

## Teaching in the (*Crash*) zone: manifesting cultural studies in science education

Noel Gough

### Why *Crash*?

In this chapter I argue that the mode of storytelling usually known as ‘science fiction’ has special significance for developing appropriate pedagogies of/for cultural studies of science. As Donna Haraway (1989) explains, the term ‘science fiction’ has in recent years been displaced by a more embracing (and more ambiguous) term, ‘SF’:

In the late 1960s science fiction anthologist and critic Judith Merrill idiosyncratically began using the signifier SF to designate a complex emerging narrative field in which the boundaries between science fiction (conventionally, sf) and fantasy became highly permeable in confusing ways, commercially and linguistically. Her designation, SF, came to be widely adopted as critics, readers, writers, fans, and publishers struggled to comprehend an increasingly heterodox array of writing, reading, and marketing practices indicated by a proliferation of ‘sf’ phrases: speculative fiction, science fiction, science fantasy, speculative futures, speculative fabulation. (p. 5)

My title deliberately includes a parenthetical reference to an exemplary and germinal SF text, J.G. Ballard’s (1985 [1973]) *Crash*, which Scott Bukatman (1993) describes as a ‘high-tech porn novel’ (p. 6) and a ‘compendium of atrocities’ (p. 326). Bukatman (1993) also describes *Crash* as

a brilliantly ironic work, set in a postindustrial landscape of highways and automobiles, high rises and airports, television sets and billboards. It is a landscape in which the erotic is denied, repressed and paved over by layers of concrete tarmac and chrome. Vaughan, the ‘hero’ of *Crash*, fantasizes his death in a headlong collision with Elizabeth Taylor. The narrator, ‘Ballard,’ is ever-increasingly drawn toward Vaughan’s vision of transcendent sex and violence. (p. 292)

I suspect that many readers may not perceive an immediate or obvious connection between science education and a novel in which most characters are obsessed with the sexual connotations of wounds caused by car crashes, so I should state from the outset that the significance of *Crash* for this chapter lies chiefly with its history and narrative form rather than with its thematic content. Istvan Csicsery-Ronay (1991a) nominates Ballard’s Introduction to the French edition of *Crash* as ‘the *de facto* founding manifesto of postmodernist SF’ (p. 306) and the novel itself has influenced several literary and cultural theorists, including Jean Baudrillard (1991).

I work from a position that takes the generativity of metaphor for granted. Metaphors matter, and they matter in the literal sense that they have material effects. As Norman Fairclough (1992) writes, ‘when we signify things through one metaphor rather than another, we are constructing our reality one way rather than another. Metaphors structure the way we think and the way we act, and our systems of knowledge and belief, in a pervasive and fundamental way’ (p. 195). In

this chapter, I present ‘the (*Crash*) zone’ as a generative metaphor that structures some of the ways I think and act as a science educator. I recognize that this metaphor may be idiosyncratic but I trust that by the end of this chapter it will not appear to be too esoteric. I also hope that it might be adaptable. *Crash* is not the only fiction that could be used to modify the concept of ‘the zone’ that I outline in the following section. For example, *The X-Files* is surreal enough for my purposes but its overtly paranoid politics means that it lacks the cool detachment of *Crash*’s hyper-realized world.

### **Curriculum theorizing in ‘the (*Crash*) zone’**

If I followed Michel Foucault (1970 [1966]), I might have titled this chapter ‘Teaching in heterotopia,’ because I imagine myself teaching science in an ‘impossible’ discursive space characterized by ‘the disorder in which fragments of a large number of possible orders glitter separately... without law or geometry’ (p. xviii). But I prefer to represent the space in which I perform curriculum inquiry as the ‘zone’ that Brian McHale (1992, pp. 250-1), Scott Bukatman (1993, pp. 163-82), and a number of other literary scholars identify as a pervasive trope in postmodernist fiction, a site in which multiple worlds are projected and ontological shifts are enabled by fragmenting, reassembling, and/or imploding familiar spaces. Many readers of my generation will recall the portentous words that opened each episode of a well-known 1960s television series:

You are traveling to another dimension,  
a dimension not only of sight and sound  
but of mind—  
a journey into a wondrous land  
whose boundaries are that of imagination.  
Your next stop: *The Twilight Zone*.

There are many other examples. In the space age mythology of William Burroughs’s (1964; 1966 [1961]; 1967 [1962]) apocalyptic Nova trilogy, the ‘Interzone’ is the region in which anything is permitted and everything coexists. The reconfigured Germany of Thomas Pynchon’s (1973) novel, *Gravity’s Rainbow*, is called ‘the Zone,’ as is a part of Canada mysteriously transformed by alien visitation in Arkady & Boris Strugatsky’s (1978) *Roadside Picnic* (filmed by Andrei Tarkovsky as *Stalker* in 1979). ‘Zones’ are also the names that Doris Lessing (1980) gives to the parallel dimensions of the cosmos she creates in her ‘Canopus in Argus: Archives’ series, explicitly introduced in the second novel of the sequence, *The Marriages Between Zones Three, Four and Five*.<sup>1</sup>

While the name may be absent, spaces that serve similar functions to these zones often appear in postmodernist fiction. These include the burgeoning evocations of cyberspace, such as the virtual ‘Metaverse’ of Neal Stephenson’s (1992) *Snow Crash* and, more particularly, the near-future megalopolises in which the technologies of human-machine interfaces are domesticated,

---

<sup>1</sup> References to ‘the zone’ as a psychological space in which one’s performance seems supernormal are also common in the literature of sport and physical adventure. For example, *In the Zone: Transcendent Experience in Sports* (Michael Murphy & Rhea White, 1995), documents numerous ‘moments of illumination, out-of-body experiences, altered perceptions of time and space, exceptional feats of strength and endurance, [and] states of ecstasy’ (p. 1) that have been reported by athletes and adventurers when they are enjoying a ‘peak performance’ (p. ix; see also Andrew Cooper, 1998). The ‘zones’ of sport and SF coincide in the movie *Field of Dreams*.

such as the gigantic urban ‘Sprawl’ of ‘BAMA... the Boston-Atlanta Metropolitan Axis’ in William Gibson’s (1984, p. 57) *Neuromancer*, and the similarly immense but even more densely inhabited ‘Glop’ of Marge Piercy’s (1992) *He, She and It*. The imaginary town that provides the title of Ursula Le Guin’s (1996) short story, ‘Ether, OR,’ serves as an ontologically ambiguous zone in which the ordinary is almost imperceptibly fused with the fabulous, as its middle-American inhabitants adapt to its shifting configurations and relocations (‘People come through here say how can you stand living in a town that doesn’t stay in the same place all the time, but have they been to Los Angeles? It’s anywhere you want to say it is’; p. 103). McHale (1987) notes that authors typically fashion such zones by ‘introducing an alien space *within* a familiar space, or *between* two adjacent areas of space where no such “between” exists’ (author’s emphasis), and that even if the zone contains allusions to historical terrestrial spaces (Canada, occupied Germany, Oregon), it ‘in fact is located nowhere but in the written text itself’ (pp. 45-6). The ‘reality’ of the zone, as Ballard (1984 [1964]) writes of Burroughs’s novels, ‘is not some pallid reflection of a hypothetical external scene, its details and local color stitched into the narrative..., but the self-created verbal reality of the next sentence and paragraph, like a track-laying train free to move about in all directions on a single set of rails’ (p. 106).

Thus, ‘teaching in the zone’ signifies that curriculum inquiry, for me, is a textual practice shared with the many SF writers who, in Samuel Delany’s (1988) words ‘posit a normal world—a recognizable future—and then an alternate space, sometimes largely mental, but always materially manifested, that sits beside the real world.... conflicts that begin in ordinary space are resolved in this linguistically intensified paraspaces’ (p. 31). I have included the parenthetical reference to Ballard’s (1985 [1973]) *Crash* in my title because I admire it as one of the most intensely realized examples of the rhetorical heightening that can be achieved through such paraspacial textual strategies. Baudrillard (1991) describes *Crash* as the ‘first great novel of the universe of simulation, the world that we will be dealing with from now on’ (p. 319), and advances his own theorizing as a similarly evocative exercise:

I am no longer in a state to ‘reflect’ on something, I can only push hypotheses to their limits, snatch them from their critical zones of reference, take them beyond a point of no return. I also take theory into the hyper-space of simulation—in which it loses all objective validity, but perhaps it gains in coherence, that is, in a real affinity with the system that surrounds us. (Baudrillard, 1987, pp. 36-7)

Baudrillard practices what Csicsery-Ronay (1991b) calls ‘the science fiction of theory’ by inviting us to assume that ‘the system that surrounds us’ *is* (has ‘real affinity with’) a paraspacial zone. In this respect he implicitly accepts Ballard’s (1985 [1974]) hypothesis that ‘we live in a world ruled by fictions of every kind’ and, therefore, that ‘the most prudent and effective method of dealing with the world around us is to assume that it is a complete fiction.... We live inside an enormous novel’ (p. 8).

As I have argued at length elsewhere (Gough, 1998b), I am convinced that we can initiate and sustain worthwhile inquiries in education by taking Ballard’s proposition seriously. By this I do not necessarily mean that Ballard’s assertion is an hypothesis to be tested ‘scientifically.’ Rather, I am suggesting that in practicing curriculum inquiry as a narrative art, I have sufficient reason to believe that Ballard’s formulation refers to ‘real’ conditions, with particular reference to the conditions under which I might need to judge my own and others’ actions to be ‘prudent and effective’ (or not). Rather than struggling with academic distinctions between stories of

imagination and ‘reality,’ I choose to situate myself in the world-as-fiction as a ‘researcher-narrator’ whose subjectivity is author of (that is, authorizes) his methodology.

Thus, in this chapter, I will elaborate and argue a case for adapting Ballard’s and Baudrillard’s assertions to science education. I will argue that the most prudent and effective method for teaching and learning science is to assume that the world in which science education is performed and represented is a fiction—a paraspatial, heterotopian zone; we should imagine that we are teaching and learning inside an enormous SF novel (or movie, or computer game, or...), that we are taking science curriculum into a hyperspace of simulation—metaphorically, into a (*Crash*) zone—in which we can push propositions and suppositions beyond their limits.

### **Science (education) and SF: ‘the boundary between science fiction and social reality is an optical illusion’**

I have one further reason for using ‘the (*Crash*) zone’ as a metaphor for the imagined space in which I prefer to teach science. *The Crash Zone* is the title of a 13-episode television series produced by The Australian Children’s Television Foundation (ACTF)<sup>2</sup> in 1999. The series follows the adventures of five young people with a shared enthusiasm for computers, gaming, and the Internet who are hired by a small, struggling software company to test its computer games after school—‘The Crash Zone’ is their name for the space in which they work (they spray paint the name on the door). I not only enjoyed viewing *The Crash Zone* with my then 10-year-old son, but also the ACTF invited me to write teaching activities for upper primary and lower secondary students to accompany the series. While the teaching activities I prepared (see, for example, Gough, 1999a; 1999b) were targeted to learning areas other than science education, writing them provided me with an opportunity to enact some of the orientations to curriculum work that I privilege here. One of these orientations, which I was pleased to see exemplified by *The Crash Zone* series itself, is expressed succinctly by Haraway’s (1991) assertion that ‘the boundary between science fiction and social reality is an optical illusion’ (p. 149). *The Crash Zone* is in the genre of socially-realist comedy-drama—a junior high variant of *Friends*—and its only ‘science fictional’ element is the inclusion of ‘Virgil,’ a virtual persona (an artificial intelligence program), as a character with whom the young people interact (a little like a Mario Brother that talks back incessantly). But Virgil is not depicted in a way that ‘objectively’ separates him from the social reality of *The Crash Zone*—he is neither *deus ex machina* nor an object of *X-Files*-like investigation. Rather, he is seen as one among several actors—or as Bruno Latour (1988; 1993) might say, ‘actants’—in a specific socio-technological assemblage.

‘A manifesto for cyborgs,’ in which Haraway’s (1985) formulation of the illusory boundaries between SF and social reality first appeared, has been described as ‘groundbreaking’ and ‘iconoclastic’ (see, for example, Csicsery-Ronay, 1991b, p. 393) because it presented and performed a new language for a socially democratic, materialist, and feminist politics. But Haraway’s implicit pedagogical strategy is also continuous with, and complementary to, the call Marshall McLuhan (1960) issued some 25 years previously for ‘a basic strategy of culture for the classroom’ (p. 2) in which ‘mass media’ and ‘mass entertainment’ are ‘carefully set beside other kinds of art and narrative’:

---

<sup>2</sup> *The Crash Zone* was produced by the ACTF in association with The Disney Channel Australia and was first broadcast nationally by the free-to-air Seven Network from 13 February 1999. For further information see <http://www.actf.com.au>

It's misleading to suppose there's any basic difference between education and entertainment. This distinction merely relieves people of the responsibility of looking into the matter. It's like setting up a distinction between didactic and lyric poetry on the grounds that one teaches, the other pleases. However, it's always been true that whatever pleases teaches more effectively (p. 3).

Similarly, 'science' and 'fiction' do not exist in separate domains but are culturally connected. This is not simply a matter of science and literature finding common meeting places in SF and other forms of popular media. Nor is it just a matter of scientific theories being translated into literary themes, a practice which long preceded the emergence of science fiction as a distinctive literary mode (for example, Copernican cosmology permeates the poetry of John Donne and concepts of disease formation are a distinctive feature of Emile Zola's novels). As Katherine Hayles (1984) demonstrates, 'literature is as much an influence on scientific models as the models are on literature' (p. 10), insofar as there is a two-way traffic in metaphors, analogies and images between them.

I have described elsewhere (Gough, 1991) some of the pleasures of learning with SF. My account is autobiographical and focuses on a small number of specific stories—by Arthur C. Clarke and Ursula Le Guin—that have significantly influenced my work in curriculum studies and teacher education. It was not written as an argument for using SF but, rather, as an example of its generative potential that might whet readers' appetites and motivate them to undertake their own inquiries. Nor is my account intended to demonstrate the 'relevance' of SF to the subject matters and methods of conventional school science education. Like Nunan & Homer (1981), I do not advocate studying SF for the 'textbook science' it may illustrate: 'To do so would amount to little more than presenting the school-science orthodoxy in a slightly unorthodox way' (p. 317). Rather, I believe that SF is a storytelling practice that science educators should welcome into the conceptual territory of science education with the deliberate intention that it should trouble the conventions and categories assumed by standard textbooks and ritual classroom activities.

The insights that can emerge from deliberately blurring distinctions between science and literature, and 'fact' and fiction, are convincingly demonstrated in *Primate Visions*, Haraway's critical history of the development and cultural effects of primatology. The introduction to *Primate Visions* is subtitled 'the persistence of vision,' and it is no coincidence that this is also the title of a story by John Varley (1978). Haraway (1989) writes:

John Varley's science fiction short story, 'The Persistence of Vision,' is part of the inspiration for *Primate Visions*. In the story, Varley constructs a utopian community designed and built by the deaf-blind. He then explores these people's technologies and other mediations of communication and their relations to sighted children and visitors. The interrogation of the limits and violence of vision is part of the politics of learning to revision. (p. 384)

Haraway exposes the 'violence' that arises from the relationship between our vision—what, how, why, who, when and where we choose to see—and those others (human, animal) who are the subjects and objects of (and who are subjected to and objectified by) our vision. In primatology, as in other disciplines, this violence is both literal and symbolic. As Haraway (1989) notes, 'the commercial and scientific traffic in monkeys and apes is a traffic in meanings, as well as in animal lives' (p. 1). Some of these meanings bear 'the terrible marks of gender and race,' because primatology has been a particularly important legitimating discipline for patriarchal, Eurocentric

and anthropocentric mythologies. Haraway is thus concerned to elucidate the ways in which the story-telling practices of science, as exemplified by primatology, ‘structure scientific vision’ and, in turn, construct myths of gender, race and nature in our culture:

monkeys, apes, and human beings emerge in primatology inside elaborate narratives about origins, natures, and possibilities. Primatology is about the life history of a taxonomic order that includes people. Especially western people produce stories about primates while simultaneously telling stories about the relations of nature and culture, animal and human, body and mind, origin and future. Indeed, from the start, in the mid-eighteenth century, the primate order has been built on tales about these dualisms and their scientific resolution (pp. 4-5).

Many of the ‘narratives about origins, natures, and possibilities’ to which Haraway refers are sustained by popular media, such as the numerous film and video documentaries about Jane Goodall’s work and various versions of the life and death of Dian Fossey (as in the movie, *Gorillas in the Mist*). Other recent examples include novels such as William Boyd’s (1991) *Brazzaville Beach*, Daniel Quinn’s (1992) *Ishmael*, and Peter Høeg’s (1996) *The Woman and the Ape*. SF has also produced many primate stories. For example, the Morlocks in H.G. Wells’s (1895) *The Time Machine* are described as an ‘ape-like’ evolutionary ‘degeneration’ of humans and were inspired, in part, by a picture of a gorilla in an illustrated book of natural history which Wells read when he was seven (see Geduld, 1987, p. 2). Wells (1934) himself describes *The Time Machine* as ‘a glimpse of the future that ran counter to the placid assumption of that time [the late Victorian era] that Evolution was a pro-human force making things better and better for mankind [sic]’ (p. ix). In similar ways, monkeys and apes have inspired numerous images of human fears—including fears of what humans might become—in SF stories and movies such as the *Planet of the Apes* series.

The inspiration of Varley’s SF story explicitly foreshadows one of the ways in which Haraway (1989) ‘reads’ primatology, that is, ‘as science fiction, where possible worlds are constantly reinvented in the contest for very real, present worlds’:

I am interested in the narratives of scientific fact—those potent fictions of science—within a complex field indicated by the signifier SF....

SF is a territory of contested cultural reproduction in high-technology worlds. Placing the narratives of scientific fact within the heterogeneous space of SF produces a transformed field. The transformed field sets up resonances among all of its regions and components. No region or component is ‘reduced’ to any other, but reading and writing practices respond to each other across a structured space. Speculative fiction has different tensions when its field also contains the inscription practices that constitute scientific fact. The sciences have complex histories in the constitution of imaginative worlds and of actual bodies in modern and postmodern ‘first world’ cultures. (p. 5)

I would describe the ‘transformed field’ produced by ‘placing the narratives of scientific fact within the heterogeneous space of SF’ as a *heterotopian zone* and, in later publications, Haraway (1994, 1997) coined the term ‘diffractions’ as an optical metaphor for the ‘resonances’ that may be set up within this textual space.

My invented category of semantics, diffractions, takes advantage of the optical metaphors and instruments that are so common in Western philosophy and science. Reflexivity has been much recommended as a critical practice, but my suspicion is that reflexivity, like reflection, only displaces the same elsewhere, setting up the worries about copy and original and the search for the authentic and the really real.... What we need is to make a difference in material-semiotic apparatuses, to diffract the rays of technoscience so that we get more promising interference patterns on the recording films of our lives and bodies. Diffraction is an optical metaphor for the effort to make a difference in the world. (Haraway, 1997, p. 16)

By diffracting the primatology story through SF (and vice versa), Haraway also demonstrates the effectiveness of a McLuhanesque learning strategy: ‘Our time is a time for crossing barriers, for erasing old categories—for probing around. When two seemingly disparate elements are imaginatively poised, put in apposition in new and unique ways, startling discoveries often result’ (McLuhan & Fiore, 1967, p. 10).

The results of adopting such a strategy are particularly apparent in the final chapter of *Primate Visions*, which alternates between ‘reading primatology as science fiction’ and ‘reading science fiction as primatology.’ Haraway begins this chapter by using Isaac Asimov’s (1964 [1952]) *The Second Foundation* to recapitulate the themes of *Primate Visions*. She then reviews the work of several women SF writers in the light of her reconstructed narratives of primatology. Haraway (1989) reasons that:

Mixing, juxtaposing, and reversing reading conventions appropriate to each genre can yield fruitful ways of understanding the production of origin narratives in a society that privileges science and technology in its constructions of what may count as nature and for regulating the traffic between what it divides as nature and culture. (p. 370)

*Primate Visions* testifies to the potential effectiveness of SF in deconstructing, demystifying, and diffracting contemporary orthodoxies—in this case, the social, textual and material history of primatology. Clearly, SF has mediated Haraway’s own learning in important ways. The type of learning that Haraway models in *Primate Visions* is as applicable to school science education as it is to research in the history and philosophy of primatology. In my experience, school students require little encouragement to mix and juxtapose the narratives of ‘scientific fact’ with the narratives of SF. Indeed, they may be more willing than their teachers to mix and juxtapose these ‘seemingly disparate elements’ in critical and creative ways. The difficulty for science teachers is that many seem to have cast themselves in roles as ‘defenders of the faith’—defenders of the privileged status of science and technology—rather than ‘understanders’ of the myths, narratives and rituals which constitute science as a social and cultural practice in the contemporary world.

In pedagogical terms, Haraway is modeling a strategy for good teaching that Garth Boomer (1982) calls ‘connecting’:

The teacher is a senior reader of the school culture and special senior reader of the specialist subculture of the subject. Wittingly or unwittingly, he/she is demonstrating how to be a reader and maker of meaning...

The more richly the teacher can spin a tapestry of metaphor and analogy into a ‘thick’ redundant text of thinking about something new, the more likely it is that students will find a way in.

If students are encouraged to spin out reciprocally their own webs of anecdote, metaphor and analogy, it is less likely that some will remain outside the next text.

The art of generating apt analogy and metaphor is central to the ‘reading’ teacher’s task. (pp. 119-20)

In *Laboratories in Fiction: Science Education and Popular Media* (Gough, 1993b), I argued that it might be preferable for much of the routine work of science education (including much laboratory work) to be replaced by such ‘connecting’ activities that would involve deconstructive readings of the cultural texts of scientific production, including primary sources (such as scientific reports), historical accounts of scientific work, the biographies and autobiographies of scientists, scientific journalism in print and electronic media, and images of science in the fine arts and popular media. In regard to the latter, I emphasized the significance of SF in its many and various forms as a ‘laboratory of ideas’ in which meanings are subjected to experimentation (see also Gough, 1993a). More recently, I have offered another alternative that arises from rereading school laboratory work as a theater of material representations (Gough, 1998a). My purpose here is to demonstrate some ways of deconstructing and diffracting stories of science in their everyday manifestations. In the following section, I rehearse a reading of a recent news story that, following Haraway’s example, deliberately mixes and juxtaposes the ‘reading conventions’ of science and SF in such a way that neither is ‘reduced’ to the other. My pedagogical strategy is to work to sustain a textual space in which diffractions of the narratives of science are enabled, that is, to deliberately position these stories in ‘the (*Crash*) zone’ I evoked in the previous section.

### **Unleashing the thylacine: reading science and SF in ‘the (*Crash*) zone’**

As Tyrone Slothrop wanders through the segmented Germany of Pynchon’s (1973) *Gravity’s Rainbow*, he observes: ‘here in the Zone categories have been blurred badly’ (p. 353). In a similar vein, I find it easy to think of teaching science in a zone in which the boundaries between science, SF and social reality are illusory because I see that these categories have been blurred (though I would prefer to say *goodly* rather than ‘badly’) within the discourses of our everyday social experience.

For example, ‘Unleashing the thylacine’ was headline news on the front page of Melbourne’s daily broadsheet, *The Age*, on 13 May 1999. Under this headline, and dominating the upper center section of the page, a large (16 x 27 cm) color photograph shows a tall cylindrical preserving jar holding a young specimen of what is identified as the now-extinct Tasmanian tiger.<sup>3</sup> Behind the upper portion of the jar, an unidentified woman looks down at the slumped corpse, her face partly obscured and distorted by the curved glass. The photograph’s caption states: ‘Back to the future: A perfectly preserved baby Tasmanian tiger offers the amazing prospect that the unique species could be rescued from beyond extinction.’

The accompanying story, by reporter James Woodford (1999), includes the following passages:

A twist of time may yet unleash the fabled Tasmanian tiger, assumed to be extinct for more than 60 years.

<sup>3</sup> A photograph of the preserved pup can also be viewed on the Australian Museum’s website. See ‘The cloning debate: could the thylacine be cloned?’ at <http://www.austmus.gov.au/thylacine/09.htm>



Dr Mike Archer, the new director of the Australian Museum, says that it is time to bring the thylacine back to life, to reverse one of the great blots on the history of the colonisation of Australia.

And scientists believe they may be able to clone a live thylacine—Jurassic Park-style—from the DNA taken from a perfectly preserved baby ‘tiger’ found in a jar in the museum. The tiger was plonked in the container in 1866, and by good luck was preserved in alcohol, rather than formalin, which would have destroyed its DNA.

According to Dr Archer, it is feasible that people could own Tasmanian tigers as pets within 50 years. ‘We’ve discovered the miracle bottle in which this time capsule is just waiting to pop back into life.’

Dr Archer said cloning and genetic technology were moving so fast that within our lifetimes, one of the continent’s unique creatures could be rescued from extinction. For Australians to turn their backs on this opportunity would be ‘immoral’.

His plan was supported by Dr Mike Westerman, senior lecturer in the genetics department at La Trobe University, who said that, with funds and application, it was possible Australia’s largest carnivorous marsupial could be cloned in the ‘not too-distant future’....

The preserved pouch-young specimen was probably just old enough to be moving independently of its mother inside the den, and has fur and the first signs of the species’ unique stripes.

Dr Archer said he was prepared to make it available to any scientist with a serious proposal to take the first steps to bring a thylacine back to life. ‘Maybe in that preserved specimen, there’s a way to get the DNA out. A researcher who came forward would be told instantly, “help yourself”. There’s probably a billion cells in that animal. That’s a lot of cells to play with.

‘There’s a moral imperative here. It’s not God’s will that the thylacine went extinct. We did it.’ (p. 1)

There are no boundaries between science, SF and social reality in this article. Both the journalist and the scientists deploy explicit and implicit references to well-known science fictions for their respective purposes. Not surprisingly, the journalist’s appropriations—such as his references to the popular movies *Back to the Future* and *Jurassic Park*—are more obvious, but the scientists (assuming they have been quoted or paraphrased with reasonable accuracy) are complicit in authenticating the article’s most persuasive message: that if scientists could possess an extinct organism’s complete and perfectly preserved genome, its entire DNA code, then bringing a thylacine (or a dinosaur) back to life is merely a technical problem. Archer seems to suggest that if ‘there’s a way to get the DNA out,’ if the ‘time capsule’ can be opened, then the problem is almost solved, since the preserved cells are ‘just waiting to pop back into life.’ Both the journalist and the scientists reinforce the popular fiction that represents DNA as a list of instructions, analogous to a recipe in cookery or a computer program.

I doubt if either Archer or Westerman would defend this interpretation if pressed, since they are very unlikely to be ignorant of the flaws in the assumptions and reasoning they support with such enthusiasm here. Indeed, my 10-year-old son refuted their reasoning with very little prompting, since he had read (of his own choosing) Rob DeSalle & David Lindley’s (1997) book, *The Science of Jurassic Park and the Lost World or, How to Build a Dinosaur* (the title of this book is a little misleading, because it actually is a rather smug litany of the science that is *absent* from Stephen Spielberg’s movies and of how dinosaurs *cannot* be built *Jurassic Park*-style). My

son thought that it might be possible to get the DNA out of the preserved thylacine, but he wondered where they would get the mother thylacine to put it in. As Jack Cohen & Ian Stewart (1994) point out, the belief that fossil DNA could be used to reconstruct a dinosaur (or, in this case, that embalmed DNA could be used to reconstruct a thylacine), is predicated on the view of DNA as ‘a genetic message transmitted from parent to offspring, a list of instructions like a glorified knitting pattern’ (p. 288). However, ‘the DNA message is not transmitted, but copied—subject to the complications of sexual reproduction—and the process whereby DNA code is turned into offspring also involves a parent’ (p. 290). Thus, dinosaur DNA ‘prescribes a dinosaur, within the context of another dinosaur’ (p. 307). If the meaning of DNA is, like any other message, dependent on context, then hopes for ‘unleashing the thylacine’ must presently be regarded as extremely slim.

I must emphasize here that I have no interest in arguing that Archer and Westerman are ‘wrong’ in any sense of the word, but I believe that as a science educator I should be able to deconstruct (that is, lay bare their construction of) the *Jurassic Park*-style spin they put on finding the preserved thylacine, and that I should be able to facilitate learners’ capacities to do likewise. Elucidating a less partial and less simplistic understanding of what scientists currently claim to ‘know’ about the functions and effects of DNA in reproductive and developmental biology is only one aspect of such a deconstructive analysis. I am ambivalent about using books like DeSalle & Lindley’s (1997) as a resource for such a purpose, especially with children, because I do not want to undermine any child’s belief in the *possibility* of restoring thylacines and dinosaurs to the world. In any case, I deplore the approach to using movies like *Jurassic Park* exemplified by Dubeck, Moshier & Boss (1988) in *Science in Cinema: Teaching Science Fact through Science Fiction*, a book that is devoted to exposing scientific ‘misconceptions’ and ‘pseudoscience’ (p. x) in more than thirty science fiction movies. Their approach devalues the educative potential of SF by suggesting that it is deficient unless it illustrates the ‘one true story’ of modern science ‘correctly,’ and also occludes the possibility of reading the films as critical and creative probes of issues in science, technology and society that their makers and consumers consider to be problematic.

‘Unleashing the thylacine’ is the type of topical news story that students might reasonably be expected to use in both developing and demonstrating their ‘scientific literacy.’ For example, Australia’s national curriculum profile for Science includes a number of outcome statements at all levels of schooling that are concerned with evaluating the findings of scientific investigations, using science, and acting responsibly (see Australian Education Council, 1994). Table 1 displays a selection of these outcomes, together with examples of relevant issues that I suggest could be raised by the article.

TABLE 1: Selected outcome statements from Science curriculum profile for Australian schools and related issues raised by ‘Unleashing the thylacine’

Year levels	Selected outcome statement	Examples of issues related to ‘Unleashing the thylacine’
3/4	Identifies ways science is used responsibly in the community.	Is trying to bring a thylacine—or a dinosaur—back to life a responsible use of science? What would you consider to be an irresponsible use of science?

5/6	Identifies the information needed to make decisions about an application of science	What further information would help you to decide whether cloning and DNA technologies should be used to bring an extinct species back to life? Should thylacines be cloned?
7/8	Identifies factors that influence people's perceptions of science	How do news items like this one (and movies like <i>Jurassic Park</i> ) influence your and other people's perceptions of science?
9/10	Analyses costs and benefits of alternative scientific choices about a community problem	What are some of the costs and benefits of using cloning and DNA technologies to bring extinct species back to life compared with other possible uses of these technologies (such as conserving presently endangered species)?
9/10	Analyses the influence certain scientists have had on the ways we think about the world	What influence have the following scientists had (or might they potentially have) on the ways you and others think about the uses of DNA technologies: James Watson, Evelyn Fox Keller, Mike Archer, Ian Malcolm ( <i>Jurassic Park's</i> 'chaotician')?
9/10	Analyses the interactions between scientific developments and the beliefs and values of society	What social beliefs and values appear to be influenced by developments in biotechnology such as cloning and DNA sequencing?

I constructed Table 1 principally to demonstrate that the prospect of cloning the Australian Museum's thylacine pup could function as both a plausible and defensible focus for teaching and learning activities in school science education at several year levels. However, I chose 'Unleashing the thylacine' as a focus for this essay because it is a ready-made interface with an imaginative 'zone' that cannot be reduced to the terms in which curriculum statements and conventional school science textbooks are framed. Although I am wary of essentializing or caricaturing my colleagues, I know that many science educators are likely to be tempted to categorize, and draw boundaries between, the 'scientific,' 'science fictional,' and 'socially realist' elements of this story—I found myself doing precisely that on first reading—but I will argue here that we should reject this 'optical illusion' and deliberately cultivate the pleasures of their coexistence, including the diffractions produced by their juxtapositions.

Put crudely, the temptation for many science teachers is to encourage learners to 'mine' articles like 'Unleashing the thylacine' for their 'science fact' content—to proceed in the direction suggested by the title of Dubeck et al's. (1988) book, cited above, of 'teaching science fact through science fiction' and leave the zone of blurred boundaries behind them. When I brainstormed ideas for classroom activities that might be used to follow up this news story with my first year teacher education students, one of their most common suggestions was to 'check out the Australian Museum's website' (some saw this as an activity for students, whereas others saw it as an aspect of teacher preparation). The Australian Museum's thylacine web pages are indeed a very useful resource for pursuing the types of outcomes and activities listed in Table 1, but they are very explicitly located in the unambiguous space of 'science fact' and cautious speculation. There are no references to *Jurassic Park*, no references to people owning Tasmanian tigers as pets within 50 years, and no open invitations to other biotechnology researchers to help themselves to the Museum's thylacine DNA.

One part of the site provides a brief natural history of the thylacine, its recent extinction, and its interrelationships with Tasmania's indigenous peoples. Another set of pages deals with fossil evidence of the thylacine and reports and rumors of recent sightings. A third series of pages presents 'The cloning debate.' The first of these pages, 'Could the thylacine be cloned?'<sup>4</sup>, provides information about 'three things that could be done in the foreseeable future with the thylacine genetic material' in much less optimistic terms than the Museum director's speculations. One of these options involves extracting the DNA in short pieces and putting it into bacteria to 'make a genetic library.' The DNA sequence 'could be determined by techniques in current use,' but 'it would be very difficult to put the various pieces in the correct order.' This is the only one of the three options that 'can be done now,' but this 'is most unlikely ever to lead to anything remotely resembling a thylacine except in conjunction with the other approaches.' The other two approaches 'cannot be done yet' and 'to be possible would require a lot more knowledge... and an investment in research into other species that would cost a great deal of money.' In contrast to the director's generosity, this page asserts that should these new approaches be developed, they should 'be proven on non-valuable specimens before using the Australian Museum pup.' Rather than any researcher being 'told instantly' to 'help yourself,' the page that deals with the question, 'Should the thylacine be cloned?'<sup>5</sup> asserts that 'thylacine specimens are so valuable that work should not be commenced without extensive consultation with both internal and external scientists and collection managers' and, further, suggests that 'it could be argued... that the Museum's pup is so valuable as an object that it should not be damaged even to revive a species.' The last page of the Museum's thylacine site invites visitors to cast their vote on the issue of whether or not the thylacine should be cloned<sup>6</sup>.

It would be all too easy for teachers and students to restrict their examination of the plausibility and defensibility of cloning the thylacine to the types of 'factual' information that can be obtained via the Australian Museum's website. But to do so would also make it far too easy to ignore many of the social implications of current trends in biotechnology that the 'Unleashing the thylacine' article invites us to consider. To analyze 'the interactions between scientific developments and the beliefs and values of society' (see Table 1) demands that we also examine what Hayles (1990) calls 'the assumptions that guide the constitution of knowledge in a given episteme' (p. xi). The juxtaposition of science, SF, and social reality that turns the prospect of resurrecting thylacines from extinction into front page news is 'culturally conditioned, partaking of and rooted in assumptions that can be found at multiple sites throughout the culture' (Hayles, 1990, p. xi). For example, Hayles demonstrates that 'different disciplines, sufficiently distant from one another so that direct influence seems unlikely,... nevertheless focus on similar kinds of problems [at] about the same time and base their formulations on isomorphic assumptions' (p. xi). The operation of such isomorphic assumptions is implicit in Cohen & Stewart's (1994) assertion that 'our current obsession with information technology and messages as bit strings has led us to focus almost exclusively on DNA as software and to ignore the contextual hardware in which it produces actions' (p. 290). However, evidence for the existence of a cultural isomorphism between information understood as bits and bytes and DNA understood as software is not obvious when issues such as cloning a thylacine are presented in the careful languages of textbook science and the Australian Museum's website. But that evidence is clearly signposted in stories such as 'Unleashing the thylacine' where the extravagant claims of a media-savvy scientist pursuing his

<sup>4</sup> See <http://www.austmus.gov.au/thylacine/09.htm>

<sup>5</sup> See 'The cloning debate: should the thylacine be cloned?' at <http://www.austmus.gov.au/thylacine/12.htm>

<sup>6</sup> See 'The cloning debate: have your vote here!' at <http://www.austmus.gov.au/thylacine/vote.cfm>

enlightened self-interests are juxtaposed with *Jurassic Park*. Neither Archer nor the journalist need to justify or explain the connection between extinct thylacine DNA and having a Tasmanian tiger ‘pop back into life’ because, like the majority of the newspaper’s readers, they tacitly acknowledge the cultural currency of *Jurassic Park*’s central fiction. Mention dinosaurs and DNA in the same breath and many of us will mentally replay the scene where the cartoon-animated ‘Mr DNA’ explains: ‘a DNA strand, like me, is the blueprint for building a living thing, and sometimes animals that went extinct millions of years ago, like dinosaurs, left their blueprints behind for us to find. We just had to know where to look!’

I would not want students simply to compare Archer’s exaggerations with the more restrained approach taken on the Museum’s website and dismiss them as scientifically naïve or opportunistic attention-seeking. Archer’s eminently quotable media bites are part of a smart sales pitch, exploiting the potential ‘domestication’ of the research he promotes (‘people could own Tasmanian tigers as pets within 50 years’), and invoking a ‘moral imperative’ (‘For Australians to turn their backs on this opportunity would be “immoral”’) with evangelical zeal (‘It’s not God’s will that the thylacine went extinct’). Inviting students to consider the relationship between public interest and financial support for scientific research is an important aspect of analyzing ‘the interactions between scientific developments and the beliefs and values of society,’ but these are rarely dealt with in the idealized (and frequently heroic) accounts of scientific achievement recounted in textbooks.

I would also invite students to consider the wider ramifications of the biological determinism that is projected by the contiguity of Archer’s assertions and the *Jurassic Park*-style message of DNA as the blueprint for life. I am reasonably confident that Archer would, if asked, explicitly reject an absolute genetic determinism—just like the scientists who speak and write about the Human Genome Project (which is mentioned as a significant resource in connection with one of the ‘things that can be done’ with thylacine DNA on the Australian Museum’s website). But, as R.C. Lewontin (1994) concludes, these scientists ‘seem to be writing more to acknowledge theoretical possibilities than they are writing out of conviction’ (p. 110). While mapping the human genome seems likely to be very useful in the diagnosis and treatment of illnesses with a unitary genetic cause, such as Huntington’s chorea and cystic fibrosis, many scientists seem to expect much more of the project. For example, the molecular biologist Christopher Wills (1991) writes that ‘the outstanding problems in human biology... will *all* be illuminated’ (p. 2, my emphasis) by the Human Genome Project. Similarly, Cohen & Stewart (1994) quote from the program of the British Institute of Biology’s 1993 symposium on Recent Advances in Human Genetics the assertion that mapping the human genome will provide ‘the prime reference material for *all* biological and medical science’ (p. 463; emphasis in source). Cohen & Stewart (1994) comment: ‘Biologists will tell you that they don’t say such naive things. They do’ (p. 463).

However, I suspect that such exaggerations are more a matter of cultural conditioning than individual naïveté. Lewontin (1994) summarizes some of the conditions under which the Human Genome Project promotes a deterministic ideology:

The study of DNA is an industry with high visibility, a claim on the public purse, the legitimacy of a science, and the appeal that it will alleviate individual and social suffering. So its basic ontological claim, of the dominance of the Master Molecule over the body physical and the body politic, becomes part of the general consciousness. (p. 120)

Evelyn Fox Keller (1992) traces the circulation of this consciousness through the social milieu of the state, the universities, biotechnology corporations, and the media, producing an unquestioned consensus that ‘the model of cystic fibrosis is a model of the world’ (p. 290). In a disturbing example of how a medical model that begins with a genetic explanation for cystic fibrosis is transformed into an explanation of all social and individual variation, Keller (1992) quotes Daniel Koshland, then editor of *Science*, who was asked why the Human Genome Project funds should not be given instead to the homeless; he replied: ‘What these people don’t realize is that the homeless are impaired... Indeed, no group will benefit more from the application of human genetics’ (p. 282).

The parallel point I want to make here is that analyzing ‘the interactions between scientific developments and the beliefs and values of society’ in the context of ‘Unleashing the thylacine’ would entail encouraging students to consider how the allure of a *Jurassic Park*-style resurrection of the thylacine becomes not only irresistible to geneticists but also becomes part of a more general social consciousness. This means keeping students’ attention focused on the cultural traces of such a consciousness and the diffractions that their juxtapositions with ‘scientific developments’ produce. For example, on the day following the publication of ‘Unleashing the thylacine,’ a cartoon by Michael Leunig on the editorial page of *The Age* (14 May 1999) whimsically alluded to other cultural images of the thylacine, such as their use in labeling and marketing a well-known brand of Tasmanian beer.

More significantly, one week later, a very prominently located, half-page feature article by Martin Flanagan (1999b), again in *The Age*, captured some of the social history of the thylacine since the European settlement of Tasmania. Titled ‘Tiger! Tiger! burning bright’ the article begins: ‘Officially, the only Tasmanian tigers in existence are those in photographs. But...the animal lives on, burning into the collective consciousness a sense of irrecoverable loss, dread of an alien past and now, fantastically, hope of a comeback’ (p. 13). Flanagan notes that in addition to names such as tiger, hyena, dingo, native wolf, marsupial wolf, zebra wolf and zebra opossum, in one location ‘the females of the species were called sluts’ (at a time when ‘Aboriginal people were called crows’). He quotes a newspaper report from early this century that depicts the tiger as ‘Too Stupid to Tame,’ and the circumstances that led to a bounty being placed on the thylacine’s head in 1888 which resulted in it being hunted to extinction. Flanagan’s story concludes:

It is now being suggested that science may be able to bring [the thylacine] back. Maybe, maybe not. What I do know is that when people meet a creature that is alien and strange and give it fearful names that enable them to strike it from their consciousness, what they find, with the passage of time, is what the sailor who shot the albatross in Coleridge’s poem, *The Rhyne of the Ancient Mariner*, found. They have killed a part of themselves that they will henceforth seek in endless and fantastic ways. (p. 13)

When this article is juxtaposed with ‘Unleashing the thylacine’ we see another set of cultural imperatives being brought into play. Archer claims that ‘It’s not God’s will that the thylacine went extinct,’ and Flanagan brings on some literary heavyweights—William Blake and Samuel Coleridge—in solemn support. If, as Jonathon Porritt (1991) asserts, between 50 and 100 species of plants and animals become extinct each day, we might well ask what the thylacine did to get God, Blake and Coleridge on its side? I am reminded of a *Monty Python* parody of a well-known hymn that (from memory) began as follows:

All things dull and ugly  
 All creatures short and squat  
 All things rude and nasty  
 The Lord God made the lot

Would similar media attention have been given to the Australian Museum finding some perfectly preserved spores of the fabled *Melanoswartus glabrocapitus* if it was assumed to have been extinct for more than 60 years? If ‘Unleashing the blackhead fungus’ seems unlikely to be front-page news, we might well ask what this means for analyzing ‘the interactions between scientific developments and the beliefs and values of society.’

From where I stand, some of the most vivid diffractions of the thylacine story in the ‘zone’ of blurred boundaries are enabled by Julia Leigh’s (1999) novel, *The Hunter*, which at the time of writing had just been shortlisted for a major Australian literary award.<sup>7</sup> In Leigh’s story, a man known only as M is hired by a biotechnology company to find and kill what may be the last thylacine and to retrieve its genetic material for the company’s exclusive use. After several weeks alone in the Tasmanian wilderness, M wonders about the company’s insistence on his mission being a one-man job when two might have been more efficient, and considers the possibility that he is being set-up for failure. M’s thoughts, as Leigh (1999) imagines them, capture the motives behind the company’s ruthlessness:

Why one, why me? Was it possible the company no longer considered retrieval of genetic material a high priority?... He couldn’t see why—what he had retrieved so far had earned them, how much? Hundreds of millions, probably billions. The company needed him, in fact, was indebted to him. Who was of more value to a biotech company than a hunter: sampler and ensurer of exclusivity. Inbred thylacine, dodo, moa, mammoth, bunyip, yeti, girls with telekinetic powers, boys with an immunity to pain, the goose that laid the golden egg... mutations all, this was now the stuff that dreams—and wars—were made of. (p. 50)

Passages like this are powerful reminders that any analysis of ‘the interactions between scientific developments and the beliefs and values of society’ falls short if it rests with sociological abstractions and generalizations. Science and society are connected through embodied knowledges and expressed in stories that capture the particularities of existence, from fairy tales to *The X-Files*.

As a science educator, the questions that ‘Unleashing the thylacine’ raise for me do not really concern the plausibility or probability of the kind of genetic engineering imagined in *Jurassic Park* or the sinister operations of biotechnology corporations dramatized in *The Hunter*. Rather, the questions I would prefer to explore with learners are concerned with identifying the present circumstances and conditions—including any theoretic and technical knowledges that may be relevant and available—that make the events portrayed in these stories even *thinkable*. Who presently has power over and control of these circumstances, conditions, knowledges and technologies? How is this power exercised? What safeguards exist against irresponsible uses of this power? What does it mean to be ‘responsible’ or ‘irresponsible’ in the circumstances and conditions made possible by these new knowledges and technologies?

---

<sup>7</sup> Flanagan (1999a) notes that there are two more thylacine novels on the horizon, and that a recent article on the international biotechnology industry in *The London Review of Books* was illustrated with a photograph of a thylacine fetus.

Teaching science in ‘the (*Crash*) zone’—or *The Twilight Zone* if you prefer a less confronting metaphor—means enacting a pedagogy in which the truth claims of scientists are constantly rubbed up against the fictions that embody the relations of these claims with other cultural narratives that enrich and/or trouble their meanings. Relevant fictions are often suggested by science journalists, as in the suggestion that cloning a thylacine involves a *Jurassic Park*-style resurrection, but we should also be alert to other possibilities. With younger children, as the above quote from *The Hunter* suggests, we could equally well diffract ‘Unleashing the thylacine’ with the story of Jack and the Beanstalk.

## References

- Asimov, Isaac. (1964 [1952]). *The Second Foundation*. New York: Avon.
- Australian Education Council. (1994). *Science: A Curriculum Profile for Australian Schools*. Carlton, Victoria: Curriculum Corporation.
- Ballard, J.G. (1984 [1964]). Mythmaker of the 20th century. *Re/Search* (8/9), 105-107.
- Ballard, J.G. (1985 [1973]). *Crash*. London: Paladin.
- Ballard, J.G. (1985 [1974]). Introduction to the French edition of *Crash, Crash* (pp. 5-9). London: Paladin.
- Baudrillard, Jean. (1987). The year 2000 has already happened. In Arthur Kroker & Marilouise Kroker (Eds.), *Body Invaders: Panic Sex in America* (pp. 35-44). New York: St. Martin’s Press.
- Baudrillard, Jean. (1991). Ballard’s *Crash*. *Science-Fiction Studies*, 18 (3), 313-320.
- Boomer, Garth. (1982). Ten strategies for good teaching. In Garth Boomer (Ed.), *Negotiating the Curriculum* (pp. 119-121). Gosford, NSW: Ashton Scholastic.
- Boyd, William. (1991). *Brazzaville Beach*. New York: William Morrow.
- Bukatman, Scott. (1993). *Terminal Identity: The Virtual Subject in Postmodern Science Fiction*. Durham & London: Duke University Press.
- Burroughs, William S. (1964). *Nova Express*. New York: Grove Press.
- Burroughs, William S. (1966 [1961]). *The Soft Machine*. (Revised ed.). New York: Grove Press.
- Burroughs, William S. (1967 [1962]). *The Ticket That Exploded*. (Revised ed.). New York: Grove Press.
- Cohen, Jack, & Stewart, Ian. (1994). *The Collapse of Chaos: Discovering Simplicity in a Complex World*. New York: Viking Penguin.
- Cooper, Andrew. (1998). *Playing in the Zone: Exploring the Spiritual Dimensions Sports*. Boston: Shambhala.
- Csicsery-Ronay, Istvan. (1991a). Editorial introduction: Postmodernism’s SF/SF’s postmodernism. *Science-Fiction Studies*, 18 (3), 305-308.
- Csicsery-Ronay, Istvan. (1991b). The SF of theory: Baudrillard and Haraway. *Science-Fiction Studies*, 18 (3), 387-404.
- Delany, Samuel R. (1988). Is cyberpunk a good thing or a bad thing? *Mississippi Review* (47/48), 28-35.
- DeSalle, Rob, & Lindley, David. (1997). *The Science of Jurassic Park and the Lost World or, How to Build a Dinosaur*. London: HarperCollins.
- Dubeck, Leroy W., Moshier, Suzanne E., & Boss, Judith E. (1988). *Science in Cinema: Teaching Science Fact through Science Fiction Films*. New York: Teachers College Press.



- Fairclough, Norman. (1992). *Discourse and Social Change*. Cambridge, Massachusetts: Polity Press.
- Flanagan, Martin. (1999a, 14 August). The hunt for Tasmania. *The Age Saturday Extra*, p. 4.
- Flanagan, Martin. (1999b, 20 May). Tiger! Tiger! burning bright. *The Age*, p. 1.
- Foucault, Michel. (1970 [1966]). *The Order of Things: An Archaeology of the Human Sciences* (Alan Sheridan-Smith, Trans.). London: Tavistock Publications.
- Geduld, Harry M. (1987). *The Definitive Time Machine: A Critical Edition of H.G. Wells's Scientific Romance*. Bloomington: Indiana University Press.
- Gibson, William. (1984). *Neuromancer*. New York: Ace.
- Gough, Noel. (1991). An accidental astronaut: learning with science fiction. In George Willis & William H. Schubert (Eds.), *Reflections from the Heart of Educational Inquiry: Understanding Curriculum and Teaching through the Arts* (pp. 312-320). Albany NY: State University of New York Press.
- Gough, Noel. (1993a). Environmental education, narrative complexity and postmodern science/fiction. *International Journal of Science Education*, 15 (5), 607-625.
- Gough, Noel. (1993b). *Laboratories in Fiction: Science Education and Popular Media*. Geelong: Deakin University Press.
- Gough, Noel. (1998a). 'If this were played upon a stage': school laboratory work as a theatre of representation. In Jerry Wellington (Ed.), *Practical Work in School Science: Which Way Now?* (pp. 69-89). London: Routledge.
- Gough, Noel. (1998b). Reflections and diffractions: functions of fiction in curriculum inquiry. In William F. Pinar (Ed.), *Curriculum: Toward New Identities* (pp. 94-127). New York: Garland.
- Gough, Noel. (1999a). The lost worlds of *The Crash Zone*, The Australian Children's Television Foundation. <http://www.actf.com.au>
- Gough, Noel. (1999b). Where in the world is... cyberspace? The Australian Children's Television Foundation. <http://www.actf.com.au>
- Haraway, Donna J. (1985). A manifesto for cyborgs: science, technology and socialist feminism in the 1980s. *Socialist Review*, 15 (2), 65-107.
- Haraway, Donna J. (1989). *Primate Visions: Gender, Race, and Nature in the World of Modern Science*. New York: Routledge.
- Haraway, Donna J. (1991). *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge.
- Haraway, Donna J. (1994). A game of cat's cradle: science studies, feminist theory, cultural studies. *Configurations: A Journal of Literature, Science, and Technology*, 2 (1), 59-71.
- Haraway, Donna J. (1997). *Modest\_Witness@Second\_Millennium.FemaleMan©\_Meets\_OncoMouse™: Feminism and Technoscience*. New York and London: Routledge.
- Hayles, N. Katherine. (1984). *The Cosmic Web: Scientific Field Models and Literary Strategies in the Twentieth Century*. Ithaca NY: Cornell University Press.
- Hayles, N. Katherine. (1990). *Chaos Bound: Orderly Disorder in Contemporary Literature and Science*. Ithaca NY: Cornell University Press.
- Høeg, Peter. (1996). *The Woman and the Ape* (Barbara Haveland, Trans.). London: The Harvill Press.
- Keller, Evelyn Fox. (1992). Nature, nurture, and the Human Genome Project. In Daniel J. Kevles & Leroy Hood (Eds.), *The Code of Codes: Scientific and Social Issues in the Human Genome Project* (pp. 281-299). Cambridge, Massachusetts: Harvard University Press.

- Latour, Bruno. (1988). *The Pasteurization of France* (Alan Sheridan & John Law, Trans.). Cambridge, Massachusetts: Harvard University Press.
- Latour, Bruno. (1993). *We Have Never Been Modern* (Catherine Porter, Trans.). Cambridge, Massachusetts: Harvard University Press.
- Le Guin, Ursula K. (1996). Ether, OR, *Unlocking the Air and Other Stories* (pp. 95-123). New York: HarperCollins.
- Leigh, Julia. (1999). *The Hunter*. Ringwood, Victoria: Penguin.
- Lessing, Doris. (1980). *The Marriages Between Zones Three, Four and Five*. London: Jonathan Cape.
- Lewontin, R.C. (1994). The dream of the human genome. In Gretchen Bender & Timothy Druckrey (Eds.), *Culture on the Brink: Ideologies of Technology* (pp. 106-127). Seattle: Bay Press.
- McHale, Brian. (1987). *Postmodernist Fiction*. New York and London: Methuen.
- McHale, Brian. (1992). *Constructing Postmodernism*. London and New York: Routledge.
- McLuhan, Marshall. (1960). Classroom without walls. In Edmund Carpenter & Marshall McLuhan (Eds.), *Explorations in Communication* (pp. 1-3). Boston: Beacon Press.
- McLuhan, Marshall, & Fiore, Quentin. (1967). *The Medium is the Massage*. New York: Bantam Books.
- Murphy, Michael, & White, Rhea A. (1995). *In the Zone: Transcendent Experience in Sports*. New York: Penguin.
- Nunan, E. E., & Homer, David. (1981). Science, science fiction, and a radical science education. *Science-Fiction Studies* (8), 311-330.
- Piercy, Marge. (1992). *He, She and It*. New York: Alfred A. Knopf.
- Porritt, Jonathon. (1991). *Save the Earth*. North Ryde, NSW: Angus & Robertson.
- Pynchon, Thomas. (1973). *Gravity's Rainbow*. New York: Viking.
- Quinn, Daniel. (1992). *Ishmael*. New York: Bantam Books.
- Stephenson, Neal. (1992). *Snow Crash*. New York: Bantam Books.
- Strugatsky, Arkady, & Strugatsky, Boris. (1978). *Roadside Picnic* (Antonina W. Bouis, Trans.). London: Victor Gollancz.
- Varley, John. (1978). *The Persistence of Vision*. New York: Dell.
- Wells, H.G. (1895). *The Time Machine*. London: Heinemann.
- Wells, H.G. (1934). *Seven Famous Novels*. New York: Knopf.
- Wills, Christopher. (1991). *Exons, Introns, and Talking Genes: The Science Behind the Human Genome Project*. New York: Basic Books.
- Woodford, James. (1999, 13 May). Unleashing the thylacine. *The Age*, p. 1.