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Dead Wolves, Dead Birds, and Dead Trees: Catalysts for Transformative Learning in the Making of Scientist-Environmentalists

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Abstract

This historical study identifies catalysts for transformative learning in the lives of three scientist-environmentalists important to the 20th-century environmental movement: Aldo Leopold, Rachel Carson, and David Suzuki. Following a brief review of theoretical perspectives on transformative learning, the article argues that transformative learning for these scientists was catalyzed by certain "disorienting dilemmas" and was both rational and emotional. Moreover, the personal transformative learning of each scientist helped provoke a process of transformative learning in society at large: Leopold's contribution to the founding of the disciplines of wildlife conservation and restoration ecology, and his "land ethic" fostered the development an ecological consciousness in the 1940s; Carson's *Silent Spring* helped provoke the environmental consciousness of the 1960s; and Suzuki's public environmental education and activism from the 1970s to the present-day played an influential role in North American environmental movement.

Keywords

transformative learning, environmental education, environmental history

This is an historical study adopting a multiple case study approach (Merriam, 1998) to investigate the process of transformative learning in the lives of Aldo Leopold, Rachel Carson, and David Suzuki, three scientist-environmentalists who have had an

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important role in the environmental movement in North America. Secondary data found in autobiographical and biographical writings for each scientists, their voluminous published writings, web-based media, and radio and television documentation (in the case of Carson and Suzuki) comprise the database for the study. The data for each case was analyzed against Mezirow's (2000, 2009) 10-phase description of transformative learning, beginning with the identification of a disorienting dilemma. Comparisons were made across the three cases and anomalies to Mezirow's stage model noted. A search for explanations in the wider literature on transformative learning was then conducted, encompassing both critiques of Mezirow's work and alternative "cosmological" and integrative notions of transformative learning (O'Sullivan, 1999, 2002; O'Sullivan, Morrell, & O'Connor, 2002). The article examines how transformative learning occurs both at the personal level (in the individual transition from positivist scientist to scientist-environmentalist) and at the societal level, wherein each of the three scientists helped catalyze a transformative shift in social consciousness in the environmental movement.

Reflecting the historical contexts of their lives, the three scientists move from an ecological consciousness in the 1940s (Leopold), to the environmental consciousness of the 1960s (Carson), and on to environmental activism of the 1980s, 1990s, and the present-day (Suzuki). Aldo Leopold (1887-1948) worked as one of the first "scientific foresters" in the United States and was an early proponent of the new science of game (wildlife) management. He eventually questioned and revised the foundational principles of his discipline and was largely responsible for founding the fields of wildlife conservation and restoration ecology. The "land ethic" that Leopold elaborated in *A Sand County Almanac* (1949), his best-known work, provoked a fundamental rethinking of environmentalism and environmental ethics, presaging a shift from homocentric to biocentric understandings of nature, that is, to an ecological consciousness. Rachel Carson (1907-1964), a marine biologist with the U.S. Bureau of Fisheries, most famously published *Silent Spring* (1962), a ringing indictment of the danger of pesticides widely credited with helping initiate the North American environmental movement. In *Silent Spring*, Carson promoted a politicized environmental consciousness encompassing a critique of corporate power and abuse of citizen rights. David Suzuki (1936-) first worked as a geneticist at the University of British Columbia, but as a result of several instances of transformative learning, devoted his life to public environmental education and activism, with broad impact on the environmental movement in Canada and beyond. He is currently long-running host of the CBC's *The Nature of Things*, a prolific author and popular public media pundit on environmental issues, head of an influential environmental think tank and advocacy organization, and frequent speaker at public meetings, community actions, and environmental protests.

Perspectives on Transformative Learning

Transformative learning has been the subject of a rich body of theorizing and research over the past several decades, centered primarily on the work of Jack Mezirow

(Cranton, 2006; Mezirow, 2000; Mezirow, Taylor, & Associates, 2009; Newman, 2010; Taylor, 2007, 2008). For Mezirow (2000), transformative learning refers to

> a process by which we transform our taken-for-granted frames of reference (meaning perspectives, habits of mind, mind-sets) to make them more inclusive, discriminating, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action. (pp. 7-8)

This is primarily a rational, individual adult learning process, in which, according to Mezirow (2000, p. 22), an adult moves through some variation of 10 "phases of meaning," at the end of which she or he has undergone a perspective transformation. A perspective transformation

> often occurs through a series of cumulative transformed meaning schemes as a result of an acute personal or social crisis, for example, a natural disaster, the death of a significant other, divorce, a debilitating accident, war, job loss, or retirement. (Taylor, 2008, p. 6)

The process of transformative learning begins with this "acute personal or social crisis" (termed a *disorienting dilemma*) and then moves through an emotional self-examination, a critical assessment of one's assumptions, recognition of shared discontent, and the exploration of options for new roles, relationships, and actions (Mezirow, 2009). It then involves planning a course of action, learning new skills, and knowledge to implement one's plan, trying out new roles, building competence, and finally "reintegration into one's life" (Mezirow, 2009, p. 19).

Mezirow's concept of transformative learning has been criticized for its lack of attention to historical, cultural, and sociological context; its dependence on rationality to the exclusion of other ways of knowing; and its inadequacy in explaining the connection between personal transformation and collective social change, among other things (Miles, 2002; Newman, 2010; Schugurensky, 2002). Mezirow's emphasis on rational thinking, in particular, has been characterized as "a particularly Western concept, a product of Descartes' mind-body split and the Enlightenment's emphasis on science and rationality" (Merriam & Ntseane, 2008, p. 185). A large body of empirical research on transformative learning has supported these critiques, but has also confirmed many of the 10 stages of learning, the centrality of critical reflection to the transformative learning process, and the importance of a disorienting dilemma as a catalyst for change (Taylor, 2007). Mezirow (2009) in fact acknowledges that because "many transformative experiences occur outside awareness . . . intuition may substitute for critical self-reflection" (p. 28). However, he sees critical reflection itself as a profoundly rational thinking process, which he terms the "transformative rationality" process (Mezirow, 2009, p. 29).

Recently, the very notion of transformative learning has been called into question by activist adult educator Michael Newman (2010). Newman identifies six flaws in

common conceptualizations of transformative learning and argues that "the literature has grown repetitive and the theory too generalized" (p. 14), that we should "strike the phrase *transformative learning* from the educational lexicon altogether" and simply replace it with "good learning," nine aspects of which he then enumerates (p. 16). In arguing his case, Newman (2010) then takes up implicit critiques of (Mezirowian) transformative learning found in broader theorizing on "integrative transformative learning" by Edmund O'Sullivan and others (O'Sullivan, 1999; O'Sullivan et al., 2002; O'Sullivan & Taylor, 2004). Newman (2010) argues, among other points, that (a) transformative learning is not just a reworking of our individual identity, but of our consciousness, along the lines of Freire's *conscientization*; (b) transformative learning is not linear, finite, and developmental, nor sudden and disorienting, but is cumulative and additive (Schugurensky, 2002), based on "the continual encounter with a multitude of mini challenges" (p. 9); and (c) spirituality seen as "inquisitive open-mindedness to one's self and the world" (Tisdell, 2000) and as "soul work" (Dirkx, 2001) is valid in the analysis of transformative learning, but the unproblematized idea of spirituality as God or divinity is simply an irrational, unreasoned Faith that can "be neither taught nor learnt" (p. 14).

In theorizing transformative learning, other scholars in the more "integrative" tradition have drawn on critical theory, feminism, and cultural studies as their foundation (Butterwick & Lawrence, 2009; Lange, 2004; Miles, 2002; O'Sullivan et al., 2002). This is in contrast to Mezirow, who grounded his work in humanistic psychology. Importantly, in this wider approach to theorizing about transformative learning, environmental issues and the human connection to the natural word are seen as key (Lange, 2009; Morell & O'Connor, 2002; O'Sullivan, 1999; O'Sullivan & Taylor, 2004). A more critical and holistic conception of transformative learning is proposed in counterpoint to Mezirow's emphasis on rationality, conscious reflection, and individual processes of meaning making:

> We do not insist on the primacy of reason or of articulation for transformative learning. We understand that crucial learning often takes place nonverbally, in the inarticulate dimensions of our bodies. We would even claim that there is no need to attempt to bring everything into our consciousness, no need to try to pin a name on every experience. When we dance, for example, or spend a night out under a star-filled sky, or examine a photograph, we learn. We learn in ways that change us and give us vision and compassion and strength to work for both personal and social change. (Morell & O'Connor, 2002, pp. xvii-xviii)

This conception of "integrative transformative learning," while sharing Mezirow's understanding of a shift of assumptions and consciousness, also speaks more broadly to changes in self-identity, human relationships, our connections to the natural world, relations of power, social change, and personal fulfillment:

> Transformative learning involves experiencing a deep, structural shift in the basic premises of thought, feeling, and actions. It is a shift of consciousness that dramatically and permanently alters our way of being in the world. Such a shift involves our understanding of ourselves and our self-locations; our relationships with other human beings and with the natural world; our understanding of relations of power in interlocking structures of class, race, and gender; our body awareness; our visions of alternative approaches to living; and our sense of the possibilities for social justice and peace and personal joy. (O'Sullivan, 2002, p. 11)

Taking up the idea of a shift in consciousness described in the first part of this description of transformative learning (above), Kovan and Dirkx (2003, 2004) seek to explain how environmental activists sustain their commitment to environmental work through transformative learning. In prefacing their study, they argue that environmental activism

> furnishes a context that evokes ardent passions, emotions, and commitment, hence providing a context for deepening our understanding of the emotional and spiritual dimensions of transformative learning, its relationship to a sense of calling, and the essential mystery at the core of this process. (Kovan & Dirkx, 2003, p. 102)

Borrowing Carl Jung's notion of "individuation" or "soul work," that is, the "profound and lifelong struggle of the person to be who he or she is called to be" (Kovan & Dirkx, 2003, p. 102), they find that for these activists, transformative learning involves "recognizing and connecting to the inner process of coming to know the self that remain largely unknown to our conscious waking selves" (Kovan & Dirkx, 2004, p. 145). Moreover, they describe transformation in consciousness not as the result of an epiphany or reasoned, rationale thought, but as gradual, cumulative and holistic shift in a sense of self.

Elizabeth Lange (2004), in a related study of "critical transformative learning" among adults undergoing life transitions, identifies a "process for revitalizing citizen action, particularly action toward a sustainable society," in which not only transformative but "restorative" learning is critical (p. 121). She finds that because disorienting dilemmas are inherently destabilizing, adults reach deep into themselves to become more conscious of their ethical grounding—they return to their "inner compass" (p. 130), and this becomes restorative, allowing not only individual transformation but also a collective commitment to social activism on ecological and global concerns as well.

The various currents of theorizing about transformative learning, from Mezirow to more integrative forms, raise several interesting questions for an investigation of how

scientists, steeped in rational traditions of positivist thought, engage in transformative learning. From the more rationalist conceptions and the empirical research base on transformative learning, we would expect scientists' learning process to be a stepwise product of rational thinking, with an emotionally charged disorienting dilemma as a catalyst and reasoned, critical reflection on their assumptions as key components. From the more integrative vein of thought, we might anticipate a holistic process of transformative learning, involving emotional, spiritual, physical, and creative dimensions of human identity; an understanding of power relations; and some connection to nature, social change, and social justice. Each case would further be embedded in a particular social and historical context, as our first example of Aldo Leopold makes clear.

Aldo Leopold and the Ecological Consciousness of the 1930s and 1940s

Aldo Leopold, born in 1887 to an upper middle class family with a home along the Mississippi River in Burlington, Iowa, spent much of his childhood roaming the river's winding sloughs and marshes, bird watching, and tromping through the prairies and forests above the bluffs, or hunting with his father (Meine, 1988; Newton, 2006). After taking a degree in forestry from Yale Forest School in 1909, Leopold went to work as an assistant forester for the U.S. Forest Service in Arizona, and by 1912 had risen through the ranks to supervisor of forest lands in the U.S. Southwest. In the early 1920s, he was instrumental in the campaign to preserve wilderness areas in the National Forest system, including 547,000 acres of the Gila National Forest in New Mexico, which was designated as the nation's first Wilderness Area in 1926 (Meine, 1988; Nash, 2001). In 1924, Leopold was recruited to work at the Forest Products Laboratory in Madison, Wisconsin, and later became the University of Wisconsin's first professor of Game Management, and then in 1936, head of the newly created Department of Wildlife Management, where he taught until his death in 1948.

It was during his years as a forester in the 1910s and 1920s that Leopold first began to question the prevailing Progressive Era's utilitarian ideology of "scientific forestry" and "scientific game management." Rather than taking forest and wildlife primarily as consumable or harvestable "crops," Leopold began to play with the idea of an environmental ethic centered on the value of wilderness in its own right. As Leopold tells the story, his own awakening to this new ecological consciousness came during his tenure as a forester and game manager in the Apache National Forest in New Mexico. Out on a timber inspection tour, he and his crew of men stumbled across a family of wolves, which they quickly blasted away with their rifles, following standard practice at the time (Meine, 1988). Local ranchers routinely killed wolves to protect cattle, and in national forests, the belief was that wolves should be culled to allow deer populations to "grow" for game hunters. This had been Leopold's assumption as well, both as a hunter himself and now as a government professional charged with managing game. However, following the killing of the wolves, Leopold began to question his personal

beliefs and, subsequently, the premises of the professional practices of game management that guided his career. In the essay "Thinking Like a Mountain" (published posthumously in *A Sand County Almanac*), Leopold (1949) described the pivotal personal experience that caused him to reevaluate his fundamental beliefs about wildlife:

> My own conviction on this score dates from the day I saw a wolf die. We were eating lunch on a high rimrock, at the foot of which a turbulent river elbowed its way. We saw what we thought was a doe fording the torrent, her breast awash in white water. When she climbed the bank toward us and shook out her tail, we realized our error: it was a wolf. A half-dozen others, evidently grown pups, sprang from the willows and all joined in a welcoming mêlée of wagging tails and playful maulings.
>
> In those days we had never heard of passing up a chance to kill a wolf. In a second, we were pumping lead into the pack. . . . When our rifles were empty, the old wolf was down, and a pup was dragging a leg into impassable slide-rocks.
>
> We reached the old wolf in time to see a fierce green light dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and the mountain. I was young then, and full of trigger-itch: I thought that because fewer wolves meant more deer, that no wolves would mean a hunters' paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view. (p. 130)

From the 1920s to the 1940s, in hundreds of reports, scientific papers, essays, policy statements, popular articles, and editorials, as a forester, founding member of the Wilderness Society, and public intellectual (Meine, 2002), Leopold then developed the arguments and ideas sparked that day by his sudden understanding of the "fierce green light" in a dying wolf's eye. His reaction to the killing of wolves was a deeply emotional one: as Leopold (1949) reflected back on the experience some 25 years after it had occurred, he realized it had been an epiphany that helped shift his life's work toward a more biocentric understanding of land and wildlife. He came to believe that wolves and mountains had intrinsic value beyond their utility as game and forest "crops" and that wilderness might be a necessary cultural counterpoint to the excesses of urban, industrial society: nature would act as a kind of reservoir for human cultural replenishment (Gottlieb, 2005).

In the last decade of his life, Leopold formulated his famous land ethic, which in many ways merged an aesthetic appreciation of land (an emotional, moral dimension), with the (rational, objective) explication of the science of land ecology and conservation. Leopold's (1949, p. 204) ethic encompassed the idea that human beings exist as part of the "biotic community" alongside all other elements of nature. He proposed both humility for the human race and an appreciation and valuing of the complex relationships between land, plants, insects, animals, and human beings as members of natural ecosystems. As Leopold (1949) saw it, "we abuse land because we regard it as

a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect" (p. viii). As he famously put it, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (pp. 224-225). Guided by this ethic, science could then be employed to understand not only the complexities of natural ecosystems but also the effects of human activities on the health of the land community (Newton, 2006).

In his life's work, Leopold challenged prevailing scientific orthodoxies about animals as game crops and wilderness as economic commodity, transforming notions of both for generations of environmentalists to come. Sparked in part by the death of a wolf, he critically reassessed his own assumptions about the management of game, forest and land, and came to see himself and other human beings as an integral part of nature, with a moral imperative to preserve it. In this process of transformative learning, he constructed entirely new fields of wildlife conservation and restoration ecology and, from his forester roots, reinvented himself as a teacher, naturalist, and scientist-environmentalist. In coming to his personal ecological consciousness, he also stimulated the shift toward a collective ecological consciousness among other scientists and in society at large.

Rachel Carson and the Environmental Consciousness of the 1950s and 1960s

Rachel Carson was born in 1907 into a struggling farm family outside of Springdale, Pennsylvania, along the Allegheny River. Her childhood was a mix of rural poverty; her mother's rich knowledge of writing, music, and literature; and the wonders of the natural world around her (Lear, 1997; Lytle, 2007). From an early age, Carson (much like the youthful Aldo Leopold), spent hours roaming and exploring the woods, marshes, and hills around the farm: the land was wild and rich, full of animals, birds, flowers, insects, and plants. At age 11, she began to write and submit stories to a youth magazine, and at age 14, she published her first nature story. In 1925, Carson won a scholarship to study at Pennsylvania College for Women in Pittsburgh, where she majored first in English and then biology, graduating with her BA in 1928. She then won a scholarship for graduate study in zoology at Johns Hopkins University, where she focused her research on fish biology. She completed her MA in 1932, then worked as a teaching and research assistant in marine biology. In 1935, she was hired as an aquatic biologist in the U.S. Bureau of Fisheries, where she remained until 1952.

Over the course of the next 20 years as a scientist and naturalist, Carson spent most of her time studying the sea and its marine ecosystems. She then translated what she learned into a host of popular magazine articles and books. Among these was the best seller *The Sea Around Us* (1951), which sold 1.3 million copies in its first edition, was eventually translated into 41 foreign languages, and established Carson's role both as a literary celebrity and international spokesperson for the environment (Matthiessen,

2007). By the late 1950s, Carson had joined other naturalists, ecologists, and concerned citizens in questioning the safety and wisdom of massive government spraying of DDT (dichlorodiphenyltrichloroethane) and other insecticides on farms, roads, parks, and housing developments (Lear, 1997; Lytle, 2007).

A pivotal, culminating moment in her decision to shift her attention from marine ecology to the dangers of pesticides came when Carson received a poignant personal letter from a woman named Olga Owens Huckins. In the letter, Huckins described the effects of DDT spraying in a large bird sanctuary she had created around her home:

> The "harmless" shower bath killed seven of our lovely songbirds outright. We picked up three dead bodies the next morning by the door. They were birds that had lived next to us, trusted us, and built their nests in our trees year after year. . . . All of these birds died horribly and in the same way. Their bills were gaping open, and their splayed claws were drawn up to their breasts in agony. (as quoted in Williams, 2007, pp. 135-136)

As Carson (1962) tells us in the Acknowledgments for *Silent Spring*,

> In a letter written in January 1958, Olga Owens Huckins told me of her own bitter experience of a small world made lifeless, and so brought my attention sharply back to a problem with which I had long been concerned. I realized then that I must write this book.(p. ix)

Carson's personal struggle with breast cancer, and her insistence as a scientist that sufficient, incontrovertible data be amassed to substantiate each claim she made, meant that four more years were to pass before *Silent Spring* was published. When *Silent Spring* finally did come out (both in book form and serialized in the *The New Yorker*), it was "nothing less than an attempt to create a new environmental consciousness" (Gottlieb, 2005, p. 125). In this, it largely succeeded: "The publication of *Silent Spring* in 1962 and the ensuing controversy that made it an epochal event in the history of environmentalism can . . . be seen as helping launch a new decade of rebellion and protest" (Gottlieb, p. 121); *Silent Spring* "delivered a galvanic jolt to public consciousness and, as a result, infused the environmental movement with new substance and meaning" (Wilson, 2007, p. 27). In short, Carson's book, and the controversy surrounding it, effectively transformed public environmental consciousness and provoked action for change. The opening "fable" of her book illustrates the disorienting dilemma at the heart of this social transformation, namely, the death of birds and other animals: the "silence" of a world without birdsong:

> There once was a town in the heart of America where all life seemed to live in harmony with its surroundings. . . . Even in winter the roadsides were places of beauty, where countless birds came to feed on the berries and the seed heads of the dried weeds rising above the snow . . .

> Then a strange blight crept over the area and everything began to change. Some evil spell had settled on the community: mysterious maladies swept over the flocks of chickens; cattle and sheep sickened and died. Everywhere was a shadow of death. The farmers spoke of much illness among their families . . .
>
> There was a strange stillness. The birds, for example—where had they gone? Many people spoke of them, puzzled and disturbed. The feeding stations in the backyards were deserted. The few birds seen anywhere were moribund: they trembled violently and could not fly. It was a spring without voices. On the mornings that had once throbbed with the dawn chorus of robins, catbirds, doves, jays, wrens, and scores of other bird voices there was now no sound; only silence lay over the fields and woods and marsh. (Carson, 1962, pp. 1-3)

With this powerful opening to *Silent Spring*, Carson then proceeds to systematically illuminate the dangers of pesticide use on birds, animals, humans, and the natural environment and indict the chemical industry and its scientist supporters, challenging the "paradigm of scientific progress that defined postwar American culture" in the process (Lytle, 2007, p. 166).

Attacks on Carson and her book by the chemical industry, government scientists, and citizen male chauvinists also demonstrated the way in which she challenged dominant cultural paradigms in U.S. society of the time (Mezirow, 2000, refers to these as "collectively held frames of reference"). Before *Silent Spring* was even published, in fact, pesticide manufacturers had assembled a $250,000 public relations campaign to undermine Carson's credibility (Wellock, 2007). After publication, the attacks intensified, painting Carson as an overly emotional female writer, a Communist, and a witch, among other things (Wellock, 2007). However, in spite of the backlash directed against her and the growing pain of her cancer, Carson went on to testify before the U.S. Congress on the dangers of pesticides, gave a national television interview defending her work, and spoke out at numerous public engagements. Carson died in 1964, shortly after her research about the dangers of pesticides was vindicated in a comprehensive government report. However, in provoking public outcry, protest, and activism on environmental poisoning, Rachel Carson's *Silent Spring* had a life much beyond its author. *Silent Spring* became "a national political force" in the environmental movement and was instrumental in the banning of DDT and the establishment of the U.S. Environmental Protection Agency (Matthiessen, 2007; Wilson, 2007).

Like Aldo Leopold, Rachel Carson was a scientist who turned environmentalist and public educator through a process of transformative learning. In Carson's case, however, she did not identify a single discrete experience as a catalyst for change, but rather experienced a gradual, incremental shift in the focus of her environmental consciousness. Although she identified Olga Huckins's letter describing the deaths of birds from DDT spraying as a turning point in her decision to write *Silent Spring*, she had in fact been deliberating on the issue itself for some time before this (Lear, 1997). In researching and writing *Silent Spring* over the course of roughly a decade, she built

her understanding of the dangers of pesticides and the complicity of the petrochemical industry in their dissemination step-by-step, systematically gathering evidence to support her argument. She searched relentlessly for new sources, poured over all available documentation, meticulously checked and rechecked her findings, and slowly developed her knowledge of pesticide poisoning and possible solutions to the problem. In this respect, her personal transformation from scientist to environmentalist might best be characterized as the culmination of a long process of assimilative learning, in which the "integrating circumstance" (Schugurensky, 2002) was the disturbing letter from Huckins. For North American society as whole, however, the transformation was dramatic and abrupt and involved nothing less than the beginning of a movement for socioenvironmental change.

David Suzuki and Environmental Activism in the 1970s, 1980s, and 1990s

David Suzuki, born in Vancouver, British Columbia (BC) in 1936, spent many contented hours exploring the wild outdoors, hiking, camping, and fishing with his father, similar in experience to Leopold and Carson before him. However, in 1942, following the bombing of Pearl Harbor, Suzuki's freedom to roam came to a sudden and violent end: his family's Vancouver home and possessions were confiscated by the BC government, their civil rights suspended, and Suzuki, his two sisters, and mother were deported to an internment camp in the BC interior. He was 7 years old.

Being incarcerated by the government was the first of three disorienting dilemmas Suzuki describes as catalysts for change in his life. The second was his intellectual confrontation with Eugenics and the questioning of his identity as a geneticist; the third a disturbing encounter with a clear-cut BC forest (Davis, 1998; Suzuki, 1987, 2002, 2006). The experience of being jailed in an internment camp, as Suzuki reflected back on it, was pivotal in the development of his self-identity and his consciousness of race and bigotry in Canadian society. All in all, some 22,000 Canadians of Japanese descent were incarcerated at the time, along with 113,000 Japanese Americans in the United States (Suzuki, 1987, 2006). As he reflected back on the racism levied against him, Suzuki explained how the experience alienated him from White Canadian Society:

> Pearl Harbor led to a total shift in the way that I perceived myself. Although I was a third generation Canadian, my country had said that I was an enemy and not to be trusted; that I had no rights along with my parents. (interview in Davis, 1998)

As a result, "All my life as an adult, my drive to do well has been motivated by the desire to demonstrate to my fellow Canadians that my family and I had not deserved to be treated as we were" (Suzuki, 2006, p. 16).

Suzuki's drive to do well—his "psychic burden," as he termed it—propelled him first to Amherst College, where he became enthralled with genetics, his "mouth hanging open in astonishment at the beauty of the insights and the elegance of

mathematical precision absent from most other areas of biology" (Suzuki, 1987, p. 131). From Amherst, he went on to the University of Chicago, where he received a PhD in genetics in 1961, specializing in the study of cell division in the common fruit fly. He was then hired at Oak Ridge Laboratories in Tennessee. In traveling through the Deep South in the early 1960s, he experienced the degrading effects of racial segregation and bigotry first hand. As a result, Suzuki (1987,) tells us, "I was consumed with bitterness and anger at the racism apparent all around me. I finally decided that I had to leave the United States altogether and return to Canada" (p. 167). He then moved to the University of Alberta for a year, and he ultimately landed as a genetics professor at the University of British Columbia (UBC). Suzuki remained at UBC for over a decade, building and running a prestigious genetics research laboratory, and passing along his passion for science and genetics to his students.

It was at UBC, when one of his students questioned him about the role of genetics in underpinning Eugenics and Nazism, that Suzuki experienced a second disorienting dilemma, turning him away from academia and toward a new career in televised public education about science:

> I discovered that the kind of reasoning that had been used to lock up the "Japs" when the war broke out was being fuelled by geneticists. . . . There were two great passions in my life at the time: one was genetics and the other had been civil rights. The civil rights had come through my experience being incarcerated as a Japanese Canadian during the Second World War. That my concern about human rights and my love for genetics came together in this incredibly grotesque way—I realized that this great activity that I loved: genetics—was filled with enormous implications for the rest of society. And for many, many months I was absolutely paralyzed. I just couldn't bring myself to continue to do any research because I felt I was contributing to a body of knowledge that had potential applications that were enormous. . . . I came out of that period of paralysis by saying one of the responsibilities was to speak out as openly and honestly and (in) as informed a matter (as possible) about the implications. And then I realized, "My God!" here's this powerful medium of television. And through television I could begin to try to educate people about science and how it affected their lives. (interview in Davis, 1998)

Suzuki then left the university for a career as a broadcaster and public science educator, a shift that further opened his eyes to the complicity of science in a range of social problems. In the long career in radio, print media, and television which followed, Suzuki served as host of the televised programs: *Suzuki on Science* and *Science Magazine* in the 1960s and early 1970s, *Quirks and Quarks* on radio until the late 1970s, and finally television host of CBC's *The Nature of Things* beginning in 1979, a role he has continued to the present-day. Over the past several decades, Suzuki has also worked tirelessly as a newspaper columnist, an author of numerous books, and a

public spokesperson on environmental issues. In 1988, after completing *It's a Matter of Survival*, a CBC radio series on scientists' views of the future of the earth, Suzuki came to realize the immensity of the problem of environmental destruction and decided that he should also offer solutions to environmental problems, not just explain them to the public (Suzuki, 2006). As a step in this direction, in 1991, Suzuki and his supporters established the environmental think tank, the David Suzuki Foundation. The Foundation focused on communicating science-based policy solutions to the public on environmental issues, including BC's salmon fisheries, sustainable forestry, and climate change. Today, with David Suzuki as its public face, the Foundation is one of the most prominent environmental organizations in Canada.

In an essay titled "Catching and Epiphany," Suzuki recounts a pivotal experience that changed his view of nature and engendered in him a deep sense of responsibility for environmental preservation (Suzuki, 2002). As he tells the story, one day in 1964, he took his two children out fishing along a logging road in the mountains near Vancouver, only to encounter the stark devastation of a large clear-cut blocking their path to the fishing stream. Struggling and sweating under the hot sun, Suzuki and his kids finally made it to the shade of the remaining forest. Entering "the dark, cool cathedral of trees was an absolute shock," Suzuki recalled, "like stepping from a hot city street into an air-conditioned building":

> I was dumbstruck. . . . In those few minutes that my children and I had entered into the forest temple, I had recognized the terrible hubris of the human economy. To transform this matrix of life forms, soil, water, and air into a war zone where soil, air, water, and life were so degraded was a travesty of stewardship and responsibility to future generations. I didn't articulate it that way at the time. I only knew in a profoundly visceral way that industrial logging was not right, that the magnificent forest we had entered was an entity far beyond our comprehension and was worthy of our respect and veneration . . . that encounter with an ancient forest on the edge of a clear-cut was my moment of enlightenment. (Suzuki, 2002, pp. 223-224)

In characterizing his transformation from scientist to environmental activist, Suzuki (in Mowat, 1990), like Carson, saw this process as incremental and assimilative rather than abrupt:

> My sense of injustice at what human beings were doing to the living world didn't suddenly happen. It was a gradual understanding that science is fundamentally flawed because scientists focus on parts of nature and study these in isolation from the rest. (Suzuki in Mowat, 1990, pp. 173-174)

As Suzuki (1987) explains, this questioning of science had profound implications for his identity and life course: "Once I left the lab, I could see the enormous social consequences of science, its tight linkage with profit motives of private industry, its

terrible dependence on military support. . . . Once involved, I couldn't go back" (p. 233). In short, much in the same way as Aldo Leopold and his dying wolf, and to some extent Rachel Carson and the letter from Olga Owen Huckins, the experience of the death of an "ancient forest" was for David Suzuki a disorienting dilemma; it was a pivotal existential experience in developing his later environmental consciousness and activism. As a result, Suzuki turned his life to public environmental education through television broadcasting, writing, and environmental activism and is today an influential leader in the North American environmental movement.

Discussion

In assessing the nature of transformative learning for the three scientists, it is apparent that all three scientists were in large part rational, analytical thinkers, who to a great extent moved through some variation of Mezirow's 10 phases of transformative learning. Yet they were also were emotional and spiritual beings living in and affected by diverse social, environmental, political, and historical contexts, supporting a more holistic, integrative conception of transformative learning (Butterwick & Lawrence, 2009; Dirkx, 2001; Kovan & Dirkx, 2003, 2004; Morell & O'Connor, 2002; O'Sullivan, 2002; Tisdell, 2000). Moreover, while Suzuki and Leopold appeared to experience distinct disorienting dilemmas as dramatic, life-changing events, followed by fairly linear developmental phases, Carson's transformative learning was more along the lines of "the continual encounter with a multitude of mini-challenges" described by Newman (2010, p. 9); it was the culmination of a gradual process of "assimilative learning," with an "integrating circumstance" (Schugurensky, 2002). In all three cases, it appears that the process of transformative learning involved an inner reworking of individual identity and consciousness. However, the empirical data does not allow us to explore or characterize this process; in particular, it does not allow a comparison to the "soul work" of other environmental activists described by Kovan and Dirkx (2003, 2004) or the restorative and transformative learning identified by Lange (2004). It is also likely, but equally unverifiable, that much of the transformative learning of the three scientist-environmentalists took place nonverbally, in the "inarticulate dimensions" of their bodies (Morell & O'Connor, 2002) as they lived in, studied, communed with, and defended nature over the course of their lives. Finally, it is clear from the data that Suzuki and Carson, and to a lesser extent, Leopold, experienced a shift of cosmological consciousness (O'Sullivan, 2002) akin to *conscientization* in their transformative learning (Newman, 2010). This occurred not only as a result of their relation to the natural world but also in their experience and awareness of racism (in the case of Suzuki) and sexism (in the case of Carson).

As the most obvious example of a classic, stepwise journey through Mezirow's phases of transformative learning, in each of David Suzuki's three transformative epochs, he identifies a disorienting dilemma (incarceration, Eugenics, a clear-cut forest), questions his assumptions (about race, genetics, forestry), explores new roles (scientist, popular science educator, environmentalist), gains competence in the new

field, and shifts his career and identity. Suzuki clearly identifies an "epiphany" in the woods and two other dramatic life-changing events as pivotal to his transformative learning. Rachel Carson's transformative learning, as a meticulous scientific researcher, follows a similar linear pattern of thinking, albeit with an "integrating circumstance" (dead birds and a poignant letter) as a culminating catalyst for action (publishing *Silent Spring*) rather than a disorienting dilemma. Aldo Leopold is again a profoundly rational thinker, yet also an emotional being, who, like Suzuki, experiences an epiphany, gradually comes to question the basic beliefs of the profession to which he belongs, proposes alternatives to his beliefs, and works to enact these alternatives in his life, ultimately shifting his career from scientific forester to environmental educator.

In reviewing the personal histories of these three scientist-environmentalists, it is clear that the process of transformative learning is both emotional and spiritual: the three scientists are deeply emotional beings, who create their self-identities within specific natural, social, and historical contexts. Their transformative learning is in this sense an integrative life process, both rational and spiritual, occurring across the lifespan, with family relationships, experience in nature, and emotional epiphanies—dead wolves, dead birds, and dead trees—acting as catalysts along the way. However, while Leopold and Suzuki identify emotionally charged disorienting dilemmas as catalysts for transformative learning, Carson appears to have experienced a less emotional, less spiritual transformational process. Yet if we consider the historical context in which Rachel Carson lived, it may be that her emotions did indeed play a critical role but were simply too risky for her to publicly document. That is, the absence of strong emotional episodes in Carson's life history could be the result of a strategic and self-protective effort against chauvinistic attacks. These attacks portrayed her, and all women, as primarily emotional beings, largely incapable of rational, positivist thinking, and therefore unacceptable for scientific careers, and unreliable as critics of conventional (male) wisdom. In the context of this negative view of women in the 1950s, Rachel Carson's public portrayals of her emotional life had to be subdued, if not invisible. Even today, as Kovan and Dirkx (2003, p. 108) tell us that environmental activists of both genders are reluctant to admit the "emotional content of their work," seeing such admissions as "perilous" when compared with factual scientific knowledge. Whatever the reason, we do not really know what Rachel Carson felt nor the role her feelings had, if any, in shifting her perspective from positivist scientist to environmentalist-scientist. However, there is no doubt that Carson's writings had an extremely powerful emotional depth that resonated with her readers and, in part for this reason, helped spark a popular environmental movement.

Leopold, Carson, and Suzuki all cite a critical experience of the natural world as a catalyst for their transformative learning, a particular type of transformative experience that is by and large absent from the extant literature on transformative learning. Furthermore, research, both historical and contemporary, on the transformative learning of other scientist-environmentalists and other adults in general, might

perhaps contribute to a more generalizable understanding of the particular case of "disorienting dilemmas in nature" and how these dilemmas help shape scientists' and other adults' "calling" to environmental activism. Such scientist-environmentalists might include, for example, scientist, civil rights, and environmental justice activist Benjamin Chavis, or physician, public health advocate, and industrial toxicologist Alice Hamilton.

In addition to their individual transformations, it is also evident that each scientist encouraged a collective, societal process of socioenvironmental transformation predicated on their own transformative learning. As argued above, Aldo Leopold helped create an ecological consciousness in the 1940s, Rachel Carson sparked an environmental consciousness in the 1960s, and David Suzuki has continued to educate and advocate for a rethinking of environmentalism from the 1980s to the present-day. In part, their activism may have been based on their own development of a cosmological consciousness through their relationships with the natural world, their experiences of racism and sexism, and even their body awareness (O'Sullivan, 1999, 2002). Here again, more research on the dialectical connection between individual transformation, conscientization, and socioenvironmental change is needed, as Schugurensky (2002) and others have argued.

Both David Suzuki's painful experience of Canadian racism and the virulent, sexist attacks against Rachel Carson point to the importance of acknowledging oppressive relations of power in not only in research but also in pedagogical practices to promote the transformative learning process. In this regard, programs such as the Audubon Expedition Model (Wittmer & Johnson, 2000) and other critical pedagogies of "educative activism" in Environmental Adult Education (Clover, 2002; Clover, Follen, & Hall, 2000; Feinstein, 2004) are needed. More specifically, in pedagogical terms, findings of the present study suggest that if we wish to foster transformative learning that might lead to ecological and environmental consciousness and activism, experiences not only of nature but also of the environmentally destructive practices of human beings should be a central concern. Such environmental education might take the form, for example, of visiting a clear-cut forest and studying the reasons for its destruction, tracing the sources of severely polluted water, examining the effects of habitat degradation on animals and humans, investigating the consequences of lawn care pesticides, housing developments, or shopping malls on human and ecological health and so on, much in the tradition of adult education for environmental justice (Hill, 2003). As Clover et al., (2000) put it,

> Learning for change within an ecological context is both a vision and a process. The vision revolves around building healthy, just and sustainable communities through new social relationships and partnerships with the rest of nature. It is about societal and environmental transformation, not separately, but at the same time. (p. 5)

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Bio

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