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CLIMATE CHANGE EDUCATION THROUGH SCIENCE FICTION

Narratives as an Educational Tool: A Review of *A Scientific Romance*

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Depictions of Global Environmental Change in Science Fiction: An Overview of Educational Applications

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“*A Scientific Romance*” - Reading and Reflection

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Narratives as an Educational Tool: A Review of *A Scientific Romance*

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This paper explores narratives as a tool for educating the general public on climate change. It provides a qualitative evaluation of the adult-fiction narrative, A Scientific Romance, written by Ronald Wright (1997). The novel is reviewed using criteria from both cognitive psychology and climatology. Wright's tightly crafted narrative successfully takes an abstract issue and transforms it into something interesting, imaginable, and relevant. It provides a detailed depiction of a plausible future climate and its implications for society. Unfortunately, no prototypes were activated with regard to the role of human action/inaction in triggering climate change and/or contributing to its consequences.

NARRATIVES, COGNITIVE THEORY AND EDUCATION

“The ambulances were streaking down the highway while I lay in bed in our farmhouse, in what used to be a very small town called Prairie Junction ... I wondered if a building was burning down, if there was a car accident at the perilous intersection, or a baby coming early in one of the subdivisions. Our range of disaster in that town was fairly limited, but we were due for something, certainly. The last rain had come at the beginning of April and now, at the first of June, all but the hardiest mosquitoes had left their paper skins in the grass. It was already seven o'clock in the morning, long past time to close the windows and doors, trap what was left of the night air, slightly cooler only by virtue of the dark. The dust on the gravel had just enough energy to drift a short distance and then collapse on the flower beds. The sun had a white cast, as if shade and shadow, any flicker of nuance, has been burned out by its own fierce center ... I often had the fanciful thought that the pond would save us; it would be the one thing that would postpone our deaths by scorching as the climate in our part of the world changed” (Hamilton, 1994: 4).

The above quotation comes from a recent novel, entitled *A Map of the World*, by Jane Hamilton. Increasingly, climate change is being woven into fictional writings, such as this. However, it is exceedingly rare for climate change to be the central theme as it is in the novel, *A Scientific Romance* written by Ronald Wright. This paper explores Wright's narrative as a tool for educating the general public on climate change.

The power of the narrative—the story—is that it fits with how people make sense of their world. In the 1999 CBC Massey lectures, *The Triumph of the Narrative*, Robert Fulford describes storytelling as “the core of civilized life, the juncture where facts and feelings meet, the bundle in which we wrap truth, hope and dread ... it is how we explain, how we teach, how we entertain ourselves—and how we often do all three at once” (Fulford, 1999: back cover).

Cognitive theory argues that human beings think, perceive, imagine, understand and make choices according to narrative structures; that they create mental models or maps of where things are, how things work, how to act, who they are (Bardwell, 1991). These maps “direct and constrain our thoughts, decisions and actions” (Kearney, 1994: 426) in that we tend to notice and rely on information that reinforces or builds on these personal maps. In other words, knowledge is constructed, not received. This blueprint for human processes

of learning and understanding reveals the attractiveness of using narratives, both fiction and non-fiction, as educational tools.

Despite the widespread use of narratives in everyday life, their integration into formal education or communication programs is biased toward selected subjects in the humanities and social sciences. From a disciplinary perspective, narratives are most established in the traditional teaching of history (Pomata, 1989; Farmer, 1990), where the value of narrative lies mainly in its vicarious nature and its connected presentation of the general flow of events in history. Modern history has largely abandoned the narrative in academic discourse (Rice, 1995), but narratives in the form of fictional novels, wartime diaries and textbook inserts continue to be featured in history curriculum at all levels. The discipline of psychology also makes significant use of the narrative approach, where novels and biographies are used to “to vivify theories, which students often find too abstract, as well as humanize the stark quantitative findings of psychological research (Boyatzis, 1992: 221). In most other disciplines, however, the use of narratives is much more restricted.

Outside of the academy, narratives in the form of parables and anecdotes have long been applied—both in oral and written form—in the realm of moral teachings. Indeed, many would argue that narrative material is central and essential to the effective teaching of morality because the narrative not only conveys information but also provides a mode of expression that produces meaning (Sandlos, 1998; Fulford, 1999).

Environmental education has two, sometimes disparate, goals. The first is to develop an understanding of natural systems, and the second is to encourage responsible action. Indeed, Sandlos (1998: 6) and others (Bardwell, 1991; Monroe and Kaplan, 1998) see the narrative approach as a means to provide a basis for environmental educators and students alike to “understand the ‘story’ of the ecological crisis as a moral dilemma, as opposed to a purely decontextualized instrumented problem”. Despite its potential value, the narrative approach has had limited use in environmental education. This is true both generally and in specific reference to climate change.

Climate has long been recognized as an integral part of setting, and various novels develop both plot and character in the context of harsh or variable climate; stories from the Dust Bowl era provide some of the best adult illustrations, but there are also some examples in children’s literature (e.g., Barrett and Barrett, 1978). However, only now are we beginning to seriously consider the use of narratives as a strategy for communicating about climate change. One of the first scientists to illustrate the value of narrative in this context was Schneider (1989) in his book *Global Warming: Are We Entering the Greenhouse Century?*. The decision to use narratives in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) is perhaps evidence that the narrative is becoming an accepted form of expression in discourse on climate change.

RESEARCH OVERVIEW

Background on *A Scientific Romance*

This paper summarizes the results of an evaluative study of one novel that develops climate change as a central theme in the development of plot. The novel, *A Scientific Romance*, written by Ontario-based writer, Ronald Wright, was first published by Alfred A. Knopf Canada in 1997. The novel, which took three years to complete, has received rave reviews from literary critics in Canada, Great Britain and the United States (Abley, 1997; Botsford Fraser, 1997; Bromrose, 1997; Weller, 1998). It is a national best-seller in Canada and won the David Higham Prize for fiction from the United Kingdom.

It is difficult to provide a brief synopsis of the novel, but essentially *A Scientific Romance* follows the main character, David Lambert, into the future via H.G. Wells’ own time machine in search of a cure for a degenerative disease from which he suffers. Lambert arrives in Great Britain, the year 2500, to find a luxuriant, but menacing new environment, which has been altered by the effects of climate change and is no longer inhabited

by humans. The reader follows Lambert north in search of a surviving civilization, while Lambert explores the remnants of the land and the ruins of his own life history.

As an entry into the novel, it is worth considering the author's perspective—his thoughts and motivations for writing this book. In January 1999, when we first contacted Wright by email, he responded, "I wrote the book for the very reason that you suggest—to use narrative to try to change the world (which it hardly ever does) or, less vainly, to rail against the mess we're in". Later during an interview in Wright's home, he indicated that he always envisioned *A Scientific Romance* as a book with a message; as part of a tradition of books—a 'dystopia' that falls in with such novels as Orwell's *1984*, Huxley's *Brave New World* and Atwood's *The Handmaid's Tale*. These dystopias describe imaginary worlds, which are actually satirical caricatures of our own world. They take us into the future; and as Wright states: "Nobody thinks generations ahead—except through the imagination; that's where fiction comes in."

The idea for this novel came from Wright's background in archaeology as well as his interest and studies of ancient civilizations. The novel was born out of Wright's concern about civilization running out of control and growing to such a scale that the natural systems of the earth are no longer going to be able to sustain us without a great deal of degradation in the human quality of life. As Wright states, he tried to create a story that exposed "the sense of fragility of any civilization—poised on the knife edge of disaster and success."

Evaluation Criteria

The evaluation has two parts. The first is a critical commentary on the novel, based on criteria taken from Kearney's 1994 article entitled, "Understanding global change: a cognitive perspective on communicating through stories", published in the journal, *Climate Change*. Based on literature in cognitive psychology and education, Kearney identified five literary criteria that are essential for effective communication on such issues as global climate change: (1) It must be interesting; (2) It must present abstract information in such a way that the reader can imagine it; (3) It must relate to the reader's existing knowledge; (4) It must present global issues at a human scale; and (5) It must be extendible to provide a large experiential base.

The second part of the evaluation compares Wright's depiction of future climate with scientific projections. The comparison is necessarily qualitative, and it focuses on the Great London-Thames Estuary region of Southern England because Wright provides the greatest detail regarding climatic conditions at this locale. The climatic variables used in the evaluation consist of surface temperature, sea level rise, precipitation amounts and wind speed. Past climatic data were obtained from the World Meteorological Organization's climatological normals (1961-1990). These data were used to construct a contemporary climatology for the study area. Data on future climate scenarios were obtained from the CCCma's first-generation coupled general circulation model (GCM), CGCM1. The values used are from the GHG+A data set for the period 2071-2100. Because this model does not provide data beyond 2100 and does not offer any projections on sea-level rise, other climate sources were used as well. Goodess and Palutikof (1997) have performed extensive research with regard to projecting the climate for the British Isles beyond the 21st century. As well, scenarios generated by coupled GCMs developed by the Intergovernmental Panel on Climate Change (IPCC) (1996) provided information on sea-level rise.

EVALUATION OF A SCIENTIFIC ROMANCE BASED ON LITERARY CRITERIA

Criterion 1: It must be interesting.

Kearney (1994: 427) argues "in order to maximize learning from a text, the reader must first attend to the text (perception) and then, while reading, integrate the information in the text with existing knowledge (knowledge integration)." Kearney suggests that an interesting text, which draws on involuntary (spontaneous and effortless) attention has the ability to accomplish both of these tasks. The first element used to create interest and promote understanding is content. Within the novel *A Scientific Romance*, Wright has woven a tale that integrates elements of time travel, a complicated romance, a deadly disease, the discovery of a startling 'new' civilization—all against the backdrop of a Great Britain that has been ravaged by the effects of global warming.

Themes such as love, death, betrayal, exploration, discovery, and loss hold the reader's attention, while revealing details on the devastating impacts of climate change on the landscapes and peoples of southern England.

The second characteristic of a text that creates interest is coherence. "The memorability of a story depends on causal cohesion among events ... an incoherent text is unlikely to hold one's interest for long" (Kearney, 1994: 432). In *A Scientific Romance*, coherence is created by a clear sense of movement through time—from David Lambert's initial discovery of the time machine, his journey into the future, his explorations of the London area, his expedition northward to the Scottish highlands, his discovery of a remnant civilization, and culminating in a daring escape back to the machine. The valued endpoint toward which Wright propels David and the reader is the quest to find a cure for the degenerative Creutzfeldt-Jakob disease that he has contracted and that has already claimed the life of his beloved Anita. Coherence is also created by the details that allow the reader to gradually piece together the puzzle of David Lambert's life history.

The third characteristic of text that instills interest is the presence of mystery or uncertainty, which causes the reader to generate a set of expectations. Wright continually forces the reader to anticipate events: Will the time machine work? Is England still inhabited and by who? Will David escape his captors? As the reader is lured further and further into the plot, s/he is involuntarily integrating information on the consequences of climate change into his/her cognitive models of human-environment interdependencies.

The final element that creates interest is vivid detail. *A Scientific Romance* is rich with description. As an example, the following quotation paints a picture of the London Estuary as discovered by David Lambert when he emerges from the time machine:

Thick vegetation along the shore hides all other landmarks ... The water high and on the ebb, muttered and gurgled between candelabra roots; mosquitoes mobbed me; the knobby knees of mangroves nudges me away. Beards of seaweed, the boasts of spring tides, hang from branches higher than my head. (78)

Criterion 2: It must present information in such a way that the reader can imagine it.

"Much of the information about global climate change is in the form of scientific data—abstract facts and figures that often have little impact on an individual's understanding of the issue" (Kearney 1994, 433). Kearney (1994) argues that information must be presented in such a way that the reader can imagine it, and this means that descriptions must be concrete and vivid.

Wright's depiction of the London area in 2500 arouses the senses, and the images that are created tackle complex issues. One such issue is ecosystem migration: "The tropical vegetation is a puzzle. How did it get here—as seeds in the stomachs of migration birds? Or did it tiptoe north, root by root, as the planet warmed?" (99). Other themes are regional variations in consequences: "I've been wondering again whether things could be better anywhere else." (176); high-order impacts, such as war: "What I found was this: a group of skeletons, human, muddled together. I exposed five individuals, all adults, four male, all with shackles of rust around wrists and ankles. Prisoners, obviously. Hostages, maybe." (118); the rapid rate of global temperature change: "Cycles have changed from ice to heat or vice versa not in millennia, but in decades" (88); and links between environment and economy: "Could it have gone another way? Is the Good Samaritan always a bad economist? Was capitalism—that "machine for demolishing limits"—a suicide machine?" (168).

Criterion 3: It must relate to the reader's existing knowledge

In order to construct new knowledge, information must activate existing prototypes and be incorporated into pre-existing cognitive maps. "Information about global change must speak to the beliefs that people already hold about the environment; it must also relate to their daily experiences and address perceived obstacles to behaviour change" (Kearney, 1994: 433).

Two aspects of the novel are particularly valuable for conveying a sense of the magnitude of the destructive potential of climate change. The first is setting. Since, much of the book's readership would be familiar with present-day London, Wright is able to build on these pre-existing images by describing water levels in reference to current landmarks or the remains of notable towers and castles. Analogies are also made between the fall of the ancient civilizations and the collapse of the modern world (88, 97).

Wright does assign blame for climate change, but many of the references are vague, for example: "their inventions, their beliefs, their ruthlessness—become indulgences that in the end will poison them" (66). There are a few references to fossil fuels as the principal anthropogenic source of greenhouse gases: "a sudden bonfire of the planet's coal and oil and timber can hardly have been a good idea" (88), but generally this theme is not well developed. Nor is the discussion on missed opportunities to reduce fossil fuel usage and energy waste, although there is one reference to electric cars (185). Furthermore, some of the references may add to public confusion about the causes of climate change versus other environmental issues, such as acid rain (e.g., "the sulphurous atmospheres of coal-fired London", 62) and the ozone hole (e.g., "Perhaps beyond this park the air conditioners are humming and the planet's envelope is still an awning gone to holes", 81).

Criterion 4: It must present global issues at a human scale.

Kearney (1994: 432) summarizes that for the average person "information about large scale events can be overwhelming" and for that reason an effective narrative must present global issues at a human scale. In *A Scientific Romance*, Wright shrinks a global catastrophe down to the level of an individual by telling the story through the eyes and experiences of a single character with whom the reader can identify. This use of a first-person narrative voice invites the reader on a shared journey with David Lambert.

There are, however, still elements of the narrative that may overwhelm the reader. The reader is not presented with any clues as to what can be done at a local scale to reduce one's vulnerability. And the radical alteration of the British Isles' environment at a time so far in the future may actually instil a state of disbelief, fear or helplessness.

Criterion 5: It must be extendible.

Kearney (1994: 433) concludes that "one interesting and useful text is a good start, but in most cases it will not be enough ... The prototypes that make up a cognitive map are built up slowly through repeated experience". Repeated exposure to a concept or idea through a variety of media enables individuals to construct, refine and/or strengthen their own mental maps. Therefore, an effective narrative must be extendible in that the story can be easily linked to other material that explores related themes.

A Scientific Romance is an excellent example of an extendible and expandable educational tool. Wright's text is a visual feast that introduces the reader to possible consequences of global climate change. The novel provides the general public with an accessible entry point into an unfamiliar domain by depicting how a familiar place may be changed. The novel introduces both direct and indirect impacts of climate change—from warmer temperatures and sea level rise to the migration of vegetative zones and the eventual disintegration of modern civilization. These images can be built upon as the individual encounters additional materials on climate change.

EVALUATION OF A SCIENTIFIC ROMANCE BASED ON SCIENCE

At present, the British Isles are associated with frequent rains and moderate temperatures. In the early part of the novel, before the time travel occurs, Wright's few references to weather are consistent with this image, e.g., his depiction of News Years' eve, 1999: "Steady drizzle had fallen all afternoon. Mist flocked over the Thames in the evening chill and nibbled at the rooftops of the West End." (26). Most of the novel, however, takes place in the years 2500-2501, when Wright's depiction of British climate is considerably changed.

Temperature

Because of its maritime location, Britain currently experiences more equable temperatures than other places at the same latitude. In the London area, mean summer temperatures are 10.5 degrees C and 20.9 degrees C, for the minimum and maximum, respectively. The corresponding values for winter are 0.7 and 7.2.

With regard to scientific projections of future climates, all models indicate a gradual warming of Great Britain. Table 1 highlights the extent of warming that is projected for the Greater London area up to the year 2100. Model outputs were not available beyond 2100, but scientists envision three possible scenarios: “The simplest assumption that can be made is of a relatively brief (say 1000 years) period of global warming followed by a return to the ‘natural pattern’ of glacial-interglacial cycles. The second possibility is that following a longer period of global warming (up to 10,000 years) the next glaciation will be delayed and will be less severe. The third possibility is the irreversible greenhouse effect” (Goodess and Palutikof, 1997: 347).

The second scenario is considered most likely to occur, and scientists anticipate that Great Britain will experience

TABLE 1
Mean Surface Temperatures for Greater London (degrees Celsius)

	WMO Normals 1961-1990	CCCma's GCM Projection for 2071-2100
Average maximum surface temperature - June	19.6	21.0
Average minimum surface temperature - June	9.3	15.9
Average maximum surface temperature - December	7.7	11.4
Average minimum surface temperature - December	1.3	7.6

1000 to 10,000 years of subtropical or Mediterranean conditions (Goodess and Palutikof, 1997).

Wright's narrative depiction of London's future climate is clearly more extreme than what scientists project. The climate of southern England is portrayed as tropical, as illustrated in many descriptive passages: “the foxheat of a rainforest” (77), “a tropical isle” (81), and “the jungle that is England” (151). At one point, Lambert remarks, “If it's this hot now [December], it must be hell in July” (82). During the months of December and January, the mornings are cool and mild (96, 119, 239). However, the temperature rises throughout the morning producing an intense midday heat (95, 96, 106, 130, 143, 147). The scenario produced by Wright appears more consistent with the irreversible or runaway greenhouse effect than with scientists' ‘best guess’.

Sea Level

Much of southern England is vulnerable to any increase in sea level, and an extensive system of sea walls currently protects some 700,000 ha of agricultural, industrial and residential land (Parry and Duncan, 1995). Most of the land adjacent to the River Thames is less than 10 metres above sea level (Ordinance Survey, 1981). Furthermore, high-tide sea levels in central London have been rising as a result of several factors: “global sea level rise; post glacier subsidence of the south-east of England; local subsidence, possibly due to water abstraction and clay shrinkage; and local river dynamics” (United Kingdom DoE, 1991: 50). Current rates of subsidence in southeastern England range from –1 mm/year to –1.9 mm/year (Parry and Duncan, 1995). Extrapolating these values to 2500 yield estimates of –75 cm subsidence. Changes due to subsidence will be exacerbated by sea level rise due to thermal expansion of the oceans and increased melting of

mountain glaciers and the Greenland ice sheet. A ‘best guess’ global sea level rise projection for 2100 is 48 to 50 cm. Beyond that, sea level would continue to rise, “at only a slowly declining rate, for many centuries after greenhouse gas concentrations have stabilized” (IPCC, 1995: 50). Together then, subsidence and sea level rise, are expected to result in increased water levels of several metres by the year 2500. Three of the IPCC’s (1995) scenarios indicate sea level rise of +1.5m to +3m by 2500.

Wright’s depictions of future sea level appear more or less consistent with this: “It’s harder to confirm my exact position, for it appears that sea-level has risen several metres, drowning Canvey Island except for this small rise on which the pub once stood ... and widening the Thames Estuary by a mile or so” (77-78). Closer to London, Wright describes a landscape where sea level rise has obliterated the river’s artificial banks; many of the industrial buildings and structures that once lined the river have crumbled and decayed; swampland can be found as far north as King George’s Reservoir (137-8); and road and rail bridges than span the lower Lea are mostly underwater (137). In summary, Wright depicts a futuristic River Thames that has undergone dramatic, but still plausible, changes.

Precipitation

WMO climate normals for the period 1961-1990 indicate that the Greater London region receives an average of 754 mm of precipitation per year; virtually all of it falls as rain as there are typically only three to six snow days per year. Winter (October through January) is the wettest and dreariest season, with measurable rainfall nearly every other day and the average duration of sunshine only 50 hours per month.

With regard to future projections of precipitation, scientists emphasize the difficulty of predicting regional phenomena. However, researchers concur that winter precipitation in the Greater London – Thames Estuary region is likely to increase, while summer precipitation amounts are likely to remain unchanged (Parry and Duncan, 1995; Raper *et al.*, 1997).

It is difficult to determine from Wright’s novel the exact amount and seasonal pattern of precipitation, but his depictions are consistent with projections of more and heavier winter rainfalls (79, 109, 137, 143, 162, 166, 187). In addition, the setting Wright creates for London in the winter of 2500 is an extremely lush and heavily vegetated environment, again suggesting the presence of abundant winter precipitation.

Wind

In present-day southern England, wind speeds are highest in the winter and lowest in summer. In all seasons, wind speeds are greatest in coastal areas (Barrow and Hulme, 1997). Researchers project that global warming will be associated with an increase in the frequency of strong winds. The CCCma GCM projects December and January wind speeds of 4.8 m/s and 5.3 m/s, respectively, for the years 2071-2100, as compared to the current normals of 4.1 and 4.4. Unfortunately, little else can be said about future wind regimes because, at the regional scale, the uncertainty in climate modeling is still quite large (United Kingdom DoE, 1991).

A Scientific Romance provides only a few insights into wind conditions: “the morning breeze still cool” (81), “a headwind creasing the open water” (96), “a gentle soak without wind” (105), “on these new waters ... the wind calm” (130), and “a breeze chased tatters of fog into the treetops” (140). Only once does the narrator find the strength of the wind notably strong: “A bothersome headwind fought me all afternoon, sweeping down the grassy floodplain that was once King George’s Reservoir” (138). However, there is also one reference to a storm or tornado that downed trees (154). Wright appears to be more interested in the literary effects of the use of wind in his narrative and not so much with the accurate depiction of wind conditions for the years 2500-2501. However, one must also consider that most of Lambert’s time in London was spent exploring inland waterways. At one point, Lambert climbs to the top of the Canary Wharf building and once above the dense vegetation cover, he notes that “the wind is alarmingly strong up here, sucking and blowing in sudden squalls—the tower yaws and shivers like the mast of a tall ship” (110).

CONCLUSION AND DISCUSSION

Narratives are a powerful communication strategy that have been underutilized in environmental education, generally, and in communications on global climate change, more specifically. This paper provides a two-part qualitative evaluation of one adult-fiction narrative, *A Scientific Romance*, written by Ronald Wright (1997). The novel was reviewed using criteria from both cognitive psychology and climatology. We conclude that Wright's tightly crafted narrative successfully takes an abstract issue and transforms it into something interesting, imaginable, personal and relevant to the reader's existing knowledge. It provides a detailed depiction of a plausible future climate and its implications for society. However, we feel that it has two minor weaknesses as an educational tool. First, there is little direct reference to the principal causes of climate change; indeed, references to sulfur emissions and ozone depletion may re-enforce public confusion over different environmental issues. Second, the climate scenario depicted in the novel is more consistent with the runaway greenhouse theory than with scientists' best guess of what future climates will be. The magnitude of the portrayed change may create a sense of disbelief or helplessness.

In closing, we would like to say that despite the inherent appeal of the narrative as a communication strategy, stories can be dangerous (Cronon, 1992; Fulford, 1999). Different story tellers will have varying agendas, such that facts and details will be carefully selected and pruned as the plot is developed. In its most extreme case, the ancient rule passed down through generations of cynical journalists will hold true: "Never let the facts get in the way of a good story" (Fulford, 1999:18). Thus, as with any powerful tool, it is important to use narratives carefully and responsibly. □

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Depictions of Global Environmental Change in Science Fiction: An Overview of Educational Applications

Lisa Kadonaga

Science fiction books and movies reach a wide audience, including people not currently in school, and those who avoid educational programming. Although most SF depictions of global environmental change are outdated and oversimplified, the genre could raise public awareness and encourage discussion of ecological and social impacts. SF writers have considered both natural systems and human societies, anticipating the work of impacts researchers. Both science fiction and global change require knowledge and creativity to construct realistic extrapolations. However, well-written SF may reach a larger cross-section of the public, while emphasizing that climate projections are principally intended as warnings, not prophecies.

INTRODUCTION

In November 1998, 63% of Canadian adults surveyed felt it was likely that global warming would “make more of the world unliveable” by 2050 (Chisholm, 1998). Various researchers, including several other contributors to these conference proceedings, have investigated where people obtain information for making these kinds of assessments about climatic change. To date, most attention has focused on the educational system, and on the news media. However, prior to the 1980s, the theories behind atmospheric change were rarely encountered outside of physics and earth science courses. Unless people elected to take these subjects during their degrees, they would have graduated without covering the conceptions of environmental problems.

Although information on environmental change has become widely available through the print and electronic media, opinion is divided on the effectiveness and accuracy of these types of sources. While Hare (1998) felt that the increased quality and quantity of reporting have contributed to better public understanding of phenomena like El Nino, Dworkin and Pijawka (1982) noted that media attention can also contribute to inaccurate impressions of environmental problems.

A third possible way in which people’s impressions of climatic change are shaped is through works of fiction, including novels, short stories, films, and television. These sources reach a wide audience, including people not attending school, and those less inclined towards popular science literature or educational programming. Gowda *et al.*, (1997) found that nearly 35% of American high school students sampled claimed that TV was their major source of information, a figure higher than print media and school curricula combined. Nielsen Media Research (1999) indicated that for the 18-49 demographic, the most popular syndicated shows included *Star Trek DS9*, *Earth: Final Conflict*, and *The X-Files*. No science-based programming made it onto the list.

Since the early 1990s, references to global environmental change have become more common in movies and TV, particularly in science fiction and fantasy. The popularity of these genres among high school and college students implies that the impressions conveyed onscreen could be either reinforcing or refuting things they have learned in the classroom.

Science fiction has received its share of criticism. Almost every movie or TV series that purports to be

science fiction seems designed to mislead viewers about science: explosions are audible in space, and telepathy is as accepted as computers. British SF author Brian Earnshaw (1983) blames his colleagues for making too much of spaceships and extraterrestrials, arguing that this type of escapism distracts us from doing anything about problems here on Earth. Yet there is also a strong opposing belief that science fiction can encourage citizen action. Judith Merrill (1994) argued: “It’s the only place you can do any useful thinking about the idea that there might not be a future” (16). Since its beginnings early in the 20th century, the genre has been credited with raising public awareness about issues like eugenics and nuclear weapons. Even global change researchers have recognized the possibilities of SF. Kearney (1994) notes that stories about realistic characters and their problems, are “particularly compatible with the way people process information; it is one way to effectively communicate information about global change” (420).

CLIMATIC CHANGE AND SCIENCE FICTION

Asserting that science fiction writers do not consider the facts is analogous to stating that all scientists are lacking in imagination. The people who are the best in either of these fields are able to combine careful and meticulous research with creativity. Climate change impact scenarios are essentially science fiction, based on the “what if” of a doubling in atmospheric carbon dioxide. The “hard” variant of SF claims a close relationship with the sciences: in this tradition, accuracy is highly prized, and errors are frequently attacked by critical readers. According to Hartwell (1994), “The world of the hard SF story is deterministic, ruled by scientific law: It is inimical to anyone who does not know said law or how to figure it out” (34). Benford (1994) describes “giving scientific misinformation to the reader” as “the unpardonable sin”, because “the authors want to retain the authority of non-fiction” (18).

Both global change researchers and hard SF writers must use reasonable assumptions to work forward from basic scientific principles. Scientists, too, have sometimes chosen to present their results in storytelling form (e.g., Carson, 1962) in order to reach a wide audience of non-specialists.

Storytelling formats are particularly appropriate for global change concepts, for at least two major reasons. First, global change involves factors that are beyond everyday human experience, in terms of spatial and temporal scale, and the complexity of the impacts”. [Carbon dioxide and ozone] can’t be smelled or seen and people generally don’t perceive their impact as being as direct or significant as that of a nuclear blast or rising interest rates” (Kearney, 1994: 424).

Second, the level of uncertainty attached to climate change projections is high, and the pace of research is rapid, unfolding in many directions simultaneously. Theories are set up, then appear to be debunked and discarded a few months later. Behind the scenes, researchers may have spent several years testing their models, and making modifications: the public rarely sees this side, and instead may suspect that scientists can’t make up their minds. Exacerbating this is the tendency of some media commentators to present global warming scenarios as virtual certainties, seldom explaining the methods used to arrive at these forecasts, or the sources of error involved. Global warming researchers take a different approach: scenarios are viewed only as starting points. From this perspective, the point of predictions is not to sit back and wait for them to come true, but to give us some advance warning of the range of possible impacts that could occur.

An early example of such an educational scenario, dealing with alternative energy futures, is Sewell and Foster (1976), which was laid out in the form of a fictional parliamentary debate occurring on May 14, 2000. A later book by Foster (1997), using a similar format, encourages readers to think about the strategies which enable societies to deal with “the stresses created by change” (3).

Fiction has an important advantage in these situations: people are much less likely to take accept it uncritically, yet still can consider the ramifications. Just as George Orwell’s novel *1984* became a watchword against totalitarian control, readers tend to interpret stories as warnings rather than hard-and-fast predictions. In the case of global warming, where there is so much uncertainty, this may be more valuable than purely quanti-

tative scenarios.

Changing climates have been featured in science fiction literature for decades (e.g., Clarke, 1966). Generally, writers have favoured catastrophic scenarios, typical of the “disaster story” or “post-apocalyptic” subgenres. While these depictions are frequently at odds with current trends in environmental change, there are some areas of agreement with scientific findings.

Direction of change

While some hard SF authors appear to have understood the theory behind the greenhouse effect (e.g., Hogan, 1977), this information wasn't always applied to forecasting possible futures. Prior to the 1990s, stories about a new ice age seemed to dominate. Interestingly, this coincides with colder conditions earlier in the century (Gullett and Skinner, 1992). Silverberg (1980) recalled: “The winter of 1962-63 was a notably snowy one in New York [...] All that snow was very much on my mind in the spring of 1963 when I proposed doing a science fiction novel [...] of the next ice age” (vi-vii).

Ice age stories were still being published in the 1990s (Reeves-Stevens, 1992; Moran, 1995), after global warming gained media prominence. Part of this may have been due to delays in writing and publication. In terms of literary connotations, cold is almost always equated with loneliness, alienation, and hostility (Carter and Carter, 1989). Reeves-Stevens (1992) used the advancing glaciers as a metaphor for emotional distance: “the ice that's ploughing down from the north in unending sheets that soon will defeat the summer for ten thousand years is my soul” (312). In contrast, words such as “warm” and “hot” have both positive and negative associations, so their symbolism is more ambiguous.

There might also be historical reasons: the Little Ice Age only ended in the late 19th century, so colder conditions may seem more familiar. Many Canadians can recount tales of winter hardships experienced by their ancestors in the years before the First World War. Intervals significantly warmer than today, such as the Medieval Optimum, may be too distant in space and time for most people to feel a connection.

Speed of Change

Many fictional descriptions of climate change have assumed a relatively rapid onset, presenting a variant of the classic disaster story. One example from television is the *Star Trek: The Next Generation* episode “A Matter of Time”. The Enterprise visits a planet where “an asteroid impact has caused a dramatic drop in temperature” (Lynch, 1995), and the crew decides to “trigger a greenhouse effect by drilling down to pockets of carbon dioxide in the crust of the planet”. The audience may be left with a confused impression of global climate change, since the story supposedly unfolds within a few days.

Ongoing change is much less common in SF than the catastrophic disaster story or the post-apocalyptic epic. In one example, McCullough (1985) portrays a society transformed by a new ice age. The direction of the temperature shift is different from that predicted by current theories, but it remains one of the most intricate novels ever to incorporate climate change. Sudden and long-term change are not necessarily exclusive: Sterling's *Heavy Weather* (1994) contains elements of both viewpoints.

Forcing Mechanisms

There appears to have been a transition in the climate forcing mechanisms selected by SF writers. In earlier decades, changes in climate were independent of human activities: fluctuations in solar output or the earth's orbit, interstellar dust clouds, volcanic eruptions, and other natural phenomena. More recently, there has been a tendency to assume that changes are anthropogenic, brought about through warfare or pollution. This coincides with the rise of the environmental and peace movements of the late 20th century, and growing publicity about global warming.

A growing number of SF writers view low technology as viable and even preferable, particularly if it is backed up

by scientific understanding (LeGuin, 1985; Hughes, 1992). A whole branch of environmental science fiction, noted by Elbow and Martinson (1980), has continued to develop the issues of coping with change and simplified lifestyles (Robinson, 1990).

She knew that in the world of the future, there wouldn't be cars [...] There would be no private houses with lawns or pleasure vehicles. There would be only small groups of people dependent on one another for survival. There would be hard and constant work for food in a sick and plundered nature (Schulman, 1994: 45).

There's not a lot us country folk can do about the ozone layer and the greenhouse effect that we haven't already done or been forced to do by circumstance. We've had to give up cattle and chemical fertilizers. We burn as little wood as we can and rely on wind and solar power for our needs (Hughes, 1992: 175).

Types of Impacts

Some SF authors realized early on that changes in average temperature and precipitation values are difficult to relate to everyday human experience. Potential environmental and social impacts are far more compelling:

The water encroaches on all coasts. Weather patterns change. The Great Lakes become desert. Food prices rocket up. Winter becomes more hesitant, with plants trying to grow in February. Annual migrations are confused and freak storms appear: thunder in January, blizzards in May. Some species – polar bears, moose, salmon – are wiped out. Others – cockroaches, rats, sea gulls – propagate wildly. This was the unbalanced, wounded world Beryl expected in the future; this was the world she thought she'd been made for (Schulman, 1994: 34).

In addition, people can identify more easily with extreme values, and specific events: how high will the temperatures go, the onset of spring rains, and the presence of snow at Christmas (Woo, 1992; Rebetz, 1995).

Summer swelled up [...] more ephemeral in these days when people were perpetually aware of its brevity [...] but no less hot [...] The only real difference [...] was its duration, shorter now by about four weeks (McCullough, 1985: 156).

It was only June, and already people were dying [...] it wasn't yet the kind of heavy weather where the feds would start sending in the iron-barred evacuation trucks [...] But it was the kind of heat that kicked up the stress several notches. So the old folks' pacemakers failed, and there'd be gunfire in the evening and a riot at the mall (Sterling, 1994: 201).

Sea level rise is one of the most popular concepts taken up by fiction writers:

The ice that melts from both poles as a result of the greenhouse effect will fill the oceans, raise the waters. Beryl lived in Boston, a harbour town. When she walked along the streets, she imagined the tops of the trees swaying gently with the water [...] (Schulman, 1994: 34).

Their thoughts are like their country now, constrained by dykes that will never withstand the thousand-year patience of the sea (Reeves-Stevens 1994, 310).

Robinson (1981) describes the mixed feelings of a former resident of Venice, about the foreign visitors who are plundering historic art treasures from the now-inundated churches. In the 1995 movie *Waterworld*, the co-opting of the Universal Studios globe at the beginning was perhaps the most entertaining part of the film: instead of cutting to the title credits, the camera zooms in as the land areas on the globe are gradually overwhelmed by the ocean. *AI*, scheduled for release in 2001, is said to take place in “a flooded futuristic world” (Rose,

2000), where cities have been inundated. The technical challenges and visual impact of “a submerged Manhattan, its skyscrapers rising totemically from the tidal stew” (Parisi, 1997) are likely irresistible to many filmmakers.

Sometimes SF has even anticipated scientific findings:

Pat had flung her teen-age years at the burning forests of northern Ontario [...] The fires had become more and more frequent as the greenhouse effect worsened [...] there was no going back, and the forests could not be saved as long as the climate continued to get hotter. (Trudel, 1994: 105).

At the time Trudel’s story was originally written, research into the impacts of climate warming on boreal ecosystems was still in its early stages (Sargent, 1988; Wheaton and Singh, 1989; Franklin, 1990). Most speculation was focused on the agricultural sector, and at the time, many Canadians anticipated a milder climate. Later research suggested that fire, disease, and species replacement could create significant disturbance in the northern forests (Cohen, 1997), if not the catastrophe depicted by Trudel.

The long-term work by Stirling *et al.* (1999), predicting serious consequences for polar bear populations, was widely reported in the press. Schulman used preliminary reports to speculate on what the disappearance of sea ice might do to the Arctic ecosystem:

Beryl knew that in the future world of small things, the polar bear probably would not exist. The greenhouse effect will warm the North Pole by up to nine degrees. The ice that the bears live on during the winter won’t form until later in the year and will melt earlier, depositing the bears one by one into a bay a thousand miles wide. (Schulman, 1994: 33)

The possible effects of global warming on human society are more nebulous. Some SF writers have chosen to explore these issues, which are also being investigated by social scientists involved in global change research. Perhaps the clearest depiction of government policies specifically intended to cope with climatic change, and the reaction to them, appears in McCullough’s new ice age novel (1985). Her fictional future American government restricts most aspects of everyday life. Although she assumes a remarkable degree of compliance, she does provide examples where people disobey the law:

[...] people who remained in Connecticut all year round, and suffered the cold dumbly, and didn’t quite understand all the reasons why the government was so adamantly against wood burning [...] now felt an unaccustomed stirring of old, buried emotions. (62-64)

Sterling (1994) imagines the fate of the High Plains inhabitants who attempt to remain on the land, in defiance of government regulations: perhaps incorporating the rise of anti-government sentiment observed in the 1990s.

They just couldn’t stand it [...] that we hadn’t cleared out for good and gone exactly where the government said we should, when we should. That we didn’t pay taxes, or get vaccinations, or have any rule books [...] They broke us up, and they shot us and arrested us, and they put us away in camps. (141)

McCullough points out that shooting is not necessary. There are other ways to close down a community:

Those who insisted upon remaining in the doomed cities [...] after winter relocation was phased out altogether (the estimate given for this was another ten years) would not be forcibly removed [...] Simply, they would receive no aid, no tax benefits and no welfare. (158)

Environmental refugees are featured prominently in global warming SF: a graphic scene from the 1993 TV miniseries, *The Fire Next Time*, shows desperate Americans trying to cross the newly-fortified border into

Canada. McCullough (1985) was among the few novelists to address the social and economic ramifications of permanently relocating large numbers of people:

When relocation had begun over twenty years earlier, no one who still had a job in the north wanted permanent relocation; but that state of affairs was now reversed [...] a harassed government fell ever further behind in the number of permanent places it could offer potential relocatees [...] because property in the north and midwest was fetching next to nothing, there were many indeed who could not relocate permanently until they received official help [...] The warmest of the southern states fought desperate battles to curb the growth of trailer parks and shantytowns [...] (156-157)

Researchers are only beginning to investigate the psychosocial dimensions of global environmental change. Fiction authors have had an early start:

Jeff was only sixteen, but he had that drawn, tight-around-the-eyelids look that Alex had seen on the faces of displaced people, of the world's heavy-weather refugees. A haunted, wary look, like the solid earth beneath their feet had become thin ice, never to be trusted again. (Sterling, 1994: 133)

Two months before relocation [...] in which to pack away things not wanted down south and wind up affairs and start the telephoning and queuing to see how and when the winter exodus would be conducted [...] people began to tell each other how glad they would be to quit the place, preferably for good. Who wanted or needed this circus living, forever packing up and moving on? (McCullough, 1985: 157-158)

Scientific literacy and climate change

Concern has been raised about apparent gaps in public understanding of the causes and potential impacts of climatic change (Nelson *et al.*, 1992; Bostrom *et al.*, 1994; Boyes and Stanisstreet, 1994; Read *et al.*, 1994; McDaniels *et al.*, 1996; Gowda *et al.*, 1997; and others). Confusion between stratospheric ozone depletion and the greenhouse effect persists even among university science graduates. This misconception seems to have made its way into popular culture: Kathy Bates's character in the 1990 film *Misery* attributes shorter winters to the ozone layer.

Both scientists and hard science fiction writers are concerned about a decline in the public's scientific knowledge: Benford (1994) laments that the "high-tech imagery" used by many films and television shows may be a shiny facade: "In a nation of declining science-related skills, written hard SF may reach a shrinking audience" (15). Regarding global warming, Read *et al.* (1994) fear that "...some of these misunderstandings could misdirect the public's support for proposed policies, as well as leave it vulnerable to manipulation by interest groups" (971).

It doesn't help that *The Arrival* (1996), one of the few big-budget Hollywood movies to mention global warming, also incorporates extraterrestrial invaders and shadowy government conspiracies. Fortunately, conditions are also becoming more favourable for more intelligent public debate. Scientific inaccuracies in books, films, and TV can be more widely discussed through the Internet: this "netpicking", often led by hard SF fans, may appear trivial at first, but can aid the development of critical thinking. A posting about *Waterworld*, on one movie discussion site, is representative of some of the more thoughtful commentary. Investigating whether this complaint is valid would be a relatively easy classroom exercise in basic physics and geology:

The premise is impossible. So only 100 or so feet of Mount Everest is above water? That would mean the world was under 29,000 feet of water. From what I have heard, even if the ice caps melted completely (as they have in the distant past), only the coastlines would be under about 300 feet of water. Sure it would be a disaster, but going from 300-29,000 feet is ridiculous. (dgm59 2000)

CONCLUSIONS

Even though *Waterworld* was a critical and box-office flop, there are many reasons why the use of global warming scenarios in written or onscreen science fiction may not be entirely bad: and if handled carefully by science educators, could improve public awareness.

First, SF makes global change information more widely available to the public, especially young people. For example, palaeontology has experienced a surge in popularity with the most recent wave of dinosaur movies.

Second, fictional scenarios may suggest new directions of research, and offer unexpected insights into potential impacts, which may have been overlooked or underestimated.

Third, collaboration between researchers and SF writers could produce some interesting work. *The Fire Next Time* is one of the few SF films which examines global warming in any detail: climatologist Stephen Schneider provided consultation. There may be an opportunity for interested groups to commission original works, as has been done for other topics such as bioethics. The study by Gowda *et al.* (1997) suggested that global change researchers can play an important role in public education. When respondents were asked which group they trusted most to give accurate information about climate change, scientists received the top ranking — ahead of teachers, environmental groups, and the media.

Finally, in the long term, encouraging interest in global environmental change can help demystify how science works. Perhaps the most valuable function of climate projections is as a starting point for learning about how the environment works, and to get people talking. Presenting scenarios as ways to identify potential problems, rather than as prophecies set in stone, still conveys a warning while lessening the expectation of absolute accuracy. In his fictional example, Strong (2000) emphasized: “This is not a prediction [...] simply an attempt to portray the kind of world that would result from our continuing a ‘business -as-usual’ attitude” (A11). Above all else, the global warming debate is in need of thoughtful, balanced presentations: this is possible in fiction as well as in non-fiction, with the advantage of being accessible to a wider cross-section of the public. □

ACKNOWLEDGEMENTS

Much of this paper grew out of discussions with Elaine Wheaton. I also wish to thank Dr. Harold Foster for his encouragement; Dr. Jamie LeClair for his insights into the phenomenon of why climatologists are teased during cold snaps; and my father Victor Kadonaga, who introduced me to SF literature.

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“A Scientific Romance” - Reading and Reflection

Ronald Wright

ABSTRACT

The novel, A Scientific Romance, is a dystopia, a chronicle of love, time and destruction. The story follows the main character, David Lambert, into the future via H.G. Wells’ own time machine in search of a cure for a degenerative disease from which he suffers. Lambert arrives in Great Britain, the year 2500, to find a luxuriant, but menacing new environment, which has been altered by the effects of climate change and is no longer inhabited by humans. The reader follows Lambert north in search of a surviving civilization, while Lambert explores the remains of the land and the ruins of his own history.

In this presentation, the author, Ronald Wright, will do a reading from A Scientific Romance and share a reflection on his reasons for writing this book. □