Revolutions*, p. 6.

10 See note 2.

11 Ruth Bleier, "Introduction," in *Feminist Approaches to Science*, edited by R. Bleier (New York: Pergamon Press, 1988), p. 15.

12 Margaret Benston (1937–1991) was a chemist and a Women's Studies scholar at Simon Fraser University; her legacy to women, science and technology was the theme for volume 13, number 2 of *Canadian Woman Studies*. Ursula Franklin and Linda Christiansen-Ruffman quote her (see footnote 2).

13 See footnote 2. An excellent example of feminist science is that carried out at the Centre pour l'étude des interactions biologiques entre la santé et l'environnement, Montreal, Quebec. Donna Mergler gave an overview of occupational health research at the Women and Other Faces in Science Conference. One example of the centre's research was an investigation into domestic cleaners being exposed to toxic chemicals: a problem set in the social context of occupational health concerns that involved the workers themselves and their unions throughout the research study.

14 I am not aware of any books or papers that take the approach I have – i.e., using the medicine wheel as an analytic tool to examine Western science. I am aware of two books that have sections describing Aboriginal science or comparing it to Western science. Gregory Cajete, an Aboriginal scholar, wrote "Seven Orientations of Environmental Knowledge," in *Look to the Mountain: An Ecology of Indigenous Education* (Kivaki Press, 1994), pp. 193–207. F. David Peat, a non-Aboriginal physicist, wrote "Indigenous Science," in *Lighting the Seventh Fire: The Spiritual Ways, Healing and Science of the Native American* (Birch Lane Press, 1994), pp. 239–74.

15 For a detailed description of the concepts embodied in the medicine wheel, refer to J. Bopp et al. (producers), *The Sacred Tree* (Lethbridge, Alberta: Four Worlds Development Press, 1984).

16 Lea Bill, an Aboriginal nurse and researcher, presented a paper at the Women and Other Faces in Science Conference describing the process of collecting data in the form of oral histories from Elders in northern Alberta. In Western science, the observations of such a group would not be considered valid scientific data because they were not collected by those trained within the scientific enterprise. Such a dismissal fails to recognize the skills these Elders have developed within their own communities to note accurately and intelligently changes in their environment – the water, earth, air, insects, plants and animals. The strength of their observations is that they are seen as connected. Moreover, their observations, collected over many years, reveal connections related to time. Their evidence is not so concrete or specific as changes in the pH of the water as measured by a piece of scientific equipment; their science is more expansive in character. Their scientific evidence is to document by observation changes in their environment that occur over time: changes in plant life, numbers and/or type of fish, physical changes in fish or animals, and so on. Western science, on the other hand, which limits itself to intensive or detailed observations of isolated or single units of a complex system, would not have the range of observations, the contextual link nor the historical perspective.

17 See footnote 13.

18 See footnote 16.

19 Kuhn, *The Nature and Necessity of Scientific Revolutions*, pp. 92–110.

20 See footnote 16.

21 Kuhn, *The Nature and Necessity of Scientific Revolutions*, pp. 122–23.

22 Kuhn, *The Nature and Necessity of Scientific Revolutions*, pp. 122–23.