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Thinking globally in environmental education: A critical history

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This essay offers a critical history of approaches to 'thinking globally' in environmental education research,[1] with particular reference to the production, reproduction and widespread circulation of assumptions about the universal applicability of modern Western science.[2] Although the transnational character of many environmental problems and issues demands that we 'think globally', I argue that environmental education research could be enhanced by understanding Western science as one among many local knowledge traditions. Global knowledge production in/for environmental education might then be understood as creating conditions under which local knowledge traditions can be performed together, rather than as creating a global 'common market' in which representations of local knowledge must be translated into (or exchanged for) the terms of a universal discourse.

Thinking globally in environmental education: first approximations

Think globally. Act locally. These familiar exhortations have circulated within the slogan system of environmental education for nearly four decades. They almost always appear as a pair, but environmental educators have not necessarily translated them into practice in comparable or commensurate ways. Many educational programs incorporate local action on environmental issues, but evidence of 'thinking globally' is more elusive, equivocal and problematic. Researchers can readily observe learners performing a school energy audit, participating in a recycling project, propagating locally indigenous plants to revegetate a degraded site, and so on. But what constitutes compelling evidence of learners, teachers, curriculum developers, and researchers 'thinking globally'? I take a pragmatic approach, which is to clarify meanings by reference to consequences.[3] In this I follow Charles Sanders Peirce's (1931-58) explanation of how a pragmatic logic can be used to analyze the meaning of a concept:

> The word pragmatism was invented to express a certain maxim of logic… The maxim is intended to furnish a method for the analysis of concepts… The method prescribed in the maxim is to trace out in the imagination the conceivable practical consequences – that is,

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1 Quoting William Reid (1981), I understand research to be 'any means by which a discipline or art develops, tests, and renews itself' (p. 1).

2 I realize that this formulation – 'modern *Western* science' rather than just 'science' or 'modern science' – introduces a problematic 'West versus the rest' dualism that might appear to overlook the historical influences of other cultures (e.g., Islamic, Indian, Chinese, etc.) on its development. However, I also want to emphasize that I am referring to the 'science' that was uniquely coproduced with industrial capitalism in a particular time/place (17th century northwestern Europe) and to the cultural characteristics of that enterprise that have endured to dominate Western (and many non-Western) understandings of science as a result of Euro-American imperialism.

3 Although my methodology is broadly situated within the discipline of analytic philosophy, I distance myself from what Michael Peters (2004) calls 'the conservatism, apoliticism and ahistoricism of analytic philosophy that has denied its own history until very recently' (p. 218). Rather, I am disposed towards Gilles Deleuze and Félix Guattari's (1994) conceptualization of philosophy as *geophilosophy*, which complicates philosophical questions by tying them to their historical and spatial specificities.

> the consequences for deliberate, self-controlled conduct – of the affirmation or denial of the concept (¶ 191).[4]

Pragmatically, the task of clarifying what environmental educators *mean* when they aspire to 'thinking globally' requires an answer to the following question: in practical and performative terms, what imaginable, conceivable consequences follow from environmental educators affirming that they are 'thinking globally'? However, as Cleo Cherryholmes (1993) notes, consequences 'are of interest and can be assessed only in terms of purposes' (p. 3). Thus, we must also ask: what purposes does 'thinking globally' serve in environmental education? How defensible are these purposes?

According to Ruth and William Eblen (1994), molecular biologist (and Nobel Laureate) René Dubos coined the phrase 'think globally, act locally' in 1972, when he chaired the group of scientific experts advising the United Nations Conference on the Human Environment held in Stockholm.[5] We might thus interpret the launch of the UNESCO-UNEP[6] International Environmental Education Programme (IEEP) in 1974 as an early (post-Stockholm) manifestation of 'thinking globally' in environmental education. This intergovernmental program sponsored many projects that promoted and supported local and regional educational action in response to concerns about the quality of the global environment. However, the consequences of 'thinking globally' in such projects are subject to the differential power relations that accompany intergovernmental cooperation (or the appearance thereof) and some critics argue that the IEEP produced a neo-colonialist discourse in environmental education by systematically privileging Western (and especially US) interests and perspectives (see, e.g., Annette Gough, 1999).

By the mid-1980s, 'think globally, act locally' had become an uncontested axiom of environmental education.[7] For example, *Earthrights: Education as if the Planet Really Mattered* (Greig, Pike & Selby, 1987) invokes 'think globally, act locally' as a taken-for-granted principle, without any citation of its author(ity). As their titles suggest, many other texts published in the late 1980s valorize variations on this principle, including *Global Teacher, Global Learner* (Pike & Selby, 1987), *Living in a Global Environment* (Fien, 1989), *Making Global Connections* (Hicks & Steiner, 1989), and the World Wide Fund for Nature's (WWF) Global Environmental Education Programme (e.g., Huckle, 1988).[8] These texts equate 'thinking globally' with knowing and caring about the global dimensions and significance of environmental problems and issues; for example, John Huckle (1988) writes:

> Starting with products such as a tin of corned beef, a packet of potato crisps or a unit of electricity, teachers and pupils are encouraged to trace commodity chains and recognise

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4 This passage is quoted from the draft of a book review that Peirce wrote circa 1904. H. Standish Thayer (1981) regards the long paragraph from which this passage is taken as 'the clearest and most complete single statement of what pragmatism is that Peirce ever wrote' (p. 493).

5 Many other sources identify Dubos as the author of this phrase, but the Eblens add weight to their claim by including his 1972 essay, 'Think Globally, Act Locally', in their *Encyclopedia of the Environment*.

6 UNEP: United Nations Environment Programme.

7 Environmental educators were not alone in consolidating this aphorism. In *Harvard Business Review,* Theodore Levitt (1983) used 'Think global. Act local' in arguing that 'the globalization of markets is at hand' (p. 92). Of course, the imperative to think globally has a longer history. For example, in 1967 Marshall McLuhan noted that with the advent of an electronic information environment, 'all the territorial aims and objectives of business and politics [tend] to become illusory' (McLuhan & Fiore, 1967, p. 5). A Google search reveals the extent to which 'Think global. Act local' continues to be a popular trope in environmental, economic, and other discourses.

8 For convenience, I cite only one volume in the WWF Global Environmental Education Programme, which consists of four multi-volume modules.

> their connections to such environmental issues as deforestation in Amazonia, the draining of wetlands in Britain and the debate over acid rain in Europe (p. 2).

All of these texts infer that the purpose of 'thinking globally' is to encourage learners and teachers to 'recognise their connections' between their (local) experiences and conditions elsewhere in the world, and all draw attention to the far-reaching – and environmentally harmful – effects of Western imperialism, colonialism, and industrialization. However they do not, for the most part, question the privileged status of the Western knowledge systems and ways of thinking within which their truth claims are produced. Some scholars in disciplines relevant to environmental education raise such questions, such as Lynn White (1967), whose influential appraisal of the historical roots of the 20th century ecological crisis in the Christian Middle Ages questions the merits of Judeo-Christian attitudes to nature relative to other traditions. Although interest in non-Western worldviews, such as Buddhism, increased within the English-speaking world throughout the 1970s and '80s, there was little substantial scholarship on such matters until the publication of J. Baird Callicott and Roger Ames' (1989) edited collection, *Nature in Asian Traditions of Thought: Essays in Environmental Philosophy*, which compares Chinese, Japanese, Buddhist and Indian worldviews with those that predominate in the West.

Callicott and Ames's (1989) conclusions concerning the relative merits and reciprocal effects of 'Eastern'[9] and Western environmental thought are, at least superficially, sympathetic to the former. For example, they assert that 'Eastern traditions of thought represent nature and the relationship of people to nature, in ways that cognitively resonate with contemporary ecological and environmental ideals' and that 'the brute fact that environmental degradation is rampant in much of Asia' is best explained by the 'intellectual colonization' of the East by the West (p. 279). Some of the assumptions underlying these conclusions are contestable (there is ample evidence of serious environmental destruction in parts of pre-modern Asia, and a number of Asian cultures have attempted to 'conquer' nature in much the same ways that Westerners have done), but I am more concerned that Callicott and Ames (1989) ignore their own complicity in intellectually colonizing textual practices. One sign of intellectual colonization is what Susan Hawthorne (1999) calls the 'unmarked category' (p. 121). For example, in the informational domains of the Internet, US addresses are unmarked but all other places are identified by the final term: au for Australia, sg for Singapore, za for South Africa, and so on. Unmarked cultural categories, such as whiteness in most Western societies, are especially troublesome for those of us who reside in them because they designate power and privilege. In Callicott and Ames's (1989) comparison of 'Eastern traditions of thought' with 'contemporary ecological and environmental ideals' (p. 279), the unmarked category is 'Western': that is, they tacitly privilege contemporary *Western* 'ecological and environmental ideals' as criteria that in some way validate Eastern philosophies (they also diminish 'Eastern traditions of thought' by inferring that they are not 'contemporary').

Thinking globally in environmental education: recent positions

To bring my discussion of 'thinking globally' into more recent times, I will focus on some of the ways in which this concept is deployed in a specific research publication, namely, *Environment, Education and Society in the Asia-Pacific: Local Traditions and Global Discourses*, edited by David Yencken, John Fien, and Helen Sykes (2000b). This book brings together some of the significant findings of a substantial comparative study of attitudes to

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[9] 'Eastern' appears to be Callicott and Ames's shorthand for a number of 'Asian traditions of thought'. As an 'Other' of Western it is as problematic as 'Oriental' (see, e.g., Said, 1978).

nature and ecological sustainability, particularly among young people, in twelve sites in the Asia-Pacific region.[10] Some of the key questions explored in this research concern the relative influence of, and relationships between, local traditions and practices and global environmental discourses. Indeed, Yencken (2000) begins chapter 1 by restating – and then inverting – Dubos's maxim:

> To protect the planet, we have long been told to think globally and act locally. But we can readily see that there are as many reasons to think locally and act globally. If we do not think locally, we may ignore rich sources of environmental knowledge and devalue local understanding and experience of environmental problems. If we do not act globally, we will never solve the big issues of the global commons: atmospheric and ocean pollution and the impacts of environmental degradation across national boundaries. Sustainability has many local and global dimensions (p. 4).

Yencken (2000) provides a thoughtful and culturally sensitive overview of the various attitudes toward nature found in both the Eastern and Western nations of the Asia-Pacific region. He focuses not only on contemporary ecopolitical positions in the sites studied but also reviews the history of Western engagement with the environmental philosophies of Eastern cultures. He concludes by expressing his hopes for 'the emergence of a global ideology of nature that transcends individual cultures' (p. 23):

> The environmental problems now facing the world are global problems stemming from the process of industrialization and capitalist development that has been taking place in every country, albeit at different speeds and intensities. We therefore need contemporary concepts to help frame both the nature of the problems and their likely solution… These concepts (sustainability, ecology, biodiversity, natural capital, intergenerational equity, precautionary principle and the like) and working models and techniques (metabolism, ecological footprint, natural step, environmental space, industrial ecology, etc.) need to gain widespread international acceptance. They should be developed cooperatively by scientists, environmental thinkers, local communities and others working hand in hand, with contributions from all cultures (pp. 24-5).

Although Yencken clearly respects 'contributions from all cultures', he nevertheless privileges (albeit implicitly) Western science as the prime source of the 'contemporary concepts' that 'need to gain widespread international acceptance'. Many of the concepts that Yencken lists – ecology, biodiversity, metabolism – are already foreclosed by their production within Western scientific discourses, and so I find it difficult to imagine how they could be 'developed cooperatively… with contributions from all cultures'. Three assumptions underlying Yencken's position deserve critical scrutiny.

First, Yencken's use of the term 'contemporary' is problematic, in part because some of the concepts to which he refers already have long histories in some cultures, such as the emphasis on intergenerational equity in the oral traditions of a number of Native American peoples. A more serious difficulty is that Yencken accompanies his conflation of 'contemporary concepts' and Western science with the suggestion that they have displaced 'traditional' ideas only in Western cultures. For example, Yencken (2000) describes the 'great environmental awakening' and 'new consciousness of Spaceship Earth' (p. 13) in the 1960s that led many people in Western industrialized nations to recognize that some of their

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[10] The sites were: Australia, Brunei, Fiji, India, Indonesia, Japan, New Zealand, Papua New Guinea, the Philippines, Singapore, South China and Thailand.

environmentally damaging behaviors were rooted in Judeo-Christian traditions. Yencken (2000) cites research suggesting that these traditions of environmental thought have been superseded by a form of 'contemporary environmentalism' that constitutes a 'single cultural consensus about the environment' in the US and Europe (p. 14). Although Yencken (2000) rejects attempts 'to project Western priorities onto Eastern countries or Eastern traditions into Western cultures', he also asserts that 'Western cultures undoubtedly have… much to learn from Asian traditional attitudes to nature in the same way that Eastern cultures have much to learn from Western environmentalism' (p. 25). In this formulation, *Western* environmentalism is tacitly 'contemporary' but 'traditional' attitudes to nature persist into the present in *Eastern* cultures. The unstated corollaries of these assertions are that Western cultures have little to learn from *contemporary* Asian attitudes to nature and that Eastern cultures have little to learn from *traditional* Western environmental thought (which is not restricted to Judeo-Christian traditions, but also includes more ancient mythologies and archetypes such as those associated with the Green Man (see, e.g., Anderson, 1990).

A second difficulty with Yencken's (2000) formulation of 'contemporary concepts' is the assumption that they can meaningfully be shared across cultures in ways that might be helpful in framing and resolving global environmental problems. For example, the term 'ecology' does not command shared meaning even *within* the Western scientific communities that have shaped its conceptual development. To which and to whose 'ecology' is Yencken referring? Many environmental education programs continue to privilege the particular variant of systems ecology pioneered by Eugene Odum (1953), such as the current (2005-2011) study design for the subject Environmental Science in the Victorian Certificate of Education (Victorian Curriculum and Assessment Authority, 2004), which presents an atomistic and reductionist view of large-scale ecosystem structure and function. For example, in Unit 1: The Environment, the first area of study is 'Ecological components and interaction' and begins with this summary:

> The Earth's structure may be classified into four major categories: hydrosphere, lithosphere, atmosphere and biosphere. This area of study examines the processes occurring within the spheres of the Earth and the interactions that occur in and between the ecological components of each major category (p. 12).

The second and third areas of study in Unit 1, 'Environmental Change' and 'Ecosystems' respectively, focus on the ecosystem as the primary unit for analysis. Neither the arbitrary categorical separation of the 'spheres' nor the emphasis on ecosystems is consistent with many contemporary approaches to environmental analysis. For example, Donald Worster (1993) describes how many ecologists, over the previous two decades and more, have repudiated Odum's portrayal of orderly and predictable processes of ecological succession, yet this is an explicit item of curriculum content in Environmental Science. Studies such as those collected by Steward Pickett and P.S. White (1985) clearly demonstrate that the very concept of the ecosystem has receded in usefulness and, where the word 'ecosystem' remains in use, that it has lost its former implications of order, equilibrium, and predictable succession.[11] Similarly, Andrew Jamison (1993) documents 'the failure of systems ecology to contribute very much to the actual solution of environmental problems' and concludes that 'systems ecology today is only one (and not even the most significant one at that) of a number of competing ecological paradigms' (p. 202). Why does a school Environmental Science course in the year 2009 privilege an approach to ecology that many environmentalists have

[11] See also Robert Ulanowicz (1997, 2009), who emphasizes that chance, disarray and randomness are necessary conditions for creative advance, emergence and autonomy in the natural world.

long regarded as a 'failure'? And if there are 'a number of competing ecological paradigms' within contemporary Western environmental science, how does Yencken see 'ecology' functioning as a concept that might help to 'frame both the nature of the problems and their likely solution' when it is at the same time a site of conceptual contestation?

These questions bring me to a third troubling aspect of Yencken's (2000) position, namely, his apparent belief in the *possibility* – and perhaps even the *necessity* – of a unitary and universal understanding of nature that 'transcends individual cultures' (p. 23) and his apparent acceptance of Western science as the best approximation to such an understanding that humans have imagined to date. Yencken et al. (2000a) elaborate this position in a subsequent chapter in which they are at pains both to recognize and respect feminist, postcolonialist and multiculturalist critiques of modern Western science. Nevertheless, they maintain the view that a culturally transcendent environmental science is possible – that what they name as 'science' provides the key to both thinking and acting globally. For example, Yencken et al. (2000a) assert: 'It is generally accepted that most scientific research takes place within global theoretical assumptions' (p. 30). This is a seriously misleading statement, because many of the feminist, postcolonialist and multiculturalist critiques that these authors claim to respect do *not* accept that the 'theoretical assumptions' within which 'most scientific research takes place' are 'global'. Indeed, one extreme way to characterize these critiques is to paraphrase Bruno Latour (1993) and assert that *we have never thought globally.*[12]

Western science: thinking locally, acting imperially

Until relatively recently in human history, the social activities that produce distinctive forms of knowledge have for the most part been localized. The knowledges generated by these activities have thus carried what Sandra Harding (1994) calls the idiosyncratic 'cultural fingerprints' (p. 304) of the times and places in which they were constructed. The knowledge signified by the English word 'science' is no exception, but the global reach of European imperialism has given Western science the *appearance* of universal truth and rationality. Thus, many people (regardless of their locations) assume that it lacks the cultural fingerprints that are more conspicuous in knowledge systems that retain their ties to specific localities, such as the place-specific understandings of nature produced in many indigenous societies.[13] This occlusion of the cultural determinants of Western science contributes to what Harding (1993) calls an increasingly visible form of 'scientific illiteracy', namely, 'the Eurocentrism or androcentrism of many scientists, policymakers, and other highly educated citizens that severely limits public understanding of science as a fully social process':

> In particular, there are few aspects of the 'best' science educations that enable anyone to grasp how nature-as-an-object-of-knowledge is always cultural… 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 (p. 1).

Over the past several decades, various processes of political, economic, and cultural globalization, such as the increasing traffic in trade, travel, and telecommunications

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12 This deliberately provocative formulation is inspired by the title of Latour's (1993) book, *We Have Never Been Modern*. I am usually reluctant to use terms like 'we' (which implies that I can speak for others) and 'never' (which suggests an absolutism that I cannot defend), but I believe that the provocation is defensible in the circumstances I describe.

13 See, for example, Tom Jay's (1986) eloquent account of the place of salmon in the lives of Northwest Coast Native Americans, in which he shows how salmon stories incorporate moral understandings of self, community, earth and the interrelationships among them.

crisscrossing the world, have made some multicultural perspectives on 'nature-as-an-object-of-knowledge' more visible, including the indigenous knowledge systems popularized by terms such as the 'wisdom of the elders' (Knudtson & Suzuki, 1992). The publication in English of studies in Islamic science (e.g., Sardar, 1989), and other postcolonial perspectives on the antecedents and effects of Western science (e.g., Petitjean, Jami & Moulin, 1992; Sardar, 1988), raises further questions about the interrelationships of science and culture. However, globalization simultaneously (and contradictorily) encourages both cultural homogenization *and* the commodification of cultural difference within a transnational common market of knowledge and information that remains dominated by Western science, technology, and capital.

I suspect that many environmental education researchers are unaware of the subtle and insidious ways in which their textual practices sustain assumptions about the universality of Western science. That is why I focus much of my critical attention here on Yencken, Fien and Sykes (2000b), colleagues for whom I have nothing but respect, and whose respect for non-Western cultures is unequivocally sincere. Nevertheless, I argue that for all of their undeniably good intentions, these researchers maintain a culturally imperialistic view of science through the use of rhetorical strategies that privilege Western scientists' representations of 'reality' and reproduce the conceit that the knowledge Western science produces is (or can be) universal.

For example, one way in which Yencken et al. (2000a) privilege Western science is to stipulate its uniqueness – 'we depend on science for the formal analysis of the physical world and the monitoring of environmental change' (p. 32) – and to infer that its unique object ('the physical world') somehow renders it acultural: *'While* science is culturally shaped… environmental science is *nevertheless* dealing with physical reality' (p. 32, my emphasis).[14] Yencken et al. (2000a) clearly intend the word 'formal' to signify something special about Western science, since they repeat and amplify this claim: 'we rely on science for the formal analysis of environmental conditions and change. We have no more informed source to depend upon' (p. 33). Yencken et al. (2000) imply a universal 'we' but their assertions are culture-bound. Are they suggesting that non-Western knowledge traditions *ignore* 'the formal analysis of the physical world' and are *not* concerned with 'monitoring environmental change'? Or are they merely saying that non-Western analyses of the physical world and environmental change are 'informal'? How do they distinguish between what is 'formal' and what is not? What makes Western science an 'informed source'? 'Informed' by what (and/or by whom)?

Yencken et al. (2000a) overstate the uniqueness of Western science. David Peat's (1997) discussion of Blackfoot knowledge traditions demonstrates that Western cultures have no monopoly on forms of knowledge production that have the qualities that Yencken et al. attribute to 'science'. For example, Peat (1997) describes 'the nature of Blackfoot reality' as 'far wider than our own, yet firmly based within the natural world of vibrant, living things… a reality of rocks, trees, animals and energies':

> Once our European world saw nature in a similar way… [but] our consciousness has narrowed to the extent that matter is separated from spirit and we seek our reality in an imagined elsewhere of abstractions, Platonic realms, mathematical elegance, and physical laws.
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> The Blackfoot know of no such fragmentation. Not only do they speak with rocks and trees, they are also able to converse with that which remains invisible to us, a world of

[14] I suggest that the rhetorical effect of the words I emphasize here (*'While…nevertheless'*) is to invite readers to accept (without further explanation) that 'dealing with physical reality' somehow sets limits on the extent to which knowledge is 'culturally shaped'.

> what could be variously called spirits, or powers, or simply energies. However, these forces are not the occupants of a mystical or abstract domain, they remain an essential aspect of the natural, material world (pp. 566-7).[15]

I am not suggesting that the Blackfoot view of reality is in any way superior (or inferior) to Western environmental science. My point is that Blackfoot people analyze the physical world (and more) and monitor environmental change in ways that are no less 'formal' than ours. They, like us, are interested in 'dealing with physical reality'. They too rely on their knowledge traditions 'for the formal analysis of environmental conditions and change'.

Other cultures have developed ways of 'dealing with physical reality' and 'monitoring environmental change' that may be different, but no less effective, than those privileged in modern industrialized nations, and insinuating that they are neither 'formal' nor 'informed' serves no useful purpose. For example, David Turnbull (1991, 2000) points out that people from south-east Asia began to systematically colonize and transform the islands of the south-west Pacific some ten thousand years before the alleged 'birth of civilization' (as Eurocentric historians describe it) in the Mediterranean basin. The Micronesian navigators combined knowledge of sea currents, marine life, weather, winds and star patterns to produce a sophisticated and complex body of natural knowledge which, combined with their proficiency in constructing large sea-going canoes, enabled them to transport substantial numbers of people and materials over great distances in hazardous conditions. They were thus able to seek out new islands across vast expanses of open ocean and to establish enduring cultures throughout the Pacific by rendering the islands habitable through the introduction of new plants and animals. Although the knowledge system constructed by these people did not involve the use of either writing or mathematics, it is patronizing and indefensible to suggest that it was any less concerned with 'physical reality' than Western science, or that it lacked a 'formal analysis of environmental conditions'.

Indeed, some anthropologists are convinced that indigenous people decipher 'physical reality' using homologous assumptions to Western scientists, including a disposition to use systematic empirical inquiry as a means of revealing the inherent orderliness of nature. For example, Brent Berlin's (1990) field research suggests that the biological classification systems developed by many indigenous groups are 'intellectualist' – that is, driven by curiosity about natural order and structure – rather than motivated only by a need to know which organisms are useful for practical purposes. Berlin therefore sees the difference between, say, Linnaean taxonomy and an indigenous classification system as chiefly one of degree: assisted by European imperialism, Linnaeus had access to a much larger sample of organisms than taxonomists who sampled relatively small sites and classified fewer organisms. But, given the vast numbers of organisms populating the earth, no system of classification – including contemporary Western phylogenies – can claim universality. Reviewing a number of similar anthropological studies, Susantha Goonatilake (1998) concludes:

> The world, it appears, is thus littered with indigenous starting points for potential trajectories of knowledge – trajectories which, if they were developed, would have led to different explorations of physical reality. The existence of all this anthropological

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[15] Although Peat (1997) refers to 'Blackfoot physics', he clearly understands that Blackfoot people do not fragment their understandings into specialized categories such as 'physics' – a term that might have no equivalent in Blackfoot vocabulary. Carol Geddes, a Yukon First Nation woman, asserts a similar perspective in relation to school curricula: 'We would never have a subject called environmental ethics; it is simply part of the story' (quoted in Wren, et al., 1995, p. 32).

> evidence does not solve the problem of Western ethnocentricity or of the distinctive rise of Western science, but it does help to further problematize them (pp. 70-1).

If the knowledge produced by Western scientists is applied only in cultural sites dominated by Western science, then their claim to its universality might be a relatively harmless conceit. However, attempts to generate global knowledge of environmental problems, such as climate change, draw increasing attention to the cultural biases and limits of Western science.

For example, Brian Wynne (1994, pp. 172-3) reports that up to the early 1990s the Intergovernmental Panel on Climate Change (IPCC) used models that equated global warming mainly with carbon emissions and largely ignored other factors such as cloud behavior, marine algal fixing of atmospheric carbon, and natural methane production. Western scientists and policy makers represented the IPCC models as a means for producing universally warranted conclusions, whereas many non-Western observers saw them as reflecting the interests of industrialized nations in obscuring the exploitation, domination, and social inequities underlying global environmental degradation. But if global warming is understood as a problem for *all* of the world's peoples, then we need to find ways in which *all* of the world's knowledge systems – Western, Blackfoot, Islamic, whatever – can jointly produce appropriate understandings and responses. I will not presume to suggest (indeed, I cannot imagine) what a Blackfoot or Islamic contribution to such jointly produced knowledge might be, but I am willing to assert that a coexistence of knowledge systems is unlikely to be enabled by the adherents of any one local knowledge tradition claiming that we *must* 'rely' and 'depend' on theirs.

The successive failures of the Kyoto Climate Change Summit in December 1997, The Hague World Conference on Climate Change in November 2000 and, most recently, the 15th United Nations Climate Change Conference in Copenhagen in December 2009, to reach effective transnational agreements on limiting greenhouse gas emissions demonstrate the difficulty of turning the rhetoric of 'thinking globally' into tangible environmental action. Press reports from these conferences demonstrate how deeply the putative 'global science' of climate change is enmeshed in local contexts, even among Western nations. This is not just because the conclusions Western scientists draw about aspects of global warming – such as how the vegetation in forests and farm crops function as 'carbon sinks' – are contradictory or controversial, but also because the same 'scientific facts' produce different meanings for different people. Thus, for example, Simon Mann (2000) reports that 'the definition of a forest' was among the areas of disagreement that preoccupied negotiators at The Hague conference for several days, and at the time of writing this essay more than 1400 documents addressing the definition of a forest can be found on the United Nations Framework Convention on Climate Change (UNFCCC) website.[16] I suspect that the impulse to attempt such a definition results from the false hope that some useful scientific truth claims can be made about all forests in the world, and their effects on atmospheric warming, regardless of their location. But each forest's local history and contingencies will uniquely determine the quantities of atmospheric carbon it fixes and solar heat it absorbs and radiates.

However, as an environmental educator I am less concerned about the warrant for Western scientific knowledge of the relationship between global warming and, say, atmospheric carbon fixing by vegetation, than with the conflation of Western science and 'global science'. Press reports and educational texts alike give the impression that the concept of 'carbon sink' is now a legitimate component of 'thinking globally' (and scientifically) about climate change. For example, one of the required outcomes of Unit 3: Ecological Issues: Energy and Biodiversity, in Victoria's Year 12 Environmental Science subject

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16 http://unfccc.int (accessed 5 January 2010)

(Victorian Curriculum and Assessment Authority, 2004), is that students 'should be able to describe the principles of energy and relate them to the contribution of one fossil and one non-fossil energy source to the enhanced greenhouse effect' (p. 19). To achieve this outcome, students must demonstrate knowledge of, among other things, 'options for reducing the enhanced greenhouse effect, including National Greenhouse Strategy, Kyoto protocol, increasing energy efficiency, emission trading and vegetation sinks' (p. 20). This list implies that 'emission trading and vegetation sinks' have some equivalence or comparability with 'increasing energy efficiency' as 'options for reducing the enhanced greenhouse effect', which gives them a global legitimacy they do not deserve. The 'scientific facts' of carbon fixing by plants do not justify the metaphorical representation of forests as carbon 'sinks'. The 'sink' metaphor is a rhetorical device for recruiting 'scientific facts' to assist the political efforts of industrialized nations to discount their greenhouse gas emissions.

The authors of Victoria's Year 12 Environmental Science study design insinuate that terms such as 'emission trading' and 'carbon sinks' have global currency – that they are part of the semiotic apparatus that supports 'thinking globally'. But emission trading and carbon sinks are terms for thinking locally – terms that allow Western politicians and bureaucrats to represent mysterious[17] physical realities in the familiar language of economic rationalism. Examples such as these lead me to dispute Yencken et al's (2000a) claims, quoted previously, that 'we depend on science for the formal analysis of the physical world and the monitoring of environmental change' and that 'while science is culturally shaped… environmental science is nevertheless dealing with physical reality' (p. 32). We cannot depend on Western science alone because environmental science deals not only with physical reality but also with 'culturally shaped' representations of this reality. Pretending that these representations are acultural is an imperialist act – an act of attempted intellectual colonization.

How can we think globally?

My story so far is a cautionary tale. In Jon Wagner's (1993) terms, I have tried to identify some of the 'blind spots and blank spots' that configure the 'collective ignorance' of Western-enculturated environmental education researchers as we struggle to enact defensible ways of thinking globally.[18] In Wagner's schema, what we 'know enough to question but not answer' are blank spots; what we 'don't know well enough to even ask about or care about' are blind spots – 'areas in which existing theories, methods, and perceptions actually keep us from seeing phenomena as clearly as we might'. Much of the research reported by Yencken et al. (2000b) and their coresearchers clearly responds to blank spots in our emerging understandings of the complexities that arise from the interreferencing of local traditions and global discourses of environmental education. My principal concern here is with the blind spots that might still remain in the vision of even the most culturally sensitive scholars. The detectable traces of Western scientific imperialism in Yencken et al's (2000b) work underscore the difficulties we face when we attempt, as Patti Lather puts it, 'to decolonize the space of academic discourse that is accessed by our privilege' (quoted in Pinar & Reynolds, 1992, p. 254). How can we think globally *without* enacting some form of epistemological imperialism?

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17 I use the term 'mysterious' because I suspect that very few of the people involved in negotiating political positions on emission trading and on discounting emissions by counting carbon sinks have even a rudimentary understanding of the molecular biology and cellular physiology of atmospheric carbon fixing by plants.

18 I realize that the term 'collective ignorance' is provocative and might even be offensive to some of my colleagues, which is why I have deliberately used 'we' in this sentence so as to include myself in this accusation.

As Lorraine Code (2000) observes, 'addressing epistemological questions along a local-global spectrum raises timeworn questions about relativism versus absolutism' (p. 68). For example, David Hess (1995) argues that understanding science and technology in a multicultural world demands that we think in terms of 'social constructivism' and 'cultural relativism', but he explicitly rejects the need to invoke epistemological, metaphysical or moral relativism. However, Code (2000) argues that 'responsible global thinking *requires* not just cultural relativism but a *mitigated epistemological relativism* conjoined with a "healthy skepticism"' (emphases in original):

> I am working with a deflated conception of relativism remote from the 'anything goes' refrain which anti-relativists inveigh against it. It is 'mitigated' in its recognition that knowledge-construction is always constrained by the resistance of material and human-social realities to just any old fashioning or making. Yet… it is relativist in acknowledging 'the plurality of criteria of knowledge… and deny[ing] the possibility of knowing absolute, objective, universal truth'.[19] Its 'healthy skepticism' in this context manifests itself in response to excessive and irresponsible global pretensions, whose excesses have to be communally debated and negotiated with due regard to local specificities and global implications (p. 69).

Code's 'mitigated epistemological relativism' resembles the 'constrained constructivism' advocated by Katherine Hayles (1993): 'within the representations we construct, some are ruled out by constraints, others are not' (p. 33); by ruling out some possibilities, 'constraints enable scientific inquiry to tell us something about reality and not only about ourselves' (p. 32). Hayles emphasizes that constraints do not (and cannot) tell us what reality *is*, but they enable us to distinguish representations that are consistent with reality from those that are not. For example, Newtonian mechanics represents gravity as a mutual attraction between masses whereas Einstein's general theory of relativity represents it as an effect of the curvature of space. Hayles (1993) refers also to a Native American belief that objects fall because the spirit of Mother Earth calls out to kindred spirits in other bodies. But no representation of gravity that, as Code puts it, is 'constrained by… material and human-social realities', would predict that when someone steps off a cliff s/he will remain suspended in mid-air. Different cultures interpret these constraints in different ways, but they operate multiculturally – and globally – to eliminate some constructions. Hayles (1993) notes that for any given phenomenon there will always be other representations, unknown or unimaginable, that are consistent with reality:

> The representations we present for falsification are limited by what we can imagine, which is to say, by the prevailing modes of representation within our culture, history, and species… Neither cut free from reality nor existing independent of human perception, the world as constrained constructivism sees it is the result of active and complex engagements between reality and human beings. Constrained constructivism invites – indeed cries out for – cultural readings of science, since the representations presented for disconfirmation have everything to do with prevailing cultural and disciplinary assumptions (pp. 33-4).

As I argue elsewhere in greater detail (Gough, 2007), constrained constructivism offers a philosophical position that problematizes the non-discursive 'reality' of nature without collapsing into antirealist language games. Constrained constructivism is not 'anything goes' but neither does it disallow representations that fail to meet criteria that disguise their

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[19] The quoted words are Peter Novick's (1988, p. 167).

Eurocentric and androcentric biases behind claims for universality. But, as my discussion of systems ecology demonstrates, many environmental educators often seem to do the precise opposite of what Hayles suggests by requiring learners to *confirm* representations that conform to 'cultural and disciplinary assumptions' that no longer prevail even in the West.[20]

The literatures that I find most useful for thinking critically about 'thinking globally' – and about the articulations between global and local knowledge production – are broadly speaking those that Harding (1998) calls Post-Kuhnian and postcolonial science and technology studies,[21] especially Turnbull's (1994, 1997, 2000) work. From the postcolonialist and anti-imperialist standpoints that Harding and Turnbull share, all knowledge systems (including Western science) are always situated and constituted initially within specific sets of local practices, conditions and cultural values.[22] Turnbull's (1997) approach focuses particular attention on the *activities* involved in producing knowledge in particular social spaces:

> Science may be seen as a history of visualisation or as a history of measurement and rational calculation. However, I would like to argue that a particularly perspicuous cross-cultural history of knowledge production is as a social history of space. That is as a history of the contingent processes of making assemblages and linkages, of creating spaces in which knowledge is possible (p. 553).

Turnbull uses numerous examples to demonstrate how particular knowledge spaces are constructed from heterogeneous assemblages of people, skills, local knowledge and equipment linked by various social strategies and 'technical devices which may include maps, templates, diagrams and drawings, but are typically techniques for spatial visualisation' (p. 553).[23] A major analytic advantage of Turnbull's spatialized perspective is that, because all knowledge systems have localness in common, many of the small but significant differences between them can be explained in terms of the different types of work – of *performance* – involved in constructing assemblages of people, practices, theories and instruments in a given space. Some knowledge traditions move and assemble their products through art, ceremony

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20 I am aware that expressions such as 'mitigated epistemological relativism', 'constrained constructivism', and 'the representations we present for falsification' might only make sense within certain modes of Western scholarship to which I have access and which my own education has privileged. The very awkwardness of some of these locutions exemplifies the difficulties we (Western scholars) face in representing the complexities towards which they gesture. For example, although I agree with the spirit (as I interpret it) of Hayles' assertion that 'constrained constructivism invites – indeed cries out for – cultural readings of science', it only 'works' for cultures in which the distinctive conceptual category of 'science' exists.

21 From some standpoints, 'postcolonial science and technology studies' might seem to be an oxymoron, but I suggest that this can be avoided by adopting a non-totalizing view of postcolonialism. As Helen Verran (2001) writes: 'Postcolonialism is not a break with colonialism, a history begun when a particular "us," who are not "them," suddenly coalesces as opposition to colonizer… Postcolonialism is the ambiguous struggling through and with colonial pasts in making different futures' (p. 38).

22 There are some subtle and thought-provoking differences between Harding's and Turnbull's positions. Harding emphasizes the universalizing tendencies that accompany the 'travel' of knowledges beyond the localities in which they were initially produced, whereas Turnbull is more concerned with how trust is established between heterogeneous knowledges that 'arrive' (or are produced) in the same space. For an extended discussion of these differences see Gough (2003).

23 Turnbull's linking of social strategies and technical devices is consistent with Latour's (1992) contention that there are no purely 'social' relations; rather, there are 'socio-technical' relations, embedded in and performed by a range of different materials – human, technical, 'natural', and textual.

and ritual,[24] whereas Western science's accomplishments result from forming disciplinary societies, building instruments, standardizing techniques and writing articles. Turnbull (1997) concludes that each form of knowledge production entails 'a process of knowledge assembly through making connections and negotiating equivalences between the heterogeneous components while simultaneously establishing a social order of trust and authority resulting in a knowledge space. It is on this basis that it is possible to compare and frame knowledge traditions' (p. 553).

Turnbull (2000) analyzes knowledge construction among diverse groups of people in different locations and times, including medieval masons, Polynesian navigators, cartographers, malariologists and turbulence engineers. He demonstrates that, in each case, their achievements are better understood performatively – as diverse, messy, contingent, unplanned and arational combinations of social and technical practices – rather than as the result of logical, orderly, rational planning or a dependence on internal epistemological features to which 'universal' validity can be ascribed. The purpose of Turnbull's emphasis on analyzing knowledge systems comparatively in terms of spatiality and performance is to find ways in which diverse knowledge traditions can coexist rather than one displacing others or being absorbed into an imperialist archive. Two examples of Western scientists attempting to displace knowledge spaces constructed by Indonesian rice farmers demonstrate the significance of Turnbull's (1997) analysis for 'thinking globally' in environmental education research:

> The Green Revolution and the introduction of high-yield rice turned Indonesia from being a net importer of rice unable to feed its own population to being one of the biggest rice exporters. This was achieved [in Java] at the price of using massive amounts of fertiliser and pesticides and in the abandonment of indigenous rice strains. That success… was short-lived. Insect pests started reaching plague proportions in the monocrop environment and increased applications of pesticide only made the problem worse. The solution was the banning of fertiliser and pesticide imports and the introduction of 'integrated pest management'. This is an… approach to pest control which recognises there will always be pests and the best way to manage them is to ensure that the populations of competing insects remain in balance. For this system to work, the local farmers had to become local experts, they had to monitor the insect populations on their own farms and to use locally appropriate rice strains.
>
> A similar reversal occurred in Bali where rice is grown under an irrigation system controlled by the temples. The Indonesian government thought this old fashioned and superstitious and introduced modern scientific methods of water control and distribution. The result was the same as in Java: initial success followed by a crash in production. So they brought in more Western experts, but this time they included a rather unusual anthropologist and a computer expert. Between them they were able to show on the computer screen how the old system of temple control worked and why it was the most efficient. This resulted in the knowledge and power being given back to the local people while satisfying the central government's yen for high-tech solutions (pp. 559-60).

These examples suggest that the globalization of knowledge production depends on creating spaces in which local knowledge traditions can be 'reframed, decentred and the social organisation of trust can be negotiated' (Turnbull 1997, pp. 560-1) – spaces created through 'negotiation between spaces, where contrasting rationalities can work together but without the

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[24] See also Jim Cheney's (1999) interpretations of the role of stories, ceremonies and rituals in the intergenerational passing down of 'modes of action' (p. 149) in Native American communities.

notion of a single transcendent reality' (Turnbull 2000, p. 228).[25] The production of such spaces is, in Turnbull's (1997) view, 'crucially dependent' on 'the reinclusion of the performative side of knowledge':

> Knowledge, in so far as it is portrayed as essentially a form of representation, will tend towards universal homogenous information at the expense of local knowledge traditions. If knowledge is recognised as both representational and performative it will be possible to create a space in which knowledge traditions can be performed together (pp. 560-1).

Turnbull invites us to be suspicious of importing and exporting representations that are disconnected from the performative work that generated them. For example, representing forests as 'carbon sinks' arises in Western industrialized nations because their emissions of greenhouse gases are of sufficient magnitude to motivate and make meaningful the work of producing 'sinks' to which excessive atmospheric carbon can be removed. The resistance of some developing nations to accepting carbon sinks as a way for Western nations to discount their greenhouse gas emissions is only to be expected, because the 'sink' metaphor has no cultural purchase in their localities. Global knowledge must therefore be coproduced – or as Yencken (2000) puts it, 'developed cooperatively' – but its legitimacy cannot be tied to any one culture's social and political traditions for conferring legitimacy on knowledge construction.

If we think about coproducing knowledge in transcultural spaces, it becomes clear that some of the most revered processes of Western knowledge production will not necessarily appear to be trustworthy. For example, many of the truth claims that constitute Western scientific knowledge of nature are produced under laboratory conditions.[26] But, as Code (2000) argues, developing 'methodological strategies for ecologically-framed global thinking' requires a more 'naturalized' epistemology than laboratory work assumes:

> I maintain that the laboratory is neither the only nor the best place for epistemologists to study 'natural' human knowing in order to elaborate epistemologies that maintain clearer continuity with cognitive experiences – 'natural knowings' – than orthodox *a priori*-normative epistemologies do. I advocate turning attention to how knowledge is made and circulated in situations with a greater claim to the elusive label 'natural.' My interests are in ways of gathering empirical evidence and in assumptions about the scope of evidence as it plays into regulative theories. My contention, briefly, is that evidence gathered from more mundane sites of knowledge production can afford better, if messier, starting points for naturalistic inquiry than much of laboratory evidence, for it translates more readily into settings where knowing matters in people's lives and the politics of knowledge are enacted (p. 71).[27]

For example, despite claims for the 'objectivity' of experimental methods, the methodological principle of controlling variables produces knowledge that can be incomprehensible in locations where this principle is not taken for granted. Again, as Code (2000) notes:

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[25] Stanley Jeyaraja Tambiah (1990) and Edward Soja (1996) name the type of space that Turnbull envisages as 'a third space', whereas Homi Bhabha (1994) calls it 'an interstitial space' (p. 312).

[26] I write 'under laboratory conditions' rather than 'in laboratories' because Western scientists typically try to create (or assume) laboratory conditions wherever they work. Indeed, Latour (1983) notes that a large proportion of national budgets for scientific activity is contributed to supporting international agencies that maintain standard weights and measures so that, in effect, the world at large can be treated as a giant laboratory.

[27] On the idea of 'messy' starting points for inquiry see also John Law (2004).

'Descriptions, mappings, and judgments that separate evidence from extraneous "noise" are always value-saturated, products of some one's or some group's location and choice; hence always contestable' (p. 71).

In light of the above considerations, I suggest that 'thinking globally' in environmental education research might best be understood as a process of constructing transcultural 'spaces' in which scholars from different localities collaborate in reframing and decentering their own knowledge traditions and negotiate trust in each other's contributions to their collective work. For those of us who work in Western knowledge traditions, a first step must be to represent and perform our distinctive approaches to knowledge production in ways that authentically demonstrate their localness. We might not be able to speak – or think – from outside our own Eurocentrism, but we can continue to ask questions about how our specifically Western ways of 'acting locally' (in the production of knowledge) might be performed *with* other local knowledge traditions. By coproducing global knowledge in transcultural spaces, we can, I believe, help to make both the limits *and strengths* of the local knowledge tradition we call Western science increasingly visible.

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