

Annette Greenall Gough Beyond Eurocentrism in Science Education
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Beyond Eurocentrism in science education research:
promises and problematics from a feminist poststructuralist perspective

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Paper presented at the Annual Conference of the Australian Association
for
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ABSTRACT

Sandra Harding recently argued that “around the world as in the West, new social movements have challenged the authority of the West to impose its values and standards on peoples with histories and present concerns that are opposed to those of privileged groups in the West”. One such challenge comes from feminist critiques of the mechanistic and dualistic views that dominate science and society and which have suggested profound changes in how human relationships with nature are perceived—changes which also have educational implications. Other challenges are forthcoming from the multiple discourses of domination of nature through gender, race, class and colonisation. Within science, the postcolonial critiques argue that Western science has resulted in

partial and distorted accounts of nature and social relations, and that “science educations rarely expose students to systematic analyses of the social origins, traditions, meanings, practices, institutions, technologies, uses, and consequences of the natural sciences that ensure the fully historical character of the results of research”. Drawing on the work of people such as Harding, in this paper I explore some of the critiques of Western science and the possibilities (promises) of multiple discourses for research in science education, as well as the problematics. The concern is to explore the poststructuralist argument that “no discourse is innocent of the will to power”, but within the practical intent of exploring possibilities for innovative science education research and practice.

Introduction

Two quotations, among many others, encapsulate much of what has directed me in developing this new orientation in my research, and I have cited them in the opening for the chapter from my dissertation (Greenall Gough 1994: 56) which is the origin of parts of this paper. The first, from Marion Namenwirth (1986: 29) states that “Scientists firmly believe that as long as they are not conscious of any bias or political agenda, they are neutral and objective, when in fact they are only unconscious”. Such unconsciousness is, as I argue in this paper, what we need to move beyond in science education research.

The second quotation, from Evelyn Fox Keller (1985: 12) reflects where I have come from and provide some of the framework for where I am

going:

As a woman and a scientist, the status of outsider came to me gratis. Feminism enabled me to exploit that status as a privilege. I began to see the network of gender associations in the characteristic language of science as neither natural nor self-evident, but as contingent, and dismaying. I began to see further that these were not just ornamental images on the surface of scientific rhetoric; they were deeply embedded in the structure of scientific ideology, with recognizable implications for practice.

In her more recent work, Keller (1992) has further developed her “linguistic turn”, as have many other writers who have informed my research and writings in this area. However, I have taken an additional step, guided particularly by the work of Sandra Harding (1993abc, 1994), and I am now exploring the possibilities for science education research of going beyond Eurocentrism¹. In this paper I am working from an acceptance of feminist critiques of modern science and only draw upon them when relevant to my arguments rather than discussing them in detail. My focus here is upon critiques of the Eurocentrism of modern science as the basis for a new direction for science education research and practice. As Harding (1993c: 1) argues,

There are few aspects of the “best” science educations that enable anyone to grasp how nature-as-an-object-of-knowledge is always cultural: “In science, just as in art and life, only that which is true to culture is true to nature”. These elite science educations rarely expose students to systematic analyses of the social origins, traditions, meanings, practices, institutions, technologies, uses, and consequences of the natural sciences that ensure the fully historical character of the results of scientific research.

Consistent with Harding’s (1993c: 3) assertion that “around the world as in the West, new social movements have challenged the authority of the West to impose its values and standards on peoples with histories and present concerns that are opposed to those of privileged groups in the West”, in this paper I firstly outline some of the postcolonial critiques of Western² science. I then outline some of the critiques that argue for a more democratic science and, in the final section, discuss some of the promises and problematics of these critiques for new directions in science education research and practice.

Postcolonial critiques of science

Postcolonial critiques of science, that is, critiques of the influence of modern Western science on other cultures, have been developed contemporaneously with the feminist critiques of science. As with these other critiques, postcolonial critiques are not so much concerned with “science bashing” but rather with “pointing out how better understandings of nature result when scientific projects are linked with and incorporate projects of advancing democracy; [and that] politically regressive societies are likely to produce partial and distorted accounts of the natural and social world” (Harding 1993b: ix). Many of these critiques have been mutually informative. For example, the works of Vandana Shiva (1989) and Donna Haraway (1989) have informed both feminist and postcolonial critiques of science.

Postcolonial critiques of science also fit within a broader framework of critiques of Eurocentrism, colonialism, and the construction of the non-West as “Other” forthcoming from people such as Chinua Achebe (1960), Ashcroft, Griffiths and Tiffin (1989), Homi Bhabha (1985, 1986, 1988, 1994), Ashis Nandy (1986), Ngugi Wa Thiong’O (1986), Edward Said (1978, 1985, 1993), Gayatri Spivak (1987, 1990ab, 1993) and those

authors collected in Adam and Tiffin (1991), Ferguson et al (1990) and Tiffin and Lawson (1994) to name but a few. According to these critiques, women and non-Europeans have been constructed as “Other” in the dualism that placed rational mechanistic male man as master of all nature, women and slaves. As Berman (1989: 232-233) argues,

Aristotlian dualism became the natural, and the ideal, precursor of the ideology of nature as a machine driven by immutable laws, the direct

progenitor of our present-day mechanism... His identification of the leisured male master with the rational, the mind, and the nonproductive (science for science's sake) and women and slaves with the irrational and the useful was patently self-serving.

Within science, the postcolonial critiques argue that Western science has resulted in partial and distorted accounts of nature and social relations, and that, as the Third World Network argues (1993: 485),

Modern science and technology has dislocated Third World societies, destroyed traditional cultures and played havoc with the environment of Third World nations. It has also replaced a way of knowing which is multi-dimensional and based on synthesis, in Third World societies, with a linear, clinical, inhuman and rationalist mode of thought.

There is now widespread agreement that "nature-as-an-object-of-knowledge is always cultural" (Harding 1993c: 1), thus the cognitive content of science claims is coherent with the cultural concerns of the society in which the knowledge is generated, and these cultural concerns have influenced the directions taken in the development of scientific knowledge³.

The need for scientists "to learn to reconceptualize science, its methods, theories, and goals, without the language and metaphors of control and domination" (Bleier 1986a: 16) has also been noted by Merchant (1980), Keller (1985) and other historians of science. As an alternative which "may enable less partial and distorted descriptions and explanations", Harding (1991: 301) proposes the use of "metaphors and models that stress context rather than isolated traits and behaviours, interactive rather than linear relations, and democratic rather than authoritarian models of order in both research and nature".

Modern science has argued that the West is "progressive, rational and civilized... in contrast to the backward, irrational and primitive 'rest'" (Harding 1993c: 7) and the knowledge claims of the non-Western cultures have thus been denigrated and silenced. It is therefore important to analyse the Western, racist, gendered and classist agendas which have directed Western science as a strategy for advancing a more democratic science. As John Dewey (1961, in Harding 1993c: 3) argued, "an effective pursuit of democracy requires those who bear the consequences of decisions have a proportionate share in making them". However, such democracy appears to be absent in the experiences of some writers in this area. Susantha Goonatilake (1984), for example, argues that Asian scientists are kept dependent on Western science and their scientific creativity is stifled while indigenous science traditions are overlooked. Shiva (1989) provides a critique of the two sacred categories of Western science's theory of progress: modern scientific knowledge and economic development. She argues that the imposition of this theory on the Third World is threatening to annihilate nature and humankind and she seeks to oppose and challenge it through asserting a

non-violent, non-gendered and humanly inclusive alternative. Harding (1993c: 8) argues similarly that “non-Western science traditions need to be evaluated in more objective ways, and that the Western traditions need to be more objectively situated in world history”. Through

examining Western science’s complicity with racist, gendered, imperialist and Eurocentric projects we should “gain a more critical, more scientific perspective on an important part of that Western ‘unconscious’ and thus on the history some groups in the West and ‘elsewhere’ have been busy making” (Harding 1993c: 19). This is an enormous challenge for both science and science education research.

Toward a democratic science

Other postcolonial critics, including those represented in Harding’s (1993b) anthology, argue that modern science is very undemocratic. Yet there is a continuing search for re-establishing science in a democratic future. For example, Needham (in Harding 1993b: 432) argues that “democracy might... almost in a sense be termed that practice of which science is the theory”. And, as *Ciencia para el Pueblo* (in Harding 1993b: 431) writes,

If we do know that there exists a science which is imperialist in its uses, its organization, its method and its ideology, there must exist, and in fact there does exist, an anti-imperialist science. It is still in its infancy, and it takes different forms, according to the conditions it is found in.

Alas, *Pueblo* does not provide much detail of this anti-imperialist science, except to “look for means to put our scientific knowledge at the service of the people”. While some post-colonial critics of modern science are developing some concrete proposals (see, for example, Shiva 1989, Third World Network 1993), some possibilities worthy of serious consideration are forthcoming from discussions of feminist science. For me, such discussions have potential to be broadened to include other notions of a more democratic science.

The question of whether there should be a feminist science, what the term means and whether it is an oxymoron, has been a topic for discussion for some time: “the question... has been raised by virtually everyone who participates in or contemplates the feminist discussions of the sciences” (Harding 1991: 296). Harding (1991: 297) also notes that “traditions in the philosophy of science and sociology of science can encourage conflicting answers to the question of whether there can be feminist science”, as both feminism and science are “contested zones”. A variety of these answers are discussed in this section.

Bleier (1986a: 15-16), for example, provides some distinguishing, but, she believes, “inadequate” principles for a feminist science:

- scientists acknowledge that they, like everyone else, have values and beliefs, and that these affect how they practice their science;
- scientists explore and understand in what ways these subjectivities specifically affect their perspectives and approaches, their actual scientific methods;
- scientists are explicit about their assumptions; honest, thoughtful and careful in their methods; open in their interpretations of each study and its significance; clear in describing the possible pitfalls in the work and their conclusions about it; and responsible in the language used to convey their results to the scientific and nonscientific public.

Such principles would seem to be consistent with a more democratic science that is postcolonial as well as feminist. For example, Bleier (1986a: 16) continues her argument by suggesting that in enacting these principles feminist scientists

may wish to claim a feminist approach to scientific knowledge that in

its language, methods, interpretations, and goals, acknowledges its commitments to particular human values and to the solution of particular human problems... (This) would aim to eliminate research that leads to the exploitation and destruction of nature, the destruction of the human race and other species, and that justifies the oppression of people because of race, gender, class, sexuality, or nationality.

For Bleier (1986a: 16) this is a science of the future – or “only after the revolution” (Harding 1991: 299) – as it requires profound changes “in a system that is based on power, control and domination and that recognizes and rewards those who support and reinforce its ideologies and aims”. Elizabeth Fee (1983: 22) reserves the term feminist science for a possible future science, arguing that what is currently being developed “is not feminist science, but a feminist critique of existing science”. According to Fee (1983: 22), our sexist society has developed a sexist science, however a feminist society can be expected to develop a feminist science, although “for us to imagine [this] is rather like asking a medieval peasant to imagine the theory of genetics”, nevertheless “our inability to imagine a fully developed feminist science” should not be taken “as evidence that a feminist science is itself impossible”.

Donna Haraway (1986: 81) similarly argues that feminist science is a radical project

To construct a different set of boundaries and possibilities for what can count as knowledge for everyone within specific historical circumstances is a radical project. Feminist science is not biased science, nor is it disinterested in accurate description and powerful

theory. My thesis is that feminist science is about changing possibilities, not about having a special route to what it means to be human - or animal.

For Haraway, narratives and discourses are paramount in “what might problematically be named feminist science... Both feminist and scientific discourses are critical projects built in order to destabilize and reimagine their methods and objects of knowledge in complex power fields” (1989: 324). She argues for altering the structure of a field through destabilizing it rather than “replacing false versions with true ones” (1986: 81).

There appears to be growing acceptance of the notion of such a transcendent approach to science, just as the dichotomies of science should be transcended. For example, Haraway (1989), Hrdy (1986) and Small (1984) report that feminist primatologists have succeeded in redirecting their field, its methodologies, basic assumptions and principles, interpretations, and conclusions. As Haraway (1986: 80) argues, “Primateology is the scene of a feminist scientific revolution, one that has changed the way both men and women practice their science”. Similarly, feminist psychologists, such as Gilligan (1982), have caused others in their field to question their methodologies, assumptions, interpretations and conclusions. In both fields feminists have undermined the most influential theories which grounded present day notions of interrelationships among primates which served as models of our ancestors, and cognitive and moral development in humans, respectively. These effects reflect Keller’s (1992: 31) argument:

Different metaphors of mind, nature, and the relation between them, reflect different psychological stances of observer to observed; these, in turn, give rise to different cognitive perspectives - to different aims, questions, and even to different methodological and explanatory

preferences.

However, it is not only important to question methodologies, assumptions, interpretations and conclusions from a feminist perspective. We also need to raise questions from the perspective of other races, classes and cultures.

A strong theme throughout the feminist critiques of science is concern with criticising the objective, value-free claims made of science. As Hubbard (1981: 218) argues, “An era’s science is part of its politics, economics and sociology: it is generated by them and in turn helps to generate them”. Bleier (1986b: 63) similarly argues that “scientists cannot simply hang their subjectivities up on a hook outside the laboratory door... as is the case for everyone else, scientists bring their beliefs, values, and world views to their work” and these affect their research questions, assumptions, interpretations and activities.

Building on the work of Berger and Luckmann (1966), Hubbard (1981: 218-219) argues that to become conscious of the biases introduced by our implicit, unstated and often unconscious beliefs about the nature of reality is more difficult than anything else we do, but “we must try to do it if our picture of the world is to be more than a reflection of various aspects of ourselves and of our social arrangements”. Harding (1986: 27) further develops this notion by arguing that “objectivity never has been and could not be increased by value-neutrality. Instead, it is commitments to antiauthoritarian, antielitist, participatory, and emancipatory values and projects that increase the objectivity of science”.

Sandra Harding has written frequently on the theme of feminist science, relating it particularly to feminist epistemology. She argues that feminists need successor science projects, “they are central to transferring the power to change social relations from the ‘haves’ to the ‘have nots’” (1986: 195). More recently she has argued that “there already are feminist sciences and that it is beneficial to both feminism and the sciences to continue developing them” (1991: 296-297), and that those who argue that feminist sciences are not yet possible “appear to have only the natural sciences in mind” (1991: 305). Instead, she believes that scientific knowledge-seeking, directed by existing feminist theories and agendas should be considered as “research traditions that compete with a plurality of theoretical approaches in their respective fields” (1991: 305), and that natural sciences “are a particular kind of social science and should be so conceptualized” (1991: 309). However she cautions that such knowledge seeking needs to be disloyal to conventional assumptions such as restricting the use of the term ‘science’ to the natural sciences rather than including the social sciences. She argues that because feminist science is still disputing the foundations of the field it is not a real science; not accepting metatheorising as an integral part of science proper; and accepting that “‘real science’ is only what the modern West has done or chooses to call science” (1991: 306). For Harding (1991: 310, emphasis in original),

the emergence of feminist science depends not on whether all fields of contemporary science can be transformed but only on whether some processes of seeking knowledge about the natural and social worlds can be developed which are directed by feminist rather than androcentric goals.

Such feminist sciences require transformation of the logics of science and of feminism and share much in common with the moves toward a democratic science for the future.

Some writers on feminist science have been exploring the links between feminism and postmodernism in science, although many are ambivalent about the relationship between feminism and the Enlightenment. Jane

Flax (1990) for example, argues that feminism is solidly in the terrain of the postmodern, as does Haraway (1988, 1991), whereas Christine Di Stefano (1990) argues that Western feminism is located in the modern ethos and puts a feminist case against postmodernism. Nancy Hartsock (1987: 191) also argues "that postmodernism represents a dangerous approach for any marginalized group to adopt". She is particularly concerned about the universalising claims that creep back into the work of postmodernists, even though they oppose such claims. It is not an intention of this paper to resolve these discussions but to note, as does Harding (1991: 183-4), that "many different social groups are trying to think their way out of the hegemony of modern Western political philosophy and the worlds it has constructed". Such groups include feminists, the ecology movement, and marginalized groups.

Harding (1991: 184) sees the tensions between Enlightenment and postmodernist agendas in feminism as healthy: "The conflict between our different and valuable political projects is just what is creating in feminist thought a necessary ambivalence toward the Enlightenment and toward the beliefs and politics of Postmodernists". She concludes that "both feminist science and epistemology proponents and also their Postmodernist critics stand with one foot in the Enlightenment and the other in the present moment - or, rather, the future... At this moment in our history, our feminisms need both Enlightenment and Postmodernist agendas" (1991: 187). This is a position with which I am comfortable in this still emerging field. I find particularly attractive her discussion about postmodernists assuming symmetry between truth and falsity and her assertion that "feminist thought can aim to produce less partial and distorted representations without having to assert their absolute, complete, universal, or eternal adequacy" (1991: 187), which she sees as bridging feminist science and epistemology and feminist postmodernism.

A concern raised by Haraway (1986, 1989, 1991), Harding (1986, 1991, 1993a) and Hartsock (1987) that has not been addressed by many others, but which is pertinent to this paper, is the intersection of feminist and postcolonial discourses in the sciences. Haraway (1986: 80) in particular writes of monkeys and apes having "been enlisted in Western scientific story telling to determine what is meant by human: what it means to be female, to be animal, to be other than man". Even a feminist perspective on primatology is a form of simian orientalism, remaining "deeply Western: deeply marked by the logics of nature and culture, by Western searches for the self in the mirror of a subordinated other, by the constantly repeating origin stories that ground Western political culture" (Haraway 1986: 80). Harding (1991: 268, emphasis in original) discusses standpoint theories as a strategy for correcting the dominant Western accounts by "moving from including others' lives and thoughts in research and scholarly projects to starting from their lives to ask research questions, develop theoretical concepts, design research, collect data, interpret findings". Hartsock (1987: 191), another proponent of feminist

standpoint theories, also discusses ways of including the voices of marginalised people and in doing so argues against postmodernist theories because they “merely recapitulate the effects of Enlightenment theories - theories that deny marginalized people the right to participate in defining the terms of their interaction with people in the mainstream”. I disagree with Hartsock in that I believe that a promise, rather than a problematic, of adopting a feminist poststructuralist perspective in science education research is that such an approach can give equal voice to both dominant and marginalised

peoples’ accounts in moving toward a more democratic science.

Beyond Eurocentrism in science education research and practice

In the light of these feminist and postcolonial critiques of modern science, and the movements toward a more democratic science, what are the implications for science education research and practice?

For me, a major implication is that we need a different approach to science education research which problematises both the view of science content that science education researchers assume and the methodologies they use. Both content and methodologies need to take account of the critiques of modern science and strategies for achieving a more democratic science. Recognising that there are links between language and power in the discourses of science it would seem important to examine the multiplicity of meanings in these discourses and to provide less partial and distorted descriptions and explanations using language which stresses context and interaction and democratic models of order. A methodology for doing this arises out of feminist poststructuralist analysis which is “a mode of knowledge production which uses poststructuralist theories of language, subjectivity, social processes and institutions to understand existing power relations and to identify areas and strategies for change” (Weedon 1987: 40-41). While my original interest grew out of feminist poststructuralist analysis, and continues to be informed by its discourses, the following discussion is informed by the broader constructions (and deconstructions) of poststructuralist analysis per se.

Working from the frames suggested by Weedon (1987) for feminist poststructuralist analysis, and by Cherryholmes (1988) and Davies (1994) for poststructuralist analysis, to date I have drafted four guiding principles which I am exploring in my own work. These principles, which are still being developed and which are all grounded in an opposition “to the longing for ‘one true story’ that has been the psychic motor for Western science” (Harding 1986: 193), include:

- to recognise that knowledge is partial, multiple and contradictory
- to draw attention to the racism and gender blindness in science education
- to develop a willingness to listen to silenced voices and to provide opportunities for them to be heard

- to develop understandings of the stories of which we are a part and our abilities to deconstruct them.

In proposing these principles I recognise that there are inherent promises and problematics in their practice, some of which I now wish to discuss.

Promises

As a way of exemplifying these principles and illustrating how less partial and distorted descriptions and explanations may become part of the content of our science education research and pedagogical practices I provide an example which comes from a teacher education module concerned with using indigenous knowledge, practices and perspectives in environmental education that I have developed for a regional UNESCO project (Greenall Gough in press). In this example of how people speak of and experience time, various texts are poststructurally analysed to develop awareness of the domination of Western perspectives in scientific accounts and appreciation that other perspectives exist. As Cleo Cherryholmes (1988: 177) explains:

Poststructural analysis points beyond structure, utility, and instrumentality. Our ability to shape and design the social world can be enhanced, I hope, if we outline, examine, analyze, interpret,

criticize, and evaluate the texts and discourse-practices that surround us.

The use of poststructuralist theory as a tool is equally appropriate for science education research methodology as it is for use by students in classroom activities on science content. In science, just as much as in other areas, we need to understand the power relations that dominate knowledge production in order to identify areas and strategies for change. An important component of this analysis is to focus on the 'unconscious' and critically examine Western science's complicity with racist, gendered, imperialist and Eurocentric projects which silence other ways of knowing, and to draw attention to this silencing, complicity and domination.

The example:

Time, according to Dick White (1988: x-xi) is a very basic concept, but it is one that is spoken of differently in different cultures:

The universe impinges on us, and we are aware of it through our senses. From the sensations we receive we construct objects and incidents and determine causes for effects. Each of us builds a world... Since the concepts are invented and.. mean different things to different people, models are constructions. Not only are they constructions themselves, they influence further constructions – the ways we interpret the world. To give an example, consider the very basic concept of time, which is spoken of in most cultures as if it were a regular continuous

progression in one direction along one dimension. It is represented mathematically in that way in our science, and we are so imbued with it that it is hard to appreciate that there are other ways of looking at it. The Hopi Indians experience time just as we do, of course, but think and speak about it in a very different way. 'Among the peculiar properties of Hopi time are that it varies with each observer, does not permit simultaneity, and has zero dimensions; i.e. it cannot be given a number greater than one. The Hopi do not say "I stayed five days", but "I left on the fifth day" ' (Whorf 1940, p.216). Whorf has called Hopi a timeless language. He points out that although the Hopi can describe the universe quite adequately, their non-dimensional view of time means that they do not share our concepts of velocity and acceleration. They are not wrong in their view, nor are we; it is just that our constructions differ. Even within cultures that follow modern science, time may be seen differently. Mori, Kitagawa and Tadang (1974) demonstrate that religious beliefs affect Thai and Japanese conceptions of time. The Buddhist Thai tended to think of time as a circular succession, infinitely recurring with no beginning or end; Japanese from Christian schools more often thought of it as linear, with a beginning and an end; and Japanese from public schools tended to think of it as linear with a definite beginning but infinite in extent.

If different groups of people speak of time differently it is most likely that time is also experienced differently in different cultures, i.e. contrary to what White says, I believe that the Hopi experience time differently from us. From what is known of Thai Buddhism and other religions it is also likely that different ways of thinking of time relate to other differences in the associated cultures. Thus, if we are going to understand "time" as a concept then we need to understand it from the perspective of other's lives not by imposing a Western modern science concept on all peoples.

Peter Høeg (1994: 278) describes a Greenlander perspective on time in relation to distance:

In North Greenland distances are measured in *sinik*, in "sleeps", the number of nights that a journey requires. It's not a fixed distance.

Depending on the weather and the time of year, the number of *sinik* can vary. It's not a measurement of time, either. Under the threat of a storm, I've travelled with my mother non-stop from Force Bay to Iita, a distance that should have required two nights.

Sinik is not a distance, not a number of days or hours. It is both a spatial and a temporal phenomenon, a concept of space-time, it describes the union of space and motion and time that is taken for granted by Inuit but that cannot be captured by any European everyday language.

The European measurement of distance, the standard metre in Paris, is something quite different. It's a concept for reshapers, for those

whose primary view of the world is that it must be transformed. Engineers, military strategists, prophets. And mapmakers. Like me. The metric system didn't become part of me until I took a course in surveying at Denmark's Technical College in the autumn of 1983. We surveyed the Dyrehaven. With theodolites and tape measures and normal distribution and equidistances and stochastic variables and rainy weather and little pencils that had to be sharpened constantly. And we paced off areas. We had a teacher who repeated over and over that the alpha and omega of surveying is that the geodesist must know the length of his [sic] own stride.

I knew my own pace measured in sinik. I knew that when we ran behind the sleigh because the sky was black with pent-up explosions the space-time around us would be half the number of sinik required when we let the dogs pull us over smooth new ice. In fog the number would double, in a snowstorm it might be tenfold.

A third perspective on time comes from an Australian society. In Stephen Davis' (c.1988) description of the seasons as a basic organising principle of Aboriginal societies he is providing yet another way of thinking and speaking about, and experiencing, time:

The simplest learning principle is at the crux of this issue ... start teaching from where the learner is. In Aboriginal schools in places like the Northern Territory, the school program must start with what the Aboriginal child knows about the environment and proceed in tandem with traditional structuring of learning about the environment. To proceed in such a way it would first be necessary to document Aboriginal traditional knowledge of the local environment and identify the major organisational principles (such as seasonal variations). The simple seasonal calendar is an ideal framework from which one may develop and integrate such information.

A problem which has faced Aboriginal schools in outlying communities since time immemorial has been the lack of equipment. A program which relies to a reasonable extent on Aboriginal knowledge of the environment will not, at least in the early years, necessitate a high level of technical resources and equipment. Rather, the emphasis will be upon the thoughtful use of local resources which may change as the emphasis on Aboriginal life changes throughout the seasons of the year.

Thus, while Western cultures (and those cultures which have been affected by Western science and religion - such as Christian Japanese people) generally speak of time "as if it were a regular continuous progression in one direction along one dimension" (White 1988: x), there are obviously many other ways of experiencing and representing time in other cultures. And these ways should be equally valued and sought to be understood as they could help provide insights into other ways of understanding the scientific beliefs of particular cultures. I thus see poststructural analysis as a promising tool for moving toward a more democratic science. By outlining, examining, analysing, interpreting, criticising and evaluating a number of texts and

discourses we should achieve less partial, less distorted accounts of the world.

Problematics

A great problematic for moving beyond Eurocentrism in science education research and practice at the present time is the renewed emphasis on traditional content in science curriculum frameworks in Australia, and in some other countries.

Although there was a content emphasis in the national curriculum statement on science for Australian schools (Curriculum Corporation 1994), it did at least have some overarching principles which were consistent with moving toward a more democratic science. For example, it encourages teachers and students

- to develop critiques of developments in science,
- to examine the social implications of science ideas and applications,
- to tolerate different world views,
- to recognise the gendered nature of the selection and presentation of knowledge in science curricula in schools, and
- to recognise that scientific understanding is not the only way of making sense of the world.

While not perfect, these principles are at least heading in the direction of those I have proposed in this paper.

The same cannot be said for the national statement's successors and relatives. For example, according to Malcolm Carr (as reported in 'Students must embrace understanding', *Campus Review* 6-12 October 1994: 19), who was intimately involved in reforming New Zealand's science and technology curriculum in schools, such a curriculum should be content-based: "Teaching and learning about science should be absolutely focused on where the students are, what they already know about, what they can develop their knowledge and skills from—and this means using contexts that are familiar to them". Such a curriculum would seem to be the very opposite of one that is encouraging of moving beyond modern science and toward a more democratic future.

A similar approach is found in the draft Victorian Curriculum and Standards Framework (Victorian Board of Studies 1994) which is very much content driven. Rather than building on research findings in science and science education and critiques from the past 30 years, the draft reproduces what has gone before. As Roger Cross (1994: 17) recently commented,

There appears to be little evidence that the committees took cognizance of the important issues in the schooling of science: gender and science education, the Science, Technology and Society Movement, the role of the history and philosophy of science, changing conceptions of scientific literacy and science for all, and the psychology of learning

among other things.

In contrast, in their re-examination of school science in America, the American Association for the Advancement of Science recommended a reduction in the amount of content covered and that curricula “should seek to weaken or eliminate rigid subject matter boundaries; to pay more attention to the connections among science, mathematics and technology; to present the scientific endeavour as a social enterprise that strongly influences – and is influenced by – human thought and action” (quoted in Cross 1994: 17). It is also recommended that curricula should be formulated with the question in mind that “Is the proposed content likely to help citizens participate intelligently in making social and political decision[s] on matters involving science and technology?” (quoted in Cross 1994: 17). These recommendations are consistent with a more feminist approach to science education. Lyn

Yates (1993: 65), reporting on the work of Jan Harding and others, argues that

if science subjects continue to be presented as ‘factual, with abstract laws and concepts to be learnt’, they will remain unattractive to many girls. Alternatively, if they were presented in a more integrated mode, as ‘enmeshed in a complex of inter-relations’, this would be more attractive to girls.

There would seem to be many arguments for moving toward a more democratic science, coming from many directions, including scientists and philosophers as well as educators. This does not help us at the policy level in Victoria, but it does provide science education researchers with a challenge to investigate and encourage more democratic science education research and practices in schools. I remain optimistic in that policy documents are often ignored, and even within the constraints of the new policies it is possible to explore less partial and less distorted accounts of the particular science content. There is no directive that other ways of knowing are not allowed to be considered; it is just that it is not overtly encouraged. The challenge for us as science education researchers and practitioners is to encourage the valuing of these other ways of knowing.

Conclusion

Moving beyond Eurocentrism in science education research will not be easy. Yet there are increasing challenges to the West imposing its values and standards on others – the discussions around the 1994 United Nations Population Conference in Cairo are a case in point (see, for example, Elliott and Dickey 1994) – which need to be acknowledged in our practices. We need to be working toward less partial and less distorted accounts of nature and social relations in science education content and we need to be working toward research methodologies that are not in pursuit of “one true story”. The principles I have proposed

in this paper, which are grounded in feminist and postcolonial critiques of science and science education, and in feminist poststructuralist methodologies, are where I am starting on my work toward encouraging more democratic science content and science education research practices. As a science education researcher I am trying to stop being unconscious.

REFERENCES

- Achebe, Chinua (1960) *No Longer at Ease*. London: Heinemann.
- Adam, Ian and Tiffin, Helen (eds) (1991) *Past the Last Post: Theorizing Post-Colonialism and Post-Modernism*. Hempel Hempstead: Harvester Wheatsheaf.
- Ashcroft, Bill; Griffiths, Gareth; and Tiffin, Helen (1989) *The Empire Writes Back: Theory and Practice in Post-Colonial Literatures*. New York/London: Routledge.
- Berger, Peter and Luckmann, Thomas (1966) *The Social Construction of Reality*. New York: Doubleday.
- Berman, Ruth (1989) From Aristotle's Dualism to Materialist Dialectics: Feminist Transformation of Science and Society. In Alison M. Jaggar and Susan Bordo (eds) *Gender/Body/Knowledge: Feminist Reconstructions of Being and Knowing*. New Brunswick, NJ/London: Rutgers University Press, pp.224-255.
- Bhabha, Homi K. (1985) Signs taken for wonders: questions of ambivalence and authority under a tree outside Delhi. May 1817. *Critical Inquiry* 12(1): 144-165.
- Bhabha, Homi K. (1986) The other question: Difference, discrimination and the discourse of colonialism. In Francis Barker et al (eds) *Literature, politics and theory*. New York: Methuen, pp.148-172.
- Bhabha, Homi K. (1988) The commitment to theory. *Formations* 5: 5-23.
- Bhabha, Homi K. (1994) *The Location of Culture*. London/New York: Routledge.
- Bleier, Ruth (1986a) Introduction. In Ruth Bleier (ed) *Feminist Approaches to Science*. New York: Pergamon, pp. 1-17.
- Bleier, Ruth (1986b) Lab coat: Robe of innocence or klansman's sheet? In Teresa De Lauretis (ed) *Feminist Studies/Critical Studies*. Bloomington, Indiana: Indiana University Press, pp.55-66.
- Cherryholmes, Cleo H. (1988) *Power and Criticism: Poststructural Investigations in Education*. New York/London: Teachers College Press.
- Cross, Roger (1994) School science draft fails a citizenship test. *The Age* 8 November: 17.
- Curriculum Corporation (1994) *A Statement on Science for Australian Schools*. Carlton: Curriculum Corporation.
- Davies, Bronwyn (1994) *Poststructuralist Theory and Classroom Practice*. Geelong: Deakin University.
- Davis, Stephen (c.1988) Aboriginal Perception of the Environment and the Implications for Environmental Education. In Stuart Traynor (ed) *Sailing on an Inland Sea. Proceedings of the 5th National Conference*. Alice Springs: Australian Association for Environmental Education,

pp.21-28.

Di Stefano, Christine (1990) Dilemmas of difference: feminism, modernity, and postmodernism. In Linda J. Nicholson (ed) *Feminism/Postmodernism*. New York/London: Routledge, pp.63-82.

Elliott, Michael and Dickey, Christopher (1994) Body politics. *The Bulletin with Newsweek* 13 September: 56-60.

Fee, Elizabeth (1983) Women's nature and scientific objectivity. In Marian Lowe and Ruth Hubbard (eds) *Woman's Nature: Rationalizations of Inequality*. New York: Pergamon, pp.9-27.

Ferguson, Russell ; Gever, Martha ; Trinh T. Minh-ha; and West, Cornel (eds) (1990) *Out There: Marginalization and Contemporary Cultures*. New York: The New Museum of Contemporary Art and Cambridge, MA: The MIT Press.

Flax, Jane (1990) Postmodernism and gender relations in feminist theory. In Linda J. Nicholson (ed) *Feminism/Postmodernism*. New York/London: Routledge, pp.39-62.

Gilligan, Carol (1982) *In a Different Voice: Psychological Theory and Women's Development*. Cambridge, MA/London: Harvard University Press.

Goonatilake, Susantha (1984) *Aborted Discovery: Science and Creativity in the Third World*. London: Zed Books.

Greenall Gough, Annette (1994) *Fathoming the Fathers in Environmental education: A Feminist Poststructuralist Analysis*. Unpublished doctoral dissertation submitted to Deakin University, Geelong.

Greenall Gough, Annette (in press) *Using Indigenous Knowledge, Practices and Perspectives in Environmental Education*. A module for the UNESCO-ACEID Project on "Learning for a Sustainable Environment - Innovation in Teacher Education."

Haraway, Donna J. (1986) Primatology is politics by other means. In Ruth Bleier (ed) *Feminist Approaches to Science*. New York: Pergamon, pp.77-118.

Haraway, Donna J. (1988) Situated knowledges: The Science Question in Feminism and the privilege of partial perspective. *Feminist Studies* 14(3): 575-600. Reprinted and revised in Donna J. Haraway (1991) *Simians, Cyborgs, and Women: The Reinvention of Nature*. London: Free Association Books, pp.183-201.

Haraway, Donna J. (1989) *Primate Visions: Gender, race and nature in the world of modern science*. New York: Routledge.

Haraway, Donna J. (1991) *Simians, Cyborgs, and Women: The Reinvention of Nature*. London: Free Association Books.

Harding, Sandra (1986) *The Science Question in Feminism*. Ithaca: Cornell University Press.

Harding, Sandra (1991) *Whose Science? Whose Knowledge? Thinking from Women's Lives*. Ithaca, NY: Cornell University Press.

Harding, Sandra (1993a) Rethinking standpoint epistemology: "What is strong objectivity?". In Linda Alcoff and Elizabeth Potter (eds) *Feminist Epistemologies*. New York/London: Routledge, pp.49-82.

Harding, Sandra (ed) (1993b) *The "Racial" Economy of Science: Toward a Democratic Future*. Bloomington: Indiana University Press.

- Harding, Sandra (1993c) Introduction: Eurocentric Scientific Illiteracy - A Challenge for the World Community. In Sandra Harding (ed) *The "Racial" Economy of Science: Toward a Democratic Future*. Bloomington: Indiana University Press, pp.1-29.
- Harding, Sandra (1994) Is science multicultural? Challenges, resources, opportunities, uncertainties. *Configurations: A Journal of Literature, Science, and Technology* 2(2): 301-330.
- Hartsock, Nancy (1987) Rethinking modernism: minority vs. majority theories. *Cultural Critique* 7: 187-206.
- Høeg, Peter (1994) *Miss Smilla's Feeling for Snow*. London: HarperCollins.
- Hrdy, Sarah Blaffer (1986) Empathy, polyandry, and the myth of the coy female. In Ruth Bleier (ed) *Feminist Approaches to Science*. New York: Pergamon, pp. 119-146.
- Hubbard, Ruth (1981) The emperor doesn't wear any clothes: the impact of feminism on biology. In Dale Spender (ed) *Men's Studies Modified: The Impact of Feminism on the Academic Disciplines*. Oxford: Pergamon Press, pp.213-235.
- Keller, Evelyn Fox (1985) *Reflections on Gender and Science*. New Haven/London: Yale University Press.
- Keller, Evelyn Fox (1992) *Secrets of Life, Secrets of Death: Essays on Language, gender and science*. New York and London: Routledge.
- Merchant, Carolyn (1980) *The Death of Nature: Women, Ecology and the Scientific Revolution*. New York: Harper and Row.
- Namenwirth, Marion (1986) Science seen through a feminist prism. In Ruth Bleier (ed) *Feminist Approaches to Science*. New York: Pergamon, pp.18-41.
- Nandy, Ashis (1986) *The Intimate Enemy*. Delhi: Oxford University Press.
- Ngugi Wa Thiong'o (1986) *Decolonizing the Mind: The Politics of Language in African Literature*. London /Nairobi: Heinemann.
- Said, Edward W. (1978) *Orientalism*. New York: Pantheon.
- Said, Edward W. (1985) Orientalism reconsidered. *Cultural Critique* 1: 89-107.
- Said, Edward W. (1993) *Culture and Imperialism*. London: Chatto & Windus.
- Shiva, Vandana (1989) *Staying Alive: Women, Ecology and Development*. London: Zed Books.
- Small, Meredith F. (1984) *Female Primates: Studies by Women Primatologists*. New York: Alan R. Liss.
- Spivak, Gayatri Chakravorty (1987) *In Other Worlds: Essays in Cultural Politics*. New York: Routledge & Kegan Paul.
- Spivak, Gayatri Chakravorty (1990a) *The Post-colonial Critic: interviews, strategies and dialogues*. New York/London: Routledge. (edited by Sarah Harasym)
- Spivak, Gayatri Chakravorty (1990b) Explanation and culture: marginalia. In Russell Ferguson, Martha Gever, Trinh T. Minh-ha and Cornel West (eds) *Out There: Marginalization and Contemporary Cultures*. New York: The New Museum of Contemporary Art and Cambridge, MA: The MIT Press, pp.377-393.
- Spivak, Gayatri Chakravorty (1993) *Outside in the Teaching Machine*. New

York/London: Routledge.

Students must embrace understanding. *Campus Review* October 6-12 1994: 19.

Third World Network (1993) *Modern science in crisis: a Third World response*. In Sandra Harding (ed) *The "Racial" Economy of Science: Toward a Democratic Future*. Bloomington: Indiana University Press, pp.484-518.

Tiffin, Chris and Lawson, Alan (eds) (1994) *De-Scribing Empire: Post-colonialism and textuality*. London/New York: Routledge.

Victorian Board of Studies (1994) *Curriculum and Standards Framework. Draft*. Carlton: Victorian Board of Studies.

Weedon, Chris (1987) *Feminist Practice and Poststructuralist Theory*. Oxford: Blackwell.

White, Richard T. (1988) *Learning Science*. Oxford: Blackwell.

Yates, Lyn (1993) *The Education of Girls: Policy, Research and the Question of Gender*. Hawthorn, Victoria: ACER.

EXHIBIT 1

The very basic concept of time

The universe impinges on us, and we are aware of it through our senses. From the sensations we receive we construct objects and incidents and determine causes for effects. Each of us builds a world... Since the concepts are invented and.. mean different things to different people, models are constructions. Not only are they constructions themselves, they influence further constructions – the ways we interpret the world. To give an example, consider the very basic concept of time, which is spoken of in most cultures as if it were a regular continuous progression in one direction along one dimension. It is represented mathematically in that way in our science, and we are so imbued with it that it is hard to appreciate that there are other ways of looking at it. The Hopi Indians experience time just as we do, of course, but think and speak about it in a very different way. 'Among the peculiar properties of Hopi time are that it varies with each observer, does not permit simultaneity, and has zero dimensions; i.e. it cannot be given a number greater than one. The Hopi do not say "I stayed five days", but "I left on the fifth day" ' (Whorf 1940, p.216). Whorf has called Hopi a timeless language. He points out that although the Hopi can describe the universe quite adequately, their non-dimensional view of time means that they do not share our concepts of velocity and acceleration. They are not wrong in their view, nor are we; it is just that our constructions differ. Even within cultures that follow modern science, time may be seen differently. Mori, Kitagawa and Tadang (1974) demonstrate that religious beliefs affect Thai and Japanese conceptions of time. The Buddhist Thai tended to think of time as a circular succession, infinitely recurring with no beginning or end; Japanese from Christian schools more often thought of it as linear, with a

beginning and an end; and Japanese from public schools tended to think of it as linear with a definite beginning but infinite in extent.

(Extract from Richard T. White (1988) *Learning Science*. Oxford: Blackwell, pp.x-xi)

EXHIBIT 2

Space-time and sinik

In North Greenland distances are measured in sinik, in “sleeps”, the number of nights that a journey requires. It’s not a fixed distance. Depending on the weather and the time of year, the number of sinik can vary. It’s not a measurement of time, either. Under the threat of a storm, I’ve travelled with my mother non-stop from Force Bay to Iita, a distance that should have required two nights.

Sinik is not a distance, not a number of days or hours. It is both a spatial and a temporal phenomenon, a concept of space-time, it describes the union of space and motion and time that is taken for granted by Inuit but that cannot be captured by any European everyday language.

The European measurement of distance, the standard metre in Paris, is something quite different. It’s a concept for reshapers, for those whose primary view of the world is that it must be transformed. Engineers, military strategists, prophets. And mapmakers. Like me. The metric system didn’t become part of me until I took a course in surveying at Denmark’s Technical College in the autumn of 1983. We surveyed the Dyrehaven. With theodolites and tape measures and normal distribution and equidistances and stochastic variables and rainy weather and little pencils that had to be sharpened constantly. And we paced off areas. We had a teacher who repeated over and over that the alpha and omega of surveying is that the geodesist must know the length of his [sic] own stride.

I knew my own pace measured in sinik. I knew that when we ran behind the sleigh because the sky was black with pent-up explosions the space-time around us would be half the number of sinik required when we let the dogs pull us over smooth new ice. In fog the number would double, in a snowstorm it might be tenfold.

(Extract from Peter Høeg (1994) *Miss Smilla’s Feeling for Snow*. London: HarperCollins, p.278)

EXHIBIT 3

Seasonal variation as an organisational principle

The simplest learning principle is at the crux of this issue ... start teaching from where the learner is. In Aboriginal schools in places

like the Northern Territory, the school program must start with what the Aboriginal child knows about the environment and proceed in tandem with traditional structuring of learning about the environment.

To proceed in such a way it would first be necessary to document Aboriginal traditional knowledge of the local environment and identify the major organisational principles (such as seasonal variations). The simple seasonal calendar is an ideal framework from which one may develop and integrate such information.

A problem which has faced Aboriginal schools in outlying communities since time immemorial has been the lack of equipment. A program which relies to a reasonable extent on Aboriginal knowledge of the environment will not, at least in the early years, necessitate a high level of technical resources and equipment. Rather, the emphasis will be upon the thoughtful use of local resources which may change as the emphasis on Aboriginal life changes throughout the seasons of the year.

(Stephen Davis (c.1988) Aboriginal Perception of the Environment and the Implications for Environmental Education. In Stuart Traynor (ed) Sailing on an Inland Sea. Proceedings of the 5th National Conference. Alice Springs: Australian Association for Environmental Education, pp.26-27.)

Some Framing Quotations:

Scientists firmly believe that as long as they are not conscious of any bias or political agenda, they are neutral and objective, when in fact they are only unconscious. (Marion Namenwirth 1986: 29)

As a woman and a scientist, the status of outsider came to me gratis.

Feminism enabled me to exploit that status as a privilege. I began to see the network of gender associations in the characteristic language of science as neither natural nor self-evident, but as contingent, and dismaying. I began to see further that these were not just ornamental images on the surface of scientific rhetoric; they were deeply embedded in the structure of scientific ideology, with recognizable implications for practice. (Evelyn Fox Keller 1985: 12)

There are few aspects of the "best" science educations that enable anyone to grasp how nature-as-an-object of knowledge is always cultural: "In science, just as in art and life, only that which is true

to culture is true to nature". The elite science educations rarely expose students to systematic analyses of the social origins, traditions, meanings, practices, institutions, technologies, uses, and consequences of the natural sciences that ensure the fully historical character of the results of scientific research. (Sandra Harding 1993c: 1)

Some suggested guiding principles for science education research and practice beyond Eurocentrism:

- to recognise that knowledge is partial, multiple and contradictory
- to draw attention to the racism and gender blindness in science education
- to develop a willingness to listen to silenced voices and to provide opportunities for them to be heard
- to develop understandings of the stories of which we are a part and our abilities to deconstruct them.

1Following Harding (1993c: 2) "Eurocentrism" means "the assumption that Europe functions autonomously from other parts of the world that Europe is its own origin, final end, and agent; and that Europe and people of European descent in the Americas and elsewhere owe nothing to the rest of the world".

2By "Western" I mean not only Europe and North America but anywhere else that follows the canons of Enlightenment science. I recognise that by using "Western" I am reinstating the West-East contrast that postcolonial writers are trying to undermine, but this is the construct in use and readily understood so I will continue to use it with the understanding that it should always be read in "scare" quotation marks.
3 This argument has been advanced by writers such as Haraway (1989), Harding (1993c), Keller (1985), Merchant (1980) and the authors represented in Harding (1993b).