Tinkering with nature: discourses of 'nature' in media coverage of genetics and biotechnology

Anders Hansen*

Abstract

Concepts of nature and the 'natural' order of things form a central anchor in public understanding, public debate and controversy about developments in genetic research and in human, animal and plant biotechnology. 'Nature', as Raymond Williams observed, 'is perhaps the most complex word in the language' and it is precisely from this complexity that its discursive and ideological power is derived. While it is widely accepted that 'nature' is a social construct, it is perhaps the chief appearance of not being so, that makes it such a powerful ideological anchor: 'nature' in discourse is used to appeal to what is ontological, God-given, the proper order of things, untainted by man, primordial.

This article examines the centrality of concepts of nature in public arena controversies about advances in genetic research and biotechnology. The aim is to show how nature is used or invoked to legitimate particular positions in public debate about genetic research and applications. The article explores the uses of nature in British newspaper coverage of genetics and biotechnology, and it examines changes between 1986/87 and 2002/2003.

Keywords: discourse; nature; genetics; biotechnology; media

1. Introduction

The rapid advances in genetics and biotechnology over the last forty years or so have brought with them, indeed necessitated, a new public vocabulary and discourse for understanding and appropriating these developments, and for articulating public controversy, fears and hopes. Like all 'new discourses' the public discourse on genetics and biotechnology draws on and inflects images, terms, vocabularies and discourses from readily available cultural reservoirs. This can be seen partly as a simple matter of comprehension, of finding metaphors/images that will facilitate public under-

* Centre for Mass Communication Research, University of Leicester, United Kingdom. E-mail: ash@leicester.ac.uk

standing, a simple 'metaphoric' process of taking meanings which are familiar and applying them to the new, which is unfamiliar and not understood. Indeed, much of the literature on the 'public understanding of science' has focused on the communication of bio-science as a matter principally of comprehension, clarity, and understanding.

But the public communication of biotechnology and genetics is clearly much more than a simple question of explanation and understanding. New developments in genetic research and biotechnology are controversial, and the language used in public representation is thus as much about the ideological – rhetorically competitive – management of competing discourses, as it is about comprehension.

The kind of key images/metaphors chosen to represent developments in genetics are thus, to use Gunther Kress's (1997) term, anything but arbitrary (in the Saussurean sense): they are 'motivated'. That is, they are deliberately chosen with a view to convey not only as much 'understanding' as possible, but with a view to framing what are often contentious and controversial issues in such a way as to promote and strengthen particular arguments and discourses. Media and public debate about genetics and biotechnology over the last forty years offers a perhaps particularly rich quarry for studying the relationship between key protagonists in the debate and attempts at influencing and governing the vocabulary and discourse. One of the particularly interesting historical points about the communication and popularisation of genetic engineering is the way in which key stakeholders in the debate have been conscious from the outset of the importance of controlling or influencing public communication and debate about these developments.

Thus, several studies have dwelt on the – partially successful – attempt by scientists, around the time of the Asilomar Conference in the 1970s, to manage relations with the news-media in an attempt to control public debate and to curb public anxiety about genetic manipulation, gene-splicing, recombinant DNA research or cloning (Goodell, 1986; Nelkin, 1995). Likewise, Jose van Dijck (1998), in her comprehensive analysis of public discourses on genetics, shows how key scientists, including co-discoverer of the Double Helix, Dr James Watson, have contributed to the discursive shaping and management of public images and understandings regarding the new genetics.

What I wish to explore in this article is the role of 'nature' in public or media debate about genetics and biotechnology. How is 'nature' used as an 'anchor', a reference appealed to for justification of particular positions or arguments in public controversy?

I start with a brief discussion of Raymond Williams's insightful analysis of 'nature'. His analysis is itself almost as old as the major public debates on biotechnology, but, characteristically for Williams, it is still one of the clearest and most incisive analyses available. This is followed by a review of what some of the many studies, which have tracked and mapped the evolution of public and media discourse on biotechnology, have found or argued specifically about constructions and uses of nature. Many studies have pointed to the prominence of 'nature' in public discourse and understanding, and this is hardly surprising or unexpected when considering the prominent strand –

in oral history, literature, film and other cultural 'products' – of historically deep-seated warnings against man's interference with nature generally, and with the basic constituents or building blocks of life more specifically.

I finish with an analysis of 'nature' in British newspaper coverage of genetics and biotechnology, seeking to trace both the changes between coverage of the 1980s and the present, and the major differences between popular and quality newspapers in their uses of nature in genetics reporting.

2. Nature, the natural and the new genetics

Synthesising analyses and discussions about nature in some of his earlier work (e. g., *The Country and the City*, 1973), Raymond Williams, in his *Keywords* essays, argues that 'Nature is perhaps the most complex word in the language' (Williams, 1983: 219) Williams identifies three central areas of meaning:

1. the essential quality and character *of* something;
2. the inherent force which directs either the world or human beings or both;
3. the material world itself, taken as including or not including human beings.

Williams points to the historically specific and changing uses and interpretations of 'nature', from the Enlightenment's emphasis on nature as a set of laws, something to be studied, understood, and controlled, to the Romantic movement's emphasis on nature as pure, pristine and original – 'contrasted with what had been made by man, or what man had made of himself' (1983: 223). Perhaps most significantly, Williams points to the binary tensions which are consistently at work in interpretations of nature: '(…) nature was at once innocent, unprovided, sure, unsure, fruitful, destructive, a pure force and tainted and cursed' (1983: 222).

Of particular relevance to an analysis of nature images in the new genetics debate of the late 20th Century, is Williams's point that '(…) one of the most powerful uses of nature, since the late 18th century, has been in this selective sense of goodness and innocence. Nature has meant 'the countryside', the 'unspoiled places', plants and creatures other than man.' (1983: 223).

It is the polysemy or semantic richness of 'nature', the ability of the word and the concept to accommodate a multitude of contradictory meanings (see also Soper, 1995), that makes it a powerful and flexible construct in virtually any public debate or controversy. The power of 'nature' as a rhetorical device or a frame for investing partisan arguments and interests with moral or universal authority and legitimacy. Uses or constructions of 'nature' are inevitably and invariably 'ideological' in the sense that they serve ultimately the purpose, as all public discourse, of presenting particular views, understandings, and interests as being 'for the common good', 'universal', and 'right'. Appeals to nature or to natural qualities are, as Cronon (1995) reminds us powerful because they invoke genuine, eternal and non-negotiable qualities, and of these, it is perhaps the 'non-negotiable' that is the most important in terms of

exercising discursive or rhetorical power. Harvey similarly notes this power: 'The advantage in seeing values as residing in nature is that it provides an immediate sense of ontological security and permanence (Harvey 1996: 157).

While there has been little or no research on how nature or conceptions of the natural have informed public debate and representations relating to biotechnology and genetic research, a number of studies have examined the discourses on nature in advertising and in television documentaries.

Particularly illuminating is Glenda Wall's study of the changing ideas of science, nature and environment in the long-running Canadian documentary-series *The Nature of Things* from 1960 to 1994. Wall demonstrates how the dominant view in the 1960s was an economic view of nature as an exploitable source of resources and wealth, a domain to be studied and understood – and subsequently controlled and managed – by science. In the 1970s, the dominant view moved towards an increasing emphasis on nature 'as vulnerable and fragile, with parts of it being under attack as a result of technological growth (…) (p. 64) and toward an increasing appreciation of the complexity evident in nature. By the beginning of the 1990s, 'the idea that nature will respond with a vengeance to the abuses piled upon it' (p. 68) had become prominent.

Another important reference point is Williamson's (1978) exemplary analysis of the raw and cooked nature in advertising. Many of the constructions of nature, which Williamson and others (Budd, Craig & Steinman, 1999; Elbro, 1983; Hansen, 2002; Rutherford, 1994) have identified in advertising, seem equally relevant and applicable in public discourse on genetics:

• Nature as pure, 'Paradise on Earth', in the sense of being untouched, un-used, un-soiled, un-polluted, un-corrupted.

• Nature as vulnerable/threatened (in relation to genetics: 'threatened' by its binary opposite, Culture, in the form of science and man's tinkering).

• Nature as imperfect (here the binary opposite, culture, represented by science is positively valorized; bio-medical science in particular is cast as the heroic saviour battling to *improve* on the imperfections and 'cruelties' of nature, e.g. genetic deformity or genetically inherited diseases).

• Nature as good, balanced, harmonious (nature is valorized as good per se, perhaps precisely because it is perceived as untouched by the interference and corruption of man). This view does not necessarily imply a static permanence, but incorporates also an evolutionary view of nature as a self-balancing system, a force that is best left to its own devices, a system which will continuously 'sort itself out' ('Nature finds a way' as the hero figure, the mathematician/chaotician of the Michael Crichton/Steven Spielberg *Jurassic Park* film expresses it so well).

• Nature as threat: powerful and vengeful; a force not to tinkered with or messed about, if only for fear of the unpredictable or unknown vengeance which may be wreaked by nature on humankind (see also Wall, above).

• In the biotechnology discourse 'nature as good/balanced' often combines with 'nature as threatening/vengeful' to form what is conceivably the most powerful or prominent message about science and nature: namely nature as taking powerful and unpredictable vengeance if interfered with by science or man. Schelde has shown how this image has deep roots in folklore and is one of the most prominent images in Science Fiction (SF) film:

> 'If the folklore monsters of the past symbolized the powers of untamed nature, the monsters of SF epics symbolize the dangers inherent in trying to dominate nature. While being the primary tool in the human ascent to absolute power in the world, science may also ultimately be the tool of our destruction. Science is the monster. In its bosom hide the Godzillas, the Slime People, the Humanoid Fish on the evolutionary fast-track.' (Schelde, 1993: 58)

• Nature as challenge. Related to both 'nature as threat' and 'nature as imperfect', but nevertheless slightly distinct from these two. This construction of nature emphasizes the testing qualities of nature, and serves by extension to test and demonstrate the ingenuity and scientific prowess of mankind in general and of scientists in particular.

Drawing on Spencer Weart's (1988) excellent history of nuclear images, Turney (1998), in his 'cultural history of genetics images', notes that there are many parallels between central public fears and images in relation to nuclear science and genetics. A core fear in relation to both is the deep-seated public fear of how these sciences interfere with 'nature' or with the natural order in ways, which are both unpredictable and potentially highly devastating. Weart argues that public narratives of the mid-20th Century about nuclear bombs polluting fish, causing birth defects, or influencing the weather system all amounted to saying that nuclear energy 'violated the order of nature' (see Weart, 1988, pp 187-188). He offers the important observation that:

> 'This idea was bound up with one of the strongest of primitive themes: contamination. In most human cultures the violation of nature, and forbidden acts or things in general, have been directly identified with contamination. According to the anthropology theorist Mary Douglas, whatever is 'out of place', whatever goes against the supposed natural order, is called polluting.' (Weart, 1988: 188)

Several of the key constructions of nature listed above invoke the same sense as that identified by Weart in relation to nuclear technology, namely the notion that genetic manipulation amounts to a contaminating and polluting interference with nature, which is 'wrong' and has unpredictable outcomes. This theme, of course, is one of the core 'scare-images' with a long history in literature and film, from Mary Shelley's *Frankenstein* and H. G. Well's *The Island of Dr Moreau,* to film versions of both of these as well as countless other horror and science-fiction films. Witness for example the by now almost

iconic status of horribly deformed foetuses and clones in science fiction films such as the fourth film in the *Alien* quartet, *Alien: Resurrection* (1995). Weart again draws the important link here with culturally deep-seated ideas about contamination:

> 'Most important was the fact that radiation could cause genetic defects. This fact resonated with certain old and widespread ideas about contamination. Traditionally, defective babies were a punishment for pollution in the broadest sense, violations such as eating forbidden food, looking at something that should not be seen, or breaking a sexual taboo.' (Weart, 1988: 189)

> 'On occasion the ideas were openly invoked. As early as 1950, liberal newspaper and radio commentators had exclaimed that hydrogen bombs, wrongfully exploiting the 'inner secrets' of creation, would be 'a menace to the order of nature'. On receiving news of the BRAVO test, the conservative publisher William Randolph Hearst told millions of readers that such explosions 'could cause dangerous changes in the orderly processes of natural law'. Even Pope Pius XII, in Easter Sunday messages heard over the radio by hundreds of millions on every continent, warned that bomb tests brought 'pollution' of the mysterious processes of nature.' (Weart, 1988: 190)

Metaphors play a central role, as many analysts have noted (e.g. Martins and Ogborn, 1997; Condit et al, 2002b; Nordgren, 2003; Nelkin and Lindee, 1995; Van Dijck, 1998), in the development of the biotechnology debate. This is important also to an understanding of the particular images invoked with regard to nature and the naturalness or otherwise of genetic research and intervention. Many have noted the key role of biblical/religious language ('the holy grail', playing God), of the language of quest and journeys of discovery ('the holy grail', journey, discovery, Columbus), of library/literary metaphors ('alphabet', 'book of life'), of mapping metaphors, and later on, as it became clear that advances in computer technology held some of the keys to advancing genetic research, of the appropriation of computer language, reconfiguring the library/alphabet/book metaphors for the digital age in terms of 'code', 'code-breaking' and 'decipherment' (Van Dijck, 1998).

There have, however, been relatively few systematic attempts at showing the changes in vocabulary, metaphors or indeed the meaning and connotations associated with individual words in the genetics discourse over time. Bauer et al (1999) touch briefly on some interesting changes:

> 'In the early days, the term biotechnology itself was hardly used. Instead, the English-speaking world commonly referred either to 'genetic engineering' or – in more technical discourse – to 'recombinant DNA (rDNA) technology'. With time, however, what came to be perceived as the negative connotations of 'genetic engineering' led to the introduction of two new terms: first 'genetic manipu-

> lation', and then (as this term, too, came to be viewed with suspicion) 'genetic modification' (GM). Recently, in what may be a borrowing from the German-speaking world, there has been a noticeable increase in the use of the term 'gene technology' (Gentechnologie).' (Bauer et al, 1999: 217)

In one of the few systematic studies of such linguistic change, Condit et al (2002) carried out a longitudinal analysis of the changing meanings of the word 'mutation' in U.S. mass magazine articles about genetics published between 1919 and 1996. They concluded:

> '(…) that the term 'mutation' has become increasingly negative in its connotations through time. (…) Increases in the negative contextualization of 'mutation' were initially associated with reports of genetic damage to humans from nuclear radiation after 1956. Later increases in negative connotations appear to arise from more diffuse sources.' (Condit et al, 2002: 69)

The particular value of the study by Condit and her colleagues is the clear demonstration that meanings and connotations associated with key vocabulary terms in popular and media discourse on genetics change over time, leading in some cases, as Bauer et al (1999) argue, to a deliberate change in the terms used, and hence in the particular public framing of the issues concerned. These arguments help sensitize us to the idea that media and public discourse on genetics does of course not just arise naturally, as it were, but is ultimately the result of deliberate rhetorical and linguistic 'work' undertaken by the key stakeholders in the debate.

Perhaps the key rhetorical task for genetic research and science in the last forty to fifty years has been to separate and distinguish – in the public mind – the endeavours, achievements and goals of the New Genetics from the wholly negative historical legacy of images and connotations associated with eugenics.

3. Media, Publics and Genetics: discourses, frames and nature referencing

Research on media coverage and public debate about biotechnology and genetics has increasingly been gathering pace since the early 1990s. The number of studies published prior to the beginning of the 1990s, and dealing with coverage of the 1970s and 1980s, is relatively small and mainly American in both origin and focus (excellent analyses of the early stages of genetics/biotechnology media coverage include Pfund and Hofstadter, 1981; Goodfield, 1981; Altimore, 1982; Goodell, 1986; and Nelkin, 1987).

Reflecting increasing media attention as well as increasing public and political controversy about genetics and biotechnology since the early 1990s, a wealth of studies both in the UK and elsewhere, have studied the nature and evolution of public discourse on genetics (e.g. Van Dijck, 1998), of popular culture images of genetics (e.g., Nelkin and Lindee, 1995), the cultural history of genetics (Turney, 1998), and of genetics/biotechnology representations in the press, film and other media.

Numerous content-analysis-based studies have contributed valuable evidence by mapping the major media content trends, both in terms of the actual amount of media coverage and in terms of prominent themes, issues, and actors in biotechnology/genetics coverage. A smaller number of studies have offered a more detailed analysis of the key discourses which define media and public debate about genetics.

In their analysis of media coverage and public understanding of the Human Genome Project, Durant et al (1996) thus identified a key polarisation between a 'discourse of hope' and a 'discourse of fear'. The discourse of hope consisted of celebrating the promising advances made in human genetics research and holding out hope that many hereditary deceases would eventually be brought under control or cured outright. The discourse of fear, by contrast, drew on and articulated conventional and culturally deep-seated images of scientists 'out of control', 'mad scientists' abusing their knowledge, interfering with nature, tampering with God's creation, and creating Frankenstein monsters.

This dichotomy and polarisation, identified in coverage of the Human Genome Project, would appear, from longitudinal analyses of media coverage of biotechnology and genetics both in the UK and the US (Bauer, 2002; Bauer et al, 1999; Nisbet and Lewenstein, 2002), to have become particularly pronounced in media coverage from the latter half of the 1990s to the present.

Bauer (2002) points to two significant developments in the 1990s: One, a sharp increase in the amount of biotechnology coverage in the British newspapers from 1997 onwards, related directly to the cloning, by British scientists, of a sheep ('Dolly') in early 1997, and to increasing public controversy over GM crops and food; and Two, a significant change in the overall 'symbolic environment of biotechnology'. The change in symbolic environment, to which Bauer refers, is essentially a deepening polarisation or gap between 'desirable' biomedical research/applications and 'un-desirable' (by the British public and media) agri-food biotechnology in Britain.

Nisbet and Lewenstein (2002), in their comparable longitudinal study of American elite press coverage, summarise along similar lines:

> 'Biotechnology coverage has been typified by an overwhelming absence of reporting on controversy, with coverage of benefits greater than coverage of potential risks. There are two exceptions to this generalization. In the late 1970s, there were elevated levels of reporting of controversy and risks linked to the rDNA debate (though risks still did not outnumber mention of benefits). This aspect of coverage was even more prominent in the latter half of the 1990s as controversy emerged surrounding cloning and, to a lesser extent, gene therapy and agricultural biotechnology. It appears that during these periods of heightened political controversy, media negativity increases but not without also a proportional increase in positive coverage from the media (…).' (Nisbet and Lewenstein, 2002: 384).

Utilising the notion of framing in media coverage, and a typology of frames similar to that deployed by Gamson and Modigliani (1989) in their historical analysis of media coverage of nuclear technology, the studies by Bauer et al (1999), Nisbet and Lewenstein

(2002) and another American study by Ten Eyck and Williment (2003) have all looked at the relative prominence of different key frames in biotechnology coverage. Some of these frames, notably the frames identified as 'nature/nurture', as 'Pandora's box' and, to a lesser extent, the frame 'runaway technology', are of direct relevance to this article's concern with uses of nature in media representations of genetics.

While the studies generally show these frames to be much less prominent than the 'Progress' frame (celebrating the rapid advances, breakthroughs, and developments in genetic research and science) or the 'Economic Prospect' frame, Ten Eyck and Williment (2003) also show the 'Nature/Nurture' frame to be the third most prominent frame. Nisbet and Lewenstein's (2002) analysis shows that the two frames 'Pandora's Box' and 'Runaway technology/science' were prominent for a time in the 1970s, then had a very low profile during the 1980s and the first half of the 1990s, only to re-emerge strongly again in the latter half of the 1990s. Similarly significant, although Nisbet and Lewenstein surprisingly do not comment on this in their analysis, is the equally strong emergence of the 'Nature/Nurture' frame in the latter half of the 1990s.

While these analyses of the relative prominence of key frames over time in the press coverage of biotechnology do not address the more specific discursive articulation of the frames, or indeed allow direct comment on how 'nature and the natural' are defined and used in the discourse, they do indicate that such discourses form an important component of the coverage. Moreover, there seems to be an indication that the significance or prominence of nature discourses and closely related discourses become more pronounced in American coverage, but much less pronounced in British coverage (Bauer, Durant & Gaskell, 1999), towards the end of the 1990s and the beginning of the 2000s.

Where these studies provide a useful overview of changing general trends in media coverage of biotechnology, Petersen's (2001) discourse-analysis-based study of Australian newspaper coverage offers more detail on the discursive inflections of key frames in coverage of genetics and medicine. Petersen summarises his findings as follows:

> 'Gene stories were found to be prominent (…) and to emphasise the medical benefits of genetic research. (…) Many stories focus on new genetic discoveries, and portray genetic researchers as involved in a quest to unlock nature's secrets. Stories of hope, and depictions of geneticists as warriors or heroes, appear regularly. (…) Scientists made extensive use of the media in their efforts to maintain a positive image of research in the face of public concerns about scientists 'going too far', following the announcement of the cloning of Dolly. Boundaries were drawn between 'therapeutic cloning' – implicitly defined as 'good', useful, and legitimate – and 'reproductive cloning' – seen as 'bad', dangerous, and illegitimate.' (Petersen, 2001: 1255)

Petersen then identifies a generally positive portrayal of genetics and geneticists, although he also points out that there is an underlying trend of concern about 'tampering with nature' and particularly about the 'unintended and unforeseen consequences of genetic research' (p. 1265) expressed especially in reporting on cloning research. In line

with other studies of the language of genetics reporting, Petersen shows the heavy reliance in media coverage on a range of now well-established metaphors, some of which help stress the celebration of scientific endeavours and progress, as well as of heroic scientists, while others invoke cautionary tales about the dangers of genetic research, and particularly the dangers of 'tampering with nature'. Comparable to the polarisation discussed above between a 'discourse of hope and celebration' and a 'discourse of fear' (see Durant, Bauer and Hansen, 1996), Petersen identifies a polarisation 'between 'therapeutic cloning' – implicitly defined as 'good', useful, and legitimate – and 'reproductive cloning' – seen as 'bad', dangerous, and illegitimate'.

A number of studies have sought to identify how far these discourses, prominent in media coverage, extend to and are present in public discourse – whether professional, political or 'lay' discourse. Sutton (1999), in a discussion of environmental campaigning against GM food trials, points to what he terms the 'continuing salience of 'nature' as a major source and symbol of political protest'.

A particularly instructive discussion is Alison Shaw's (2002) analysis of public discourse on GM food in the UK. Of particular interest here is her identification of recurring phrases used by the public in focus-group discussions about genetic modification:

> 'Thus, a recurring theme in the lay people's accounts was genetic modification as inappropriate human intervention in nature. Close parallels were often drawn between BSE and GM food in relation to the question of how far scientists should 'interfere' with nature.
>
> (…) despite seeing the scientific value of genetic modification, the majority rejected GM foods as 'unnatural.' They expressed opposition to such scientific alteration of food, and scientists were frequently described as 'playing God.' Commonly recurring phrases were genetic modification as 'fiddling with,' 'tampering with' or 'messing around with' nature.' (Shaw, 2002: 280)
>
> 'Nature was seen as fundamentally good and human intervention in nature was seen as inherently bad. Furthermore, nature was personified by several interviewees, being portrayed as a powerful 'she' who has demonstrated through the BSE crisis that she will 'hit back' at inappropriate human intervention (…)' (Shaw, 2002: 281)

Interestingly, we then see in play in public discourse several of the key images and constructions of nature identified earlier by studies of advertising and television. Although it would be naïve to assume that such public discourse and images are drawn directly from the media in some kind of linear-effects-model fashion – naïve, if only for the reason that, as argued above, these images have deep cultural roots – it is also quite plausible that the media are a significant contributor to the circulation of these images in the public sphere.

4. Nature/The Natural in British Newspaper Coverage of Genetics and Biotechnology

The overall aim of this analysis was to investigate how 'nature' or what is regarded as 'natural' is used in newspaper coverage of biotechnology and genetics, and more specifically to identify 1) whether such uses have changed in the course of the rapid development in the genetics and biotechnology field during the last 15 years, and 2) whether there were any major differences between broadsheet and tabloid newspapers in this respect.

The *Lexis/Nexis Professional* database, which contains the full text of a large number of UK newspapers, was used for identifying relevant news coverage. The two quality/broadsheet newspapers, *The Guardian* and *The Times*, were chosen for the analysis of change over the period from January 1986 to December 2003. These particular two newspapers were selected because of availability and because they have traditionally represented different political stances and particularly different stances on controversial scientific and environmental issues. Two 2-year periods at either extreme of the overall period of analysis, 1986/1987 and 2002/2003, were selected for a more detailed comparison of the particular uses of nature.

Anticipating a generally quite different – and in the case of genetics and biotechnology, a possibly more alarmist and more populist type of reporting – three tabloid newspapers were also selected for analysis during the 2002/2003 period, but due to limitations in the retrospective availability of these, it was not possible to compare with their coverage of 1986/1987. The tabloids selected for analysis are *The Daily Mail*, *The Daily Mirror* and *The Sun*.

The aim was to identify all uses of or references to 'nature' or to what is 'natural' in news articles, which also mentioned one or more of the terms 'DNA', 'genet*', 'clon*' or 'biotech*' (where the asterisk indicates words derived from the listed word stems). The search allowed for the occurrence of words anywhere in the headline or text-body of each newspaper article.

All the articles satisfying this combination of search terms in *Lexis/Nexis Professional* were then downloaded in full and analysed with the help of the computer text analysis programme *Concordance* (Watt, 2002).

In order to get an idea of the relative prominence of 'nature' references in genetics coverage, it was also necessary to establish the total amount of genetics and genetics-related coverage. This was done by identifying the number of newspaper articles which contained one or more of the words 'DNA', 'genet*', 'clon*' or 'biotech*' (referred to in the graphs as 'all genetics').

Two findings stand out from this initial analysis:

1. The very considerable expansion in genetics coverage over the 18-year period from the beginning of 1986 to the end of 2003 is little short of astonishing: from fewer than 800 articles in the two broadsheet newspapers in 1986 to over 3500 articles in 2003, see figure 1. It is also interesting to note that the major and rapid increase in genetics coverage has taken place within the latter half of the period, i.e.

from 1996 onwards. In fact, the amount of coverage seems surprisingly 'low level' throughout the period from 1986 through 1995.

2. The sheer prominence of references to nature in genetics coverage. Thus, on average just under a quarter (24%) of all genetics coverage contains references to nature. This confirms, at least at a first level of analysis, the overall premise of this article, namely that reference to nature and assumptions about what is 'natural' form a central component of media and public discourse on developments in biomedical and genetics research and science. Although the relative prominence of 'nature' referencing remains above 20% throughout the period, the graph in figure 2 also indicates a general, albeit relatively small and gradual, decrease up to and including 2001, and then a resurgence in 2002/2003. Articles referencing nature were 25% of genetics coverage in 1986/87 compared with 23% in 2002/2003 in the two broadsheet newspapers (table 1). Nature referencing is much less prominent in the three tabloid newspapers, where articles referencing nature were only 11% (less than half as prominent as in the broadsheets) of their overall coverage of genetics in 2002/2003.

Figure 1 – All genetics articles and articles referencing 'nature
Guardian and *Times* 1986-2003

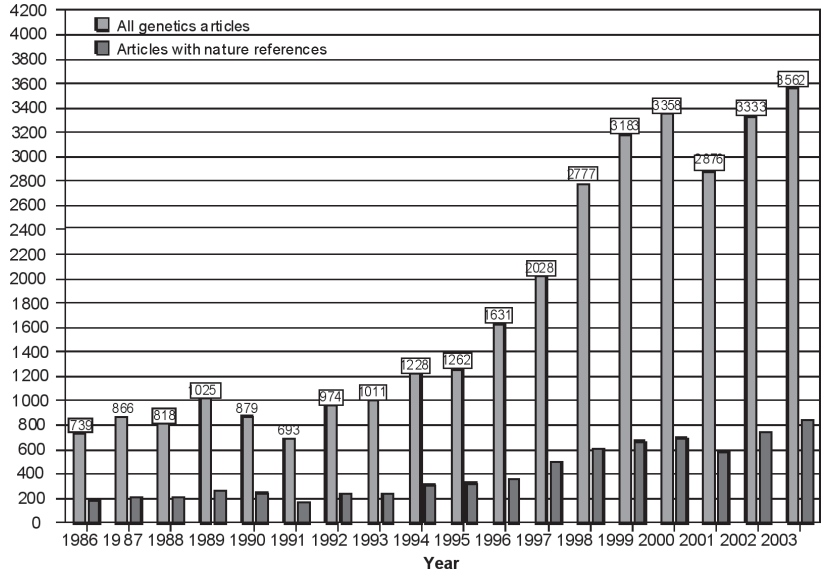

Table 1 – All genetics articles and 'natur*'-articles by period and newspaper groups.

	Guardian/Times 1986-87	*Guardian/Times* 2002-03	*Mail/Mirror/Sun* 2002-03
All genetics articles	1 605	6 895	6 757
Articles referencing natur*	399	1 588	716
'Natur*'-articles as % of all genetics articles	25%	23%	11%

An analysis of the words most closely associated with the keyword 'nature' (discourse analysts refer to this as 'collocation analysis', see for example Fairclough, 1989 and 1995, or Stubbs, 1996) is an efficient way to get an overview of how 'nature' is referred to or used in reporting on genetics, and it also offers a route into examining key vocabulary differences between the two types of newspaper and between the two periods analysed. Table 2 shows extracts from the collocation analyses in the form of the most frequently occurring words appearing immediately *before*, i.e. on the left of, the keyword 'nature'.

Table 2 – Partial collocation table showing the most frequently occurring words immediately to the left of 'nature'.

Guardian/Times 1986-87		*Guardian/Times* 2002-03		*Mail/Mirror/Sun* 2002-03	
The	46	The	118	The	40
In	29	In	98	Journal	31
Of	25	Of	84	With	25
Journal	11	Human	83	Of	21
Source	8	Journal	59	English	20
Human	5	From	46	As	10
Magazine	5	English	31	Human	10
That	4	With	27	In	8
And	3	To	24	Mother	8
Its	3	For	20	Very	7
Very	3	By	19	That	5
A	2	That	14	Abhorrent	4
Brooding	2	And	12	And	4
By	2	Mother	11	This	4

An analysis of the most frequent words appearing either immediately *before* or immediately *after* the keyword 'nature' shows that the majority of occurrences of the word 'nature' are not ideologically charged in the sense outlined at the beginning of this article. The single most common use of 'nature' is in the common phrase, *the nature of [something or someone]*, corresponding to Williams's first meaning (see above), i.e. 'The essential quality and character *of* something'.

References to the leading science journal *Nature* also account for a large proportion of 'nature'-references, confirming the central agenda-setting role of this particular prestigious journal as one of the key sources for science correspondents and other reporters on the national press (see Hansen, 1994). Another journal, *Nature Genetics*, also accounts for a sizeable proportion of the 'nature'-references in the coverage.

References of a similar kind, which also figure prominently, are references to public bodies, which have the word 'nature' in their name, notably 'English Nature' (established in 1990, and thus not present in the 1986/87 coverage of the Guardian and the Times). Other examples include 'The Nature Conservancy Council' and the 'World Wide Fund for Nature (WWF)'.

Of particular interest in this article are the uses of nature which invoke or appeal to a more 'ideological' or value-laden meaning, particularly where this is used as a defence for preserving the status quo, regulating scientific endeavour, or preventing scientists and others from pursuing a particular scientific/medical development, path, or application.

The collocation 'human nature' is a co-occurrence, which veers in this direction. It occurs remarkably frequently across both types of newspaper and across the periods examined. And it is what we might term a 'discursive stopper' in the sense that by invoking 'human nature', further questioning or argumentative discourse is somewhat hampered by the notion that if something is characterised as 'human nature' then it is also implied that there are limits to what can or should be done about it.

> *Daily Mail*
> February 23, 2002
> HEADLINE: Depraved New World?;
> 70 years ago, Aldous Huxley published his vision of a Britain where babies were mass produced and society was controlled through drugs and sexual pleasure. With 'designer babies' in the news, just how accurate was he?
> Throughout history, there have been doom-merchants, like Huxley, Marx and Malthus, predicting a nightmarish future for mankind.
>
> What they have all ignored is human nature. With all its infinite adaptability, its romance, its optimism – and, above all, its innate love of freedom – our civilisation has always proved more lasting than any prophetic theory or ideology.
>
> *The Sun*
> June 20, 2002
> HEADLINE: Beam Me Up, Totti
> BYLINE: Rikki Brown
> ( ) We can all be lazy sometimes, that doesn't mean it's genetic, it just means that sometimes we just can't be a***ed. That's human nature.
>
> *The Guardian*
> April 9, 2003
> HEADLINE: DNA pioneer urges gene free-for-all
> BYLINE: Tim Radford, Science editor
> Since the launch of genetic modification, there have been alarms about enhancement of future babies. 'Enhancement means making better,' Prof Watson

> said. 'I'd have liked to have been born brighter. Our whole civilisation has been giving people the right to try and improve things. Occasionally you get very conservative governments who want to stop all improvement. I think it is human nature, the drive to make things better.'

Most of the uses of 'human nature' in the broadsheet newspapers are in fact not discursive stopper uses, but precisely a questioning of the ideological properties normally associated with the concept of 'human nature':

> *The Times*
> February 27, 2003
> HEADLINE: Do you need a soul for free will?
> BYLINE: Anjana Ahuja
> ( ) Dennett's critics, such as Rose, director of the Brain and Behaviour Research Group at the Open University, dispute the idea that human beings are merely products of their genes. Rose has consistently rounded on thinkers such as Richard Dawkins and Steven Pinker, who believe that human nature has been honed largely by evolutionary forces and therefore human behaviour is influenced overwhelmingly by biology.

> *The Guardian*
> December 18, 2003
> HEADLINE: The unselfish gene: Evolutionary theory says self interest dictates our behaviour. So why do we show such generosity at Christmas.
> BYLINE: Johnjoe McFadden
> Sociobiology claims that human nature – and by extension human society – is rooted in our genes: we are, according to Dawkins, 'lumbering robots' created 'body and mind' by selfish genes. This is anathema to social scientists and biologists such as Steven Rose, who see human nature as far more malleable.

Closely related to these references – and associated debates – is another cluster of relatively prominent references, namely to 'nature versus nurture'. 'Nurture' was among the three most frequently occurring words within two words to the right of 'nature' in the coverage of 2002-03, but appeared only once in the 1986/87 broadsheet coverage (interestingly showing a very similar trend to that identified by Ten Eyck and Williment, 2003, in US reporting). Overall, it appeared within four words either side of 'nature' 42 times in the broadsheets and 12 times in the Tabloids during 2002/03. The 'nature/nurture' debate – in relation to genetics coverage – has thus gone from being virtually absent from this coverage in the 1980s to being one of the single most prominent reference points during the 2002/03 period of coverage.

The prominence of the collocation 'with nature' in both broadsheet and tabloid newspapers in the later period, 2002/03, and the infrequent occurrence of this

collocation in 1986/87, provides a direct indication of how concerns about what scientists and others do 'to' (itself also a prominent co-occurring word in the broadsheets of 2002/03) or 'with' nature have become a key part of the newspaper discourse in the early 21st Century.

It is through the 'with nature' collocation that most of the common phrases from public discourse of fear or concern is articulated, using terms identical or similar to those identified in studies such as Shaw's (2002) or in a recent large-scale UK Department of Trade and Industry study *GM Nation* (2003) on public, political and scientific concerns about genetic manipulation. The most prominent of these are phrases with the following, or variations of the following, key words:

5. Interfering, Meddling, Fiddling, Tampering, Tinkering, Toying, Messing, Playing God/games... with nature.

The use of these phrases is almost invariably deployed to invoke the sense that doing any of these things to/with nature is fundamentally wrong and potentially highly dangerous. These phrases frequently occur together with (headline-) references invoking Frankenstein images (*The Mail* for example repeatedly uses the prefix *Franken-* in reference to various genetically modified animals and plants) or the equally potent 'Pandora's Box' reference from Greek mythology. There are one or two exceptions, including when 'tinkering' is used to invoke a sense of admiration (of scientists) and celebration (of their clever actions/inventions) rather than the sense of improper, possibly unethical and immoral, and likely dangerous trespassing more usually implied by these phrases.

It is indicative, not only of the tremendous development that has taken place in the field of genetics over the period examined here, but also, and perhaps more significantly, of the increasing polarisation and controversy which has marked both media and public debate about genetic research and applications, that these phrases of concern/fear were very infrequent in the 1986/87 coverage, but highly prominent in both broadsheet and tabloid coverage of 2002/03.

Two further tentative trends are worth noting about the use of these phrases in the coverage: 1) they are, perhaps expectedly, relatively more prevalent in the tabloid newspapers than in the broadsheets; 2) they tend to be voiced by readers in the 'Letters to the Editor' section or in feature/opinion pieces rather than in news or in the specialist sections devoted to science, environment or medical coverage. Both tentative trends indicate that these phrases belong perhaps to a more populist discourse than to a journalistic or newspaper discourse as such (which in turn raises some interesting questions about where, if not in the mass media, the chief repository for these kinds of phrases is).

The Times
February 22, 2003
HEADLINE: Meacher's caution over GM crops
From Mr John Mellin
If, in 1983, a government minister had given a warning of the hypothetical danger of tinkering with nature, creating carnivores out of herbivores in order to increase the supply of a product already in surplus, would we have listened?

The Guardian
November 16, 2002
HEADLINE: Meet the cloned cash cow – coming soon to a farmyard near you: Replica DNA developed in US will arouse anger if sold in Europe
BYLINE: Suzanne Goldenberg in Williamsport, Maryland, and James Meek
(…) Mr Wiles said he was confident British farmers would find the prospect of replicating such high yielders irresistible, despite the anxiety prevalent across Europe about tampering with nature.

The Guardian
April 20, 2002
HEADLINE: Weekend: Spirit: Pets: I WAS MOGGY'S DOUBLE: First there was Dolly the sheep, now there's Copycat the feline. Many owners have embraced the idea of cloned pets, but are they right to?
BYLINE: JD Carpentieri
(…) Cats Protection, the UK's largest feline welfare organisation, said that cloning 'interferes with nature and raises serious questions concerning whether a pet can ever truly be replaced'.

Daily Mail
November 30, 2002
HEADLINE: DOCTOR FRANKENCLONE; He's the man who enabled a 62-year-old woman to give birth. Now he claims to have created the world's first cloned human baby. So what is the truth about the doctor who is playing God?
BYLINE: David Jones
In the Vatican (which is so close to Antinori's clinic that, in the words of a former colleague, 'he is able to thumb his nose at the Pope every morning') officials branded him 'immoral' and demanded that he be banned from playing God with Nature.

Daily Mail
September 4, 2002
HEADLINE: Calls for a clampdown on 'zombie' farm animals
BYLINE: James Chapman
(…) How science is toying with nature.

Daily Mail
August 23, 2002
COMMENT
The stark fact is that the scientists, driven by the seemingly insatiable urge to meddle with nature, cannot really know what Pandora's box they may be opening up. The public is promised that it is 'all for the best' but the facts keep suggesting that many of the consequences could be the very opposite.

The Mirror
January 8, 2002
HEADLINE: MIRROR M@ILBOX: END ORGANS HORROR
BYLINE: Steve Fuller
Altough I was sad to read that Dolly the sheep has developed arthritis (The Mirror, January 5), this is the cost of interfering with nature.
Scientific progress can be marvellous, but this is a step too far.

The Sun
August 24, 2002
SECTION: INTERVIEW; QUYUM MOHAMMED; OPINION
HEADLINE: WHITE VAN MAN
BYLINE: Sally Brook
(…) This is crazy. Scientists could be unleashing something dangerous. I don't think they should be playing around with nature – they might get some nasty surprises.

Daily Mail
May 21, 2002
HEADLINE: Franken Chicken;
Created In The Lab, The Featherless Birds Designed To Survive Life In The Hothouse
BYLINE: Beth Hale
(…) TINKERING WITH NATURE
Science seems to be determined to meddle with animal development: Pigs in Japan were implanted with spinach genes to produce pork that is healthier than that from normal pigs.

Nature is frequently personified as female, not least as 'Mother Nature' (a term which itself invokes the sense of goodness and nurturing, something not to be violated) and ascribed active agency in the coverage, as in 'nature will do this or that, nature will react, nature will respond with vengeance' or in the possessive form of 'Nature's way' of doing, showing, telling us this or that.

The Times
June 6, 2003
HEADLINE: Not in my backyard
(…) Transplanting the genes of a fish into a tomato is putting a gun to the head of Mother Nature. Of course she will roll over and comply –until we have turned our backs.

A common collocation, which fits into this category, is 'as nature intended'. While occurring both in the broadsheets and in the tabloids, this phrase is particularly prominent in the tabloids, and generally serves to reinforce the notion of something, which 'knows what it is doing' and is best not interfered with.

> *The Guardian*
> July 23, 2003
> HEADLINE: Society: environment: Foreign fields: Interest in wildflowers is blooming, but, says Paul Evans, many conservation projects are using seeds inappropriate for their locality
> BYLINE: Paul Evans
> (…) 'Meadows like this were taken for granted 50-60 years ago,' says John Hughes, development officer with the Shropshire Wildlife Trust. 'They were part of who we were, but now even the folklore attached to these plants has been wrung out of the countryside as the landscape gets more bland. The diversity here at Wenlock Edge feels right, deeply imbedded – not like those fields of monoculture wheat and oil-seed rape over there. This is diversity as nature intended.'

The adjective 'natural' and, even more so the adverb 'naturally' (Table 3), are possibly more powerfully 'ideological' than the various uses of nature analysed above. They are 'ideological' in the sense that they serve, potentially, as important 'discursive stoppers' – as argued above in relation to the expression 'human nature'. They can be used to invoke an essentially unexplained blanket justification for a particular situation, state of affairs or phenomenon. In this respect they also imply a sense of 'we all know what this means' or 'this does not require scientific knowledge', in contrast to whatever 'non-natural' procedure, phenomenon, drug etc. may be discussed or explained.

Table 3 – Frequencies of 'nature', 'natural' and 'naturally'.

	Guardian/Times **1986-87**		***Guardian/Times*** **2002-03**		***Mail/Mirror/Sun*** **2002-03**	
	(399)		**(1 588)**		**(716)**	
	n	%*	N	%*	n	%*
Nature243	61	1 141	72	374	52	
Natural	321	80	1 118	70	483	67
Naturally	86	22	248	16	204	28

* The number of occurrences of the listed words as a percentage of the total number of articles containing any reference to 'nature'-words. This percentage is used purely as an indication of the *relative* prominence of these individual words within each of the three groups being compared.

Roland Barthes's (1972) notion of 'inoculation' may also be helpful in describing the ideological use of 'natural' and 'naturally' – they are words which 'immunise' against further questioning of the processes or traits described. If something is described as 'occurring naturally' or being 'produced/released/created naturally' – these being some of the most common collocations of natural, as indicated in tables 4 and 5 – then an implicit line is also being drawn to distinguish this from the (wrong or inappropriate or improper?) artificial interference or tampering by science/scientists.

As indicated in Table 3, 'natural'/'naturally' occurs more frequently than references to 'nature'. Tables 4 and 5 also highlight two particular differences between the broadsheets and the tabloids:

Table 4 – Partial collocation table showing the most frequently occurring words immediately to the right of 'natural'.

Guardian/Times 1986-87		*Guardian/Times* 2002-03		*Mail/Mirror/Sun* 2002-03	
Environment	13	Resources	208	Causes	21
Selection	12	History	86	History	13
Resources	9	Selection	69	Father	9
Defences	8	Gas	45	World	9
History	8	World	17	And	8
Philosophy	8	Environment	10	To	8
And	6	Father	10	Birth	7
Mother	6	Causes	9	Products	7
Environmental	4	Disasters	9	Process	6
Father	4	Products	9	As	5
Sciences	4	Sciences	9	Conception	5
Substances	4	Order	8	Environment	5
Virus	4	To	8	Habitat	5
Way	4	Process	7	Hair	5
Gas	3	And	6	Heritage	5
Hormone	3	Evolution	6	Order	5
Human	3	Parents	6	Colour	4
Insecticide	3	Genetic	5	Mother	4
Processes	3	Habitats	5	Resources	4
Production	3	Heritage	5	Way	4

1. The collocation for 'natural' in Table 3 immediately indicates a very different emphasis or focus between the broadsheet newspapers and the tabloids. It shows that the broadsheet newspapers use this word overwhelmingly in the context of 'natural resources' or the 'natural environment' and 'natural selection', while the tabloids focus on 'natural' in the context of human reproduction and relationships: natural father/mother, natural birth, natural conception etc. The main difference between the two periods, 1986/87 and 2002/03 in the broadsheets, is a massive increase in references to 'natural resources', from a mere 9 references in 1986/87, 'natural resources' has moved up to being the most frequently occurring phrase in 2002/03, and with 208 mentions, very considerably ahead of the next most prominent collocations.

2. 'Naturally' is used relatively more frequently in the tabloids than in the broadsheets. This may be an indication that 'naturally' is used as a kind of short-hand in newspapers which do not have as much space for scientific explanation or detail as the broadsheets; a short-hand way of invoking a distinction between, on the one hand, controversial scientific or medical interference in processes related to human reproduction (see the prominence of collocation words from this discourse domain) or manipulation of human or plant genes, and, on the other hand, a notion of these processes in their primordial state.

Table 5 – Partial collocation table showing the most frequently occurring words immediately to the right of 'naturally'.

Guardian/Times **1986-87**		***Guardian/Times*** **2002-03**		***Mail/Mirror/Sun*** **2002-03**	
Occurring9In12		Occurring		8	
In	7	Occurring	11	In	7
And	3	The	7	We	6
By	3	To	7	A	5
Infected	2	And	5	And	4
Resistant	2	Conceived	5	I	4
'plastic'	1	It	5	The	4
Adapted	1	But	4	By	3
Are	1	Present	4	Conceived	3
Blue	1	Creates/created	4	Lean	3
Bred	1	A	3	As	2
But	1	Erotic	3	Big	2
Compared	1	Produced	3	Doctors	2

Table 6 – Partial collocation table showing the most frequently occurring words immediately to the left of 'naturally'.

Guardian/Times 1986-87		*Guardian/Times* 2002-03		*Mail/Mirror/Sun* 2002-03	
Are	6	A	11	Are	9
Produced	6	Is	11	Conceived	8
A	5	And	10	Is	8
Is	3	Are	8	Conceiving	7
Which	3	Conceived	5	And	5
Bacteria	2	Occur	5	Occurs	5
Not	2	They	5	A	4
Quite	2	Comes	4	Born	4
The	2	Not	4	Have	4
And	1	Of	4	Was	4
Any	1	The	4	As	3
Be	1	Conceive	3	Child	3
Breathe	1			Come	3
But	1			Conceive	3

6. Conclusion

The analysis presented here confirms that discourses of nature form a prominent part of media coverage of genetics and biotechnology. It shows that almost a quarter of all articles about genetics in the broadsheet press make reference to nature or to what is characterised as natural, and although a slight overall decline in the prominence of 'nature'-references can be seen over the 18-year period examined, it is perhaps the relative stability, which is more noteworthy.

While many of the uses of the word 'nature' must be understood as descriptive and factual, and thus, ideologically quite innocuous, many uses of nature/natural draw on and invoke more deep-seated and more powerful ideological meanings. This is particularly the case with regard to what I have described as 'discursive stopper' uses of expressions such as 'human nature' or the short-hand referencing of processes or phenomena as being 'natural' – uses, which serve the discursive purpose of inoculating (Barthes, 1972) or immunising against further or deeper questioning or examination of the processes or phenomena being described. And uses, which also carry with them their binary opposite in the sense that whatever *is not* seen as a natural phenomenon or a natural process is, by implication, regarded as open to questioning and as potentially wrong, immoral, unethical, dangerous, or simply 'unknown'. This

sense is particularly embedded in, and articulated through, the prominent and common 'with nature'-phrases of the kind: Interfering, Meddling, Fiddling, Tampering, Tinkering, Toying, Messing, Playing God/games ....with nature.

As these phrases have also been shown by a number of studies to be commonly deployed in public 'talk' about genetics, it is, of course tempting to begin to speculate about the relationship between their prominence in media discourse and in public discourse. It is important to note, however, the finding of this analysis, that a large proportion of these phrases, when used in newspaper discourse, in fact originate from the public/the readers in the sense that they tend to occur in readers' letters to the editor or in opinion pieces rather than in journalistic reporting proper. In speculating about the possible relationships between media reporting and public discourse, it is also worth bearing in mind the strong evidence from 'cultural history' studies that most nature/genetics images and metaphors have a long historical pedigree and are a deeply embedded part of our cultural history. While bearing this in mind, there is clearly also a need to be sensitive to the potential re-definition, the changes in meaning and connotation, which flexible anchors such as nature and 'natural' enable and facilitate within the media and public debate about genetics and biotechnology. *Which* uses of 'nature' and 'natural' – and more significantly, *whose* deployment of these – become, over time, the winning arguments in media and public controversy about 'appropriate' and 'acceptable' uses of genetic research and biotechnology applications?

References

Altimore, M. (1982) 'The social construction of a scientific controversy: comments on press coverage of the recombinant DNA debate.' *Science, Technology and Human Values,* 7(4): 24-31.

Barthes, R. (1972) *Mythologies*. London, Jonathan Cape.

Bauer, M. W. (2002) Controversial medical and agri-food biotechnology: a cultivation analysis. *Public Understanding of Science,* 11(2): 93-111.

Bauer, M., Durant, J., & Gaskell, G. (eds.) (1999) *Biotechnology in the Public Sphere: A European Sourcebook*. London: The Science Museum.

Budd, M., Craig, S. & Steinman, C. (1999) *Consuming Environments: Television and Commercial Culture*. New Brunswick, NJ: Rutgers University Press.

Condit, C. M., Achter, P. J., Lauer, I. & Sefcovic, E. (2002a) The changing meanings of 'mutation': A contextualized study of public discourse. *Human Mutation,* 19(1): 69-75.

Condit, C. M., B. R. Bates, *et al.* (2002b) 'Recipes or blueprints for our genes? How contexts selectively activate the multiple meanings of metaphors.' *Quarterly Journal of Speech,* 88(3): 303-325.

Cronon, W. (ed.) (1995) *Uncommon Ground: Toward Reinventing Nature*. New York: Norton.

Department of Trade and Industry (DTI) (2003) *GM Nation? The Findings of the Public Debate*. Accessed at http://www.gmnation.org.uk/docs/gmnation_finalreport.pdf, 5 August 2004.

Durant, J., A. Hansen, & Bauer, M. (1996) 'Public understanding of the new genetics'. *The troubled helix*. M. Marteau and J. Richards. Cambridge, Cambridge University Press, pp. 235-248.

Elbro, C. (1983) *Det overtalende landskab : ideer om menneske og samfund i digternes og annonceindustriens naturskildringer i 1970'erne*. [The persuasive landscape: concepts of man and society in the portrayal of nature in literature and advertising in the 1970s] København: C. A. Reitzel.

Fairclough, N. (1989) *Language and Power*. London, Longman.

Fairclough, N. (1995) *Media Discourse*. London, Edward Arnold.

Gamson, W. A. & Modigliani, A. (1989) 'Media discourse and public opinion on nuclear power: a constructionist approach.' *American Journal of Sociology 95*(1): 1-37.

Goodell, R. (1986) 'How to kill a controversy: the case of recombinant DNA' in S. M. Friedman, S. Dunwoody, & C. L. Rogers (eds.) *Scientists and journalists: reporting science as news* . New York: The Free Press.

Goodfield, J. (1981) *Reflections on Science and the Media*. Washington, American Association for the Advancement of Science.

Hansen, A. (1994) 'Journalistic practices and science reporting in the British press.' *Public Understanding of Science*, 3(2): 111-134.

Hansen, A. (2002) 'Discourses of nature in advertising.' *Communications, 27*: 499-511.

Harvey, D. (1996) *Justice, Nature and the Geography of Difference*. London: Blackwell Publishers.

Kress, G. (1997) Language in the Media. Unit 49 of the *M.A. Mass Communications (By Distance Learning)*, pp 13-43. Centre for Mass Communication Research, University of Leicester, United Kingdom.

Martins, I. & Ogborn, J. (1997) 'Metaphorical reasoning about genetics.' *International Journal of Science Education*, 19(1): 47-63.

Nelkin, D. (1987) *Selling Science: How the Press Covers Science and Technology*. New York: W H Freeman & Company.

Nelkin, D. (1995) *Selling Science: How the Press Covers Science and Technology*. 2nd Revised Edition. New York: W. H. Freeman.

Nelkin, D. and M. S. Lindee (1995) *The DNA Mystique: The Gene as a Cultural Icon*. New York: Freeman.

Nisbet, M. C. & Lewenstein, B. V. (2002) 'Biotechnology and the American media – The policy process and the elite press, 1970 to 1999'. *Science Communication, 23*(4) : 359-391.

Nordgren, A. (2003) 'Metaphors in behavioral genetics.' *Theoretical Medicine and Bioethics*, 24(1): 59-77.

Petersen, A. (2001) 'Biofantasies: genetics and medicine in the print news media'. *Social Science & Medicine, 52*(8): 1255-1268.

Pfund, N. & L. Hofstadter (1981) 'Biomedical innovation and the press.' *Journal of Communication,* 31(2): 138-154.

Rutherford, P. (1994) *The New icons? The art of television advertising*. Toronto, London: Toronto University Press.

Schelde, P. (1993) *Androids, humanoids and other science fiction monsters: science and soul in science fiction films*. New York: New York University Press.

Shaw, A. (2002) "It just goes against the grain'. Public understandings of genetically modified (GM) food in the UK'. *Public Understanding of Science,* 11(3): 273-291.

Soper, K. (1995) *What is Nature?* Oxford: Blackwell.

Stubbs, M. (1996) *Text and Corpus Analysis: Computer Assisted Studies of Language and Culture*. Oxford: Blackwell Publishers.

Sutton, P. (1999) 'Genetics and the future of nature politics'. *Sociological Research Online, 4*(3): U251- -U257.

Ten Eyck, T. A., & Williment, M. (2003) 'The national media and things genetic – Coverage in the New York Times (1971-2001) and the Washington Post (1977-2001)' *Science Communication, 25*(2), 129-152.

Turney, J. (1998) *Frankenstein's Footsteps: Science, Genetics and Popular Culture*. London: Yale University Press.

Van Dijck, J. (1998) *Imagenation: Popular Images of Genetics*. London: Macmillan.

Wall, G. (1999) 'Science, nature, and The Nature of Things: An instance of Canadian environmental discourse, 1960-1994'. *Canadian Journal of Sociology-Cahiers Canadiens De Sociologie,* 24(1) : 53-85.

Watt, R. J. C. (2002) *Concordance, Version 3.0*. Dundee: RJCW. http://www.rjcw.freeserve.co.uk/ .

Weart, S. R. (1988) *Nuclear Fear: A History of Images*. Cambridge, MA: Harvard University Press.

Williams, R. (1973) *The Country and the City*. London: Chatto & Windus.

Williams, R. (1983) *Keywords: A Vocabulary of Culture and Society*. London: Flamingo/Fontana.

Williamson, J. (1978) *Decoding Advertisements: Ideology and Meaning in Advertising*. London: Marion Boyars.