Science as Pantomime:

Explorations in Contemporary Children's Non-Fiction Books

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Abstract

This project explores a case study in children's science culture: *Horrible Science*, a UK based series aimed at 7-11 year olds. Children, I believe, are one of science communication's most interesting audiences. They are both potential members and potential outsiders of the scientific community, and *Horrible Science* produces a 'liminal' identity to meet these two markets. I apply a metaphor of pantomime to help describe *Horrible Science*, partly because of the series' approach to using fiction and its style of audience participation. It is also panto-science because it is presented as a carnivalesque show, exciting and fun, laughing at authority. *Horrible Science* invites us to snigger at science's heroes and explore the hidden underside of both nature and of scientific work. However, I believe that this, at least in part, is largely a matter of excusing a type of earnest reverence, delight and excitement for science that had become unfashionable by the end of the 20th century.

I investigate *Horrible Science* as an interesting phenomenon in its own right, but also because I hope to develop ideas about the popularisation of science. Since the early 1990s, theories on popular science have tended to describe popular science as sitting (obstructively) between scientists and the rest of the world. Its public audience are defined as receivers; the scientists, the providers. However, recent work from historians of 19th century science have critiqued this view, instead positioning popular science within a 'marketplace', full of empowered consumers choosing not only what cultural products to partake of, but who to trust and how far. I accept this emphasis on the marketplace, but with a less utopian view of consumer power which retains some of the scepticism of the 1990s analytical approaches. I suggest that *Horrible Science* aims to appeal to its readers by implying they can use a 'horrible' version of scientific knowledge to take up a position between the great and the good of the scientific community and an assumed, unenlightened othered public. Drawing on Bourdieu's ideas on symbolic 'capitals' of culture, I conclude with a reading of popular science as a product through which interaction between and across cultural fields allows a range of actors to, at once, share social power, declare their own cultural status, and fall prey to the hierarchies of science in society.

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I should admit upfront to having funded much of my academic studies by producing forms of 'pantomime science' myself and, also at this point, thank the Science Museum's Explainer Unit and the Planet Science team. This does not, however, mean this thesis is an exercise in the business of advocating the wonders of panto-science (neither has my experience left me with a bitter desire to oppose them). Rather, I see this work as an opportunity for reflection, some of which is self-reflection, as I apply *Horrible Science*'s sophistication (and apparent assumed sophistication n the part of its readers) as a challenge to develop more sophisticated understanding of knowledge in culture.

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Introduction
Irreverent Knowledge Consumption

The broad context for this thesis is a recent trend towards irreverence within the popular communication of knowledge. My interest in this topic stems largely from a desire to develop scholarly ideas on 'popular science' (i.e. science media for non-scientific audiences) and, slightly more specifically, to extend our understanding of the types of relationships we assume children might have with science, although I also think the analysis can be applied to a broad range of issues surrounding knowledge in culture. The kinds of media products I have in mind are sometimes dubbed 'edutainment', bemoaned as evidence of the 'dumbing down' of culture or, worse still, a pernicious form of anti-rationalism. Equally though, their use of humour and apparent subversion of social boundaries might be celebrated as a more reflective approach to knowledge in society. This thesis hopes to argue that such a turn to irreverence is perhaps better understood as all these things rendered bourgeois: a nod towards science's critics within a largely traditional veneration of the scientific establishment (and all the while, simply selling books).

I think such irreverence is best understood as a way of presenting a liminal position; one that does not align itself specifically with one group or another but is situated in-between, showing off its awareness of a range of views. Liminality is attractive commercially. It opens texts up to a range of audiences; it nods to a critique of one or another point of view, takes none seriously, and yet at the same samples the seriousness of all. This commercial context is crucial, and to more than just irreverent non-fiction. The science book business is, after all, a business. As such it is keenly aware of having to provide something for the customer (however illusionary this provision might be). This commercial context is crucial to my use of this research to develop our understanding of popular science. Traditionally, the social studies of science tend to think of popular science as something imposed upon its audience, as enacting an ideological labour for the benefit of the scientific community; its very existence emphasising the distinction between scientific

knowledge producers and lay public 'receivers'. However, I want to sketch some of the ways in which popular science offers something to its consumers, and offers itself in reference to a liminal position that both connects itself to and shows some suspicion towards scientific authority. This does not necessarily mean it is any less hegemonic. But it can be something those people generally dubbed 'the public' appear to ask for.

I base my analysis on a case study from children's science culture: *Horrible Science*, a contemporary series of books, toys, magazines and games targeted at 7-11 year olds. A sub-section of a successful and established children's non-fiction brand, *Horrible Science*'s roots are in the UK, but it sells internationally and has been translated into several modern European languages. I apply the metaphor of 'pantomime' to describe the particular type of irreverence at work here, as well as the explicit way in which *Horrible Science* references the constructed nature of its mediated message. I take *Horrible Science* as an interesting case study in its own right, but it is also an opportunity to explore broader trends in cultures of popular science. *Horrible Science*'s generally ambivalent position arises in part, I believe, from the series' rather broad educational remit (as well as the same aesthetics governing other irreverent non-fiction). The brand aims to speak about all forms of science – biology, chemistry, medicine, technology, physics and a host of disciplines between – thereby reflecting a range of ideas about and attitudes to science. Moreover, it seeks to do so to children, who are unusual in all of science's audiences in that they are both potential members and potential outsiders. Each child reader of *Horrible Science* might (or might not) grow up to be a scientist themselves, and the series works its ambivalence to meet both markets.

The intellectual roots of this work are chiefly sociologically inclined studies of children's and science media, though I have also drawn on literary studies (again, both children's and science literature), the sociologies of science, childhood and education, as well as the history and philosophy of science. Just as I have applied a reasonably broad scope of analytical influence, I hope my case study in children's science culture can help us reflect on science and its publics beyond child-specific issues (and on children and knowledge other than just science). In particular, I believe the pantomime nature of *Horrible Science* is indicative of how complex and sophisticated a cultural product it is. Moreover, *Horrible Science* appears to assume such complexity and sophistication on the part of its audiences too. As such, this is not a study in binary questions of pro vs. anti-science, top-down vs. bottom-up policy

or passive vs. participative concepts of audience, but rather one in the complexity, paradoxes and liminality of science and its audiences, young people and the contemporary cultural products that are aimed at them. I hope to reflect not just on the existence of such complex liminal positionings, but also their rhetorical use. Showing an awareness of two points of view at once is, after all, a strong political (not to mention epistemological) position to adopt.

An increasing irreverence can be spotted across a range of knowledge-based cultural products; popular non-fiction books, journalism, quiz shows, documentary, museums, teaching. *Horrible Science* itself was spawned by the bigger series, *Horrible Histories*, and Scholastic, their publisher, has also produced *Horrible Geography*, *Murderous Maths* and a biography series, *Horribly Famous*. Margaret Scanlon's (2008) recent study contrasting *Horrible Histories* to Dorling Kindersley's *Eyewitness* books suggests that because the *Horribles* have been so successful they have not inspired many imitators: publishers feel, simply, that there is no point in competing.[1] However, there are imitators, or at least those seeking to connect themselves with the brand (e.g. *How to Turn Your Parents Green*, Russell, 2007, *Smelly Science*, Hamer, 2000). Moreover, the irreverent style is one that a range of other non-fiction media (with a range of audiences) adopt for their own reasons, regardless of the *Horribles*. On television there is *Brainiac: Science Abuse* (Sky Television, since 2003) and *Mythbusters* (Discovery Channel, since 2002); both globally syndicated brands.

None of this, however, means irreverent non-fiction should be considered 'kids stuff'. Interestingly, John Farnam's (1992) *Very Bloody History of Britain*, which might contend with the *Horrible Histories* for having lead the non-fiction/humour trend, started life with a cross-generational appeal, sold in (adult) history and humour sections as well as children's departments of bookshops. Another, science specific, example, comes from the Science Museum, which has recently adapted styles of performance developed in their children's galleries to produce *Punk Science* (Dana centre and touring, since 2003) for adult consumers of performed popularised science. These shows apply a similar 'carnivalesque' style of pantomime spectacular, but with an explicitly over-18 approach (e.g. inviting audience members to eat doughnuts off a dildo). The television quiz show, *QI* (BBC television, since 2003) also makes for a good 'grown-up' comparison to *Horrible Science*, as it

[1] I do not have a final formatted copy of Scanlon's thesis, and therefore cannot give specific page references to my citations to this work.

similarly applies irreverence in the face of high-status knowledge apparently laughing at the pomposity of thinking we know anything, yet, at the same time, using this irreverence to delight in the processes of knowing.

What does it say about our society if we choose not only to consume knowledge as a cultural activity (an odd thing in itself, though we have been doing it for hundreds of years) but to consume it with a dose of the uncertainties and liminalities of humour; if our 'serious non-fiction' is to be taken non-seriously? In terms of the specifics of the young people's culture that *Horrible Science* sits within, irreverent non-fiction reflects a shift in ideas about the child audience. Children's media is less likely to assume their audiences will be the well-behaved, quiet and innocent audiences implied by *Listen with Mother* (BBC Radio, 1950-1982). Rather, they are the rowdy crowds surrounding *Tiswas* (ITV, 1974-82) or its various antecedents (e.g. *Live and Kicking*, *SMTVLive*), revelling in anarchy, mess, toilet humour and a general feeling of rebellion.[2] However, I think the shift can also be considered cross-generationally and reflects the changing attitudes of 'post' modernity; or, depending on your view, the knowledge politics of late, liquid or reflexive modernity (Bauman, 1999, Beck, 1992, Giddens, 1991). A simple claim to scientific authority may still have power, but is also easily disputed and will not hold on its own. As Gregory and Miller (1998) emphasise, the more complex nature of contemporary expertise means the scientific community's relationship with the rest of the world is a matter of discursively establishing trust. Similarly, Norman Fairclough (1992) notes in a study of medical professionals that in gaining the trust of their patients, people hoping to fashion themselves as authoritative may do so by presenting themselves, simultaneously, in the role of esoteric expert and 'man on the street' (see also his analysis of GMO discourse, Fairclough, 2003: 184-190).

To look at the issue from a (slightly) different direction, it is often suggested that the rise of consumerism has somehow forced a 'dumbing down' of culture, producing work which is both banal and spectacular as it aims to attract the largest number of people and to make itself stand out amongst the clamour of the competition. To put a more academic swing on that, Jean Baudrillard's (1981) writing on the political economy of the sign, or Fredric Jameson (1991) on the various fabrications of postmodern culture can provide helpful analytical insights. Also useful are Horkheimer and Adorno's (1973) arguments on the development of the 'culture

[2] For a more globally resonant example: the difference between clean-cut early years of *The Mickey Mouse Club* and garishly green 'gunge' of *Nickleodeon.*

industries' as a way of maintaining the status quo by filling the public's time with engrossing entertainment that ultimately distracts them from (and obscures) political action. Adorno can be easily criticised for maintaining a rather romantic, nostalgic and, arguably, highly conservative idea of 'true' art which largely assumes that media audiences are happily-passive, easily-influenced drones (see also Adorno, 1991, for useful overview). However, David Gauntlett's (1996) study of young people and the environment draws out two key points to 'save' Adorno that I feel are highly applicable to this study. Gauntlett notes the apparently counter-cultural content of much popular media; for example, satire on commercial television, multi-national industries enthusiastically marketing rap music or, in terms of Gauntlett's specific study, calls to ecological action. Following Adorno, he describes this as a way of giving the impression that mass culture is engaged in critical dialogue; the audiences feel as if they have participated in action, so they do not actually have to. However, Gauntlett further emphasises that it is precisely because the audiences are *not* passive that the need for apparently-critical media has been developed; cultural products which appear to challenge the status quo are 'only the footprints of the culture industry keeping pace with the ever-increasing sophistication of its audience' (Gauntlett, 1996: 15).

I will end this introduction with a description of each of the chapters, followed by a brief overview of my general argument.

Chapter 1: Studying Children's Science Culture. This chapter provides a brief literature review of previous studies of children's science culture. More theoretically, it also focuses on broad questions of the formation and articulation of symbolic cultural boundaries (e.g. those which define our ideas of what is or is not 'childish' or 'scientific'). I end this chapter with a methodological statement about the empirical processes I took with respect to my data.

Chapter 2: The Case Study. This provides a brief run-through of the content of *Horrible Science* and a taster of the books' style, tone and narrative approach. I then discuss the history of the series, and refer to some of its competitors within the current UK children's non-fiction market. I also briefly introduce the features of pantomime that I apply to *Horrible Science.*

Chapter 3: The Branded Book. Here I introduce some of the repeated features of *Horrible Science* and reflect upon what such repetition signifies. This chapter also

considers the status of *Horrible Science* as a brand and explores some of the ways in which consumer culture is referred to within the content of the books.

Chapter 4: Making Science 'Horrible'. This chapter aims to uncover the diversity of meanings associated with 'the horrible', and asks how the *Horrible* brand patterns the images of science that the books present. It contrasts the *Horrible* style with more traditional approaches to addressing children, as well as discussing the ways in which various senses of 'the horrible' allow the books to generate an appearance of both masculinity and authenticity.

Chapter 5: Styles of Narration. How does *Horrible Science* choose to tell its science, how does it lead its readers through content, and in what guise? I suggest the books sample a 'mix' of different types of content from a range of different media styles and apply a range of narrators, as they walk a line between chaos and consistency.

Chapter 6: Fiction and Realism. *Horrible Science* is quite clearly factual, yet it is also suffused with fiction. This chapter investigates *Horrible Science*'s use of intertextuality, and even its allusions to metatextuality. I argue that although *Horrible Science* might in this respect appear postmodern, even relativist, its explicit and parodic uses of fiction are largely enacted to construct a sense of realism.

Chapter 7: Audience Participation. Through specific study of experiments and quizzes, this chapter argues that *Horrible Science*'s sense of interactivity is best understood as pre-scripted 'audience participation'. The experiences offered through experiments and quizzes are 'didactic dialogues' where the audience is very much situated as the consumer of knowledge.

Chapter 8: The Uses of Humour. This chapter argues that *Horrible Science* uses humour for a range of social and educational actions. In more incongruous mode, *Horrible Science*'s comedy suggests a subversion of social norms, but comedy is equally applied quite didactically, challenging the audience to take on the point of view of the joke-teller.

Chapter 9: Appeals to Wonder. *Horrible Science* frequently appeals to a sense of wonder and curiosity, and this chapter seeks a critical framework for considering such an aesthetic. It also argues that although we often think of science's privileged

social position as a hegemonic action enacted in popular science through labelling their audience 'lay public', appeals to wonder embody an aesthetic of popularised science that works only with an audience's compliance (so that they might feel some sense of superiority through a form of reflected glory).

The application of a *Tiswas* style of address to 'serious non-fiction' should not simply be read as Yet Another Example of Dumbing Down. Nor is it evidence that the world has suddenly started to pay attention to relativist critiques. As we shall see, *Horrible Science* invites us to laugh at science's heroes and explore the hidden, previously censored, 'horrible' underside of both nature and scientific work. However I believe this, at least in part, is to provide an excuse for a type of earnest reverence, delight and excitement for science that had become unfashionable by the end of the 20th century. Although *Horrible Science* presents itself as explicitly revolutionary, as breaking boundaries in order to anarchically upend culture and explore the world unhindered by ideology, such allusions to transgression are generally rhetorical.

Moreover, one of the results of the liminal positioning is that *Horrible Science* invites its readers to take up a position between the 'great and the good' of the scientific community and an unenlightened Othered 'public'. We often conceive of the hierarchies of science communication (that is, its emphasis that scientists know best) as something imposed upon the audiences. However, with *Horrible Science*, I think we can see a game of bartering with cultural capital, as audiences are invited to join in on the building of boundaries between science and the rest of the world so they can take some of the reflected glory for themselves. It is, I believe, too simplistic to conceive of science communication as disempowering its audiences by inviting people to interact with science as a 'public'. Rather, the popular science industry provides an opportunity for scientists, publics and people who might self-identify as somewhere in-between to take part in a complex exchange of symbolic power.

Chapter 1
Studying Children's Science Culture

Introduction

This study is predicated on the assumption that children's science culture makes for a fascinating area of social analysis, but I appreciate I may need to spend some time convincing my audience of this. Although I do not assume my work to be unique in considering children's interactions with science, such research is rare, and largely scattered. Further, in advocating research on the topic, it is all too easy to fall back on rather self-important celebrations of the significance of both science and the child to contemporary life. Yes, political intersections between children and science and/ or technology can be some of the most controversial: vaccinations, digital culture, the future effects of current energy policy. Yes, increasingly, science and technology is becoming a central part of children's lives; whether because they increasingly find themselves in front of flickering electronic screens or because various people mobilise their concern to train a scientifically literate futurepeople, plotting science into curricula the world over. But I am not in the business of repeating such rhetoric. Rather, in attempting to side-step such manifesto building, this chapter advocates a study of children's science culture by emphasising that our processes of defining these things called 'children' and 'science' (a) have a reasonable amount in common and (b) are in some respects produced by their interaction with one another (see also Bell, 2008).

I plan to use such assumptions about science and the child to my favour, and make them the basis of the study. We all have them. Children's studies know we have them about the child, and will happily explode them for you. Ditto science for science studies. As I suggested in my introduction, the apparent cultural clash when children meet the scientific community is a fruitful arena for learning more about what we mean by 'science' or 'the child'. When (clever) science is contrasted with (ignorant) child, we both draw on and reproduce images of science and the child as

having particular characteristics. The implicit assumptions make their way, at least partially, out of the parenthesis, and the idea that science is clever and children do not have a role in the construction of scientific knowledge becomes ever more emphasised. Our ideas about child/science interaction are not so singular, and as we shall see, we might similarly cast an image of (destructive, corrupting, unnatural) science acting against (pure, innocent, natural) childhood.

This chapter comes in four parts. Firstly, I provide a brief sketch of the diversity of research in arts and social sciences that has considered children's science culture. I define culture quite broadly here, deliberately conflating so called 'informal' and formal educational contexts. The second section is reasonably abstract, and surveys questions of the formation of cultural categories and the application of symbolic boundaries. The third part then reflects on the ways in which both science and children's media have traditionally considered their audiences. The fourth and final section then changes track slightly to provide a brief methodological statement. In particular, I wish to emphasise that this is a study of adult culture through its vision of the child. What any given child chooses to make of the science culture proffered to them may well be something entirely different from what adults imagine of them. I would also like to state upfront that this is an exploratory study, reading a textual case study to unpick some questions in (child)publics' cultural interactions with science. I do not claim to have found truths about social reality as much as offer some new ways of thinking about them, with the hope that future empirical research questioning children about science (or science about children) can do so with a greater degree of analytical rigour.

The State of the Field

It would be unfair for me to sketch an academy completely ignorant of child/science issues. Indeed, the topic is becoming increasingly fashionable in a range of academic areas, and researchers are starting to discover each other across disciplinary divides. I apologise if this section, at times, appears a little like bibliographic diarrhoea, but the so-far generally disparate nature of research on the subject means that it is worth providing a general overview.

The most developed area of study to consider children and science is research into science education. However, such work tends to occur in teacher-

training institutions and focus on classroom concerns and policy agendas. Although it might contest what school-science should be, and how exactly it could be of use to a range of stakeholders, science education research rarely questions the worth of school-science. A rare critical view can be found from science teacher turned sociologist Michael Young (1976), writing within the field of sociology of education. Here Young argues that a theme of social separation runs throughout the history of science education, as it continually sorts students into pure scientists, applied scientists and failures. A form of response to such inequalities is the STS education movement, which has been growing in popularity since the 1970s (see Turner, 2008, for an up to date international history). Although usage varies, the acronym 'STS' in this context usually denotes Science, Technology and Society (rather than the academic field of Science and Technology Studies, though there are some connections). This approach maintains the educationalist's position that knowledge about science is useful and children should be educated in it, but suggests that knowing *about* science is more useful than scientific knowledge itself, and indeed might be used by students to empower themselves against the might of the scientific establishment.

However, STS-education is not without its own problems, both practical and intellectual. Harry Collins (2000) argues that there is a paradox at the heart of such curricula; while it is useful to teach the general public that science is uncertain, such messages would be harmful to any future-scientists also in the classroom. In many respects, Collins's argument is simplistic, and assumes a similar simplicity in STS education's audiences, but the idea that time spent with the social studies of science might somehow undermine science's claim to access truths is a belief often at the root of STS education's more conservative critics (see, for example, Starr, 2005). More practically, studies have shown that science teachers are ill-trained in both the humanities content and more discursive teaching methods required when discussing science issues (as opposed to relaying uncontroversial facts) (Osborne et al, 2002). Additionally, despite STS education's message that it provides a curriculum for everybody (not just for the few who want scientific careers), we should be wary of assuming it is a quick fix to democratic education. For example, when curriculum developer Martin Hollins describes it as a change from thinking in terms of preparing science 'producers' to trying to prepare science 'consumers' (Hollins, 2001: 22), he is meaning to be complimentary. But such an economic metaphor would not please everyone, and it is worth reiterating David Layton's point that the first person to publicly advocate such a 'science for all' approach was, in 1971, the then secretary

for state for education, Margaret Thatcher (Layton, 1994: 39).

Significantly, the few times science communication studies has looked to young people, it has tended to back on the assumption that knowing more science, or at least learning to love science, must be good for young people and their wider society (e.g. Weigold & Treise, 2004, Mares et al, 1999, Long & Steinke, 1996). This is perhaps odd, considering science communication studies' emphatic move, since the early 1990s, away from what it tends to dub a 'deficit model' (i.e. the public have a 'deficit' of scientific knowledge, Irwin & Wynne, 1996). Educationalist Robin Millar may be correct in arguing that such 'deficit model bashing' is merely a fashion of science communication work and out of place in the education context (Millar, 1996: 12), but there is much more to children's interaction with science than the schoolroom, and science communication studies' (usual) critique of works which might be seen as patronising their audiences should not be dismissed simply when content is designed for under-18s. I think science studies is missing a trick when it forgets the child; not only are children a key audience for much science communication, but they are also an interestingly variable one. It might be intuitive to imagine children as the most ignorant of science's lay publics, but unlike adult audiences, children have an undecided relationship in respects to science; they might grow up to be scientists themselves, they might not. Thus, science communication addresses children as current outsiders, but also as potential insiders, plotting quite complex cultural politics in the process.

Arguably, one of the reasons for Millar's dismissal of 'deficit model bashing' is that science education previously attempted a more audience-led approach with the discovery learning movement. Loosely, this approach, popular in the mid-late 20th century, is based on the idea that it is wrong to indoctrinate children with the beliefs of the previous generation; rather, they can discover science for themselves. However, as many educationalists pointed out, this only works in as much as one believes that scientific research comes straight from interaction with evidence. Classroom ethnographers Atkinson and Delamont (1976) conclude that such learning styles may stress pupils' engagement with 'real' experimentation and 'real' discovery', but this relies on a rather Baconian image of knowledge that simply does not work in the classroom (if anywhere, see also Driver, 1989, French, 1989). As Atkinson and Delamont emphasise, discovery learning too often dressed up 'cold' science (normalised, decided knowledge) as if it were 'hot'.

Understandably, children/science interaction is a rather amorphous topic, and it is specific issues that have inspired the most analytical study. There has been a reasonable amount of reflexive work on the issues of creationism in schools (e.g. Nelkin, 1982, Locke, 1999a) or girls and science education (e.g. Whitelegg et al, 2008, Mellor, 2001, Schiebinger, 1999). A few historians have considered the role of the child in the development of professions in natural history (e.g. Sleigh, 2007, Keeny, 1992), Massimiano Bucchi (1998a) has studied science classroom wallcharts, and there have been several histories of sex, health and hygiene education programmes (e.g. Barnes, 2006, Hampshire, 2005, Toon, 2004). The increasing use of technology in children's play and education spaces has led to some reflective studies of social assumptions of children's relationships with technology (e.g. Prout, 2005). In particular, Susan C Herring (2008) questions our age-based images of technological skill, arguing that we should remember the continued role of adults within young people's digital landscape.

The topic of the environment brings out questions of child agency in respect to science, perhaps because the notion of the child as 'the future' has a particular role in the consequences of climate change that cuts across usual prejudices against (a) allowing children a political voice or (b) mixing science with politics. Both Gauntlett (1996) and Myers (1995) discuss agency in respect to apparently eco-critical media for children, or see Blanchet-Cohen and Rainbow (2006) for a description of a policy-orientated project (authored in part by a twelve-year-old participant). Still, appeals to the child in terms of environmental action could be a way of putting the issue off, rather than a way of addressing the 'future needs' of the child (Buckingham, 2000b: 45). Outside of ecology, there are other projects aiming to encourage child agency with respect to science. The STS-education programmes may base themselves on the idea of public 'engagement' with science policy, but tend to consider the child more as they might interact with science policy in their future rather than as a child now (see Bell, 2004). In contrast, Balen et al (2006) argue that we should think of young people's participation with health issues more in terms of their active roles as children, rather than 'human becomings', purely imagining their functional life in the future. One innovative project (Cerrini et al, 2003) asked students to evaluate the English science curriculum, building a survey around questions set by school-children themselves. Still, this project was arguably a lot less user-led than those working on it seemed to assume.

In terms of my specific interest in book-based media, studies of children's

science fiction often note the relative marginalisation of science and technology, with images of modernity often juxtaposed (negatively) with Romantic images of the child in tune with untouched nature (e.g. Applebaum, 2005, 2006, Nodleman, 1985). This is unusual for science fiction, which is generally quite reverent of science and technology. Farah Mendlesohn (2007, 2009, with Baxter, 2007) also notes this trend, although her work combines surveys of science fiction fans' reminiscences of childhood-reading to discuss young peoples enjoyment of more pro-science stories. Moreover, other work on science in children's fictional literature has found expressions of delight in science and technology, or at least concluded that the genre is a diverse one (e.g. Hintz & Ostry, 2003, Westfahl, 2000, Sands & Frank, 1999, Westfahl & Slusser, 1999, Outram, 1996, Esmonde, 1982). I suspect the increasing quantity of children's books which self-consciously blur genres is bringing with it ever-more complex attitudes to science and technology; as tropes from traditionally anti-modernist fantasy intersect with the usually pro-modernity science fiction (see Bell, forthcoming, also Bullen & Parsons, 2007).

Despite such occasional interest in children's science fiction, there has been very little consideration of print-publications presenting science fact. Margaret Meek (1996) provides some useful analysis in her survey of 'Information' books for young people, but her study perhaps suffers from tackling the entirety of the genre (or rather, genres); a sort of collective consideration of all the books left out of more literary analysis (see also Heeks, 2004, Fisher, 1972). For some work on specific topics: Blumenreich and Siega (2006) consider non-fiction within their study of contemporary children's books about AIDS, Sands and Frank (1999) discuss non-fiction content within didactic science fiction, and the odd fantasy/fact combinations of dinosaur books and toys have been considered by Buckingham and Scanlon (2003) and Susan Willis (1999). From a slightly different academic perspective, typography researcher Katherine Gillieson (2008ab, 2006) takes children's science books as a case study in the combination of image and text within book design. Drawing on a study of rhetoric, Greg Myers has applied case studies in children's media to the history of science (1989) and children's media studies (1995). The history of science and medicine appears to be leading the way on children's science non-fiction, as scholars in this field increasingly discover issues of popularisation and pedagogy make for rich case studies (e.g. Lightman, 2007, Keene, 2007, Al-Gailani, 2007, Fyfe, 2007, 2000, Jordan, 1992, Secord, 1985). In particular, Aileen Fyfe's (2003a) collection of classic children's popular science provides an absorbing historical background to the kinds of texts my study considers, I will, however, leave

detailed discussion of this work until the next chapter. Another fascinating historical study comes from Julia Mickenberg, who devotes a chapter to science in her study of 20th century American left-wing children's literature. According to Mickenberg, left-wingers black-listed from teaching found a wide audience in writing children's books which, for various reasons, came under less McCarthyist scrutiny. The rhetoric of popular science suited (or could be made to suit) Marxist ideas very neatly. Moreover, the apparent non-ideological glaze of science, coupled, ironically, with a post-Sputnik craze for science education, meant classrooms were quite receptive to such books (Mickenberg, 2006: 175-230).

Studying Cultural Categories

If there is any central theoretical assumption that this thesis makes, it is that cultural categories are socially constructed and further, that a large part of what makes up the construction of these categories is their relationships to one another. The categories of most interest to this work are 'child' and 'science', but the various (and varying) resonances of concepts such as fiction, play, story, humour, horror, knowledge, authority and the sublime, amongst others, are all considered here. The deconstruction of cultural categories is to some extent undertaken by *Horrible Science* itself, which invites us to such an approach through its continual word play, explicitly twisting and turning concepts to show off their diversity of meanings. As I have discussed elsewhere (Bell, 2008), *Horrible Science* depicts not only a diversity of ideas of the child and of science, but applies them to suggest a range of ways in which children might relate to the scientific community.

Because what makes up child, science, play, knowledge etc is not a singular demarcation criterion, such categories are formed by the construction of symbolic boundaries. In examining the making and breaking of such rhetorically applied boundaries, I draw on a range of social theorists, and this section seeks to introduce and compare them. As demonstrated by Lamont and Molnar's (2002) useful survey, much sociological research relies on some idea of symbolic boundaries. As these authors stress, we should not imagine there is some form of consistent research programme at work. Rather, disparate researchers in many different areas apply similar ideas, whether they consider class, race, generational or gender identities, divisions around professions or knowledge groups, or more tangible tracked boundaries linked to an individual's situation in space (i.e. location within

communities and nations). As the breadth of Lamont and Molner's study demonstrates, people use symbolic boundaries for a range of different purposes, often several at once. Exerting a boundary between one group and other might be seen in a negative light, as divisive and excluding, snobbish or even prejudiced. But it can also help foster a sense of inclusive, cohesive identity.

I start my discussion of symbolic boundaries with a brief sociological explosion of two key categories of interest to this study, science and the child. None of this should be of huge surprise to anyone of even slight sociological predilection. Rather, this section aims to provide a constructivist warm up and overviews both history and some of the key power considerations at play. I hope it also draws attention to similarities between issues of childhood and science in society. I then move on to contrast theories of symbolic boundaries as an exertion of hierarchical power with concepts that put a greater emphasis on boundaries as liminal spaces for communality and communication.

Deconstructing the Child and Science

First up: 'the child'. Complete with scare quotes. As Anne Higonnet (1998) and Patricia Holland's (2004) studies of iconography of the child in visual culture both emphasise, the child is often used to stand for a form of unquestioned, unsullied, pre-social 'natural' human state. Higonnet in particular emphasises the ways in which imagery of childhood continually depicts children as existing somehow beyond or above social life: presenting a 'secret garden' of classless, androgynous non-identity. Indeed several critics read something suspect in the continual use of such images of the child (e.g. Morh, 1996). Chris Jenks (2005), however, stresses that there is a diversity of ideas as to what the nature of childhood equates to: innocent, pure, pre-social, but also playful, innovative, futuristic, mischievous, even deviant. It is worth quoting Jenks at length to help us consider the range of meanings at play here:

> Whether we regard children as pure, bestial, innocent, corrupt, charged with potential, tabula rasa, or even as we view our adult selves; whether they think and reason as we do, are immersed in a receding tide of inadequacy, or are possessors of a clarity of vision which we have through experience lost; whether their forms of language, games and conventions are alternative to our own,

> imitations or crude precursors of our own now outgrown, or simply transitory impenetrable trivia which are amusing to witness and recollect; whether they are constrained and we have achieved freedom, or we have assumed constraint and they are truly free – all these considerations, and more, continue to exercise our theorising about the child in social life (Jenks, 2005: 2)

It is important to note that when Jenks talks about 'theorising' about the child, he does not only mean academic work, but also refers to the quite prosaic theorising which we all do as part of everyday social life. Yet, as Jenks acknowledges, there is a key distinction to be made between such everyday theorising of the child and similar social work we all also do around class, race or gender. Every adult has at one time been a child and every child (tragic events avoided) has the potential to be an adult. Indeed, it is what is expected of them. As Jenks puts it, children are both alien and similar to adults: 'the child inhabits our world and yet seems to answer to another' (Jenks, 2005: 3). James and Prout (1997) in particular draw our attention to temporal issues in terms of ideas of the child and emphasise that part of the work of the sociology of childhood is also an understanding of the social construction of time. Childhood is social identity that is, unusually, at once apparently timeless and yet also heavily reliant on ideas of change over time. Vivian Sobschack (1991) puts it well when she describes children as equally futuristic and nostalgic.

Next up: 'science'. Traditionally science has been considered not only as a reasonably consistent state, but a status to be sought after, achieved through proper application of the 'scientific method'. Philosophers have argued over what this method might be exactly, but the sense that there was, somewhere, a consistent criterion for scientific status was (and in many places still is) generally assumed. Karl Popper's (1963) 'demarcation criterion' of falsificationism is perhaps the most well known (see Chalmers, 1999, for elaboration). From the 1970s, sociological work in what became known as 'Science & Technology Studies' started to problematise this view. Inspired by Thomas Kuhn's (1970) contention that science was signified not so much by method but by its 'revolting' progress and Robert Merton's (e.g.1973, part three) sociological studies arguing that science articulated itself less through 'method' and more through a set of social norms, proponents of the so-called 'Strong Programme' (e.g. Bloor, 1976) aimed to challenge the idea that science was in any way a fixed entity, but rather socially constructed and highly variable over time. What the sociologists aimed to do was to go and look; to study what science actually was

in all its inconsistencies and complexity, rather than assume the ideal types of philosophy held true in action. Indeed, Collins and Pinch (1982) argued that workers in so-called fringe or pseudo science not only met the explicit requirements of 'the scientific method', but often more so than the conventionally accepted members of the scientific community. Thus, being 'scientific' or not is largely as a matter of cultural position and social agreement.

Particularly influential in contemporary science studies and pertinent to this study is Thomas Gieryn's (e.g. 1995, 1999) work on the cultural boundaries of science, in which he also coins the useful term 'boundary work' to describe active articulation of symbolic social boundaries. Gieryn depicts science 'cartographically' as analogous to space on a map; science is of a transient cultural space, its characteristics are selectively and inconsistently constructed incrementally (and variably) through a series of border disputes with characteristics around it:

> Mount Science, located just above the town of Reason in the State of Knowledge, which is adjacent to the States of Fine Prospect and Improvement, across the Sea of Intemperance from the State of Plenty, all this on the other side of the Demarcation Mountains from the towns of Darkness, Crazyville, and Prejudice, and the islands of Deaf, Blind and Folly (Gieryn, 1999: 6)

In many respects Gieryn's approach is a somewhat dialectical study into the ways in which binaries define social objects. Although this is not a point made especially explicitly in Gieryn's own work, one of the key advantages of the cartographic approach is that territories tend to work several boundaries at once (see Bell, 2007a). Moreover, maps not only depict boundaries and distinction, but articulate shared space too; they show us where two points lie next to each other, side by side as well as apart.

Predating Gieryn's cartography, Ian Mitroff (1974) uses a rather straight reading of Merton's sociology of science to emphases scientists' dynamic alternation between 'norms' and 'counter-norms' of science. For example, the norm of 'organised skepticism' works alongside its counter-norm, 'organised dogmatism': scientists believe they should always be open to new ideas and question old ones, yet at the same time the notion of what is a 'scientific question' is heavily framed by how neatly it fits to conventional theory. For example, scientist

and children's writer Russell Stannard reflects a sense of science as organised scepticism/dogmatism in his *Uncle Albert* books (1988, 1992, 1994). Reflecting this, he splits the image of Einstein in two: a child character named Gedanken and her eponymous Uncle Albert. Gedanken's questions and youthful imagination drive the books' narrative, but she always works within her uncle's authority and experiential knowledge. Albert points out how other people have already answered her questions and frames her exploration (she discovers scientific worlds inside a magic thought bubble he creates). Crucially for the plot of these books, and I believe for Stannard's philosophy of science, these characters require each other; the scientific work they achieve would be impossible without both of them (see Bell, 2007c). This is hardly a deliberate aim to show indifference to norms of behaviour, but rather reflects quite everyday inconsistencies (for this issue more broadly than just scientists' talk, see Billig, 1996: chapter 8).

Thus, the child and science are both clearly variable and multiplicitous cultural entities. However, it is interesting to note that they are both subjects that have, at the end of the 20th century, been described as being 'under threat' in some way: the Science Wars (see Labinger & Collins, 2001) and a perceived End of Childhood (e.g. Postman, 1994). Arguably both were largely momentary non-events, the controversies of which have largely settled down to be unpicked by social and historical scholars (e.g. Leane, 2007, Broks, 2006, Prout, 2005, Buckingham, 2000a). Still, notions that either science or the child might be under threat from aspects of post/late modernity remain in public discourse. Moreover, both (non)events at least underline not only a suggested 'crisis' in childhood/science, but also a desire to maintain a form of singular identity.

Power and Boundary Articulation

Who is allowed the power to suggest the perimeters of cultural categories is a key topic for both sociology of childhood and that of science. In terms of science, it becomes a matter of who gets the right to define what is real. This can have huge ramifications in questions of science policy or, as with genetics, personal identity. As Gieryn emphasises, 'Cultural cartography is not idle play with Venn diagrams' (Gieryn, 1999, 12). Just as a map provides a traveller with physical directions, the cultural cartography of what we commonly agree is science is used as shorthand when faced with a range of practical decisions (e.g. do we give our child an MMR

vaccine; is a hybrid car worthwhile?) To Gieryn, 'science' is 'the winners' map' (Gieryn, 1999: 17). Bruno Latour (e.g. 1987) takes a similar view, though his theory relies upon the enrolment of a range of material and 'semiotic' actors into production of what counts as science (see Prout, 2000, for an application of this theory to thinking about the child).

Probably the biggest theoretical influence on this thesis is the work of Pierre Bourdieu. His metaphor of choice for considering the movement of power around, within and between what he calls 'cultural fields'[3] is an economic one, suggesting that we all have a form of symbolic 'capital' which we earn, exchange and lose as part of our day-to-day social life (e.g. Bourdieu, 1986). The notion of such 'cultural capital' is broad; its symbolism may exist within material objects (i.e. books) but it can also manifest through more apparently immaterial symbols, such as notions of authority or prestige. Cultural capital only has value if accepted by a field; what constitutes capital in some contexts can actually be negative in others (e.g. a scientist's research credibility falling when they do public communication work). How much power you have within a field depends on how much cultural capital you have, but, crucially, the more power you have also allows you some role in defining what the cultural capital might be (see chapter seven of Ball, 2003, for elucidation of this in application to contemporary education issues). This is why science is a map drawn by winners, or why adults largely define the notion of the child; they have the power, the cultural capital, to exert their opinions.

Expressing cultural capital is an important way of maintaining it; capital does not work simply by being kept in a bank. Bourdieu's (1984) work on art, in particular, argues that the ability to articulate a particular appreciation of the values of a cultural field (such as visual art) is a key way of expressing one's class status. Further, capital breeds capital, as perhaps most notably discussed in the context of the power struggles around a university campus (Bourdieu, 1988). Here, Bourdieu argues that we can see powers at work that are both competitive and complementary, that are, in some respects at least, accomplices (Bourdieu, 1988: 112-3). This is noticeable between disciplines, but also at the 'chalk face' of educational encounter, as students are happy to submit to the symbolic violence of

[3] In some respects, similar to Gieryn's cartography, cultural fields are a series of people, their organisations and the various status symbols that surround them. They tend to constitute a hierarchy, and will produce, sustain and authorise certain ideas about the world. The perimeters of a cultural field generally stem from some conflict between groups or individuals, but they are fluid and dynamic rather than stable.

being inferior because doing so allows subsequent admittance to a distinguished club of graduates (Bourdieu, 1988: 90-94). It might be imagined that education acts as a space for the changing of cultural capital patterns; e.g. working class children can make up for the financial capital they lack by developing cultural capital at a Grammar School. However, Bourdieu and Passeron's (1977) classroom studies argue that the low cultural capital of working class children means they are continually likely to fail (although this might be read as being 'low ability') whereas the extensive vocabulary and wide-ranging (high) cultural references provide middle class children with resources to 'do well'. This work focuses on the idea of 'symbolic violence', that is when an agent is treated as inferior or denied resources in some way. Importantly, this involves some complicity on the part of the victim who is unlikely to perceive it as violence rather than simply 'the way of things' (a state which Bourdeiu dubs 'the habitus').

There is, however, an alternative to all the competitive imagery of, in particular, the science studies theorists. In response to Latour, Star and Griesemer (1989) ask us to consider the spaces and objects between science and other groups as opportunities for communication and multiple views, not simply as locus for conflict and the declaration of a singular philosophy. They coin the term 'boundary objects' to refer to items of shared space that several different groups can, simultaneously, use, spend time with and find meaning in. They suggest libraries as an example of spaces built to deal with problems of heterogeneity: ordered piles, indexed in a standardized fashion so that people with a host of agendas can use or borrow from the pile for their own purposes without having to negotiate differences in purpose (Star & Griesemer, 1989: 410). It should be emphasised that this approach is in many ways rooted within a Latourian theory of science, and does not seek to argue against the existence of boundary disputes. Rather, it aims to add a layer of subtlety and emphasises that difference is not always about dialectic battles and repression. Bowker and Star (1999), in particular, make reference to a more Foucauldian idea of power as, at once, both enabling and repressive.

Transgressing Boundaries

As well as the Foucauldian anchoring of Bowker and Star, another possible response to boundary objects is to apply Basil Bernstein's (1975) idea of 'invisible pedagogies'.

Bernstein, a sociologist of education, draws his readers' attention to non-traditional classroom spaces where there is an apparent loosening of the process of symbolic classification: a teacher arranges the context of the child's exploration but (rhetorically, at least) the child apparently has very wide powers over how they select and structure their own movement around the classroom. In drawing our attention to such classroom organisation (or rather apparent lack of organisation), Bernstein argues that despite their rhetoric, these looser styles are just as didactic as the more traditional education. Within such systems, which he calls 'invisible pedagogies', the hierarchy is implicit. Students still have to do what the teacher wants, but they do so through games of second-guessing what this is. Thus, Bernstein argues, rather than opening up educational success to everybody (not just those who keep to the regulations), by acting 'invisibly' such approaches to education act to favour the middle class child who has already learnt to play by these rules at home. He further argues that the invisibility means it goes unquestioned and even acts to naturalise ideas of what is appropriate or not in school; effectively naturalising what it is like to be middle class. Importantly the teachers in such cases are acting in 'good faith'.[4]

As an adjunct to Bernstein's warning to beware of invisible pedagogies, it is worth extending a similar awareness not just to the apparent blurring or loosening boundaries, but also the explicit breaking of them and claims for the ability to move amongst them (that is, to be, oneself, a flexible boundary object). Much has been made of the power of transgressing boundaries, especially in respects to Mikhail Bakhtin's (1968) notion of the 'carnivalesque'. In Bakhtin's view, the carnival's parody, playfulness and non-conformity subverts social hierarchies to provide an alternative reality to dominant officialdom; its laughter is a form of political resistance. Similarly, there is an attractive power in the various uses of a communicative boundary object. For example, Chris Jenks (2003) suggests the child as a sort of liminal cultural actor, arguing that the 'interstitial' nature of childhood can be utilised as a disruption of dominant ideologies of the status quo (for a slightly more subtle take on this see also Jenks, 2005). Jenks argues that this is not a Romanticisation of the child, based on assumptions of childish 'innocent creativity', but is rooted in post-structuralist ideas of positive transgression. However, I fear he is being naïve. Moreover, he is in danger of romanticising transgression. I do not wish to argue against the many advantages (intellectual and political) of either transgressing

[4] Some readers may note comparisons between this and Foucault's (e.g. 1977) sense of a disciplinary power structure playing out through the construction of freedom. There are interesting points of comparison between Foucault's work on discipline and Bernstein, especially the latter's original (1971) paper on curriculum codes.

boundaries or situating oneself between them, just we should beware of over-valorising a lack of deference for symbolic boundaries.

As mentioned in my introduction, to appear critical of the status quo has become a normalised part of contemporary cultural products. As Gauntlett's (1996) application of Adorno emphasises, this can be interpreted as the cultural industries providing an impression of having disagreed with something. This impression fulfils the audience's desire to complain and thus lulls society into inaction. Gauntlett argues such production strategies are a reaction to the greater sophistication of audiences who seek at least some illusion of the critical in their cultural experiences. As an extension of this, explicitly eschewing boundaries appears to have become normalised to the point where we have to at least nod to them in order to be taken seriously. Commodified, it becomes a resource for reproducing and reasserting power as well as gaining, overthrowing or questioning it. This is not that new: as Rob Shields's study of the history of Brighton beach (in particular, 'saucy' postcards) convincingly demonstrates, Western culture has long sought a 'capitalistic pseudo-liminality [...a] wink at transgression' (Shields, 1990: 52, 58).

Sarah Thornton (1995) provides a useful application of the term 'subcultural capital' (a development of Bourdieu's term) to discuss late 20th century youth culture. She positions herself 'post Birmingham' in terms of a study of culture, concerned that many cultural studies theorists have been under critical of sub-cultures; distracted by their apparent ability to contest dominant ideologies. Instead, Thornton goes back to sociology's Chicago School, especially research into aspirant jazz musicians' use of the word 'hip' against other people. She also refers to 1960s work on Beatnik culture, which found not only a distinction between hip and square, but the derogative use of 'hipsters' (people trying too hard to be hip) (Thornton, 1995: 185). Thornton suggests that although youth cultures have always have wanted to distinguish themselves, there is even more distinction going on in late 20th century western culture, emphasising that the people she studied were in many ways 'Thatcher's children', well versed in the virtues of competition. Moreover, whereas youth cultures of the mid-20th century might have seen distinction as a way of emphasising difference in a way that celebrated dissidence, by the 1980s, consumers were so used to being prompted to individualise themselves for the sake of the market, it was hard to regard processes of distinction as necessarily progressive (Thornton, 1995: 191).

Within the specific context of science, the celebration of revolution as a power

against stagnation is central to much thinking about intellectual progress, especially post-Kuhn. Indeed, a form of applied Kuhnian notion of science can be traced through Stannard's use of the child 'Gedanken' character in his Uncle Albert books (see Bell, 2007c). Elizabeth Leane's (2007) study of images of scientists within popular science writing further shows that an appeal to the transgressor is not just one applied by explicitly 'radical' scientists such as Rupert Sheldrake, but can be a key part of self-fashioning the scientific establishment. Leane provides the example of Richard Feynman, suggesting he constructs a popular image for himself as a 'social naïf'. Behind stories of asking for lemon and cream in his tea is an image not only of a comical absent-minded professor, but the boy[5] who saw the emperor's nakedness; one who can debunk unnecessary or cruel social practices in order to find the efficient, true and (morally) right way ahead (Leane, 2007: 151).

Again focussing more on liminality than transgression, Paul Sweetman (2003) combines Bourdieu's concept of the habitus with Giddens's sense that identity is increasingly reflexive to suggest that people seem increasingly to possess a flexible (and reflexive) habitus; the re-fashioning of our self has become 'second nature'. Sweetman notes his debt to Mike Featherstone's description of types of middle class identities that are highly aware of the range of experiences open to them, and declare this through a frequent lack of anchoring in terms of a specific locale or community, exhibiting a refusal to be classified and resistance to fixed codes (Featherstone, 1986: 163). Here, the ability to act as a boundary object has become a way of presenting a form of cultural capital. Elsewhere, Featherstone (1992) suggests that some members of the middle-classes exhibit an aesthetic for 'controlled de-control', a sort of allusion to transgression. He suggests that images of the grotesque body appeal to such an aesthetic because having Othered such images in the construction of appropriate middle-class identity, the grotesque now becomes a romanticised Other, nostalgically desired as a site for lost authenticity (Featherstone, 1992: 283, 285. See Featherstone, 2007, for both articles. Stallybrass & White, 1986, make a similar point). Crucially, none of these citations are especially new, and Featherstone in particular stresses the historical roots of such aesthetics. As such, it is perhaps not surprising that these forms of (sub)cultural capital may have found their way into the generally conservative area of children's non-fiction.

[5] Leane does not reflect the use of a childlike characterisation here, but such application of the innocence of the child is worth noting.

Conceiving of 'the public'

As sociologist David Chaney neatly puts it, the public is largely 'a rhetorical figure, both as a mode of address and as a form of social being' (Chaney, 1993: 127). It is strategically applied, to a variety of sometimes contradictory meanings. In the specific contexts of children's and science media, the public is largely an exclusive category (despite also supposedly meaning everyone). By this I do not mean that the public is a hard group to get into, rather that it is defined by what is excluded. They (and it is 'they') are the leftovers once the process of exclusion has taken place. This rhetorical entity of the public is very easy to use, generally applied to denote something vaguely existing elsewhere without actually having to specify; to suggest a sense of distinction without necessarily having to define exactly how. David Buckingham's (1996) study of children's emotional responses to television notes that parents and children he interviewed might believe television or film violence could be damaging to children, but it was always 'some boy in Scotland', or 'it influences them in America' (Buckingham, 1996: 61-2). Additionally, the children subscribed to what Buckingham dubs 'lay theories of development', in which they suggested that younger children were more likely to be upset (Buckingham, 1996: 83-4). The public, in this context at least, always exist elsewhere. To explore this in more detail I first discuss a brief history of science's publics, then the audiences of children's literature.

Science and its Publics

The apparent gap between science and the public is one that is often seen as problematic, as articulated most famously in CP Snow's (1959) iconic *Two Cultures* speech. In the last twenty years or so, especially within the UK, there has been a marked step-up in projects to mend assumed gaps between science and the rest of the world. As Gregory and Miller start their still-relevant introductory guide to science communication, 'scientists have been delivered a new commandment from on high: thou shalt communicate' (Gregory & Miller, 1998: 1). Indeed, a whole industry for science communication has emerged largely as a consequence of the so-called 'Public Understanding of Science' (PUS) movement, which largely codified around Walter Bodmer's (1985) report on the subject to the Royal Society. Reflecting the religious language Gregory and Miller dryly apply, there is a sense that public understanding of science work is done out of the goodness of the scientists' hearts. Thomas and Durant (1987) list, manifesto-like, the reasons for PUS – greater

democratic engagement, a better economy, happier people – presenting a somewhat utopian vision rather more suited to Snow's 1950s. The lay 'public' of the PUS conception of the world (and they really were 'lay' – PUS happily borrows from the religious) were in dire need of science and the science communication industry could prove nursemaid (PUS also happily borrows from medical language).

As many in science communication studies have since made careers out of saying, there is much wrong with this approach to science in society. Several researchers, notably Brian Wynne, have argued that such an orientation has substantial practical problems. In particular, Wynne's (e.g. 1992) seminal study of sheep farmers argues that characterising lay publics as ignorant not only makes them disinclined to listen, but loses out on key political points of view and even key evidence about the natural world. Limiting ourselves to purely scientific ideas under-determines not only public policy, but science itself. Many also complain that PUS characterises the public as recipients of knowledge, noting their 'deficit' in scientific knowledge. It discounts the possibility of non-scientists making their opinions known, or even having opinions in the first place. It creates a tight boundary around those who can articulate true, reliable knowledge. Stephen Hilgartner neatly articulates the problem when he argues that PUS provides the scientific establishment with 'the epistemic equivalent of the right to print money' (Hilgartner, 1990: 534). To views such as this, the whole notion of popularised science acts to emphasise that there is a gap in need of bridging (see also Bucchi, 1998b, Dornan, 1990). Science communication may explicitly exist to connect disparate cultural spaces, but its very existence only acts to emphasise it: as if the scientific community only invited the public to play in order to reinforce its most powerful boundary. From such a view, it is no surprise that popularised science first emerged as the most significant stages in the professionalisation of science were taking place.

The counter-PUS arguments of Wynne and Hiltgartner had some impact, at least to the somewhat closed community of professional science communication who soon came to feel uncomfortable in the patronising stance of the deficit model (at least on the surface). As a consequence, PUS as a movement is largely dead, mentioned only with the tone of voice its unfortunate acronym suggests. One alternative has been to replace the perceived need for scientific information with one for the social studies of science, what Durant (1993) calls scientific literacy as knowing how science 'really works'. This was perhaps most cogently articulated in the alternative popular science Golem books (e.g. Collins & Pinch, 1993) and the

STS-education projects I discussed at the start of this chapter. There is, arguably, a qualitative difference between an STS curriculum and a science one, and the former may well be of more help for non-scientists debating science policy (discussion in Bell, 2004). Still, as Simon Locke (1999b) notes, we could read the Golem as simply replacing the public's presumed science deficit with a sociological one. A less didactic alternative is the 'Dialogue' movement, or Public Engagement with Science and Technology (PEST), an approach in many ways now enshrined within UK science policy (House of Lords, 2000). Work advocating dialogue and engagement suggests the equal meeting of science and the public. At least this is the explicit aim. As Brian Wynne (2005) argues, such work may go under nomenclature of participation or dialogue but this can be read as a mirage, hiding a very traditional PUS message. As I have argued with others elsewhere, virtually all 'post-PUS' projects can be used as cover for quite old-fashioned forms of empire building; whether such empires are scientific institutions, business, left- or right-wing politics, individual scientists, science communication professionals or sociologists (Mellor, Davies & Bell, 2008: 5).

Further, recent work from historians of science has started to critique the idea that 'popularised science' simply exists because its implication of ignorant lay audiences helps define a sense of the professionalised, specialist expert. For example, Fyfe and Lightman's (2007) collection of essays on 19th century popular science, *Science in the Marketplace*, characterises the audiences of popular science not as an othered 'public', but rather as consumers. It is important to note here that they are applying a sense of consumer identity as a relatively powerful one. They propose the idea of the marketplace not only as a description of what was happening in popular science, but as a metaphor for thinking about expertise. To Fyfe and Lightman, the consumers of scientific culture in the 19th century were increasingly aware of the range of forms of expertise and the different, competing, ideas on offer. As well as choosing which products to partake of, such consumers had the ability to choose which ones to trust and how far (Fyfe & Lightman, 2007: 12). This is an approach to the consumer I only half subscribe to. As Fyfe and Lightman argue, customers are not simply passive dupes. However, they are not all-powerful either. Still, I find Fyfe and Lightman's take on popular science useful, largely because it focuses attention upon the audience's desire (even clamour) to be provided with popular science content.

For some recent empirical work on the subject, Sarah Davies's (2007)

analysis of scientists' talk argues that scientists make use of a wide repertoire of discourses on the public, it is not simply formed by PUS modelling (i.e. not only as we described in, for example, Irwin & Wynne, 1996, 215). Interestingly, her study compared scientists' talk about the public with ethnographic studies of so-called 'dialogue' events (a form of PEST), and she found versions of the deficit model being used in the talk of 'public' audience members too. Micheals and Brown (2005) also find examples of 'publics making publics' (i.e. a range of definitions of 'the public' used by people themselves in a form of 'public' identity), and Harvey (2007) notes what he calls 'citizens' happily defending the hierarchical status of scientific knowledge above others. It is worth noting that Davies's research into dialogue took place in a rather odd 'non-policy dialogue' location of the Science Museum's Dana Centre; that is, without the policy outcome most PEST work is designed for. This is dialogue as a form of edutainment, play with public participation over a bottle of beer from the 'design-led' bar. We might read Davies's data of a public comfortable with discourses of the deficit model as a simple matter of Bourdieu's habitus. However, Buckingham's (1996) interviews with children suggesting the media only affected others seems to resonate. We could also argue that, as in Bourdieu's (1988) reading of the university, there is something to be made from defining yourself as stupid in respects to another. Here, capital breeds capital; allow others to amass more cultural capital through a hierarchical encounter with you, and in turn receive some for yourself for having gone through the process. It is PUS reconfigured to meet the desires of the 'reflexive habitus' of the 21st century middle classes.

Imagining the Youthful Audience

As several critics of children's literature have argued, most notably Jacqueline Rose's (1994) study of the 'impossibility' of children's literature, the key problem for this field is the apostrophe: children do not really own children's books, adults do. Children's literature scholar Peter Hunt emphasises that the medium is especially susceptible to control at all stages of its production. Hunt borrows a metaphor from children's author Alan Garner, suggesting that writers, editors and parents (along with librarians, teachers, booksellers) are dominos, falling upon the unsuspecting child reader (Hunt, 1994: 163). Even writers aiming at a 'child-centred' approach will draw on their own childhood; the memories of which may well, in turn, have been influenced by books they have read. Alongside the 'generational hegemony' exerted as adults compose children's media content, are questions of adult censorship over

what cultural products young people might be allowed to consume. It is often assumed that children are somehow more susceptible to media influence. Aiden Chambers, for instance, argues that there is a difference between the way children read and the approach taken by more 'mature' readers who have learned how to put aside their own ideas, for the sake of reading a story, in order to take on the ideas of the text, 'becoming part of it while at the same time never abandoning their own being' (Chambers, 1985: 93).

It may be true that young people are in some respects aspirational in their consumption of culture, often coming to media products with a desire to learn, especially considering the educational context of much of children's reading. But being ready to change themselves, does not mean they will, in Chambers' words, unthinkingly 'abandon their own being'. David Gauntlett (e.g. 1998) is fond of listing his 'ten things wrong' with an effects model (see also Gauntlett, 1995, for extensive literature review in respects to television). To summarise his position, in addition to the class issues outlined above, such models tend to inadequately define their own objects of study and, without founding, will extend them; e.g. by bundling 'violence' together as a whole rather than distinguishing between types or context or assuming hitting a doll is the same as hitting a person. Effects models tackle social problems backwards, because they begin by assuming the cause is known, rather than starting with an exploration of the phenomenon in question (crime, violence, hatred of science). They treat children as inadequate, assuming they cannot have a meaningful sense of the media themselves, yet at the same time presume some people (e.g. the researchers themselves) can remain immune. In contrast to effects research, those who have investigated children's responses to the media have found high levels of critical awareness of the workings of the media, and even a ready desire to communicate this, as well as the use of a range of strategies to distance themselves from more upsetting content (e.g. Buckingham, 1996, Sarland, 1994ab).

At least in some places, worries about sex or violence in children's media have been eclipsed (or subsumed into) concerns over the role of consumer culture in children's lives. Worries about branded youth (e.g. Quart, 2003) often assume an all-powerful industry, exploiting young people. Moreover, commercialism and the 'true' meaning of literature are often assumed to somehow at odds. As Reynolds and Tucker note, with more than a degree of scorn, 'so hard does the marketing tail wag the publishing dog' that the very nature of creating fictional characters is beginning to change as books are produced about toys, even books of films of books (Reynolds &

Tucker, 1998: xii). As I shall discuss in more detail in chapter three, I think such divides between literature and commercial culture are largely illusionary. Further, as the above quote suggests, the perceived advent of commercialism in children's publishing (which Reynolds and Tucker seem to date as starting around the 1970s) implied literature was being 'polluted' with other media forms. In contrast, Andrew Burn (2005) argues from a study of the various media products of *Harry Potter,* that young readers employ a 'multi-literacy' approach to texts, understanding stories and characters through a mix of computer game, toy, book and filmic representations. Burn concludes that it therefore behoves researchers to consider how games, books, films and other media all work together to build stories in the minds of young audiences (c.f. Lewenstein, 1995, on multi-media construction of science).

Here, I want to make semi-methodological point in respect to my approach to children's media. This research takes as central focus a set of books, but contemporary children's culture is embedded in other media and we should not take a literary-reductionist view. Moreover, as we shall see, *Horrible Science* is not only a multi-media brand, of magazines, live shows, a website, CD-ROMS and boxed toys as well as books, but it assumes that its readers are highly aware of other media, as the books continually reference film, television and adverts (though not, interestingly, digital culture). I do not mean to suggest that their status as a book has no symbolism. Book media have their own special distribution roots and cultures, and audiences come to a book with a different set of expectations for use than they do, for example, a website; *Horrible Science* plays on this as much as any other publication. My point is rather that our analysis should not aim to maintain or build a sense of the book as inherently special (though we may note other people applying such ideas). Thus, this study applies scholarship from children's literature studies and research specifically into book culture, but also draws extensively on research into children's television, film, games and classroom experiences.

To many critics of children's culture, something else other than simply literary value disappeared with the presumed 'advent of commercialism' in children's publishing. Reynolds quotes publisher Kaye Webb, from Puffin: 'The feeling of responsibility has gone, and it's been replaced by making money and selling any kind of book' (Reynolds, 1998: 34). Yet, as Reynolds herself notes, even such well-meaning pre-1970s publishers tended to produce books about white, middle-class, educationally successful boys (Reynolds & Tucker, 1998: 30). Read thus, such change is not so much a matter of children suddenly being exploited, just a slight

shift in those who hold power. What is noticeable is a change in the narrative address of children's media, from roughly the 1970s onwards. As cultural industries targeted children more directly, they would often do so by way of suggesting children want or need something very distinct from adult culture (see Kenway & Bullen, 2001, for critique of this). Children, and the appeals of their media, seem to be defined primarily in terms of being not adults. As Buckingham describes the talk of *Nickelodeon* executives:

> Adults are boring; kids are fun. Adults are conservative; kids are fresh and innovative. Adults will never understand; kids intuitively *know* (Buckingham, 2000a: 96).

This is not just some insidious marketing tactic; children's authors are often well versed in the politics of their work and will draw on generally left-wing political ideas to argue that they are better than old-fashioned paternalism which would speak down to children. Terry Deary's accounts of his attitude to children's writing are indicative of this; proudly stating that he will publicly laugh at editors such as Webb – middle-class, middle-aged southerner women who can't really relate to their audiences. Moreover, when imagining his readership, Deary seeks to take on the mantle of an 'ignorant person' sharing the excitement of finding out something new; not so much a teacher as 'a big kid' who wants to share fun information with other kids (Deary, 1999: 96). Yet, for all the apparently egalitarian stance of such views, it is still an adult's idea of what children might like. As Buckingham (1995) argues, the post 1970s children's television presenters who suggest themselves as 'down with the kids' are still presenting a particular (adult) idea of what the child is. Thus, narrative addresses such as the ignorant enthusiasts/never-a-teacher that Deary adopts can still be read as indicative of the 'impossibility' of children's media, just with an added layer of sophistication as they aim to eschew the now easily-visible paternalism of old fashioned styles.

Methodological Notes

The first point to emphasise is that this is an exploratory study. It is largely concerned with the development of ideas and arguments. It does not set out to prove or disprove a hypothesis on social reality. I hope that time spent exploring this case study in children's science culture will enrich future empirical work.

Just as Gauntlett (e.g. 1995) complains that one of the failings of the 'effects model' of audience research is that it tends to be under-theorised, jumping into ill-thought out hypothesis, I felt there was something simplistic about many conceptualisations of science in culture, especially when it came to children's culture. As both a science communication student and practitioner, I wanted to think reflexively about my work with children. However, avenues for research tended either to seek proof for whether or not children liked science, or hoped to discover a singularly efficient way of feeding young people scientific information. Classic examples of the former include David Chambers' (1983) study asking children to 'draw a scientist' (see also Frayling's, 2005, recent repeat or Mead and Métraux's, 1957, original). Although such studies provide some empirical evidence that children are aware of the existence of stereotypical images of scientists, they tend to make broad assumptions as to the images' origins, and provide little discussion of whether children hold such ideas about science outside of the rather odd context of being asked to draw a scientist.[6] Work about children in science communication studies already cited (e.g. Mares et al, 1999) provides further examples of such a narrowly-conceived view of the possible interpretations of science and reasons for interacting with that it children might have.

From my own everyday empirical experience of working with children and the adults who mediate science for them, I suspected more was going on, and that there was more to learn. Thus, this work aimed to identify a complex case study in children's science culture, and use it to re-examine ideas about science and the child with the hope of finding new avenues for future research. I should also add that this work is less about what children think or feel about science and more about the ways in which adults choose to talk to children about science. To me, this is one of the logical consequences of Rose's (1994) contention about the 'impossibility' of children's literature. Children's media says more about adults' ideas about children than it does about the ideas of actual children; why not use it to learn about these adult ideas? None of this is to say that children's ideas are not either assessable or interesting to research; simply that adult views are too.

I chose a book-based case study because I personally found the medium

[6] Whitelegg et al (2008) have recently applied a more methodologically-knowing variation in respects to gender and the portrayal of science on children's television. This does however come from the particular (although by no means undertheorised) perceived problem of women's participation in science.

absorbing to work with. Books also make for handy research subjects: they are neatly archived in libraries making them cheaply and easily accessible, they tend to stay reasonably still and at the same time they are relatively portable. This last attribute meant I could bring along examples of my case study when I presented work, providing hands-on examples and making it easier for my audiences to argue against me. I settled on *Horrible Science* partly because it is one of the major children's science book brands in the UK, but also because it talked about a range of sciences (not only 'physics' or 'biology') and used a mix of pictures, text and instructions for activities, all of which I hoped would make my findings more widely applicable. Moreover, from my initial scouting readings, it appeared to be selling itself as something different from traditional children's science books whilst also reflecting and reproducing some of the tropes of the genre. *Horrible Science* thus appeared to offer itself as a case study that was both an exception that unpicked some rules and yet also indicative of the genre as a whole.

I started off by reading the series as a whole, taking notes based on a set of topics. Or to use social science terminology, I developed a set of 'codes' for analysis. For example, as I read through the series, I collected all the references to science fiction. These codes reflected my initial thoughts at the sart of the project (e.g. I expected to find promises of interactivity and/or fun, a mix of images and texts, a range of images of scientists), but they soon developed to take into account new issues emerging from the data (e.g. the reliance on, and celebration, of humour, especially wordplay; how explanatory the cartoons were; images of teachers). For the sake of clarity, in presenting my findings I have adopted a 'theory, examples, conclusion' structure for most chapters of this thesis. However, I want to emphasise that my reading and coding was, throughout, an iterative process as I found new codes from both the analysis of *Horrible Science* and the literature review that I was undertaking at the same time. This literature review was in turn chiefly directed by topics I found in *Horrible Science*.

Because I was working with a live case study, it was especially important that I took an iterative approach. New books were published while I was researching and I needed to both take them into account and revisit older texts (and literature reviews) in the light of the new data. When new books came out, I would read them with reference to the old ones but would also look out for new themes of analysis, pausing to re-read the series as a whole when I felt it was necessary. I found the inclusion of new books useful in developing my analysis, and I am pleased that I had

not chosen to draw a line around my data set to exclude books published after a particular date. Equally, I am pleased I did not choose to sample within the series although this was tempting with such a large series. *Horrible Science* is nothing if not diverse, and considering the series in its (current) entirety allowed me to reflect on the rhetorical meanings of such diversity. Keeping up with the live series also allowed me to think about the way the brand has changed and developed over the years. I should note that the pantomime metaphor I use in this thesis was not part of the coding process. This only emerged at the stage of writing the thesis, and it is applied here as an expository tool to help communicate my ideas rather than as a structure for analysis.

The coding process allowed me to reduce the quantity of data to noteworthy examples, and helped to define what I felt was noteworthy by grouping together similar material to spot emerging themes. Perhaps due in part to the deliberately genre-blurring and multi-discourse nature of *Horrible Science* (as well as its delight in slippery wordplay) I encountered occasional problems with overlapping codes; for instance, the way *Horrible Science* intersects humour and horror alongside (in places) wonder. In the end I choose to define (admittedly contrived) perimeters to each topic so as to be able to manage and communicate my analysis. When they do occur in the thesis, I hope these overlaps are sufficiently highlighted. On occasion it was worth being precise about instances of particular issues and counting how many times they occurred. Still, this is by no means a quantitative study. Counting, when possible, simply allowed to me check the accuracy of my responses to *Horrible Science* as well as providing a degree of precision (e.g. was a feature actually in 'most of the books'?).

From the start it was clear that whilst *Horrible Science* may be rooted in a series of books, it is in many respects a multi-media brand. I therefore choose to take into account the various surrounding products, some of which are also books (e.g. teachers' resource guides) but many of which are boxed toys, such as jigsaws, produced by GALT or CDROMS given away free with cereal. I folded an analysis of these into my regular audits of the central series. As inclusion of these sources made my data set very large, to keep it manageable I anchored my analysis in the central series, only drawing examples from the other products when I felt they were especially illuminating. This thesis also draws some comparisons with other, non-*Horrible,* books. These are largely explanatory, and are not invoked as a representative sample of the genre. It is also worth noting that both *Horrible Science*

and my study of them are UK-based, and I have largely considered the series within the British publishing scene. The most successful children's popular science products have always crossed the Atlantic (and spread to other English speaking countries) and been translated into European languages, *Horrible Science* included. Still, *Horrible Science* is very British in its style of humour and cultural references and I therefore chose to contextualise them within a British setting.

Aiming to come to the books as social objects more than simply literary ones and keenly aware of literature's 'modes of production' (Milner, 2005), I also regularly checked their web-presence, searched international catalogues to track translations and the global reach of English language editions, explored a range of libraries and bookshops to see how they were displayed, and attended publicity events. I aimed to interview the publication teams, author and illustrator. I hoped this would give me insight into the ways in which the books were conceived and produced, as well as challenging my individual readings of them. For example, from my own readings I thought the books applied a reasonably seamless mix of images and text, and yet the illustrator described their development almost as two concurrent processes. Although I was successful in securing an interview with the lead illustrator and author of *Horrible Science,* the publishers ignored all my requests for interview.[7]

I conducted loosely structured interviews with the author and illustrator. I prepared similar questions for both, but these were more topics for conversation rather than questions I felt I required an answer to. I was conscious that they might find someone doing a PhD on their work hard to talk to, and did not want them to feel 'quizzed'. Also, I had no desire to check their answers against each other, so consistency between my question sets was unnecessary for my research aims. Once completed and transcribed, I incorporated the interview data into my data set, applying my iterative coding process to them as I had done the books and games before them. Although I have quoted these interviews occasionally in this thesis they probably had most impact at the level of developing codes. I would have liked to interview them both again (they were too busy) and I wonder if it would have been more useful if the interviews had taken place later in the process. Later interviews would have allowed me to use questions based on a more finalised set of codes, although they would have not been able to have so much impact on the development of the coding processes.

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[7] Oddly, Margaret Scanlon seemed to have the opposite problem with her research into the *Horrible Histories.*

To say a little about the mechanics of my reading; broadly, it was a process of reading reflexively. By reflexively I mean that I aimed to notice and reflect upon the signals to meaning that the books provided their readers in order to unearth some of the rhetorical strategies the books had adopted. For example, in chapter five I refer to the way that *The Body Owner's Handbook* (2002) has a slight storybook narrative, at least compared to the more magazine styles of the other books. Reading the book before starting the PhD, I felt it had a more satisfying end point than some of the others in the series, and it was easier to read the whole book rather than leaving the last chapter or two unread. However, as a researcher stopping to reflect on this, I noticed the way the book suggested itself as a cohesive whole by dressing itself up as a 'handbook' for using the human body. Further, I noted that the character of Dr Frankenstein and his boy monster provided a (very loose) sense of character development, and that both the *Horrible Science* body books applied a sense of the aging of the human body as part of their structure. These were the examples I then used in my analysis, and you will find them in chapter five.

In the course of this reflexive reading, I was helped by Fairclough's (2003) advice on analysing language and Kress and van Leeuwen's (2006) on reading images. However, it would be reductive to have simply taken a single 'method' from these authors. I have been influenced by an academic culture of ways of reading texts, and happily apply these approaches in the production of my own arguments, and I should equally be reflexive about this influence on my reading of my data set. As well as the post-Halliday take on linguistic analysis that I have followed via Fairclough and Kress, there were also specific theoretical influences on each specific topic, most notably work on comic art used in the chapter on fiction. My analysis also has roots in post-structuralist semiotics; post-structuralist in that I do not expect to unearth any 'deep structure' of truth in social reality, and semiotic in that it is concerned with interpreting signs and symbols. In particular, Barthes' (e.g. 1977) emphasis on symbols as denoting (wearing a white coat, glasses, male, white) and connoting (scientific) was useful, as was his application of semiotics to deconstruct 'mythologies' (e.g. unearthing the socially constructed nature of 'scientific'). In some respects this is a project in unearthing some of the myths surrounding children's science culture so that future research into this topic, and science culture in general, may be more conceptually rigorous.

Concluding Points

As emphasised in my methodological statement, this study is aiming to be exploratory rather than investigative. It provides ideas rather than evidence. I am aware that there is little opportunity for generalisation or reproduction. Still, even with such explicitly truncated reach, I believe such work still has value in what I hope will be an ongoing sociological investigation of children's science culture. The key reason for undertaking such an approach is to explore ideas that will, I hope, provide the basis for later empirical investigative work, a point I will return to in the thesis's conclusion.

In keeping with these exploratory aims, this chapter has been largely preoccupied with the question of symbolic boundaries around our construction of science and the child. It considered such boundaries both as means for expressing social distinction and as places where divergent groups find a 'common coin' to communicate. I also noted the ways in which cultural groups may apply a sense of breaking or subverting boundaries to enact a sense of social distinction. This chapter also considered the ways in which the 'public' are imagined, and I argued that this is largely a rhetorical figure anyone and everyone strategically spots elsewhere. To sum up this chapter's discussion of children's science culture, the few studies there are on children and science demonstrate that how we imagine (analytically or normatively) children's interactions with science depends on how we choose to conceptualise 'science' and 'child'. Generally, it is assumed that children are stupid, in need of scientific education, or at least that society needs children to receive scientific education if only to provide future scientists. However, as studies of children's science fiction have shown, people also (Romantically) conceive of children as good, pure innocent 'natural' beings in sharp contrast to the polluting and alienating evils of advanced science and technology. The connection between children and nature is something the scientific community may also appropriate for their own advantage; either to sell the study of nature to children or suggest themselves as childlike, as somehow culture-free or with a similar innate connection to nature. We might, variously, also think of children or science either futuristically or nostalgically, and connect or disconnect them accordingly. As we come to consider the specifics of the case study, such a breath of occasionally contradictory views are worth keeping in mind; *Horrible Science* is happy to sample any and all of them (see Bell, 2008, for fuller notes on child/science definitions of *Horrible Science*).

I want to end this chapter by looking to the rest of the thesis and drawing some key theoretical/methodological points that have structured my reading of *Horrible Science*. Firstly, the cultural categories 'science' and 'the child' are both socially constructed and variable cultural entities, and are strategically (or at least subjectively) applied to produce a range of different ideas over what a child's relationship with science should be. Additionally, multiple understandings of these topics can co-exist at once. Secondly, children's media is largely the output of adults and as such reflects adults' *ideas* of the child rather than actual children. It is still interesting despite this. Thirdly, contemporary media, especially those aimed at young people, are best understood through a multi-media approach; though the specific social images of each medium should be acknowledged (e.g. books have a different, arguably higher, cultural status than television). Finally, media seeming to exhibit a critical discourse can be read as a rhetorical strategy to support the status quo; ditto apparent boundary-blurring and liminal or 'bottom up' educational or participatory devices (i.e. beware of invisible pedagogies).

Chapter 2
The Case Study

Introduction

When *Horrible Science* arrived on the bookselling scene in 1996, it was reasonably novel, at least applied to science (its historical older brother, Terry Deary's *Horrible Histories,* had been running since 1993). This *Horrible* tag has a double meaning: it alludes both to the way children are assumed to feel about school-taught subjects (ewww, *history* homework) and to a promise to dwell on what adults are assumed to find disgusting (e.g. gore, not especially brave, clever or nice people, disease). In both cases, it is largely applied ironically: you think science is horrible, but it is really lots of fun; adults would say 'horrible' content should be avoided, but we really know it is what you want to find out about. The books promise not to overwork or overtax the readers, with introductions heavily distancing themselves from the tedium of school. Yet, at the same time their content is suffused with quizzes and lesson-learning activities. In that respect, the books offer the standard (and somewhat patronising) address of child-orientated edutainment; this is learning without even realising. Humour is deployed to prevent boring the children and against the traditional authority figures around the subject. In the science series, teachers are typically the butts of the jokes, with a few historical figures laughed at too. In the original history series, the targets are more likely to be the traditional heroes of history. Whereas traditional children's popular non-fiction invites reverence for knowledge and conventional modes of knowledge construction or dissemination (i.e. scientists and teachers), the explicit tone of the *Horribles* is irreverence. Additionally, whereas traditional children's popular non-fiction sells itself on a promise to provide readers with access to mainstream expertise, the *Horribles* allude to the apparently privileged view of an outsider perspective.

This chapter hopes to contextualise *Horrible Science*, and preview some of the types of examples to be found in the rest of this thesis. It starts with an

introduction to *Horrible Science*; I provide a brief overview of the series, talk about its history through a description of Deary's original series, and then provide some more detail on *Horrible Science*'s content and style. I then move onto a section discussing other traditional types of children's popular science. This chapter then finishes with a short section discussing the pantomime metaphor with which I have chosen to frame this study, and I conclude with a brief overview of how the idea of pantomime science will work its way through the rest of this thesis.

Introducing Horrible Science

Horrible Science started in 1996 with *Ugly Bugs* and at time of writing (summer 2008) consists of 36 book titles, along with a range of associated toys, games and magazines. *Ugly Bugs* was soon followed by *Blood, Bones and Body Bits.* These science books are a spin off of the larger *Horrible Histories*, and their publisher, Scholastic, produce similar 'humour/non-fiction' titles under the sub-brands *Horrible Geography*, *Murderous Maths, The Knowledge* and *Dead Famous*. At the centre of *Horrible Science* is a series of novel-shaped books, all reasonably cheaply priced by the standard of children's non-fiction (under £5, often on BOGOF or 3-for-2 deals). The brand also includes 'specials', either thicker novel-shaped books, or ones that feel more like exercise books, coffee-table books, hardbacks and, more recently, shorter and squarer full-colour 'handbooks', complete with wipe-clean covers. The books have recently undergone a re-brand, with covers pared down to more simple illustrations upon lurid neon-coloured backgrounds (fig 2.1), and their content augmented with added indexes and extra quiz questions.[8]

As a whole, *Horrible Science* covers a broad range of scientific topics. Each book takes an area of scientific concern, such as electricity, diseases, poison, plants or time. The books are aimed at schoolchildren around the ages of eight to eleven, and these topics are often linked to those of the school science curriculum (e.g. sound, light, electricity), with additional titles focused on animals, medicine and invention in some ways reflecting the non-school relationships children might have with science and technology. They promise an unusually fun approach to science; as their promotional tag line repeats across the brand, it is 'Science with the squishy bits

[8] The re-brand happened as I was at a 'writing up' stage of my research (and is still on-going), so there is a limit to how much of the new content could be included into this study. However, it is worth noting that there are only very few differences between old and new *Horrible Science*. It is largely a matter of the re-drawn covers, indexes and quiz.

left in'. This appeal to humour is always upfront, emphasised in the books' introductions, which act as a sort of cross between classical prologue and PR material, inviting readers in. These introductions also make promises of the utility of scientific knowledge and the wonder one might feel when learning about the natural world. They readily apply references to fiction and some quite fantastical explanatory devices; for example, shrinking a character so it can travel inside the body, or a filmic reference to 'meet the atom family'. The fiction is often celebrated as part of the fun, yet it is also always contextualised as 'make-believe', distinguished from facts.

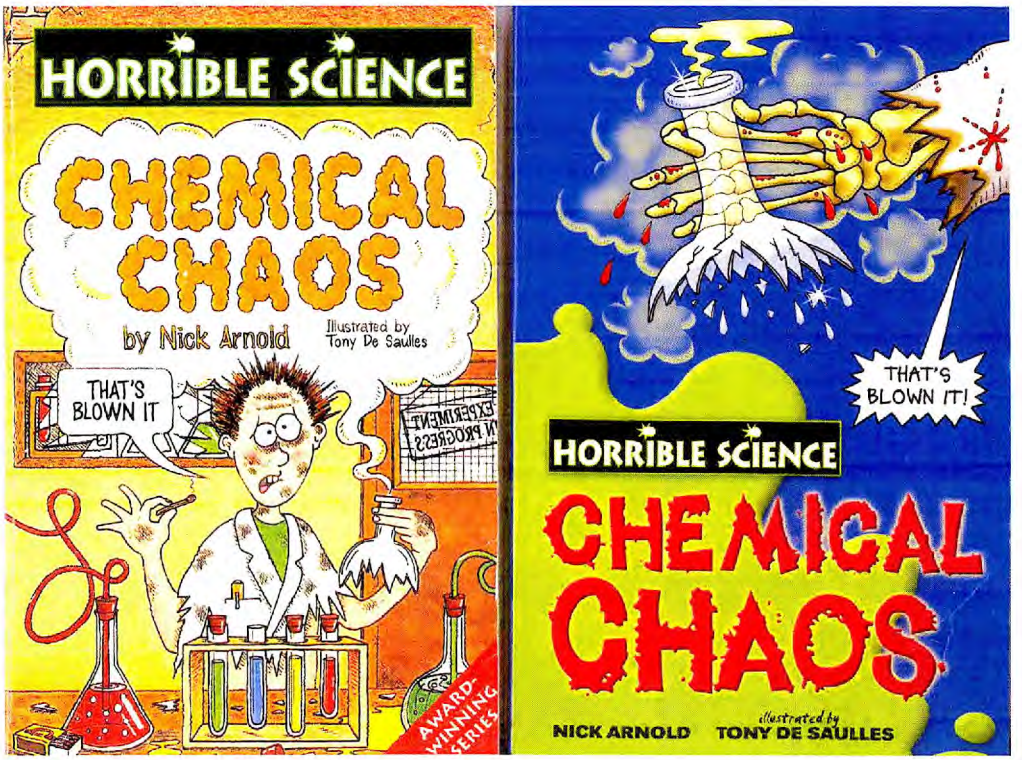


Fig 2.1. Horrible Science covers (old and new)

All but one of the books are written by Nick Arnold. Most of their illustrations are by Tony De Saulles. A few of the recent special books and magazines have used other illustrators, but De Saulles is credited for setting its style. The only *Horrible Science* book not authored by Arnold is *Evolve or Die* (1999)[9] by Phil Gates. As Arnold explained to me in interview, Gates was asked to write the book on evolution to come out at the same time as Arnold's first *Horrible Science* book, *Ugly Bugs*.

[9] With the exception of the teacher's guides, this thesis cites all *Horrible Science* books, regardless of author/ illustrator by their title and publication date. All 2008 publications citied, except the Dinosaur jigsaw book and *Beastly Body Experiments*, are part of the re-brand and referenced with the original edition.

However Gates's book was delayed, and by the time it was ready several of Arnold's books had been successful. By then, a 'voice' of *Horrible Science* had been established and Gates had to reformulate his book to fit the now established house-style (Arnold, 2006b). Arnold is a historian by training. He started writing about science while working as a journalist, and describes himself as a keen observer and communicator of science, rather than someone situated firmly within the scientific community. He researches chiefly by reading popular science books, online and from discussions with scientists (Arnold, 2006ab). De Saulles was a book designer before working as an illustrator and now writes his own books in addition to his work on *Horrible Science*. He has no special training in scientific illustration and, like Arnold, sees this outsider identity in many ways as an advantage in communicating science to young people (De Saulles, 2006).

Blood, Bones and Body Bits won the junior category of the 1997 *Rhône-Poulenc Junior Science Book Prize* (later known as the Aventis Prize, now the Royal Society book prize), which the series later won again with *Really Rotten Experiments* (2004). According to Scholastic, at the point of its ten-year anniversary, the series had sold over 3.3 million books.[10] Although based in the UK, *Horrible Science* sells internationally and has been translated into several modern European languages (including French, German, Italian, Polish, Hungarian, Czech, Norwegian, Danish). De Saulles and Arnold are both proud of its success in China. The recently re-launched promotional website, horrible-science.com explicitly applies to the UK (you are asked your location on the introductory screen) although there is a website attached to the *Horrible Science* magazine for a selection of other English-speaking countries (Canada, New Zealand, Australia and South Africa), suggesting that the UK is the primary market.

Horrible's History

The first 'Horrible' books were the Histories, written by Terry Deary and illustrated by Martin Brown. Although both Arnold and De Saulles insisted in interview that their books were quite distinct (and I agree there are many differences), it is still worthwhile sketching out something of the history books, if only as an origin story.

[10] This figure comes from Georgina Lawe, Publicity Manager of Scholastic Children's Books (personal communication, 12th December 2006). She did not provide any historical and geographical perimeters of this statistic but Lawe used it as an illustration of their success, which is how it is applied here.

This series started in 1993 and has been incredibly successful, with an extensive 'media assembly' of products accompanying the books, including an animated television series, theatrical productions and a museum exhibition. As Deary (1999) tells it, he was a jobbing children's writer for Scholastic whilst also working as a drama teacher. The idea for *Horrible Histories* came out of a history-themed joke book which was to be padded out with a few anecdotes from history. Deary and his publishers quickly realised the anecdotes were more interesting than the jokes ('Where did the French keep their guillotine? In the chopping centre!') and the series developed from that. After four reasonably successful titles, they happened to turn their attention to *The Blitzed Brits* in 1995, the 50th anniversary of VE day. Bookshops wanted displays of World War Two themed titles, and this one neatly filled a gap between *Anne Frank* and *Goodnight Mr Tom*. From Deary's perspective, their success was entirely luck (Deary, 1999: 94-95).

By poking fun at the characters that traditional history education tells us to revere and focussing on 'untold' aspects of how unpleasant life was in past times, the *Horrible Histories* take a similar approach to the work of John Farnam's *Very Bloody* series (e.g. Farnam, 1992, 1999, 2001). Indeed, Farnam might contend with the *Horribles* to have started this humour/non-fiction trend. His books are a mix of non-fiction and humour genres, revelling in (perhaps ironically) both the spectacular of knowledge and the subversion of anti-authoritarian comedy. Deary is revealing when he talks about a precursor to the *Horribles* that he worked on for Scholastic, a set of 'true monster' stories:

> And I thought, well, there are no such things as *true* monster stories, because a monster by definition is a fabulous creation. What I decided the book would be is a collection of stories that people have *said* are true, and that would be the validation for the 'True' in the title – and not that they are true *per se*. I also wanted to allow the readers to make up their own minds. And how could I do that? By giving them facts (Deary, 1999: 94. Emphasis as original).

There is a distinction between the knowledge the world provides you (what people have said is true) and the stark facts which are assumed to free people to make up their own minds. Yet, for all that these books show off their constructedness as media products, there is little reflection that they are also 'a collection of stories that people have *said* are true'. As Scanlon (2008) notes in her thesis, Deary appears to

equate 'Horrible' with truth.

Farnam's books predate *Horribles* slightly, but it is likely that they were being developed around the same time as Deary was working up his joke book. Interestingly, Scanlon's interviews with publishers note that around the same time Simon and Schuster were also working on a title called *Horrible Histories.* According to the current editor at Scholastic, who previously worked at Simon and Schuster, Deary and Scholastic just happened to find the most successful formula for meeting what was an early-1990s post-*Blackadder* zeitgeist for irreverent history. Tony Robinson's *Maid Marian and Her Merry Men* (BBC Children's Television, 1989-1994) is also worth bearing in mind in terms of this style applied specifically to children's media. Scholastic's *Horrible Histories* is also often compared to *1066 and All That.* However, as Deary points out in interview with Scanlon, the humour of *1066* relies on a 'knowing readership'; as with *Blackadder* and the *Monty Python* films, its humour is based on already having some historical knowledge, not as an impetus to it. Such distinctions, I think, are largely due to the differences of intertextuality within children's and adult discourse, a topic I shall explore in more detail in the chapters on fiction and humour.

A key distinguishing factor between the *Horrible Histories* and Farnam's books is their explicit reference to a child-specific audience; the earlier *Very Bloody History* books were as likely to be shelved in a bookshop's general humour section as in children's non-fiction. As I referred to briefly in the previous chapter, Deary is keen to eschew the image of a teacher, and prefers to act as a 'big kid'. When imagining his audience, he takes on the mantle of an 'ignorant person' sharing the excitement of finding out something new; it is 'You'll never believe', rather than 'you should know', and he suggests himself more as an enthusiastic 'big kid' than an academic or teacher (Deary, 1999: 96). Another key difference between the two authors comes from their approach to structure. Whereas Farnam structures 'amazing facts' on chronological time-lines, the *Horrible Histories* work thematically. For example, *Awesome Egyptians* provides some idea of chronology, but structures itself around chapters on the lives of children, war, science, slavery and religion. The narrative will be broken up to include stories of people living in historical times told in the first person (often made to look like diaries or newspapers). Artwork in the *Horrible Histories* tends to act to tell the story as much as to decorate, compared to the *Very Bloody* books (despite being illustrated by Farnam himself) which tend to use images as an interruption or break from the expository text. Moreover, whereas

Farnam will use speech bubbles from the cartoons to pass some humorous comment on the time-line history, Deary will take on the (often happily anachronistic) mantle of a child's diary or newspaper to provide an apparent first-hand witness report on the subject. Importantly to Deary's approach to history, these are presented as first-hand reports of everyday people.

These key differences between *Horrible Histories* and other non-fiction/ humour books are arguably the bedrock of the Horrible approach and we will see it worked across *Horrible Science*. If there is any distinction I would like to emphasise between the styles of *Horrible Histories* and the science books, it is a matter of which characters they choose to laugh at. Both series take an explicitly anti-authoritarian alternative approach to knowledge, but whereas the *Histories* suggest an alternative history, Arnold's books do not wish to present new knowledge that they have constructed themselves, only to find a more engaging way of presenting information that scientists have found. The 'baddies' of *Horrible Science* are therefore less the scientists themselves and more those who tell us about it. Indeed, *Horrible Science* is reasonably reverent about scientists and scientific work, at least compared to the attitude Deary appears to have for professionalised history. *Horrible Science* is also rather more fantastic. This can be explained in part from traditions of explaining abstract entities of science through fiction, but Arnold has also worked his definition of 'Horrible' in some reference to the fictive genre of horror, thus populating the *Horrible Science* world with a colourful range of monstrous beasties, both natural and supernatural.

Content and Style

In some respects, it is hard to sum up the content of *Horrible Science*. It consists of so many things together it is difficult to tie them down to one set of features. Arnold, explaining what he feels distinguishes *Horrible Science* from other books, is revealing:

> they take a whole range of genres, a whole range of different styles of writing. And indeed cartoon, the whole tradition of cartooning. And they put them all together. [...] Quizzes, um [pause] diaries, newspapers, er, advertisements, fictional characters, experiments, um, straight text. Um, science fact files, cartoon things. It is an

> incredibly rich mixture and I don't know anyone else who's doing that. So, yes, the mix is unique. (Arnold, 2006b)

This suggestion that 'the mix is unique' should not imply complete chaos, although arguably part of the point of constructing *Horrible Science* around such a mix is to present a rather frenetic tone. Features are repeated within each book, as well across the series, creating a sense of coherence and, for fans of the brand, familiarity. These recurring features are titled clearly; for example, 'test your teacher', 'science fact files', 'dare you discover'. Characters are also repeated within and, to a lesser extent, across, books, though this is more notable in the later titles, creating a sense of a populated *Horrible Science* world. They are heavily intertextual and appear to 'sample' a range of different media styles as they narrate their content. The best analogy is probably children's television magazine shows such as *Going Live*, *The Really Wild Show* or *Wacaday*.

Each title is the size and shape of a short children's novel, with heavily illustrated, colourful covers. Each book tends to be around 160 pages long. Their content parodies images and styles of popular and consumer culture as well as borrowing approaches common to popular science, textbooks and other educational media. As fig. 2.2 shows, text and images work together on the pages of *Horrible Science*, applying traditional styles of both textbook and comic. This is as likely in the telling of a joke as in explanatory content. According to De Saulles, however, the text and illustration come at different phases in the production process and De Saulles and Arnold largely communicate through the publishing team. It is still an iterative and reasonably collaborative process, with De Saulles creatively reacting to ideas Arnold has had about images, and on occasion providing his own ideas about the text or transforming a text-based joke into a visual one (De Saulles, 2006). Humour is a key selling point for the books, as they promise their readers a more fun experience than school-science, but the books are equally likely to show off their facticity, suggesting that the knowledge it contains will provide readers with power and insight into the world. Thus, again, the books can be read as embodying a combination of textbook and comic.

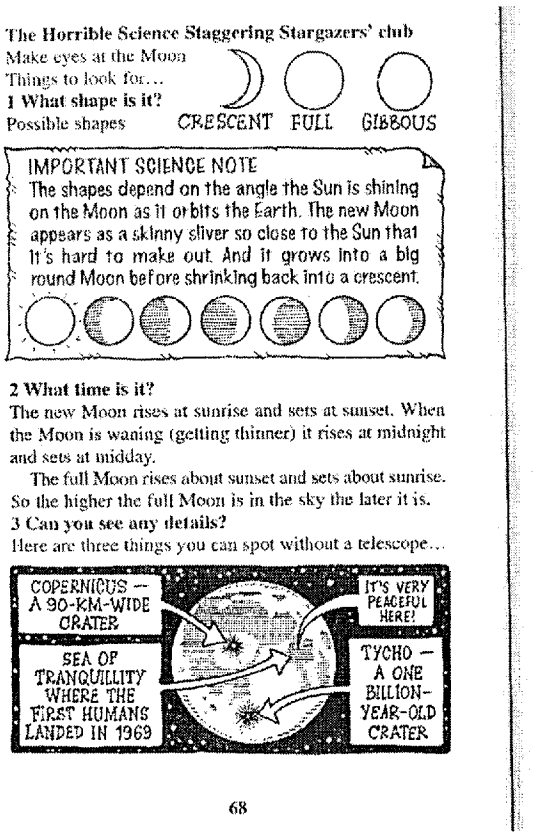
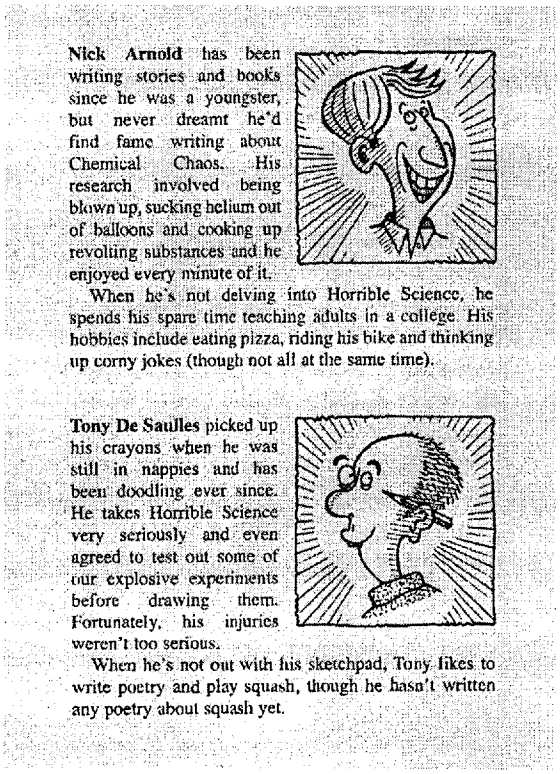


Fig. 2.2. Sample double-page spread (*Space, Stars & Slimy Aliens*, 2003: 68-9)

Before the main content of the book starts, there is a page devoted to introducing the author and illustrator. These are written in the third person, but are much less formal than traditional frontispiece author biographies and are accompanied by a cartoon portrait (see fig. 2.3). The biographies typically refer to Arnold and De Saulles's childhood in some way, as well as 'child-friendly' interests such as eating pizza or coming up with corny jokes. In contrast to most science books, they do not focus on their academic authority but on their expertise in constructing entertaining books; for example, they might refer to having undertaken some dangerous task, such as swimming with sharks, as part of their research. Following this, the books' narration is generally chatty, often employing conversational language (e.g. 'yeah' or 'well, maybe') and in places directly talking to the reader as 'you there'. Images of child readers litter the pages. This is all part of what is a reasonably personal approach. When it comes to discussing the science, *Horrible Science* also focuses on the people involved, discussing the characters (and caricatures) of the history of science as much as abstract scientific entities, which themselves are often anthropomorphised. Such people are dirty and messy, physically and psychologically. Historical figures are less heroic and more likely portrayed as self-

absorbed and mistaken. Readers are shown as silly, but so are scientists, teachers and other characters.



Nick Arnold has been writing stories and books since he was a youngster, but never dreamt he'd find fame writing about Chemical Chaos. His research involved being blown up, sucking helium out of balloons and cooking up revolting substances and he enjoyed every minute of it.

When he's not delving into Horrible Science, he spends his spare time teaching adults in a college. His hobbies include eating pizza, riding his bike and thinking up corny jokes (though not all at the same time).

Tony De Saulles picked up his crayons when he was still in nappies and has been doodling ever since. He takes Horrible Science very seriously and even agreed to test out some of our explosive experiments before drawing them. Fortunately, his injuries weren't too serious.

When he's not out with his sketchpad, Tony likes to write poetry and play squash, though he hasn't written any poetry about squash yet.

Fig 2.3. Introducing author and illustrator (*Chemical Chaos*, 2008: 5)

Horrible Science is, at its heart, a series of novel-shaped books and this is where most of my analysis is focused. However, the brand also exists as a range of accompanying products (many also books, or at least book-like) which are also worth keeping in mind. In addition to the main titles, there are two exercise-book sized 'specials': *The Awfully Big Quiz Book* (2000) and *Really Rotten Experiments* (2003). These have the look and feel of activity books (as a 'bumper holiday edition' of a magazine), but there is no space given to invite the readers to write inside them. Some of the main titles have come in 'special editions' publishing two at once, coupling books to a theme (e.g. *Nasty Nature* bound with *Ugly Bugs*). There are also two survey books: one historical, the other methodological (respectively, *Suffering Scientists*, 2000, and *Explosive Experiments,* 2004). Although these are packaged as 'specials', in many ways they simply constitute a thicker version of the standard books. The special element seems to be that they take a historical approach to a science-based theme compared to the other books which consider more everyday topics such as insects or disease and look to science to explain them. We could say

the specials look *at* science rather than using science to look *with*, but all the books apply history and philosophy of science to some degree. Another 'special' addition to the series is the *Stunning Science of Nearly Everything* (2006) – a rich, full colour, large format book with pull-out pages which extend longer than many of its readers' arms. This book's initial hardback release was in time for the Christmas market and in some ways acted as a *Horrible Science* 'annual' for fans of the series, a product more conventionally provided for the 2007 market. To support the use of the books in classroom settings, there are also teachers' guides linked to some of the titles (Tomlinson, Arnold & De Saulles, 2004abcd, 2005abcd, 2006ab).

At the entertainment end of the brand are sticker and jigsaw books, as well as a magazine. The sticker books (*Ugly Bugs*, 2006, and *Disgusting Digestion*, 2006) feel like a more disposable activity book and are much shorter. The jigsaw books (*Dinosaurs*, 2006, and *Ugly Bugs,* 2008) are more expensive, and have thicker pages to accommodate the puzzle pieces. These are the only books in the series that can be changed and manipulated by the readers, although the action expected of them is chiefly moving two-dimensional shapes around the pages. The most interesting thing to note about these activity sets (although not the magazine) is that, like the teaching guides, they are packaged as books and sold through bookshops. They are book shaped and have pages, even although in the case of the jigsaws, these are very thick. Most importantly in terms of the way they are sold, they have ISBNs and spines for display on shelves. Away from the bookshelves and sold through toyshops, as well as bookshops' 'non-book products' sections, are jigsaws, large boxed activity sets and smaller 'bag' versions. These are, as with the teacher guides, based on titles in the main series. For example the *Bulging Brain*'s bag contains plaster, paints and 'brain surgery tools' to 'make your own brain' (or rather, cast then paint a model).

Horrible is a broader brand than just history and science. Scholastic also publishes similar scientific titles in the smaller series *The Knowledge* (e.g. Goldsmith, 2003) and *Dead Famous* (now called *Horribly Famous.* E.g. Cox, 2003, Goldsmith, 2003). Arnold himself has written *Awesome Archaeology* (Arnold & Goddard, 2001). This remains a one-off, but *Murderous Maths* and *Horrible Geography* have both developed from one-off editions to small series of books (e.g. Poskitt, 1999, 2000, Ganeri, 1999, 2000). The *Horrible Geography* series is probably the biggest of all of these, and its publication record seems to follow the *Science* books, which in turn follow the *Histories*. For example, the *Horrible Histories* will bring out a hardback

Christmas annual or the new handbooks, then Science versions will appear to be finally joined by Geography ones too. It is also worth noting that a reasonable amount of science content is covered in the Geography books, however for the sake of setting manageable perimeters around my work I have largely chosen to ignore them.

The Context of Children's 'Popular' Science Publishing

It would be an unnecessary digression to sketch a history of popular science publishing here.[11] It is, however, worth briefly reflecting on what is meant by the term 'popular science'. Simply put, it is a tag applied in adult publishing and bookselling to denote non-fiction books about science that do not assume expertise on the part of the reader. You can spot it printed on the backs of books or emblazoned across the top of booksellers' shelves. It is often applied by analysts slightly more broadly to denote other media aiming to package science for an assumed 'public' (e.g. lectures, songs, museums), and in some respects it is in this broad analytical form which 'popular science' is applied to children's books. *Horrible Science* does not label itself 'popular science' in the way, for example, *The Blind Watchmaker* or *A Brief History of Time* would. Moreover, as several historians of science have recently pointed out, the analytical category of popular science is extremely problematic (for overview, see Lightman, 2007: 9-17). As suggested in the last chapter, it is also a politically problematic term, labelling its readers as a distinct and largely silent audience for scientific expertise (see Hilgartner, 1990).

Children's science books are perhaps better kept as simply that, science books for children. The 'popular' designation is apparently less necessary, perhaps because the divide between expert and other audiences is less of an issue for children's media where it is assumed all audiences are non-expert. Such books have their own history, their own ways of organising into sub-genres of nature, space, health, encyclopaedia (all of which may mix into other genres), and, as this section will show, their own traditional styles. Despite being largely ignored by both children's literature scholars and historians of science (less so the latter in recent years), children's science publishing does have a relatively prestigious history. Indeed, the

[11] Leane (2007), Lightman (2007) and Topham (2007) are all excellent sources on the subject. See also Broks (2006), Fyfe & Lightman (2007) and Gregory & Miller (1998) for 'popular science' taken more broadly than publishing.

man credited with the creation of children's literature as a publishing genre in the late 18th century, John Newbury, was the likely author of the classic children's popular science text, *Tom Telescope* (Fyfe, 2003b, xiii. See also Secord, 1985). We could, depending on our working definitions of 'science' and 'children's book', go back even further; according to one professor of Children's Literature, the first ever children's book was Chaucer's *Treatise on an Astrolabe* (Hunt, 1994: 189).

This section aims to explore some of the central recurring trends in children's popular science and introduce a few key examples in the field (both historical and contemporary). Under each of the subsequent sub-headings – instructive and amusing, invoking wonder, fiction and narrative and interactivity – I first describe examples of 18th and 19th century publications, largely rooted in Fyfe's (2003) edited reprints of key texts, then reflect upon comparable late 20th century/ early 21st books. I then finish with some discussion of recent trends in children's publishing which have emerged since *Horrible Science* was first published in the mid-1990s and, interestingly, appear to look back to the history of non-fiction publishing themselves. This mix of contemporary and Victorian examples is applied for several reasons: (a) I will be drawing on some examples of other children's science books (both old and contemporary) as contrasts throughout the thesis and so it is worth introducing them now, (b) it helps us understand something of where *Horrible Science* comes from and that its approach is not always as novel as it might seem, (c) I want to say something of *Horrible Science*'s current competitors, and (d) it allows us to situate *Horrible Science* historically, even to consider it as a relatively old approach to children's non-fiction which may well have seen its popularity peak.

A point worth making upfront: most of my examples sit within the 7-11 age range that *Horrible Science* aims itself at. This is partly because this is the age that children's popular science books are produced for. There are few explicitly 'science' books for younger children, perhaps because learning tends to be assumed to be at a pre-subject boundary stage. There are some exceptions, such as those emanating from the *Baby Einstein* brand (e.g. Aigner-Clark, 2006) or scientist Russell Stannard's foray into picture books (Stannard & Ledger, 2001abc). In terms of popular science for teenagers, this often apes the conventions of adult publishing (e.g. Singh, 2003). A rare example of a popular science book that takes teenagers as teenagers and addresses teenage-specific issues is Nicola Morgan's (2005) *Blame My Brain*. There are a host of medically-themed books for this age-group, but these tend more towards self-help than science (at least in address, if not always in

content). What we choose to define as a 'children's' 'science' 'book', will always be reasonably open to dispute.

Instructive and Amusing

As Fyfe (2003b) describes, the genre of 'instructive and amusing' dominated children's publishing in late 18th and early 19th centuries. So much for 'edutainment' being a disdainfully contemporary phase, as these books had a similar aim of rendering educational content suitable for leisure time (and to some extent, vice versa). *Evenings at Home: or, the Juvenile Budget Opened,* which first appeared between 1792 and 1796 in six small volumes, was indicative of this genre in the 18th and 19th centuries (Fyfe, 2003b: xxiii). Like other similar books of the time, it consisted of a set of stories, aimed to inculcate practical and moral lessons through entertainment. It mixed genres as well as subject matter; poetry, narrative and dialogue were all used to discuss history, chemistry or botany as the writers of *Evenings* firmly believed that variety was the way to keep a child's attention.

In some respects the *Horribles* could be considered a modern-day *Evenings at Home*, with their desire to be educational (if not 'instructive') and entertaining (if not 'amusing'), especially considering their application of a mix of genres. The differences between the two can be easily explained as due to a change in which popular genres are alluded to and changing assumptions about what will charm a child audience. As I mentioned in my introduction, there are a few publications that seem keen to ape *Horrible Science*'s successful format (e.g. Hamer, 2000) and a similar focus on 'science with the squishy bits left in' can be seen in the North American 'Grossology' series (e.g. Branzei, 1995, 2004, 2003). However these books, which we might dub a 'humour/non-fiction' genre conflation, are only a small part of a much more complex picture in the diversity of children's popular science.

In contrast to the *Horribles,* much of children's 'domestic' non-fiction (i.e. books which are to be read at home rather than at school or as homework provided by a teacher) is explicitly linked to education policies, carrying logos of government reading campaigns and explicitly referencing connections to the National Curriculum (e.g. Vorderman, 2002). This trend has been discussed in detail by Buckingham and Scanlon (2001, 2003, 2005). These researchers report that one independent bookseller interviewed claimed she could fill her shop with such books, the demand was so great (Buckingham & Scanlon, 2005: 47). Such books may market

themselves as amusing enough that the child does not realise they are being instructed, but in many ways they owe to traditions of educational publishing rather than domestic literature. Explicitly at least they are quite different from *Horrible Science*'s image of providing science for the sake of having fun. We might argue that *Horrible Science* are not edutainment in the same way. They may well be 'educational' and market themselves as a form of 'entertainment', but do not link so explicitly to formal education as the curriculum linked guides. Also, they do not see education and entertainment as necessarily two separate areas to be conflated together, rather to show science as inherently fun.

Invoking Wonder

A common trait of 19th century children's publishing, which is less readily tracked to today's works, is an overt connection between studying nature and learning about God. As Fyfe describes it, by the 19th century, learning about nature was part of general education, but it was also considered to be a devotional activity (Fyfe, 2003c: x). Fyfe (2003c) describes two books, *Wonders of the Waters* and *The Starry Heavens*, which represent the many science publications from the Religious Tract Society and the Society for Promoting Christian Knowledge (see also Sheffield, 2003). Such books were generally by unknown writers, many were anonymous (as was, initially, *Evenings at Home*). Nature was a favourite of such publishers because children were assumed to be naturally curious about nature, and examination of the natural world was assumed to lead easily to contemplation of the Creator (Fyfe, 2003c: vi). These books presented nature as God's creation, something worth describing so it could be marvelled at (Fyfe, 2003c: v).

In the contemporary scene, the types of books Scanlon (2008) and Gillieson (e.g. 2006) both dub 'glossy non-fiction' provides a good example of a similar, albeit less religious appeal to the wonder of nature. Such 'glossy' books are arguably the dominant form of children's non-fiction. The key publisher in this area is Dorling Kindersley (DK), and chief amongst their output has to be the *Eyewitness Guides*. These books are full of lavish colour photography and Gillieson draws comparisons between the typography of such books and glossy magazines such as *Vogue* or *National Geographic*. As with glossy magazines, the images of glossy science books are in some respects aspirational; there to be admired often for their aesthetic value. DK's science books often invoke a sense of awe at scientific objects (or those

objects scientific work can show us), sometimes drawing on assumptions of the natural curiosity of a child audience. *Horrible Science* does this too, albeit through the rather different lens of the *Horrible* brand and I will discuss this topic in more detail in chapter nine. As with *Evenings At Home*, the *Eyewitness* books draw on and link to other genres too, though generally non-fiction ones, especially museums and the internet. The connection between museums and children's science books is nothing especially new, as demonstrated by Fyfe's (2007) case study of the *'Pictorial Museum of Animated Nature'* (from 1848 to 1849). The *Eyewitness* books also owe much to the multi-volume encyclopaedia and other part-works of scientific content (including the *Pictorial Museum*). Their spines are numbered and they encompass a range of subject areas (not just science). They also tend to downplay individual authorship, but are rather produced by an anonymous editorial team at DK, and sometimes carry logos of internet or museum brands as well as the publisher's.

A recent non-*Horrible* contrast to the traditional glossy approach is DK's attempt to market a children's encyclopaedia to teenagers/ aspirant pre-teens, *Pick Me Up* (Roberts & Leslie, 2006). This also references glossy magazine styles, but with a nod to slightly less mainstream publications than *Vogue*, as well as board games and digital culture. It is also explicitly a mix of styles: with each turn of the page you shift from the styles of *Eyewitness* to *Heat*, from a snakes and ladders game to *National Geographic*, from a textbook to *Just Seventeen*, then it appears 1950s, now Edwardian, next it's a 1950s take on the futuristic. *Pick Me Up* is also interesting structurally in terms of this mix, as it is explicitly applying styles of digital technology (it has been marketed as a 'shufflepedia') as they aim to use such formats to eschew the linearity of the traditional book and to emphasise the interconnected-ness and discontinuous nature of knowledge, all the while sampling genres of entertainment media.

Fiction and Narrative

A trend that has particular relevance for *Horrible Science*, is that of applying tropes of fiction. Aiming to cash in on the Victorian mania for fairies, *Fairy-Land of Science,* by Arabella Buckley was first published in 1879 by the maps and travel specialists Stanfords. It was immensely popular and was speedily reprinted across North America (Gates, 2003: v) and revised and reprinted at least 20 times up until 1919, mainly by Macmillan and several religious publishing houses. Buckley aimed to

generate interest in her scientific subjects by borrowing the language of fairy stories and wizardry – her fairies were the forces of magnetism or gravity – and suggest the wonders of science were not only parallel but could surpass the wonders of fairyland. In the sequel, *Fairy-Land Through Magic Glasses* (first published in 1890), Buckley concentrated on what children might see through the 'magic glasses' of a telescope, camera, microscope or the fictional guide of a magician character who described the wonders of the 'new worlds' science had discovered (Gates, 2003: vi). Further, Buckley was keen to appropriate the assumed pleasures of reading fairytales and to claim that science can provide not only these but more. The first book starts with the story of *Sleeping Beauty*, asking whether science can provide a match for this (and quickly answering in the affirmative). However, interestingly, despite its reliance on a sense of fantasy, the reason Buckley gave for learning science was generally practical utility (Gates, 2003: viii).

A more explicitly masculine attempt to similarly apply narrative can be seen in *Peter Parley's Wonders of the Earth, Sea and Sky,* a 'thrilling' nature of geology, geography and meteorology popular in middle class homes from its publication in 1837 (Secord, 2003a). Many children's science books had previously aimed to be encyclopaedic and to discuss everything, but this explicitly focussed its subject matter and said so in its preface. It was published under the name Peter Parley, as were many children's titles between 1830s and 1860s, the nom-de-plume of Samuel Griswold Goodrich, a New England educational writer. Goodrich was against the 'horror' tales of Little Red Riding Hood and the like (which he felt would only reconcile children to vice and crime) and hoped to replace fairytale monstrosities with natural marvels (Secord, 2003a: vi; see also Heeks, 2004). *Wonders of the Earth, Sea and Sky*, however, was by a London-based writer, Samuel Clark, who took up the Peter Parley brand, a point Goodrich was not especially pleased about (Secord, 2003a: vii). Parley books addressed their narration directly to his 'young friends', generally with no reference to gender or age. Although Parley's character varies across the Atlantic (and across the change in author), in *Wonders* he comes across as 'gentle, modest, well-travelled and extraordinarily knowledgeable – a universal uncle with a panoptic vision of nature's secrets and the gift for telling human-interest stories' (Secord, 2003b: ix). He would discuss phenomena as if he had really seen them. Whether it was visiting Mary Anning's fossil shop or walking behind the falls at Niagara, the stories were travellers' tales. This is significant because many children's science books had used dialogues with mothers, yet Parley's voice was a 'non-threatening masculine voice' which drew a sense of authority from the notion that he

had really managed to travel to all these places (Secord, 2003b: ix).

We can see several of these approaches to fiction today. Scientist writers have long been enamoured by the idea of using fiction to take readers to semi-fantastical worlds which are actually constructed from scientific ideas. Such books might shrink a character so they are small enough, like Buckley's fairies, to explore worlds the human eye cannot normally see. Stephen and Lucy Hawking's (2007) *George's Secret Key to the Universe* is a recent, high-profile example. Other similar books include the Victorian mathematical 'romance', *Flatland* (1984), Stannard's *Uncle Albert Books* (1989, 1992, 1994), *The Spark Files* from *Horrible Histories* author Terry Deary (e.g. 1999ab) and the self-consciously British reapplication of comic-book hero stories, *Captain Fact* (Knife & Packer, 2004ab, 2005). Usborne have long utilised the trick of mixing small quantities of fiction in with their fact, as in their classic *How Your Body Works* (Hindley, & Rawson, 1975) that included robot-body machines filled with white-knight blood cells. *How Your Body Works*' fictional qualities largely amount to visualisations of the sorts of metaphors that occur in text less clearly as make-believe. For example, it applies the metaphors of the body as a processing machine and a fortress against disease. In this book, which uses cartoon illustration, we see characters processing food along a conveyor belt and fighting off green-monster germs. Joanna Cole's *Magic School Bus* series (e.g. 1989, 1999), based around a magic teacher who can take her students back in time, under the sea, into space or shrunk into the body often includes scientific content, as does Scholastic's version, *Pickle St Primary* (e.g. Cox, 2002). These last two examples are perhaps more *Peter Parley* than *Fairy-Land of Science*, as they are as likely to take characters on a 'trip' to other parts of the world as much as use fantastical devices to shrink them into the human bloodstream or take them up into space.

DK, who more commonly take a strictly realist approach, have recently introduced the lift-the-flap *Brainwaves* series (e.g. Walker, Swerling & Lazar, 2007, MacLeod, Sterling, & Lazar, 2006). Its pages are populated by troops of tiny characters, the eponymous Brainwaves, who pass comment on the scientific action taking place. In this respect the books echo picture-books, especially *Where's Wally*, as much as non-fiction publications. DK have also produced comic-book crossovers for both science and history (e.g. Hibbert, 2005). These take an approach comparable to Buckley's fairy science, and often used in contemporary adult non-fiction, of explaining the 'science of' ready-made fictional characters (see also Gresh, 2002) to suggest science as equal, if not more entertaining, than the attractions of

make-believe.

Interaction

Another book which, like *Peter Parley's Wonders*, applied a masculine identity in communicating science is John Henry Pepper's *The Boy's Playbook of Science*, first published in 1860. Indeed, Secord suggests that this was not only an expression of, but a contributor to, the increasingly gendered nature of physics in the 19th century onwards (Secord, 2003b: ix). It is also indicative of the final trend in children's popular science I want to discuss here; that of presenting instructions for undertaking scientific activities. As Secord argues, the real difference between the *Playbook* and its later successors is that children's science books of the post-Sputnik era were more about recruiting for scientific careers whereas Pepper felt scientific play was a sort of intellectual equivalent to sport. What mattered was not the ability to memorise information or to secure a scientific career, but a mental preparation for the challenges of the modern world of global capitalism in which life was a 'race' both with one's immediate fellows and with those of other countries. Readers were expected to use the *Playbook* to build character and prepare for 'The Battle of Life', to serve their nation and empire (Secord, 2003b ix).

The main appeal of Pepper's book was its 'experiments'. Some were easier to do than others but, as Secord describes, all seemed accessible because they were readily visible through the inclusion of four hundred wood engravings (Secord, 2003b: v). The *Playbook* was explicitly authoritative, with examples drawn from iconic scientists of the day, such as Faraday. Because many of these scientists also gave public lectures, it was easy to find parts of their research to translate into exciting visual effects (or rather, some came ready-translated). Thus the *Playbook* is largely rooted in the tradition of demonstration and public display. It was not the first of its style (e.g. *Tom Telescope*) but was better illustrated, had more experiments and appealed to slightly older readers (Secord, 2003b vi). Pepper was well known as 'a flamboyant and accessible showman' from his work at the London Polytechnic and the *Playbook* aimed to put the experience of attending Pepper's lectures into print.

Books which play on the empirical associations of scientific work, inviting children to follow instructions to work through an 'experiment' of some sort, did not end with the *Playbook*. This is perhaps most noticeable in the US market, where

instruction manuals for science fair activities dominate the children's science shelves in a way curriculum-linked primers do in the UK. However, the UK has a long history of children's science books with (sometimes tenuous) scientific links to making toys or tricks (e.g. Andrews & Knighton, 2004, Bigham, 1991/2006, Gilpin & Pratt, 2007, Hunter, 1976). A slightly different approach to interaction, can increasingly be seen in DK or Usborne books which now come 'internet linked' (e.g. DK publishing, 2004, Gilpin & Pratt, 2007). Perhaps similarly alluding to a sense of discovery and finding the hidden in science, pullout pages and lift-the-flap devices are also reasonably common across children's non-fiction (e.g. the *Brainwaves*), and non-fiction pop-up has recently enjoyed a publishing boom, from grammar to ecology and palaeontology (e.g. Petty & Maizels, 1996, 2002, 2006, Sabuda & Reinhart, 2002, 2005). From the US, the *Klutz* books also provide some particularly interesting examples of hands-on literature; especially the *Explorabook* (Cassidy, 1992) which, marketed as the Exploratorium Science Center in book form, includes mirrors and moveable optical illusions within the pages and a magnet hanging off the (spiral bound) spine.

21st Century Nostalgias

If the emergence of the *Horribles* in the early-mid 1990s symbolised a reaction against traditionally reverent approaches to non-fiction, then many of the new titles of the 21st century could be characterised as a nostalgic desire to return to didacticism, straightforward celebration and the certainty of knowledge and/or moral purpose. Such books also seem to conflate generational address with their nostalgia, perhaps exhibiting some boredom with the 'down with the kids' presentation style of post-70s children's media. For example, *Schott's Original Miscellany* (Schott, 2002) initially a single book aimed at adults, was soon reproduced for a range of specific markets (e.g. fans of particular sports or pastimes, family identities) including a series for children (Morgan, 2004, Enright, 2005, Macdonald, 2006). In many ways the miscellanies provided a similar experience to aimlessly surfing through hypertext knowledge, not dissimilar to *Pick Me Up*, and as such were very 21st century. However, their existence as a printed repository of information you might need to know (which today most of us would google when needed), and the specific types of information included, such as ways to knot a tie or lists of great battles, seemed to allude to pre-computer times.

The miscellanies may already have become passé, and for the last few gift-

book buying seasons they appear to have been replaced by pastiches of mid-20th century children's non-fiction, such as *The Dangerous Book for Boys* (Iggulden & Iggulden, 2006) and their various imitators. Indicative of the speedy turnaround of such publishing, Buster Books' *The Boys Book: How to Be the Best at Everything* (Enright, Macdonald & Catlow, 2006) includes material republished from their earlier children's miscellany books. Although not explicitly science, *The Dangerous Book for Boys* devotes a large number of pages to describing how to make or try or explore some physical aspect of the world. Indeed, this is part of their appeal against the apparent artificiality of contemporary life:

> In this age of video games and mobile phones, there must still be a place for knots, tree houses and stories of incredible courage [...] Boyhood is all about curiosity and men and boys can enjoy stories of Scott of Antarctic and Joe Simpson in *Touching the Void* as much as they can raid a shed for the bits to make an electromagnet, or grow a crystal build a go-cart and learn how to find north in the dark (Iggulden & Iggulden, 2006: preface).

Sean Connolly's (2007, 2008) *Wholly Irresponsible Science* books imply a similar form of nostalgia, coupled with an explicit dismissal of 'health and safety' worries about children's play.

Wholly Irresponsible and their other *Dangerous* counterparts are also interesting in the way they seem to target a dual adult and child audience, yet do so through a book (explicitly) presented to children (albeit largely imaginary children of a fantasy mid-20th century); what Marsha Kinder (1995) calls, in a different context, a 'transgenerational' address (a simultaneous exaggeration of generational conflict and conflation). The nostalgia surrounding youth in general, and children's literature in particular, coupled with adults buying for younger generations means there is a sort of cultural stickiness about children's books. This is no less the case in non-fiction publishing, even when our sense of what 'facts' should be relayed has changed. Both Fyfe and Secord put the longevity of, respectively, *Evenings At Home* and *Pepper's Playbook* down to the tradition of giving these books as school prizes, the books only disappearing around the time of World War One with the revolt against Victorian didacticism as well as developments in theoretical physics (Fyfe, 2003b: xxiii-xxiv. Secord, 2003b: viii). The simplifications of children's science are often several decades, if not whole centuries, behind current research. Arguably, the *Dangerous*

Book et al are a commodified form of this 'stickiness' of children's literature; a form of glossy nostalgia that draws on the appeals of an imaginary mid-20th century childhood (not that far from the way Buckley used Victorian fairy-mania).

The *Horribles* approach to presenting decontextualised 'bet you never knew' facts fitted the trend to 'miscellanies' quite well, even if their packaging was significantly different, and a *Horrible History Miscellany* was produced (Deary, 2004). However, as a pastiche of mid-20th century children's publications such as *Eagle*, the *Dangerous Book* is explicitly addressed to children, yet at the same time very explicitly appeals to adults' ideas about what children will or should enjoy (both in the re-application of old publications and also in their original style of address). Despite *Horrible Science*'s similar tendency towards empirical action, it is perhaps harder for the *Horribles* to expand to include this vogue than it was for miscellanies, as the style of narrative address (and associated image of childhood) that each type of book predicates its appeal upon are so different. Still, this vogue may well be passing. Even if it lasts, there could still be a market for *Horrible* books; not everybody enjoys such a cosily old-fashioned approach which wears its didacticism on its sleeve.

Science as Pantomime

Broadly, science as pantomime is science presented as a sensational show. I apply pantomime to *Horrible Science* for two key reasons. Firstly, because of the relatively carnivalesque attitude that it applies, which aims to poke fun at the status quo and ridicule the establishment as well as laughing at itself and at its audience. Secondly, because of the ways *Horrible Science* uses fiction and appeals to interaction with its audience, both of which draw attention to the constructedness of the medium and yet maintain a reasonable amount of power for the presenters.

Sociologists are often drawn to metaphors of performance to discuss individuals' behaviour in social interaction (for an overview and some critique see Billig, 1996: 42-47). Erving Goffman (1959) most influentially brought a 'dramaturgical perspective' to the analysis of the ways individuals behave within social interaction. Judith Butler suggests that articulations of gender are largely 'performative' (Buter, 1990: 139 onwards) and, following a discussion of drag acts, suggests that all articulations of femininity are fashioned in such a way. To Butler, genders do not stem 'expressively' from an inherent sense of self but are rather

'made' from a range of cultural ideas:

> Gender is not a stable identity or locus of agency from which various acts follow; rather, gender is an identity tenuously constituted in time, instituted in an exterior space through a *stylised repetition of acts* [...] Genders can be neither true nor false, neither real nor apparent, neither original nor derived. (Butler, 1990: 139, 140. Emphasis as original).

In many respects, Butler's sense of the fashioning of an apparent singular gender identity from a (sometimes inconsistent) range of cultural images is similar to the strategic application of multiple meanings of both 'science' and 'the child' discussed in chapter one. Indeed, Stephen Hilgartner (2000) connects a Goffman-inspired stage metaphor to the sociology of science so as to discuss the strategic fashioning of scientific expertise within science policy debates.

Yet, although Bulter's sense of 'performative' identity is a useful background context, for the special case of *Horrible Science*, I am perhaps more interested in the drag acts she took inspiration from; articulations of identity that in some respects draw attention to their constructedness through an exaggeration of particular features of a character. David Chaney draws our attention not just to performance, but to the dramatic fashioning of it. He suggests that moments of dramatic spectacle may be attempts to get the audience's attention by displaying striking, awe-inspiring content, but that they embellish communal activity in a way which lifts particular themes out of the ordinary. This includes 'making a spectacle of oneself' through transgressing norms of behaviour (Chaney, 1993: 21-2). We might use the term 'sensationalism' for this discussion, but part of the reason for the pantomime metaphor is that I would rather avoid the value-ladenness of that term.

Pantomime is a type of traditional stage show characterised by a disregard for the norms of theatrical performance and a carnivalesque, topsy-turvy (sometimes bawdy) humour. They were first developed on the London stages of the early 18th Century and largely remain a British cultural form. Although the popularity of pantomime is in some respects in decline, it still runs as part of Christmas family entertainment. Pantomime has changed immensely during its history, often including references to topical events within very traditional folk tales and fairy stories and frequently applying the latest in stage effects. And yet, as a Christmas ritual, once a pantomime style is set, it tends to stick (if a pantomime deviates from tradition, there

will be complaints). As both Millie Taylor (2007) and Gerald Frow (1985) both emphasise in their studies of panto, audiences go to be surprised and shocked at its spectacle, but they also go for the comfort of familiarity, reciting when prompted by the actors, the audiences' own catchphrases of 'He's Behind You' or 'Oh Yes It Is'.

Pantomime was originally designed for adults as a take on classical drama, but it quickly picked up other influences (e.g. Harlequinade, burlesque and Gothic melodrama) and is now generally framed within a children's story (Peter Pan, Cinderella), aiming at a family audience. Shows will weave into these stories a host of other intertextual references. The story is somewhat tangential though; pantomime is much more about the experience of the show and individual skits within the overall story rather than a central 'take home message' or narrative resolution. As Taylor argues, story may attract audiences and structure the piece, but panto is at heart a variety performance, one that provides 'a controlled experience of anarchy, chaos, disruption and, to some extent, danger' (Taylor, 2007: 33). This is one of the key reasons for applying the pantomime metaphor to *Horrible Science*; it is a way of describing the books' particular form of variety performance (as Arnold says, 'the mix is unique') and, in particular, their self-consciously anarchic approach. As we shall see in chapter six, *Horrible Science* applies familiar stories and other intertextual references in a similar way to pantomime.

From Harlequinade, in particular, pantomimes take their themes of masks and disguise as well as slapstick forms of comedy (Lewcock, 2003: 134). Harlequinade also provides a key theme of transformation, as well as a general sense of chaos, although this is also rooted in the street carnivals and shows of the 18th century and earlier (see Gaull, 2003). Huge amounts of mess can be produced by panto actors (e.g. as soap bubbles or gunge), sometimes threatening to spill out onto the audience. The actors will also fight, sometimes slapstick style, sometimes in a 'straight' staged duel. Yet, as Taylor emphasises, cartoon pain never hurts. The pantomime world is an overtly dangerous place, the performers are behaving anarchically and everything its comedians touch will, in some way, cause mayhem. But this is only ever an appearance of anarchy and is tightly controlled. Moreover, the audience know it (Taylor, 2007: 49).

Pantomime is particularly well known for its recurring characters. These are not just the specific characters of traditionally re-told stories (e.g. Cinders and her Step-sisters), but roles specific to pantomime which run through the genre regardless

of which narrative the troupe happens to be presenting that year. There is, for instance, the 'Principal Boy', who is traditionally played by a woman. The principal boy is generally tied up in some quest to win the heart of a lady and a villain of some sort will get in the way. Comics on either side might do battle as well as there being more conventionally staged heroic battles. Traditionally there is also a range of animal characters (e.g. two actors working together as the back and front of a cow) and human animal mimicry ('skins') or puppetry would be mixed with mechanical effects (Frow, 1985: 175-80). Perhaps the most famous of the masked pantomime characters, however, is the dame: a kindly maternal old lady who is generally played by a man. The pantomime dame should not, however, be confused with drag act. She is generally played just as a man in women's clothes. The distinction is not easy to define, but it is the one between Les Dawson and Lily Savage. Still, pantomime is a changing and complex form (as is comic female impersonation) and a variety of drag acts, notably Savage, have played panto, bringing their style with them (for some discussion with pictures, see Lathan, 2004: 68-79).

Crucially, pantomime began life in the theatre as a commercial product and has largely remained so (Taylor, 2007: 19). Pantomimes may also ironically reflect and refer to commercial culture in their content (e.g. covering Daisy the Cow with a sandwich board advertising the local estate agent), in part to provide a sense of topicality in their intertextual references and in part to make money through 'product placement' whilst also laughing at their own quite blatant profit-hunting. Throughout the 19th century, and far into the 20th, the expenses paid on special effects, advertising and cast were seen as necessary, even when it meant doubling the usual number of theatre staff, as the success of the Christmas panto would profoundly affect the financial success of a theatre for the whole year (Booth, 1981: 76). To some extent, the reliance on panto revenue is still an issue today (Lathan, 2004: 132). As I shall discuss in the next chapter, *Horrible Science* is also, above all, a commercial product and also one suffused with (sometimes ironic) references to commercial culture.

Pantomime performance is known for its audience participation. This may allude to a sense of audience involvement, but consists largely of pantomime set pieces – e.g. shouting 'He's behind you' as the villain approaches – which involves the audience in the telling of the pre-scripted story everybody already knows will conclude with a fairytale ending. Audience members know to expect to behave in a particular way. If they do not, the other audience members and cast lead them on.

This is, I believe, largely the approach to interaction also applied in *Horrible Science*. However whereas pantomime is quite open about the lack of audience agency, *Horrible Science* seems to maintain the illusion of it. For Taylor, a pantomime's interaction with the audience is indicative of its desire to show off the 'fourth wall' of the theatre (i.e. that between stage and seats). For example, when comedy is worked as an aside to the audience the comedian steps out of the story to become a watcher of the pantomime, conspiring with the audience in commenting on its progress and quality, thus revealing the frame of performance (Taylor, 2005: 338). To some extent, we can also see such 'wall-breaking' in the spectacular of the technologies of pantomime and the (often humourous) approach to intertextuality. *Horrible Science* similarly draws attention to (aspects of) its theatrical presentation, which I believe is enacted to build its claims to realism, as I will discuss in more detail in chapters five and six.

Concluding Points

Horrible Science makes for a useful case study in children's science culture partly because it is significant enough in the UK market to make it worthy of study in its own right. It is a broad series, covering the breadth of science, with titles on physics, chemistry, biology, medicine and technology. Further, *Horrible Science* is not just a series of books, but a range of other products, even if these are largely book-based (e.g. jigsaws come with ISBNs). Yet, crucially, *Horrible Science* also presents itself as very different from other children's non-fiction. In both respects, it makes for a good study in tracking and considering the norms of children's non-fiction.

The content of *Horrible Science* is, in the author's words, 'a mix' of quizzes, fiction, activities and explanatory prose. The books apply a range of fictional devices (for a range of reasons) and offer a hands-on experience of science through instructions for 'experiments'. In many ways *Horrible Science* is equally comparable to a textbook and a comic, and its design codes appear to borrow from both. The books narrate their science with an explicitly child-friendly address, promising not to over-work their readers. Whereas traditional children's popular non-fiction invites reverence to both knowledge and the conventional modes of knowledge construction and dissemination (i.e. scientists and teachers), the explicit tone of the *Horribles* is irreverence. Moreover, whereas traditional children's popular non-fiction sells itself on a promise to provide readers with access to mainstream expertise, the *Horribles*

allude to hidden knowledge, the esoteric and the outsider perspectives. *Horrible Science* is in many respects a spin-off of the *Horrible Histories,* which apply humour to produce an anti-establishment approach to history education, laughing at the authority figures of traditional history. Yet, in comparing the two series, we should note a key difference in who we are invited to laugh at. *Horrible Science*'s irreverent approach is not targeted at the producers of knowledge nearly as much as those who tend to communicate it; the 'baddies' are generally teachers, not scientists.

Science as pantomime is science presented as a show. It is spectacular; a show performed at an audience. Pantomime science is never, at least explicitly, reverent. Panto-science also draws attention to itself as constructed, by literally falling through the 'fourth wall'. Panto-science plays with connecting with the audience, but only plays. It plays with realism, but again, only plays. It plays with the idea of being counter-cultural, but only plays. My application of the pantomime metaphor should not be taken as a dismissal of *Horrible Science* as 'trashy'. In many respects, it is happily 'trashy', with its roots in the carnivalesque and the culture of the dispossessed. As we shall see, *Horrible Science* quite happily applies and references a range of similarly 'low culture', from horror movies to advertising. However, just as pantomime delights in its fairytales (for all its satire and clowning about), *Horrible Science* may appear to laugh at authority but also maintains a central link to science's claims to authority, the excitement of discovery, the new and weird ideas and objects scientific study can show. In many respects, it is what David Meakin describes in a study of alchemy in literature, 'having your myth and relativizing it' (Meakin, 1995: 197).

Chapter 3
The Branded Book

Introduction

This chapter hopes to introduce some of the repeated features of *Horrible Science* and reflect upon what such repetition signifies. It also considers the status of *Horrible Science* as a consumer product, a brand, and explores some of the ways in which consumer culture is referred to within the content of the books. Theoretically, forms of ambivalence around contentious boundaries and exchanges of symbolic (as well as economic) capital are central to this chapter. I argue that rather than dubbing *Horrible Science* a 'series', it is best understood as a multi-platform brand, albeit one that is quite explicitly book-based. In terms of its use of imagery from consumer culture, we can see an ambivalent pantomime style of irony at work here. As *Horrible Science* both spoofs and celebrates its role in consumer culture, it reflects some very complex forms of ownership and social distinction around knowledge, which I believe are key to understanding contemporary issues of science in society.

In some respects, *Horrible Science*'s connections with consumer culture exemplify its status as pantomime science. Pantomime began its life in the theatre as a commercial product, and in many respects remains one (Taylor, 2007: 19). *Horrible Science* has a place in consumer culture simply because it is part of the book business, but it is an unusually openly branded one. It also exists within a culture saturated, even preoccupied, with consumption: one which it reflects in its cultural references, continually referencing styles and tropes of advertising language and imagery, even drawing on consumer products as explanatory metaphors. Like pantomime, within the pages of *Horrible Science* I think we can see commercial culture concurrently laughed at, applied and celebrated.

After a brief introduction to *Horrible Science*'s position in consumer culture, this chapter is split into two sections. Firstly, I address tensions in the idea of a

children's book business, both in terms of considering the consumption and marketing of literature, as well as issues raised by imagining children with respect to economic action. Secondly, I look at the specific issue of purchasing and marketing ideas about science (or the idea of science), including invoking images of commercial culture ironically in order to suggest distance from it. One point I do not really address in this chapter is the idea that consumer culture somehow amplifies claims and pushes us towards the spectacular (so-called sensationalism or tabloid-isation of culture). That is, as Dorothy Nelkin starts her book on science journalism, *Selling Science,* the constant reporting in terms of '-est' (the biggest, coldest, hottest, smallest, newest thing in the world), so that science only appears in the coverage of 'dramatic crises, major discoveries, or the feats and foibles of science stars' (Nelkin, 1995: 1, 3). I have avoided this topic here partly as issues of sensationalism are covered in chapters four and nine, but also because such points are generally made in criticism, and I do not necessarily wish to play a blame game with consumer culture here.



Fig 3.1. Items from the *Horrible Science* range

Horrible Science: Branded Book

Whether or not we are concerned by associations between literature and business, it is clear that *Horrible Science* is a commercial product. The previous chapter already outlined the different types of *Horrible Science* branded products. Fig 3.1 shows how the branding is worked across a range of these products, not only through the repetition of the words *Horrible Science*, but also the illustrative style, choice of colours and font. All the products keep to a set *Horrible* style and a *Horrible Science* specific one within that. This has changed slightly at the start of 2008 with the recent re-brand (see fig 2.1, for comparison of re-brand with original style). Fig 3.2 shows cross-promotion not just between the *Horrible* brand and a multi-national bookseller, but also across the *Horrible* range. Scholastic are not the only publisher to pursue such a strategy: fig. 3.3. shows a *Horrible Science* branded cereal box next to a competing foodstuff, similarly utilising the image of *National Geographic* (and vice versa), albeit with a rather different exchange of iconography. Arguably, *Horrible Science* wears its consumer identity slightly more openly than other literature, continually referencing advertising and consumer products within the texts. Scanlon (2008) quotes a *Horrible Histories* editor: 'We are not just publishers, we are brand managers', although my interviews with Arnold and De Saulles suggested they felt there was some integrity to the central set of books, and that this was where the heart of *Horrible Science* lay. Arnold described the jigsaw books as an added 'extra' for those who already enjoy the books (Arnold, 2006b).

One of the most interesting places where the *Horrible Science* brand is replicated is within the books themselves. The books are suffused with ironic references to consumer culture, some of which are self-referential. For example, 'Horrible Science Holidays' is a recurrent device that allows readers the idea of being transported to various inaccessible locations such as outer space (*Space, Stars & Slimy Aliens*, 2004: 28-9). It is important to note that the tone here is with tongue firmly in cheek and in many ways this is part of the pantomime style that draws attention to the construction of the book as an imaginary space. It is the equivalent of a story set in the village of 'Much Giggling' or an intertextual reference to a lead actor's well-known role in a television soap. However, it is worth noting that this is done through repetition of the brand name and considering not only why they draw attention to their branded nature, but seem to laugh at themselves for it, poking fun at their own commercialism.



Fig. 3.2. Everything's *Horrible* at Borders



Fig 3.3. Cereal cross-promotion

There are also references to consumer culture as it exists outside of the *Horrible*, as many of the books are filled with references to advertising, imaginary commercial products and appropriations of popular media narratives as forms for exposition. The technologically-themed books are perhaps the most noticeable example of this as their subject matter neatly intersects with questions of products, even if the portrayal of the historical examples through modern advertising language is done with explicit (comic) anachronism. There is also the recurring character of 'Honest Bob', a used car salesman in the mould of British sitcom characters. Honest Bob appears throughout the later books advertising various dubious technologies or ideas, such as failed planes or 'used planets' (see fig 3.4). At one point he even presents a 'kiddies book of snakes' (a fascinating example of a children's science book within a children's science book), in which the readers are asked to 'spot the porkies' (See fig 8.4).

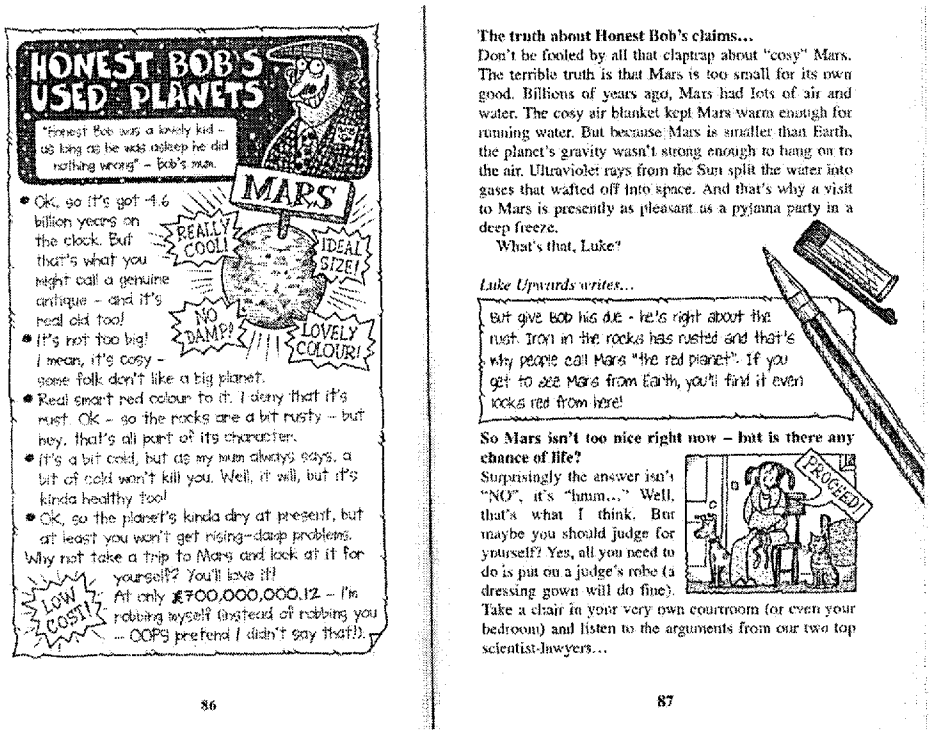


Fig. 3.4. Used Planet Salesman (*Space, Stars & Slimy Aliens*, 2003: 86-7)

A particularly significant set of references to commercial culture can be found in *The Body Owner's Handbook.* Or rather found 'with', rather than 'in', as the whole book is constructed around a metaphor drawn from commercial culture. The book is, in some respects, a standard child's 'body-book', not dissimilar to the Usborne *How Your Body Works* (Hindley & Rawson, 1975) or even *Horrible Science*'s own *Blood,*

Bones and Body Bits (1996). However, it is laid out as an instruction manual for a piece of consumer technology. Mike Featherstone (1982) has noted the way in which the body is increasingly commodified; not only seen as a reason to purchase cosmetic or health products, but a way of marketing oneself. *The Body Owner's Handbook* seems to take this discourse of the commodifed body and work it as a structure for explaining scientific ideas, albeit with a small degree of ironic distance. The language is superlative and the jokes are heavy and explicit, as is the use of fictional devices:

> Looking for a new body? Why not choose the real McCoy – the one and only Human Body. It's Planet Earth's most advanced living machine! It's built of the finest material to a tried and tested design that's over two hundred thousand years old! (*The Body Owner's Handbook*, 2002: 8)

In some respects this idea of the human body as a product echoes traditional metaphors of the body as technology. For instance, the text refers to the digestive system as a 'fuel storage tank and conveyor belt' and a 'body repair shop' is used to discuss cell replacement (*The Body Owner's Handbook*, 2002: 22, 28). We might argue that a sense of economics as competition also fits in to recurring ideas of the body as a battlefield (c.f. Sontag, 2002), albeit with a rather different moral turn, however, I am not sure *Horrible Science* extends the metaphor to suggest germs as competitors for market-share. Rather, metaphors of war, mechanism and consumer product overlap within this idea of the commodifed body.

Because *Horrible Science*'s ironic tone seems to position commercial culture as a dismissible 'other', we could argue that to render the child's body as a consumer product is to laugh at it (e.g. as it laughs at Honest Bob). However, Honest Bob's products are never denigrated nearly as much as his marketing strategy. Indeed, if anything, the metaphor of a consumer product, as well as the associated superlative language of advertising, acts to celebrate and show off the 'features' of the body: 'Congratulations on owning the best body machine in the universe' (*The Body Owner's Handbook*, 2002: 8). Commercial products are assumed to be fun, even if their advertising is only fun when we make fun of it.

Significantly, *The Body Owner's Handbook* draws on a machine metaphor in the quite personal, diffuse and entertainment-based sense of post-industrial

technologies such as personal computers or MP3 players, rather than the technologies of mass industrialisation of the early 20th century. It thus implies some sense of individualism: note the location of the apostrophe in the book's title, it is body-owner singular. Images of mechanised bodies of the 1920s and 1960s may imply a sort of alienating, poisoned or dehumanised body (c.f. Haraway, 1985), but the machines young people work with today are very different. We are also told the body is available in a variety of colours; 'light brown, dark brown, pink, beige and yellow' (*The Body Owner's Handbook*, 2002: 9). Yet, this note on race is emphasised by arguing that bodies are all the same underneath; the sense that everybody's body is the same is very important to the scientific stories of the book. This is the curtailed (and occasionally illusionary) individualism of interaction with branded technology. One of the key problems of tying an idea of personal identity to the consumption of products is that, to some extent, such identities come pre-packaged. Moreover, in the specific context of a contemporary technological product, there is the implication that there are right and wrong ways of interacting with its surface, and that its internal workings are supposed to be left a relative mystery to users (see Turkle, 1995, Davis, 2004, Mosco, 2004). As the book warns: 'The body isn't designed to be opened by non-experts and this can result in serious body breakdowns' (*The Body Owner's Handbook*, 2002: 12).

Imagining the Children's Book Business

I have argued elsewhere for greater critical awareness of consumer culture in children's literature research (Bell, 2007b). Brands of retail chain, publishing house and, to some extent, author all interact (competitively, disruptively, and on occasion, co-operatively) on the shop floor, as well as making their way into schools, libraries and home bookshelves. This chapter follows that paper's call to recognise children's literature as consumer products, and not to allow romanticised images of either literature or the child to obfuscate the processes of commodity exchange which are at work.

Books as Consumables

In a sociological analysis of the sites of contemporary bookselling, David Wright (2005) argues that much of our literary consumption embodies a style of 'soft

capitalism'. The bookshop is continually imagined, and depicted by its marketers, as 'a distinctive type of place [...] a paradise of calf-bound volumes' (Wright, 2005, 304). He goes on to argue that this is an image that the book business actively constructs, not only to lull consumers into 'safe' feelings, but also to express particular artistic credentials and perform a relatively high class status, unconcerned with matters such as money. Unpicking the history of literary culture and consumerism, Colin Campbell (1987) argues that the emergence of the novel in the middle of the 18th century was not only central in the development of a 'fiction-manufacturing industry', but the novel's content, which its new wide readership often took quite personally 'to heart', was a key part of the construction of the consumer identity. Campbell argues that the romantic take on notions of authenticity and self-expression generally found in early novels has become central to contemporary ideas of consumerism. The novels' connection to images of authenticity is part of their appeal, it is part of what readers purchase with a book. Thus, we shop to define ourselves and, perhaps perversely, show ourselves as real. Peter Corrigan expands Campbell's ideas, arguing that our concept of the lone, expressive genius of the writer emerges as a consequence of the dilemmas of industrialised society. Under ties of patronage, art and literature were produced to order. When this relationship ended, artists were pleased to have more freedom, but found themselves faced with the choice to produce 'commercial art' (Corrigan, 1997: 12). In response, writers constructed the idea of an 'expressive' theory of art, the idea of a lone genius expressing superior insight, and obfuscated the commodity exchange in the process. The consumer, in turn, is constructed as requiring aspects of the artist's output in order to re-create some small aspect of the superior insight, and a market relationship is thus developed. This is not to suggest that authors are cynical in their approach to writing. Rather, such analysis is provided here to suggest there is an economic history to our ideas of the literary.

Such obfuscation of the economies at work are, arguably, part of the book business's success. At the same time as relying on consumption to express a sense of authenticity, western culture tends to assume that consumption, and anything it touches, is inherently inauthentic and therefore seeks to distance itself from the artifices of economics and marketing. This is only one of the many ironies and discontinuities of consumer culture, as many of its critics have remarked (notably Baudrillard, e.g. 1981).[12] Of course, books are not only sold, but borrowed, lent, even stolen. However it would be naïve to imagine that libraries are spaces somehow

[12] See also Bauman (2007) on the topic of 'subjectivity fetishism'.

immune to marketing; not only are they a significant market in the buying of books, but they also exist within (and as part of) the marketplace since readers come to the books ready versed in PR and libraries will often display posters for particular books, writers or illustrators, as well as aping bookshop styles to shelve books 'face out'. The rewards for such display are not economic, at least not in an immediate sense, as book-borrowing from public libraries is free at the point of use, but symbolic. Bourdieu's metaphor of capital to describe the movement, accumulation, loss and expression of symbolic political and cultural power is a salient one in the context of the book business. Even apparently anti-market projects such as bookcrossing (leaving tagged used books in public spaces for others to freely pick up) tend to take place in bars, pubs and cafes: its logo used as a form of cross-promotion to help the owners of these businesses identify their particular site of consumption as inviting, a way for the 'hospitality' industry to borrow some of the book business's soft capitalism.

Publishers have been known to leave new books in bookcrossing sites, hoping it will have similar (or more powerful, albeit localised) benefits to handing out review copies (see Bell, 2007b). To the best of my knowledge, the salespeople of *Horrible Science* do not appear to have attempted these more subtle forms of social marketing. However, they do sell themselves through a sense of self-expression, utilising images of implied readers across the pages (often sitting reading the books) and asking for audience participation throughout the live science 'show' versions of the books performed by the author. Traditional 'meet the author' book-signings also appeal to a notion of personal interaction with the book, as well as implying a quality of authenticity and uniqueness with the signature. Additionally, a sense of being a *Horrible Science* type of 'person' is often implied in the books through challenges of 'are you up to it?', and by asking readers to join the *Horrible Science* 'club' when subscribing to the magazine or signing up to an email list.

Children and (the Book) Business

The business of juvenile literature introduces, arguably, another level of complexity entirely as the odd disconnections between books and their business intersect with similar disconnections between the child and commerce. Complaints over commercial sponsorship of children's book prizes (Barker, 1998) are indicative of ways in which commercialism is somehow meant to remain outside of both the

childlike and the literary. There is, within much of the children's literature community (scholars, writers, critics), a long-standing disregard for the apparent commercialism of so-called 'series' literature (e.g. much of Enid Blyton). Bruce Butt (2003) is indicative of this attitude when he describes *Lemony Snicket's Series of Unfortunate Events* as the 'literary equivalent of junk food – predictable, filling, but lacking nutrition' (Butt, 2003: 280).[13] As I discussed in my first chapter, many working in children's literature assume something is lost when concerns for money-making promote 'selling any kind of book' (publisher Kaye Webb, quoted in Reynolds, 1998: 34). In some respects this reflects Horkheimer and Adorno's (1973) contention that the products of the cultural industries 'no longer pretend to be art. The truth [is] that they are just business' (Horkheimer & Adorno, 1973: 121). Even Charles Sarland's (1994ab) ardent advocacy to take the *Point* books seriously shows how many critics tend to look for something 'more' than commerce in children's books:

> these young readers never for a moment think they have to lie back and believe; on the contrary they want to observe and learn. Thus, while explanations of big marketing operations are undoubtedly part of the story, they are not in my view the whole story (Sarland, 1994a: 61)

Throughout he is explicitly aiming to get away from the 'kidlitcrit stereotype' of children as passive dupes of marketing svengalis. Yet Sarland's aim to celebrate the pleasures of branded reading still implies a desire to locate 'something' more than the 'big marketing operation'.

Arguably, one of the key reasons for such distaste for the business side of children's books is not only because it clashes with a sense of 'high' art and literature (a problematic identity for 'kiddie lit' at the best of times), but also because of cultural attitudes to the idea of the child in commerce. It is often assumed that young minds are somehow more open to suggestion, more likely to be susceptible to advertising's influence than adults are (see Mediawatch, 2007). There is the further suggestion that the broad 'assemblages' of products in contemporary branded media are especially powerful; subsuming child audiences entirely into a multi-media world where they can act out characters with toys, costumes and through reading books and watching films (Jordon, 2004: 472. Mackey, 2001: 167).

[13] See also Watson (2000), Bixler & Agosta (1984) & MacLeod (1984).

Sociologist Daniel Thomas Cook (2005, 2004) complains that studies of the child and the consumer tend to develop in isolation from each other, as if there was an 'either/or' state, with childhood somehow standing in opposition to capitalism. Buckingham suggests a historical dimension to tensions between images of childhood and commerce. He argues that the child consumer invokes ideas of child labour; we imagine child consumers as victims of evil capitalists. Such images, he contends, make us uneasy because they subvert Romantic ideals of the child as existing somehow outside of human culture (Buckingham, 2000a: 146). As Cook argues, we can easily juxtapose the child as victim with an image of one that is 'at home in, and even thrives on, commercial culture' (Cook, 2005, 157).

The implication that a consumer identity is a powerful one can go some way to explaining the appeal of consumer culture to children. Marsha Kinder (1999) gives the example of a boy she noticed on the street, leaping to a *Power Ranger* pose, with a look of great pride on his face, as soon as he spotted a poster in a shop window. Kinder surmises this is because the poster specifically addressed him, rather than his mother or his little sister.

> The poster acknowledged his importance as a knowledgeable player within a culture, but it helped him map the world and his own place within it [...] with a sense of drama and style that belied his subordinate position within the culture [...] What I had witnessed was the morphing of a powerless four year old into a consumer. (Kinder, 1999: 183-184)

Kenway and Bullen (2001) similarly suggest that contemporary children's commercial culture succeeds so well because it successfully targets the child market as a *specifically* child market with the sort of address of 'no adults allowed' and adults in generational drag that I have already discussed. However, to Kenway and Bullen, such an address is ultimately disempowering to children as they are simply being asked to rebel against the parent by subjugating themselves to corporations (see also Kapur, 1999). They believe this is socially divisive, claiming that, in the attempt to make children autonomous consumers, children's consumer culture 'others' the adult. Talking to the child as child, consumer culture constructs children in isolation from the commercial decisions of their parents (even if, all along, such culture comes from adult writers and producers). This, Kenway and Bullen argue, has the

simultaneous effect of increasing the generation gap and suspending it, forcing children into an adult economic role they are not prepared for.

Robert Lantham (2002) perhaps provides the most useful compromise on the question of children's agency and consumption. Inspired by Marx's metaphorical use of the word 'vampire' to describe physical labour in the factory, Lantham argues that the prevalence of vampire characters in young people's media has emerged in an attempt to work through the implications of capitalist society. Young people, he suggests, are vampiric; both consumers and consumed, empowered and exploited. Lantham's point helps sum up the multiple ways young people are pushed and pulled by, and can themselves push and pull, consumer culture. Waetjen and Gibson (2007) note the apparent inconsistencies around consumption within *Harry Potter.* At times the texts lampoon the hollowness of hyper-consumption, especially with respect to the non-fantastical 'muggle' world where the books start. But when Harry enters the wizarding world, many of the new and different objects he delights in discovering are products. Sweets that move or explode or change colour all have brand names, which readers are invited to learn. Waetjen and Gibson conclude: 'Rowling's texts, like the wider social field of which they are a part, would seem to be of many minds when it comes to understanding the role of material goods in contemporary life' (Waetjen & Gibson, 2007: 20).

Locating Books Within the Brand

Thinking about *Horrible Science* as a brand is a useful way of understanding its implied relationships with readers, as well as the forms of repetition at work across the series. For the sake of convenience of clarity and norms of language around books I do refer to *Horrible Science* as a series throughout this thesis. However, there is a sense of narrative temporality within the notion of a 'series', which does not suit the structure of much non-fiction. For instance, although DK number *Eyewitness'* spines, this is more to prompt a sense of completeness across the series (as well as an allusion to encyclopaedia) than a signal of what order the books are best read in. Analytically, we are therefore better served by accepting such books as branded. Temporality aside, the covers of children's books are littered with symbols which have nothing to do with authors; characters, locations or even specific genres are used to suggest a particular type of book, or to imply that they address a particular 'type' of person. The *Point* books are a good example: also published by Scholastic,

although aimed at a slightly older age range than the *Horribles,* and had started to decline before Deary and Arnold's texts became popular. The *Point* 'series' included a range of horror, romance and crime books, utilising a network of writers. There were some small 'series' within each category, some following a chronological sequence, some not. What *Point* stood for was less a marker of being about a particular set of characters or sequel to an already-loved story, but, like the *Horribles*, a symbol of a particular type of literary experience.

In her book on branding, Celia Lury (2004) asks us to consider the brand as an object of the material-semiotic networks of Actor-Network Theory (e.g. Latour, 1987). To Lury, a brand is 'not simply either here or somewhere else, but rather is some-thing that emerges in parts' (Lury, 2004: 1). Brands may appear coherent. Indeed, they strive to engender coherence, but this is an illusion to cover a flexible, multi-authored and often incoherent mass of ideas underneath. Importantly to Lury's view, behind all the apparent coherence, brands are also necessarily 'dynamic', and will change in response to feedback from consumers (Lury, 2004: 3). This rather postmodern (or at least post-1970s) approach to the brand is the most fitting description of *Horrible Science*: its character emerges not simply through each book, but via a diversity of media surfaces. It is also influenced by associations with other non-fiction works under Scholastic's logo, especially those which share the prefix *Horrible*. Key to the sense of the brand as an object, Lury suggests brands are a 'guarantee of a consistency or quality or sameness' across the space and time of complex contemporary society (Lury, 2004: 26). They are, abstractly, 'a platform for the patterning of activity' (Lury, 2004:1), a symbol which links products with a sense of 'sameness' as much as they distinguish them.

As a patterning activity, brands are also inherently repetitive; reflecting the culture of mass production from which they emerge. This multiplication may be of single products, such as neatly piled stacks of a new *Harry Potter* book. It can also be of images, characters and/or storylines across media: films, toys, clothes, games and trading cards. As we have seen, there are repetitions of *Horrible Science* across its special editions, toy kits and activity books, as well as supporting resources for teachers and cross-promotion with breakfast cereals. According to Lury, the shift to multi-platform (or the extension of brands across space) can be detected from the 1970s onwards; a movement from promoting stand-alone products towards branding ranges of products and services. Thus the 'pattern' of the brand is not located in a single place, not here or there, at a single time, but 'distributed across a number of

surfaces' (Lury, 2004: 50), emerging in parts.

Following Margaret Mackey (2000), we might describe products such as activity kits, computer games and stickers as 'spin offs' of the central book. However, this is perhaps too literature-centric an approach; inappropriate not only in the case of *Horrible Science*, but, I would argue, for culture industries in general, particularly those targeted at young audiences. Products linked to a book do not always spin off, but sometimes spin on (and back again). Moreover, different media products are often co-produced; cartoons about toys being an obvious example. Nostalgia for the cross-media products of previous generations (e.g. *Transformers*) is leading to even greater layers of confusion for those who aim to keep a sense of a distinct media starting point to 'spin' from: the toys of the film of the cartoon of the toys; the book of the cartoon of the film of the book. Even when, historically, a book is the starting point of a narrative, it may not be so for each individual reader. To call non-book products spin offs ignores the diverse routes to the story a child may take to a narrative, as well as the complex ways in which books and other products interact (Burn, 2005, as mentioned in chapter one). Arnold's description of the jigsaw books as an 'extra' for people who really like *Horrible Science* books suggests some form of directional line drawn from book to (spin-off) product. But audiences come at *Horrible Science* from a variety of directions, and there is no explicit structural sign indicating that the one item should go before another as there is in the temporal narrative of, for example, school-series (e.g. *Harry Potter*), or even numbered spines of *Eyewitness* books. The cereal box association works in part because Scholastic hope customers will be prompted to buy books having tried the 'taster' computer game as much as the cereal company hope to utilise the symbolic power of *Horrible Science*.

The literary critic's tendency toward the term spin off could be explained as a reflection of (or attempt to maintain) the primacy of the book within culture. Yet co-production across a range of media is nothing new. Mackey (2000) traces the 'multi-media' tendencies of *The Wizard of Oz* from the very start of the 20th century, which included a very long series of books, radio plays, lantern shows and a stage play long before the 1939 film (Mackey, 2000: 185-187). Considering this issue in the specific context of popular science, Aileen Fyfe (2007) suggests a 'multi-media' element to Victorian natural history museums, working her idea through examples of museum guidebooks and the case study of a 'pictorial' museum part-work. Perhaps the looser association with the literary allows science publishing (compared to fictional works) slightly more reach to work with non-book media.

Still, amongst all the multi-media extended brands, large companies also aim to create an image of internal coherence and uniqueness with their brands, developing several smaller brands to invoke an idea of brand 'consistency' and speciality. For example, Dorling Kindersley and Penguin may cross-promote, but generally there is power in remaining distinct. The same is true, or at least has been on occasion, for Books Etc and Borders, Waterstone's and HMV (including Hatchard's and Fopp), Scholastic and Klutz; as branding is used to create the symbolic appearance of a whole, one consistent in itself and distinct from others. In terms of the specifics of child-orientated markets, as Jack Zipes points out, there are often invisible links between publishing houses and food or toy companies (Zipes, 2001: 7); there is a reason why some dub branding a form of applied semiotics (Rowland, 2007). In the post-1970s world of 'distributed' brands, sometimes the larger name will be worked in tandem with the smaller, distinct ones. *Horrible* both constructs a holistic sense of the *Horrible* approach to knowledge, but will use different authors and, moreover, illustrators to emphasise the difference of subject areas within this. Analytically, we should not lose a sense of the book entirely, however, as it is worth noting the ways in which the special symbolic status books hold in contemporary society is utilised by the book business.

Indeed, the *Horribles* can be seen as an example of a 'book-based brand', where the centrality of the book is maintained by its producers as part of the brand strategy. I have discussed this elsewhere in reference to products associated with 'every girl's best friend' Jacqueline Wilson, which, whether branded stationery or magazines on creative writing, tend to connect themselves in some way to literature (Bell, 2007b: 92-3). The *Horrible Science* toy boxes and computer programmes reference titles from the books and re-apply their content, as well as following their lead in terms of style of language, illustrations, characters and tone. Wright refers us to the way the book-trade constructs non-readers as uncultivated in some way, flawed or 'in need of salvation' (Wright, 2005: 303), which implicates reading in a hierarchy of activities placing reading above other cultural pastimes. Arguably, book-orientated products, although reasonably cheap compared to some children's toys, are culturally disassociated with the working classes and may be utilised as a way of performing social distinction as middle class (Nadesan, 2002, Vincent & Ball, 2007). However, book-based brands are not simply a matter of the middle-class imagery of literary culture; publishing houses have the strongest retail relationships with the bookshops, whose distribution and shop-floor selling systems lend themselves to book-like products. The best example of this in *Horrible Science* are the jigsaw

books; a product traditionally packaged in boxes and sold as toys is here produced book shaped, with pages (albeit thick ones to accommodate the jigsaw's pieces), ISBNs and titles on their 'spines'.

Shopping for Science

As discussed in chapter one, Fyfe and Lightman argue that the sense of shopping for science is perhaps a more productive metaphor than the more problematic moniker of 'popular science', noting that the particular audiences for such works generally saw themselves as consumers. They start their collection of essays thus:

> Although it might be tempting to assume that there is something unique about the consumption of science that we ourselves are surrounded by in our bookstores, on our television channels and in our toy shops [...] the sciences have long been a part of consumer culture (Fyfe & Lightman, 2007: 1)

What strikes me most about this line is that Fyfe and Lightman feel the consumption of science is obvious enough in today's culture to use as a starting analogy in describing events a hundred and fifty years ago. Earlier I described Corrigan's (1997) depiction of the artist exchanging aspects of their 'superior insight' for a lay public's money. Just as literary culture constructed a sense that the public needed the artist's insight, science communication relies upon the idea that the public needs some connection with science. Sites of science communication exhibit exactly the same tension in their relationship with consumer culture. Shops inside science museums are a good example; the Smithsonian even displays small cards alongside their branded books, toys and games explaining how the profits from the shop help their educational work.

I believe much of our understanding of science's interaction with the public could be improved if we acknowledge its frequent basis in consumption. Aside from simply opening our eyes to economics at work (and distribution/exchange of financial power within this), the notion of trust is central to branding. Moreover, I think an awareness of the consumption of science communication allows us to consider the various exchanges of symbolic cultural capital at work, including the role of the consumer within this. The idea that science is somehow above commerce is a

common one and as such is worth tracking. As we shall see, the symbolic capital associated with science can be constructed by distancing or dismissing commercial culture; tensions such as the Smithsonian's desire to excuse its shop are cultural phenomena worth considering, rather than simply instances to either celebrate or laugh at. Similarly, *Horrible Science* not only builds a sense of authority through use of its brand, but will also perform itself as somehow above commercial concerns through parody.

Trust and the Brand

A history of the soap business can go some way to helping us answer to the repetitions of the brand can be appealing within the specific context of popular sciences. Historian Anne McClintock tells us that the first wrapped soap was sold under a brand name in 1884. From then on, items once indistinguishable from each other would be marketed by their corporate signature; soap was no longer simply soap (McClintock, 1995: 210). The Victorian context of McClintock's study is significant as a time when companies became larger and everyday social lives more complex and transitory. Large producers could no longer maintain sustained personal relationships with all their consumers and retailers, and instead relied on the shortcuts of marketing a brand. The role of the advertiser was not only to inject a 'radiant halo of imperial glamour,' but acted as a replacement for the shopkeeper: a symbolic advocate for merchandise, suggesting the appropriateness, trustworthiness or value of a product (McClintock, 1995: 211). Reflecting this, branding is often understood by researchers as a symbol of trust or, as a heuristic tool for the customer, a way of simplifying consumer decisions (Holt, 2006: 356-7).

Buckingham and Scanlon suggest that series publishing offers a means of dealing with risk (Buckingham & Scanlon, 2005: 44). They are talking here about economic risk to publishers, but we can also consider it in relation to the consumer, unsure about unfamiliar knowledge, going for books with recognisable stamps of approval. Why 'risk' investing in a new imaginative world, when inscriptions signalling familiar writers or well-known characters indicate the possible repetition of a previously enjoyed experience? Yet, branding soap, or the characters and authors of fiction, is one thing, but with non-fiction we brand *knowledge*. In terms of the question of consistency, we could argue that the subject boundaries within the *Horrible* brand act to show differences between knowledge systems, not consistency at all. Just as

Point's distinctions between Romance and Horror are co-constructed alongside other social distinctions of the assumed audience, those between history and science, maths and geography are similarly accentuated within the *Horrible*. This is emphasised by the use of different writers and illustrators for each sub-brand. Yet, the overall 'Horrible' (or 'Point') suggests a sense of coherent 'whole'. What is more it arguably emphasises consistency within each subject, be it science or geography by giving them each the same voice and style (through their own author and illustrator), even if it is a distinct knowledge system from other areas. The self-conscious references to the *Horrible Science* brand only add to this.

Non-fiction tends to maintain a strong link to the symbols and characters of academia and other stamps of 'official' knowledge. In adult publishing, popular science books tend to be written by scientists, or else journalists keen to display their academic authority. As referred to in chapter one, logos of government education programmes are replicated across much UK children's non-fiction. DK's use of the Google brand (e.g. DK Publishing, 2004) is a slightly more ambiguous articulation of trust symbols at work. Any distrust of the breadth of the internet is mitigated by the more closed, traditional, perhaps elitist, values of a publishing house, which in turn gains from its association with the notions of freedom and the contemporary associated with the internet. Unlike fictional genres (or *Horrible Science*) many children's science books are authored anonymously, or play down the name of the writer. When names do occur, they are often more a matter of citation than a way of attracting readers. DK, however, have recently employed people famous for achievements other than writing children's science books to write (or feature on) science and technology books (e.g. Winston, 2004, Vorderman, 2002, Ackroyd, 2003ab, & Hammond, 2006).

Although other children's science books appropriate various external symbols of authoritative knowledge to signal their trustworthiness, the *Horrible* books tend to sell themselves in opposition to conventional official images of authority and instead emphasise their closeness to the child sub-culture. They do this by way of connecting the idea of the 'horrible' alongside the more apparently straightforward 'science'. *Grossology* (e.g. 1995, 2003, 2004) similarly repeats the word grossology across a range of topics. Their first, central title is simply, *Grossology: the science of really gross things*; the 'ology' connected with the 'gross' suggesting itself as a way of going about scientific understanding. Other titles suggest a variation on the theme, similar to playful twists and turns of *Horrible Science*. For example: *Naked*

Grossology (about the human body) and *Hands On Grossology* (experiments).

From Lury's quite abstract definition of a brand, it is possible to consider the word 'science' as a brand; a sort of illusionary sense of consistency worked through a range of platforms. Indeed, it should be remembered that Lury's theoretical framework comes via actor-network theory, thus stemming from an attempt to understand the illusionary consistency of science. The key distinction between this use of science and a conventional product brand is that the former is more likely to apply its sense of internal consistency to keep people out, rather than invite them in (see Rowland, 2007, for a practical application of this). To some extent, *Horrible Science* and *Grossology* are setting up a parasite brand on the periphery of 'science' which both feeds on scientific authority and aims to connect with those outside by presenting itself as also somehow else. Moreover, it uses this dual-faced identity to draw those who would think of themselves as outsiders into the central brand. This application of a form of 'subcultural capital' which serves to connect itself to the object it critiques is reasonably common in contemporary marketing. As Naomi Klein notes, the 1990s saw several old brands masquerading as new and undiscovered, aiming at an 'indie' aesthetic. Such brands, Klein argues, aimed to express their disdain for mass culture not by opting out, but by abandoning themselves to it entirely 'with a sly ironic twist' (Klein, 2000: 77-8). Stephen Wagg similarly traces the use of so-called 'alternative comedians' in advertising, suggesting that 'irony flatters the consumer' not only by implying the advertisers do not take themselves, or the advertisement, seriously, but by anticipating any resistance customers might have about being sold to (Wagg, 1992b: 281).

Constructing Authority Through Spoof

I have already mentioned some of the ways *Horrible Science* uses spoof advertising materials as narrative and explanatory devices (notably the character of 'Honest Bob'). Moreover, *Horrible Science*'s general style of language is one that appears to be making fun of the repetitions and over-dramatisation of commercial culture. I will revisit this in the next chapter, and in more detail in chapter six, but it is worth introducing the topic here, and reflecting on the implications for constructing forms of cultural capital, particularly the construction of a sense of authority by showing a knowing take on popular culture. To start with what *Horrible Science* is parodying, children's literature critic Anne Scott MacLeod, firmly in the anti-series camp,

complains of the 'awful prose' of popular literature which she feels is repetitive and formulaic. She emphasises the language of many series fiction:

> The narrative is an unbroken string of clichés; any page is likely to be full of twinkling eyes, square jaws, splitting headaches, menacing glances, and furrowed brows. Mansions are "gloomy", girls "vivacious", villains "surly" (MacLeod, 1984, 134).

To MacLeod and many like her, this is evidence of the trashiness and crassness of popular culture. Such formulaic fiction is not real literature; it does not challenge readers or say anything of substance. It is, as I have previously quoted Butt (2003), the 'junk food' of reading. We can easily see such language reflected in *Horrible Science*'s prose, aside perhaps from the vivacious girls. To some extent, it is even signalled in their titles. Crucially, however, I think Arnold is doing so with a degree of irony. *Horrible Science* seems very aware of the styles of 'formulaic' fiction, and appears to assume this awareness in its audience too. In some respects this is a form of homage, a celebration and enjoyment of, for example, describing mansions as gloomy. Yet, it is still done with irony, which provides some distance between *Horrible Science* and the object it is referring to, even if it is only short distance. A form of hierarchical distance at that, suggesting *Horrible Science* can see through the artifices of 'trash culture' and knows better. To some degree it is, in equal measure, a pastiche both of formulaic fiction and of critics such as MacLeod.

John Weaver (2004) celebrates the way children's television channel *Nickelodeon* places spoof adverts alongside regular ones. He argues that this farcical approach to advertising 'right under the noses of advertisers' subtly questions the whole concept of selling to young people, offering the potential to question advertisers' manipulation. Drawing on empirical research with 8-12 year olds, Buckingham suggests a considerable degree of scepticism and cynicism about television advertising. His research subjects were clearly aware of the persuasive functions of advertising and quick to mock or parody advertisements. Far from worshipping the glamorous figures we stereotypically consider to populate the world of advertising, these children labelled them 'wallies' or 'has-beens' (Buckingham, 2000a: 152). However, Buckingham also notes that this display of wise consumerism often had a competitive edge, as they hoped to reject any claim that they might be gullible. The gullible Other was often taken to be younger children or ignorant adults. This often had a class element; working class children appeared to have a lot less

invested in their ability to see through advertising (Buckingham, 2000a: 153). Buckingham's earlier work with Julian Sefton-Green similarly describes a class of teenagers producing a parody of *Cosmopolitan* magazine entitled *Slutmo*, and argues that in many respects this reads as an imitation or replication of the codes of women's magazines, not a subversion of it. The medium of parody, Buckingham and Sefton-Green suggest, enables the young people to explore contradictions and multiple readings of the texts (Buckingham & Sefton-Green, 1994: 207).

In the context of *Horrible Science*, however, such jokes are those of adults acting 'in drag' as children, and thus disseminate adult ideas. It might be nice to believe, as Weaver, in the subversive power of such parodies, or at least that they provide a way of exploring a mix of opinions. However such jokes also act to show distance from that which is perceived as crass or unbelievable. This rhetorical application of irony is a well-rehearsed form of contemporary marketing. In Klein's words, irony provides advertising with a very 'cozy, protected, self-referential niche' (Klein, 2000: 89. See also Wagg, 1992b). In the case of *Nickelodeon* it can equally be read as making real adverts seem more credible in comparison to the extreme spoofs. Indeed, Buckingham et al quote a *Nickelodeon* executive as describing his channel as a 'self-contained advertising agency' (Buckingham et al, 1999: 59). For *Horrible Science*'s treatment of Honest Bob, or even its ironic use of its own brand (i.e. *Horrible Holidays*), it could be seen as constructing a sense of authority in contrast to consumer culture, even whilst being part of such culture itself.

Branded Identity

As already discussed, for David Wright (2005), bookselling and buying is largely a matter of social distinction. The reading of books, and the ownership of them, is a form of expression of social identity. Performing reading can be a way of displaying ourselves, as we use our 'love' of books in general, or authors/genres more specifically, to signal membership of particular groups; it is an especially intimate part of the construction of identity. Arguably, this is particularly true of children's books; people will keep copies of their favourite children's books with them throughout their lives, reproducing their cultural messages by passing them on through generations. Further, as with toys, children's books for the 7-11 age range that *Horrible Science* are targeted at, are often marketed as being specifically for girls or boys, and can be quite narrowly defined in terms of class and racial imagery (i.e. largely about middle

class white people). Adam Arvidsson (2005) argues that branding is an exemplary response of capitalism to postmodernism, as it provides a source of stability and consistency in the construction of self-identity which our other social environments no longer provide. Further, the unstable and reflexive nature of postmodern identity works to provide and increase the demand for the sorts of symbolic capital that the cultural industries provide. As Arvidsson concludes, contemporary capitalism 'feeds directly off life itself' (Arvidsson, 2005: 252. See also Bauman, 2007).

Although we might read *Horrible Science*'s references to, for instance, 'Honest Bob's kiddies book of snakes' as simply using humour to distance the books from more commercial and (thus apparently) less authoritative sources of knowledge, it is perhaps harder to make this argument convincingly when it comes to the self-referential fictionalised versions of the *Horrible Science* brand. For this I think it is worth applying the idea of the 'brandscape'. Lury describes brandscapes as spaces, real or virtual, where customers can try on or simply spend time around products: 'playgrounds' for products rather than shops, provided to encourage customers to consider their sense of self in relation to the brand (Lury, 2004: 38-42). Thus, *Horrible Holidays* can be read as a way of creating a form of 'brandscape' within the imaginative format of the book; it provides a metaphorical geography to the community of readers. Again it does so through some ironic distance, but as with Klein's jeans examples, that is perhaps necessary to be taken seriously in a contemporary consumer culture. It is worth drawing comparisons here with the construction of fan identities. Martin Barker's study of *Judge Dredd* fans is particularly noteworthy for drawing out the ways in which fans can carefully plot a very precise position for themselves in the middle of a range of imagined extremes. Barker also notes the ways in which the publishing companies take advantage of forms of fan identity, even suggesting they construct them, as a way of ensuring continual consumption (Barker, 1993: 179-80. See also Sandvoss, 2005).

Purchasing Distinction

I believe *Horrible Science* offers its readers a form of social distinction based on the ability to perform scientific knowledge (or connection to the scientific community). *Horrible Science* is not unique in this respect: Majia Nadesan (2002) has discussed the marketing of intellectual-training toys under the suggestion that it will allow parents to increase their cultural capital. It is possible to extend this analysis to

science-related culture. Buyers of popular science in general, visitors to museums, readers of some forms of science fiction, documentary viewers and customers of science toys are all buying a bit of science to connect with their own personal identity, and are performing their connections through such consumer choices. As journalists and comedians often repeat, everyone bought *A Brief History of Time,* but no one read it. However, the butt of this particular joke is less that we are all too stupid to understand theoretical physics (or that Hawking is not an especially good writer), but that popular scientific culture is largely one of display.

One of the recurring features of *Horrible Science* is that they tend to start and end with a collection of explicit statements (often heavy with advertising-style language) on why reading the book is worthwhile. It is worth examining these because they not only tend to reflect a sense of needing to 'sell' the books to their readers, but are revealing in what symbolic capital they feel the books can provide their audience with. A neat, short, example of this comes from a World Book Day mini-edition, *The Seriously Squishy Science Book*:

> Most people think that science is serious. Seriously dreary, seriously brain-dead and seriously boring [...] But most people are wrong. Science isn't boring – it's horrible. And when Science is horrible it comes to life in an exciting way [...] You'll be stunned at how many foul facts there are to flabbergast your friends and freak out your family (*The Seriously Squishy Science Book*, 2007: 5)

And from the last page:

> One thing's for sure – there's more to science than boring boffins. Science belongs to us all – it's the most amazing way to discover the universe and everything in it. And if science can be serious – it's also seriously funny, seriously exciting and seriously squishy (*The Seriously Squishy Science Book*, 2007: 78).

Here we see *Horrible Science* presented as an alternative to other science, or at least different from what one might assume. It promises the 'squishy', which is in turn linked to the non-serious and exciting. There is also the promise of 'facts', which the introduction suggests can be used to impress your social peers, and the conclusion links to an assumed inherent excitement in discovering the universe. In the

conclusion, there is also reference to inclusion, the emphasis that science is for 'us all' and the suggestion that the book may have brought the reader closer to being able to gain ownership of science. From surveying the series as a whole, I have collated the appeals of this identity building into three groups: delight in the ridiculous, promise of practical application and veneration of the sublime. All of these are incredibly complex, and at no point can they be taken at face-value. *Horrible Science* will twist and turn its connection with the scientific establishment; constructing a sense of outsider-identity through ridicule, whilst at the same time situating itself quite firmly on the side of the experts, equally laughing at those 'some people' so much stupider than the implied community of author and reader. I will unpick the appeals to the sublime and to the ridiculous in later chapters, but it is worth reflecting briefly here on the promise of practical application.

In some respects these promises are comparable to several of Thomas and Durant's (1987) reasons for promoting the public understanding of science; they allude to the standard discourse that science makes the world better, that it is important for the environment and economy, that it is easier to manage our lives in such a scientific world if we know a bit about how it works, and that this also leads to fuller democratic engagement. Although *Horrible Science* often alludes to all of these justifications, its practical appeals tend towards the more 'individualistic'. The books frequently promise personal success in learning science, be this in terms of academic achievement, impressing your friends or being able to understand what scientists are saying. Once armed with skills of science, the books emphasise the social power it will provide you:

> Scientists have their very own language which only they understand. Now's your chance to learn a few key words. And afterwards you can sound off and amaze your friends and silence your teacher with your word-power (*Sounds Dreadful,* 1998: 8-9)

> [the laws of thermodynamics] sound dead posh and impressive but actually they're horribly easy to understand. (Don't tell anyone how easy, and with luck your friends will think you are a scientific genius!) (*Killer Energy*, 2001: 14)

> Your new-found knowledge of light science is sure to put your teacher in the shade. And afterwards, who knows? You might even become a

leading light in science – then you'll really enjoy the limelight!
(*Frightening Light*, 1999: 7)

The first quote above is notable for the way it starts by referencing the more 'democratic' appeal but ends with scientific knowledge seen as a means to impress people with less scientific knowledge than yourself. The latter transports the reader from the locally social, impress your friends, discourse to notions of future careers. This has consequences for what we imagine the use of science is to both young people and non-experts. Knowledge is, quite explicitly here, power. Power we may wish to deconstruct when we find ourselves outside the boundary, but at the same time worth maintaining, so as to allow us to utilise it ourselves when able.

Conclusion

Children's books are products: products which are bought, sold, marketed and branded. We should not assume the book sits at the centre of (or above all other) cultural products. Products spin onto literature as much as they spin-off. Yet at the same time, books can be constructed as superior by their producers, who will utilise the cachet of literary culture to sell a range of other products. Moreover, the cultural and economic contexts of publishing mean that books can be placed at the centre of brands by their producers, and other media may come packaged within pages, complete with spines and ISBNS.

One of the central consequences of the branded book appears to be the emergence of a range of inconsistencies which, articulated through applications of irony and irreverent-reverence, leads to liminal positions for both the presenter and their implied audiences. To Lantham (2002), the liminality of the content of much young people's culture is largely a consequence of the vicissitudes of consumer identity; one that is both powerful and disempowering. Following Lury (2004), we might understand such inconsistency more as the inevitable consequence of a brand's attempt to flexibly apply itself to as many aspects of consumer identity as possible. The parasitic outsider/insider identity, which *Horrible Science* embodies in respect to science, acts to draw those who would think of themselves as outsiders into the central brand. The next chapter, which considers the meaning of 'horrible', will unpick the flexibility of this particular brand in more detail, and I will discuss the complex relationship with science that it reflects in more detail in chapters eight and

nine (though arguably, it is a key theme of this thesis as a whole).

Thinking about the repeated features of children's literature as branded allows us to consider the sense of coherence they present as well as the flexibility and inconsistency which lies underneath this. Ideas of branding also point us towards the ways in which consumer products offer a sense of a coherent personal identity, even if it is a sense of self which comes pre-packaged. Moreover, considering the audiences of popular science as consumers invites us to consider what is on offer to them: the forms of symbolic capital at play. Science communication, especially popular science, is often seen as something done to its publics, but *Horrible Science* suggests appeals for its readers too – appeals which are individualistic rather than PUS's promises of greater democratic engagement or a better informed workforce. This is a key topic for this thesis and an issue to which I shall return.

Chapter 4
Making Science 'Horrible'

Introduction

Horrible Science is, in its own words, 'horrible'. It sells itself largely on a promise to dwell on the grotesque, the scary, the macabre, or at least the yucky. As the promotional tag line repeats across the brand, it is 'Science with the squishy bits left in'. Crucially though, it is 'horrible in a safe way' (Arnold, 2006b): child-friendly pastiches of horror films which do not take themselves that seriously. *Horrible* is also the brand, and drawing on Lury's (2004) concepts of branding discussed in the previous chapter, 'Horrible' is both highly flexible and also a coherent 'patterning of activity'. This chapter aims to uncover the flexibility of what is meant by the horrible and asks how it patterns the images of science that the books present.

Keeping with aspects of commercial culture as an explanatory framework, we might imagine the appeal to sensation as a consequence of the brand's role in commercial culture. Horrible Science might be understood as spectacular science, aiming to be heard through a mass of other media discourse on offer. Nelkin (1995) quotes Edwin E. Slosson, editor of the first science writing syndicate in America, writing in the 1920s to suggest the audiences of popularised science are at 'the cultural stage when three-headed cows, Siamese twins and bearded ladies draw the crowds [...] Drama lurks in every test tube' (Nelkin, 1995: 1, 82). Some of the questions around 'lurking drama' will be discussed in chapter nine, but 'the horrible' is similarly sensational, and as we shall see, similarly evoked via fantasy. We could, following Baudrillard (e.g. 1981, 1994) see postmodern consumer culture as a sea of unanchored cultural referents and suggest that within the clamour of sign-exchange there is a desire for a sense of authenticity. Thus, cultural industries produce more real-seeming signs, which (perversely perhaps) might be ever-more sensational and ever-more fantastical. We might equally read *Horrible Science*'s references to the gothic as explicitly transgressive and a way of critiquing science; a late modern

reaction against the scientific establishment. Yet, following Gauntlett's reading of Adorno, we could also consider references to 'the horrible' undersides of culture as the simple consequence of the cultural industries keeping pace with the critical urges of an ever-increasing sophistication of its audience (Gauntlett, 1996: 15). As we shall see, there are ways in which the horrible can be invoked to support a very pro-science discourse.

The first part of this chapter provides a descriptive overview of what 'horrible' means to *Horrible Science*. I then question whether a horrible take on science presents a pessimistic view of either science or natural objects. Next, I contrast the *Horrible* style with more traditional approaches addressing children in order to explore changing attitudes to children and horror, before discussing the ways in which *Horrible Science*'s sense of 'the horrible' allows the books to generate an appearance of masculinity and authenticity. *Horrible Science*'s treatment of 'the horrible' overlaps with several other topics, and it is worth saying upfront what will not be covered in detail here as this chapter raises many issues which will be tackled with increasing detail throughout the thesis. Arnold often works the horrible though intertextual references to fiction, a topic that will also be discussed in chapter six, as will questions of engendering realism with symbols. Many of the issues of mixing comedy with horror will be covered in chapter eight, and questions of terror and sensation will be picked up again at the end of the thesis in chapter nine.

The Horrible of Horrible Science

The *Horrible Science* books tend to start with some promise of 'horrible' content. By this, I mean what the books self-consciously call horrible. 'Horrible' is twisted and turned across the series in a variety of ways. 'Horrible' might be something painful, or scatological. It can also be something to do with dirt or other natural objects that, although not especially associated with the toilet, are still seen as slightly taboo, or at least 'untouchable', such as spiders or disease. Throughout, the horrible generally plays on an assumed childish fascination with subjects adults would dub 'yucky'. A sense of the 'horrible' is also constructed in recourse to the fictional genres of horror or thriller, applying characters such as Frankenstein, vampires, private detectives and historical stories of execution and disease. In this respect, *Horrible Science* employs a slightly more fantastical approach to the horrible (a more 'horror movie' horrible) than that taken by the *Horrible Histories.* On occasion, words other than

'horrible' will be used; depending on which wordplay happens to work with the topic in question. The books' titles are indicative of this: *Ugly Bugs, Suffering Scientists, Chemical Chaos, Angry Animals.*

From these examples, we can start to fashion a meaning of the horrible as variously painful, confusing and unsightly. Yet, crucially, this pain and confusion is at the same time supposed to be a large part of what signals the books as fun. It is celebrated; 'horrible' is an aesthetic, one that in some respects plays on a sense of the countercultural. It is a good thing by way of normally being considered bad. This is not to suggest that *Horrible Science* is nihilistic or happily macabre because it enjoys misery. Rather, the books represent a conflation of what might normally be seen as horrible with a sense of jovial enthusiasm. Indeed, the smiling tone with the horrible is presented is part of what constructs it as an aesthetic. In this respect it is similar to what Bruce Butt calls, in an analysis of *Lemony Snicket's A Series of Unfortunate Events*, an 'inverted promotional technique' (Butt, 2003: 281). The sense of inversion is quite explicit in *Horrible Science*'s treatment of the horrible, as it plays on both an ambivalent reading of the horrible and the ambivalences of the vicarious thrills comic horror provides. This section starts by discussing how the horrible is explicitly twisted to a multiple set of meanings, before exploring some of these many meanings first with respect to how the horrible is packaged 'in a safe way' for children and then by examining how the science theme can prove both a challenge and an advantage in constructing a notion of the horrible.

Twisting the Horrible

Within the books, words such as 'seriously', 'disgusting' or 'mysterious', act as cognates to horrible, all modifying and developing what exactly is meant by this odd positive-negativity. Importantly, the horrible in *Horrible Science* is also the school, reflecting in a playful, overstated way the 'horror' of being educated. For example, the opening lines of the one of the first *Horrible Science* books:

> 'Science is sickening! Extra science homework is really rotten – but one of the most horribly sickening science subjects is the science of the body. I mean, doesn't the thought of all that blood and all those guts and bones turn your legs to jelly? (*Blood, Bones & Body Bits*, 1996: 5)

Here the book starts with 'sickening' taken in a reasonably conventional sense; it is not something to be enjoyed or sought after, basing itself in the assumption that no one likes extra homework. The connotations of this 'horror' quickly change direction though. With the reference to turning your legs to jelly, the concept starts to work in a more sensational thrill-seeking sense akin to watching a horror movie or riding a ghost train. Following the view of branding examined in the last chapter, this flexibility is to be expected. What is particularly interesting about the quote above is that we can see a transformation from a straightforward 'horrible' (urgh, homework), into something more appealing (ooo, blood). Thus, by the end of this opening page, the notion of 'horrible' is celebrated and clearly rooted in an assumption that it is meeting the desires of the audience by providing 'The things YOU really want to know about YOUR body. The horrible bits. The horribly interesting bits' (*Blood, Bones & Body Bits*, 1996: 5). As I will discuss in more detail in chapter eight, *Horrible Science* is quite comfortable with the ambiguities of such wordplay, and readily mobilises it for rhetorical purposes.

In interview, when asked what his working definition of 'horrible' was, Nick Arnold was slightly hesitant to reduce the term to a singular answer, reflecting the flexibility and complexity of its use in the texts. However, he did formulate a response that presents the horrible chiefly in terms of amusement value:

> Um, Horrible? [brief pause] Horrible, horrible is something that'll make a child go yuk. [...] if we had an eight year old child, that child would go yuk. The child would be amused and entertained by the fact that it is yucky (Arnold, 2006b)

There is in this answer a suggestion that this yuk is very child-orientated, with Arnold alluding to an imaginary eight year old child to provide endorsement of the 'yuk', as if our adult perception would be somehow insufficient. The reference in *Blood, Bones and Body Bits* to those things you 'really' want to know about points us towards the way the horrible is constructed as something these books provide but which would be censored elsewhere. Similarly, *Chemical Chaos* (1997) starts by promising:

> the funny bits and the fascinating bits, the bits you really want to find out about... nasty bubbling green mixtures, vile and sometimes poisonous potions, test tubes, horrible smells, bangs, blasts and dodgy discoveries. (*Chemical Chaos:* 6. Ellipses as orgional)

There is a key appeal to the hidden in horrible-branded science. Again this reflects an attempt to appeal to a child audience with the suggestion of transgressing adult censorship. It appeals to a sense of autonomy that both dangles the attraction of adult-like autonomy and is childlike by way of being anti-adult.

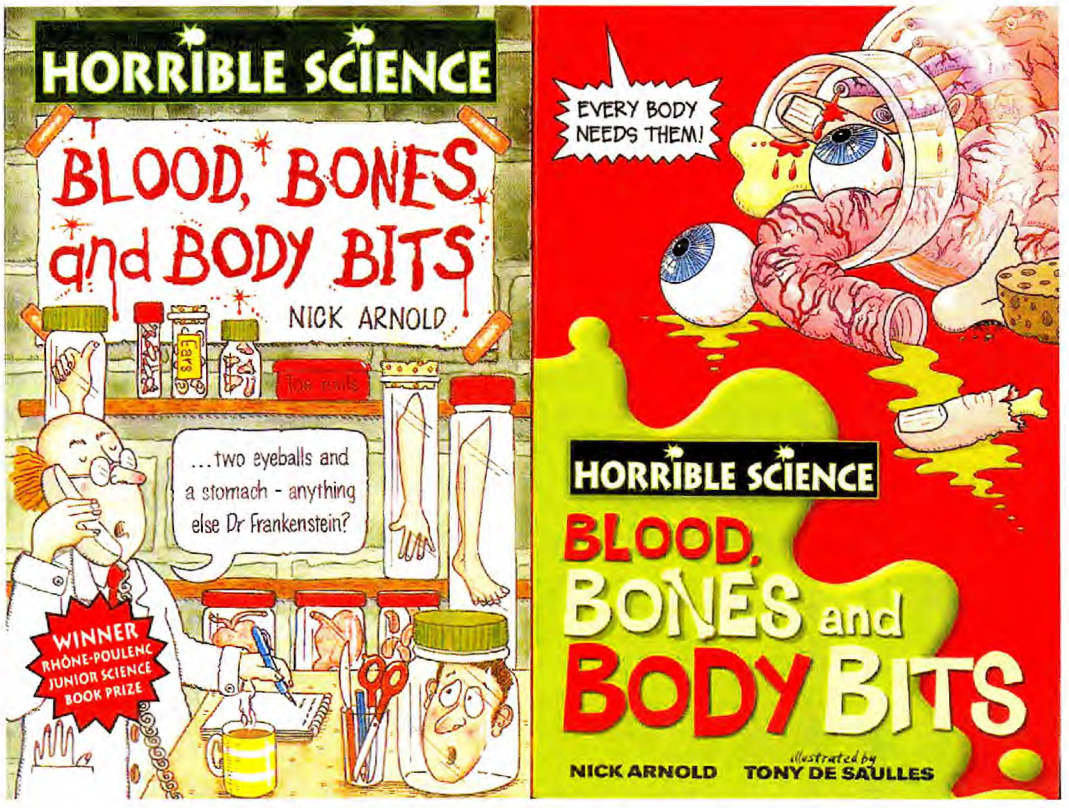


Fig 4.1. New and Old Covers *Blood, Bones & Body Bits*

Horrible for Kids

In many ways the positioning of the horrible is part of the 'down with the kids' address, as it explicitly goes against the norms of sanitising children's literature. *Horrible Science* can be quite violent in its 'horrible' cultural referents, and very explicit in its gore, a point clearly signalled on the covers of the books. Jokes on the covers might involve a character suffering an electric shock, or poisoned, with garish green skin tones, yellow sparks or bright red blood. *Evil Inventions* (2007) shows the guillotine chopping heads off, spatters of blood everywhere, a crowd looking keenly on; one member of the crowd holds a blood-spattered umbrella (see fig 4.5). The re-branded books have produced more simplified cover-artwork, but this generally focuses on the gore. *Blood, Bones and Body Bits*, for example (fig 4.1), initially

showed a doctor surrounded by jars of 'body bits' (legs, a hand giving a thumbs up, a perturbed looking head). In contrast, the 2008 edition has just the one jar. However, it overflows with fingers with bone sticking out, a sliced up piece of intestinal tubing shows its cross-section dripping stomach juices. The colouring of the whole piece is based on red (blood) and a pale green (snot, slime, bile); the contrast of these opposite colours only adding to the sensation of their cultural referents.

In chapter two, I quoted Arnold saying that, although generally he thought of children as 'being a person' and did not address them differently, 'Of course there are some distinction [sic] and some things to bear in mind' (Arnold, 2006a). His example there was language, but I think we can also see an awareness to 'bear in mind' that some horrible content might not be suitable for children, or at least a desire to keep the horrible light. From my second interview with Arnold:

> I suppose you might call it horrible in a safe way. It's, it's a way for a child to um, getting a vicarious thrill, in the same way they might do watching *Dr Who*, but they wouldn't actually be so totally, be terrified that they wouldn't be able to sleep or they might become quite neurotic about it. (Arnold, 2006b)

The horror of *Horrible Science* is not as readily comparable to Stephen King books (or even the more ironic style of Tarantino films) as much as they seem to follow *Bugs Bunny, Road Runner, Tom and Jerry* and traditions of fantastical slapstick and the carnivalesque behind them. In some respects the safety catch on the horrible is managed through *Horrible Science*'s framework of the cartoon. For example, in the *Disgusting Digestion* sticker-book, the reader is invited to handle human excrement; except these are stickers of cartoons on a comic mock up of the digestive system (fig 4.2). The relative realisms of caricature and humour are complex, and will be discussed in more detail in later chapters (six and eight, respectively), but as we can see the stickers of fig 4.2 are clearly signalled to us as a safely-fabricated form of excrement.

Further, in some respects the appeal of the horrible is less about pain and smells and more simply an allusion to chaos. The 'slosh scene' of pantomime makes for a useful comparison here. A traditional component of pantomime, almost as necessary as the dame, slosh scenes are largely about making a mess. The stage will become filled with liquid of some sort, covering the actors, set and threatening to

leak over to the audience. Be it dough from baking, paste for decorating, soap from washing or water in a bathroom scene, these scenes are often based around a relatively mechanical process of domestic work going astray. Millie Taylor (2007) argues that the slosh scene is, in terms of its appeals to the audience, a vicarious thrill of playing with the taboos of acceptable behaviour. The pantomime world is a safely dangerous place; suffused with the allusion of mayhem. The performers behave anarchically, explicitly breaking the conventions of the theatre, including that of the 'fourth wall' between stage and audience, threatening to pour a bucket of soapy water into the seating. Yet all appearances of anarchy are both tightly controlled and predictable. The audience know the type of routine that is likely to take place and are comfortable in the knowledge that no one will be hurt, or even likely to be splashed. Similar to a fairground ride, this is a form of controlled fear and excitement: 'The audience is moved to scream with fear, excitement, laughter and, most importantly, recognition' (Taylor, 2007: 49).



Fig 4.2. Inside cover of *Disgusting Digestion* Activity Book (including stickers)

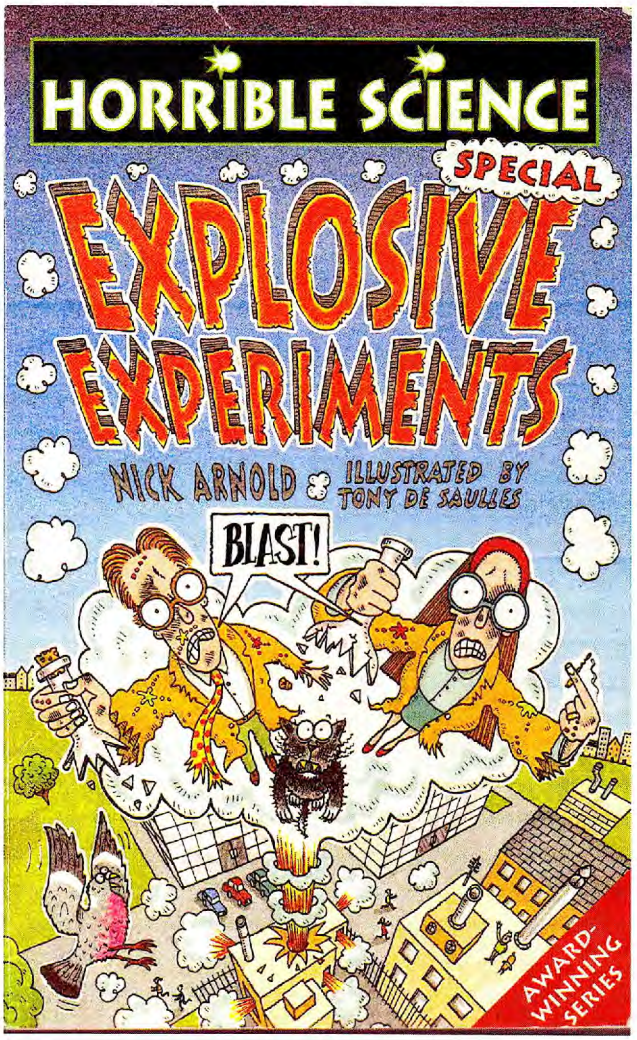


Fig 4.3. Cover of *Explosive Experiments*

Considering the sense of chaos presented by *Horrible Science,* the experiments kits and instruction manuals do, perhaps, provide small quantities of 'slosh', although this is more rhetoric than actual mess as the activities described tend not to cause much explosive 'chaos' despite allusions in the illustrations (e.g. fig 4.3). In *Ugly Bugs* (1996) pictures of insects are drawn across the page, suggesting they are crawling everywhere, and there is a picture of a female scientist looking bewildered at a procession of butterflies going past (*Ugly Bugs*, 1996: 87). Similarly, a theme of uncontrollable schoolchildren is played on throughout the series, in some respects drawing on the cultural history of *St Trinian's* or *The Bash Street Kids,* but connecting such youthful rebellion and delight in the macabre to a sense of curiosity and unfettered thirst for knowledge (e.g. fig 4.4.).





Fig 4.4. Chaotic kids (*Vicious Veg,* 1998: 6. *Really Rotten Experiments* cover)

We should be careful of simply criticising Arnold for pigeonholing children as uniquely enjoying 'yuk'; it is worth noting that, in interview, Arnold connected forms of the grotesque to adult culture:

> there is, there is a very honourable tradition of scatological humour in British literature. You know, Pope for example is a case in point. I mean there is a whole tradition of um, in theatre, of the grotesque

> which is, which is very very similar to what I'm doing. And in art as well, of grotesque art, which is meant to make the, the viewer have exactly the same <makes urgh-eww noise> admittedly it's not aimed at children, but it's the same, the same thing. (Arnold, 2006b)

Like other comments from Arnold, this statement suggests a sense of inter-generational consistency, although it can also be read as a desire to frame the horrible as in some way respectable by way of connection to adult culture (historical, and relatively 'high culture' at that). As I shall explore in more detail later, there is an odd tension over generational identity in a form of 'horrible' that fuses the scatological with the gothic.

Finding the Horrible in Science

Some aspects of science readily supply the yuk; bugs, digestion, diseases and the more historically orientated books (e.g. *Suffering Scientists*) follow the *Horrible Histories* in finding the horrible in stories of violent and otherwise unpleasant lives of our ancestors. Some subjects, however, are less clearly gruesome. As Arnold emphasised:

> if you're writing a book on horrible history then, you've practically got the book made, any period you like, it's very very easy to find horrible facts about. Now if you're writing a book about science, you'll find that a little bit more tricky. Yes, alright so maybe you can write a horrible book about um insects [...] but you start to write about light, or electricity and it just becomes that bit more difficult to, to get a horrible approach. (Arnold, 2006b)

Arnold goes on to explain that the 'innovation' he came up with to solve this problem was application of fiction, which in this context largely means references to fictional characters drawn from horror, science fiction and thriller films: MI Gutzache, a recurring 'private eye' detective who shrinks to undertake investigations inside the human body, Baron Frankenstein and a rather 'cuddly' incarnation of his monster, and the 'Energy Monster', a metaphor for energy drawing on a mix of Superman and Frankenstein. Various fantastical beings from horror and science fiction, such as aliens, vampires and the Loch Ness monster, also make appearances. Thus, the

horrible of *Horrible Science*, as much as it can be tied down, could be seen as a conflation of toilet humour and the tropes of horror fiction. Crucially, all of this is articulated in an overblown, parodic fashion, even if it works through an appeal to horror in a very similar way to the horror comics it makes fun of.

Horrible Science is not alone in its promise to provide science with a comic form of the horrible; it is a reasonably common trope to all those invoking forms of pantomime science. In terms of books, there are the *Grossology* series and *Why is Snot Green*, on television we can see similar approaches within *Brainiac: Science Abuse* or *Mythbusters*. Science Museum staff invite visitors to make 'snot' out of borax, PVA glue and green food colouring[14] or to sit on a 'chair of nails', complete with a skeleton head and glowing green eyeballs (force over area, it is a chair of five hundred nails). However, children's science culture is not entirely preoccupied with a sense of the horrible. Yuk science is not present to nearly the same degree within the *Eyewitness* books or indeed in any of the DK publications. For example, a recent DK book *Alive: The Living, Breathing, Human Body Book* (Walker, 2007) uses various forms of pop-up engineering to represent the human body. From the promotional back-cover blurb on Walker's DK book:

> Open me up and take a heart-thumping, muscle-flexing, nerve-tingling inside look at what makes me and you alive! Want to hear my heart beat and see my diaphragm move? [...] Peel away the layers and get a hands-on understanding of what makes me tick. Open up my light-up brain cover to find stupendous pop-ups, see-through pages, flaps, and tabs. (Walker, 2007: cover-pages)

Here the appeal is to the spectacular, a revelation of otherwise hidden knowledge, but it is articulated without going as far as presenting pop-up projectile vomiting, as you would see in the pantomime equivalent: *Chewy Gooey, Rumble, Plot! A Deliciously Disgusting Pop-Up Guide to the Digestive System* (Alton & Sharratt, 2007). DK's spectacle of science is not the transgressive pantomime grotesque, but one produced with rather more reverence. *Horrible* is not a serious discourse, even if in its own way it might be seen to have strong scientific connections. Thus, publications aiming to be taken with more seriousness tend to avoid it. Indeed, much of the success of the discourse of science as horrible within popular non-fiction is

[14] An activity also found in the *Horrible Science Explosive Experiments* boxed kit.

that it is not a tone generally present in school textbooks.

Conflating Science Fiction and Horror

Horrible Science often appears to mix its allusions to science fiction and horror film as if they were one and the same thing. For example, in *The Body Owner's Handbook* (2002) we are introduced at the start to the character of Baron Frankenstein – 'the one and only madly famous, famously mad scientist' – accompanied with a picture of him in period dress with 'mad eyes', spots and bushy eyebrows (*The Body Owner's Handbook,* 2002: 13). We soon learn that he enjoys playing the church organ madly at night, and that his monster sleeps in a coffin, has a crush on a vampire and gets into fights with zombies (*The Body Owners Handbook,* 2002: 20, 69, 117, 98) and, moving towards science fiction associations, has work done by robots (*2008 Horrible Science Annual*, 2007: 42-3). As I will discuss in chapter six, this is part of their rather playful approach to fictional texts. For the purposes of this chapter, I want to suggest that if horror genres are largely critical of science and science fiction is generally celebratory, then conflating the two, as *Horrible Science* does, suggests a more ambivalent position.

Kim Newman, introducing a *Sight and Sound* collection on science fiction and horror films, suggests that science fiction communities tend to see the conflation of these two genres as distasteful: science fiction likes to think of itself as in some way 'pure' by association to science's apparent rigour and rationality, yet 'the misshapen lump' of the horror genre 'pollutes' with its intent for the 'exclusion of rationality, progress and credibility' (Newman, 2002: viii). As Christopher Toumey puts it, whereas science fiction celebrates science and technology by endorsing their ability to shape human lives, mad scientist stories are 'homilies on the evil of science' (Toumey, 1992: 411), which exhibit a form of cultural critique of science. Whether we think such critiques are problematic or not arguably depends on our personal moral view of science and technology. Indeed, Collins and Pinch (1993) celebrate an image of science as 'golem' monsters as part of their STS-informed take on affecting the public understanding of science.

To momentarily put aside 'PR' questions of whether people like or dislike science, it is worth considering the application of the *Horrible* brand to the subjects of science: does an application of the horrible to the human body, other animals,

climate change or atoms make them all appear as 'misshapen lumps'? For example, it has been argued that pessimistic stories of climate change scare the public to inaction (Ereaut & Segnit, 2006). Although I do not necessarily subscribe to these views, questions along these lines are often asked of me when I present my research on *Horrible Science*, and are therefore worth addressing. Environmental science is more the remit of *Horrible Geography*, but we can deviate briefly to this sister-brand to explore the issue. For example, the recent *Horrible Geography* 'handbook' on weather (Ganari, 2008) is structured largely as a guide to dealing with extreme weather conditions, including ones some readers may have experienced first hand (e.g. floods). Only an end chapter provides explanation in a discussion of climate change. Moreover, all these forms of weather are covered in the horrible style, referencing their disastrousness with a reasonable amount of glee. Such a tone coupled with the structure of the book (that places climate change only at the end) could be read as an invitation to take climate change as inevitable; we should learn how to cope with floods and fires, not bother to act against them.[15] I think, however, that such a reading would be a simplistic way of thinking about the way *Horrrible* brands its scientific content. If we extend the question to topics covered by *Horrible Science* we can find new ways around the argument that referring to scientific ontology as 'horrible' is necessarily A Bad Thing.

For example, a childlike Frankenstein's monster is used throughout *Horrible Science* as an analogy for explaining the workings of the human body; do we really want children to think of their physical make up as monstrous? The clearest answer to such problems with an apparent horrible patterning of natural objects is that *Horrible Science* takes up its images of pessimism with gusto and delight, celebrating monsters as an aesthetic in their own right. The image of a childlike Frankenstein is, in practice, a reasonably 'cute' one (see fig 8.7). Still, as I will discuss in more detail in chapter eight, simply saying 'only joking' does not stop an ideology from also being articulated. Rather than simply invoking humour as an 'excuse' for allusions to violence or suffering, a more convincing response is to ask whether a degree of the horrible might actually be appropriate in the depiction of a particular scientific object; that a monstrous take on the human body might actually be a productive one.

To take an example from zoology, *Angry Animals* (2005) applies the aesthetic of the horrible to emphasise the animal world not as cute and cuddly, but 'Big

[15] Another 'handbook' in this series providing a guide 'to save the planet' is slated for release in August 2008.

dangerous beasts that kill lots of people' (*Angry Animals*, 2005: 5). We might argue that this provides a rather negative image of the animal world, prompting young people to feel threatened and alienated from their natural environment. Yet, at the same time it is possible to celebrate this discourse for a 'no holds barred' approach. We could similarly argue that a focus on the horrible allows the books to celebrate aspects of scientific study that might otherwise be unfairly considered unappealing (e.g. entomology, gastroenterology). Indeed, in an interesting contrast to concerns over the effects of violence on young people, Stuart Marriot (2002) argues from a study of over a thousand picture books[16] that children's literature's tendency towards 'fluffy' images of animals lulls children into a false sense of security. As with any issue of scientific risk, claims that reporting is too negative or too positive largely arise out of a lack of consensus as to what the truth actually is. Whether we argue *Horrible Science* is inappropriately negative (or positive) about ecology, anatomy, zoology or any other topic will largely depend on our own assumptions about scientific reality (and how much we trust children to deal with such reality); it is culturally contingent and, as such, highly variable.

Moreover, the cultural legacies of science fiction and horror genres are not as neatly divisible as Newman or Toumey imply. For example, Andrew Tudor's (1989) cultural history of the horror film suggests that science is often the basis or inspiration for horrific events. Similarly, horror is often invoked as an appeal within science fiction. Science fiction historian Roger Luckhurst argues that there is a significant strand of the genre that considers the impacts of science and technology as profoundly traumatic, as apparently invasive technologies subvert, enslave or ultimately destroy an idea of humanity: 'The sense of trauma induced in the subject by modernity means that Gothic and SF writing are constantly in dialogue' (Luckhurst, 2005: 5). As such, we could argue that *Horrible Science* is reflecting an ambivalence that is already quite deeply rooted in the genres they refer to and, more broadly, the cultures they stem from and speak to. Whatever the exact histories of these genres, it seems that *Horrible Science*'s particular use of fiction within factual writing mixes pro-science tropes of reverent science fiction and traditional popular science with the less celebratory, even critical attitudes of gothic horror et al. Thus, the use of fiction in building the science version of the horrible brand not only signals a link with entertainment, but also an ambivalent cultural attitude towards science

[16] Though without talking to their readers; it is in many ways a simple mirror image of studies counting references to violence or sex in media and assuming their malignant impact on audiences.

and technology. To read *Horrible Science* quite cynically as a product of commercial culture, this could be understood as the simple consequence of cultural industries keeping pace with critical urges of an ever-increasing sophistication of its audience (Gauntlett on Adorno, in Gauntlett, 1996: 15), part of *Horrible Science*'s repertoire for articulating its status dangling on the periphery between science and its outsides, drawing on cultural capital of both fields.

Exploring Horror and the Child

In their study of British comics, Paul Gravett and Peter Stanbury (2006) describe a spoof-comic that appeared as a six page pullout in the (adult-orientated) publication *Lilliput* in September 1953. Entitled *Vulture,* it parodied the repeated features of *Eagle,* but presented them as sensationally gory, alluding to crime, danger and viscera:

> The back cover's usual biographical comic took readers back to *A Beano with the Borgias,* the Italian poisoners. The regular cut-away diagram across the middle pages was devoted to torture, *How to Make your own Rack,* while one advert offered a complete banknote forgery outfit. *Vulture's* editor promised "Next week, Mr Whitfield, who spent some years in the East, will tell us about Chinese tortures, and there will be a grand feature by Doctor Boddington on our digestive systems, with an attractive coloured diagram" (Gravett & Stanbury, 2006: 156).

As Gravett and Stanbury emphasise, *Lilliput* and *Eagle* shared a publisher, and this *Vulture* spoof was less a send-up of the conventions of British children's publishing, and more an attack on the American 'horror comics' that were causing some controversy at the time. *Vulture* aimed to poke fun at allusions to horror through juxtaposition with the more 'clean-cut' *Eagle* approach of educational stories, cross-sections and how-to guides. What makes this example so interesting is that in many respects, *Horrible Science* can be understood as *Vulture* applied in earnest; spoof horror used to present quite traditional educational content for young people. Indeed, a neat reflection of the Vulture spoof can be seen in a text balloon on the cover of *Beastly Body Experiments* (2008), which declares, under an image of a jar of dismembered fingers and bloody eyeballs, that its own grand features on the digestive system come 'In Stomach-Churning Colour!'

What Changed?

The first response to what's changed is simple: not much. As Barker's (1984) history of the horror comics campaign shows, the content *Vulture* was parodying was already comedic and would eagerly self-parody (Barker, 1984: 129-133). Much of *Horrible Science*'s style of language could be read as a highly accurate pastiche of the horror comics; there is even an image of a book of 'dark tales', complete with blood-dripping font, in the introduction to *Evil Inventions* (2007: 5). To consider the similarities of language, from a 1964 reprint of the horror comics quoted by Barker:

> CAUGHT YOU! Sneaking a glance at the back cover of my first paperback COLLECTION OF TERROR, eh? Well, just what did you expect to find? All the fiendish fun is on the inside! There's just *me* back here... *The Crypt Keeper*... waiting to curdle your blood with spine-tingling stories from my vast collection in *"The Crypt of Terror"*... stories of walking dead... and poor, screaming, clawing unfortunates who've been buried alive... and creatures that ooze slime and rise from graveyards in the dark of night... and other – heh, heh – pleasant fun-subjects! [...] so don't just stand there with your knees knocking! Pay the man, rush us home, pull up a coffin, and make yourself comfortable inside and start reading... IF YOU DARE! (back-cover of the Tales from the Crypt, Ballantyne Books, 1964, reprinted in Barker, 1984: 113. All emphasis and ellipses outside of square brackets as original)

The page is headed 'Shriek-a-boo', with text addressing the reader directly as if on stage or in conversation, with conventions of informal spoken language rather than written prose (e.g. eh and don't) full of capitals and italics for drama, and ellipses to create of a sense of suspense (as well as alluding to the hidden, the taboo and the unknown). Like *Horrible Science*, it applies an 'ironic bloodthirsty pose'; a nod to the inverted promotional technique of complicity, noting the fun of something generally understood to be unpleasant. According to Barker's reading of the horror comics, 'foul' is not applied in the detrimental sense. Rather, as in *Horrible Science*, it is almost something to be celebrated (Barker, 1984: 114). When a similar tone is adopted in young people's discussions of horror, David Buckingham (1996) suggests this is a way for the speaker to express their distance from the image of the scared child and to demonstrate their recognition of the formulaic nature of the genre (Buckingham, 1996: 127-9); a similar analysis could be made of the application of

horror in adult-to-child discourse.

Looking at similar introductions from *Horrible Science* books, again we see the ellipses, emphasis and conversational style:

> I hope you're not easily scared, because... you're about to meet a huge, horribly powerful MONSTER!
> [break for cartoon]
> It's a very, very old monster (yes, it's even older than your science teacher). In fact, it's so incredibly ancient that it's as old as time itself. And the amazing thing about this monster is that it's always around but no one has ever seen it – *well not until now that is!*
> The Energy Monster gets everywhere. It makes stars shine and bonfires burn, and it moves everything from the slowest slug to the speediest spacecraft. But don't go thinking that the Energy Monster is a helpful gentle giant. No way! Take a deep breath and read on... if you dare! (*Killer Energy,* 2001: 5. See also fig 4.7. All emphasis and ellipses as original)

> MONSTERS that make made-up monsters in stories appear lovable and fluffy. And make no mistake – the monsters in this book are REAL as you are! At this very second they're strolling on your skin and snuggling into your bed and scoffing your sandwiches and splashing about in your toilet! (*Microscopic Monsters*, 2001: 8)

> Science is horrible, and just as you suffer in science lessons, so scientists suffer for science. Did you know there was a scientist who had his head cut off, and that some scientists were poisoned by the chemicals they discovered, and that one scientist jumped into a volcano? So, should *you* risk becoming a scientist? Or is it too *dangerous*?
> [break for image of girl looking scared from thought-bubble of disembodied head, man being poisoned and someone leaping into a smoking volcano]
> Well, before you make up your mind, maybe you ought to read about suffering scientists. Of course, you won't read the all-important stomach-churning details in any old science book. What you need is a

> HORRIBLE science book full of gruesome facts to tell you the horrible truth about Science. But hold on... looks like you've found one. And you're already reading it! Oh well, don't let me stop you... (*Suffering Scientists*, 2000: 6. All emphasis and ellipses as original)

Crucially, both *Horrible Science* and the horror comic set up a sense of the horrible as a challenge for their readers, suggesting (comically) that only the courageous will continue reading. The conversational address talks to the reader as if they are a child, playing with the assumption that they might be scared, goading them to show their maturity by proving they can read the book. Many of these *Horrible Science* introductions are followed by a 'health warning' (as I shall discuss later, see fig 4.6). There are also key differences; the *Horrible Science* examples seem to signal more care in the childishness of the reader than the horror comics do (warning that 'you are about to meet a monster') and are more teacherly in their address (e.g. 'did you know'). This is not, however, an appeal to be applied in seriousness. Rather, it is as if *Horrible Science* takes on an ironic didactic voice as much as an ironic bloodthirsty 'crypt-keeper' voice. The biggest difference between the horror comic and *Horrible Science* is arguably that in the latter the sense of awe and mystery is applied to either a scientific entity or the process of doing science; a topic which will be picked up in chapter nine.

Even if *Horrible Science* is simply a re-emergence of the 1950s horror comics' style, there are key differences in the context in which they appeared. The horror comics were seen as cheap and trashy, inspiring quite emotive complaints; laws were passed to keep children away from them. *Horrible Science* is not only seen as uncontroversial, but it applies this style to the relatively 'non-trashy' genre of serious non-fiction. It has won awards from the Royal Society for doing so, and readily references this in the books' covers. Also, perhaps by the advent of *Horrible Histories* the idea of a childlike horror genre had simply become more prosaic. Interestingly, Kimberly Reynolds (2001) notes that by the 1990s, it was not so much the horror which offended the critics of Scholastic's *Point Horror* series, as much as the books' association with 'low culture' pulp fiction. They were worried more about damaging young people's cultural taste than about what images of violence or sex might do to them (Reynolds, 2001: 1-2). *Horrible Science*'s association with academic communities (by way of being science-themed, as well as use of images of scientists) would arguably mitigate this. David Hess (1993) implicates the work of Steven Spielberg in the sanitization of both ideas of aliens and the ghostly 'from the

negative, horrific Other to the harmless exotic Other' (Hess, 1993: 121). More generally, Hess suggests that domestication of threats of the supernatural is indicative of post-cold war culture in which such fears had become almost normalised (see also Jameson, 1991: 284-5). Arguably, there has also been, since the 1950s, a shift in the dominant discourses of the child. Moreover, there have been decades' worth of children's media that have applied the results of this shift. As I shall discuss in chapter eight, when I tackle the question of comic horror in more detail, it is important to remember that *Horrible Science* comes not only after the horror comics, but also after the *Bash Street Kids*, Roald Dahl and the *Horrible Histories.*

Managing Childish and Adult Horror

Although we should remember that the horror of *Horrible Science* is explicitly cartoon-like (childish, fictional, fantastic and therefore, by extension, relatively ineffectually safe), the fictional genre of horror is not so readily associated with the child. Indeed it is more indicative of an adult culture that, rated-18, explicitly excludes the child. According to Barker, many of the complaints about images of horror in children's publishing were less about the actual violence per se, but rather based in worries that horror presented a too-early introduction to the adult world (Barker, 1989: 29); that the disturbing or violent content of horror is somehow counterpoised to images of a playful, innocent childhood. Of course, such a disconnection between childhood and horror also supplies the genre with the attraction of appearing grown up. Indeed Kevin McCarron suggests that the central appeal of *Point Horror* is that they do not look like children's literature; rather they ape the materiality of a Stephen King book (McCarron, 2001: 20). Although there is little of the materiality of a King book in *Horrible Science*, they do present themselves as appealing by providing the taboo horrible which is normally kept away from children. Still, *Horrible Science* does also retain a sense of the childlike, and I think the lack of Stephen King-like design is indicative of this. It is a sort of *Point Horror*-lite, similar to *Goosebumps.*

Indicative of the tensions surrounding generational identity and horror within the brand's sense of the horrible is the cover of *Evil Inventions* (fig 4.5), one of the few covers in *Horrible Science* to show children. It is also worth noting that this book came out just before the re-brand and combines aspects of both the new and old design styles. Here, we can see adults looking onto a beheading with various

expressions of glee, relish, and (perhaps most sinisterly) calm enjoyment. Yet the children look on quite innocently. The two children here are very much bystanders to the horrible, they are not leading the events, even in the sense of an audience calling for gore, as they both have a relatively placid expression. They are simply passive observers, happy to watch on. The smaller one in particular (on the back cover) is kept far back from the audience, and waves blithely from behind an adult's shoulders. The large child, at the bottom right hand corner of the front cover is much closer to the action and peeks into basket of dismembered heads. Arguably, this suggests an idea of a natural connection between the child and the gruesome, perhaps underlined by the dog being the first to view it, although the dog does also act as a barrier between this child and the actual event of humans killing humans.

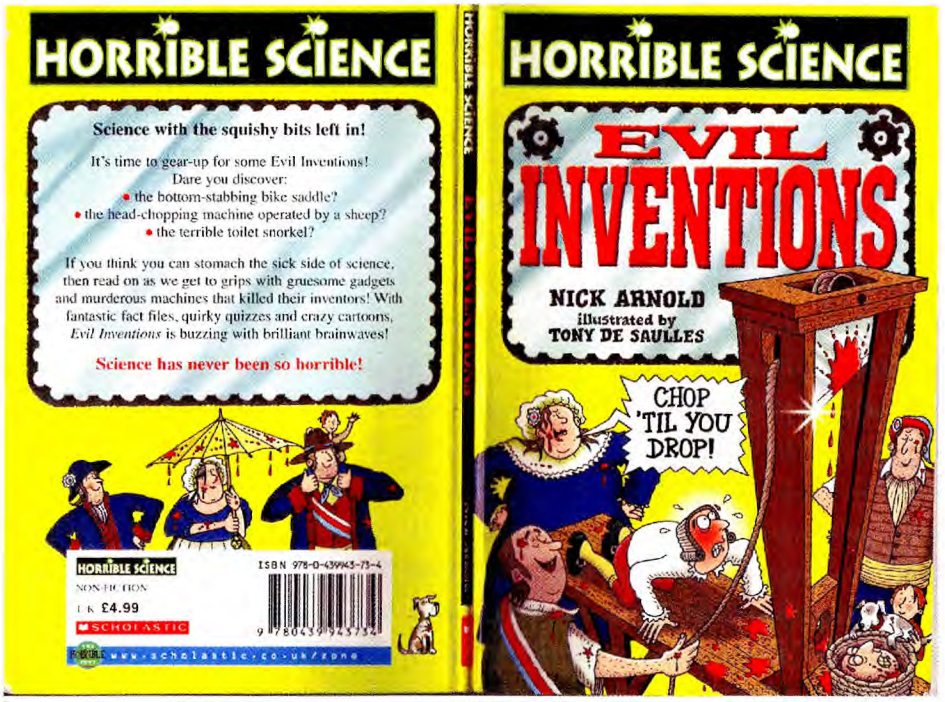


Fig 4.5. Cover of *Evil Inventions* (2007)

Another important point to remember is that the horrible of *Horrible Science* is not just the horrible of the horror-film or historical events; it is also a more biologically-orientated sense of 'yuk'. Appeals to slime or the scatological are often associated with children (see Mills, 2006, for psychoanalytic reading). Kenway and Bullen suggest that the scatological has become convenient shorthand for defining a 'child-only space' for children's media, of signalling dissidence from the norms of what adults define as taboo (Kenway & Bullen, 2001: 70-71). This, they argue, is indicative of the way in which the producers of children's commercial culture seek to

exaggerate the generation gap in order to create a distinct child market, and yet, at the same time, collapse child/adult boundaries in order to allow children a role as autonomous consumers. Adults are depicted as annoying, but at the same time adulthood is something to strive for; the boundaries of generational identity are at once collapsed and exacerbated (Kenway & Bullen, 2001: 63). Kenway and Bullen also note that writers of children's culture today had their own childhood experiences constructed within a culture that suggested childhood was about the transgression of adult taboos (Kenway & Bullen, 2001: 87). As I have argued earlier, appeals to the horrible can be considered as adults in generational drag, but it is also the old story of adults producing media for children based on what they remember liking as children. Moreover, we could argue that *Horrible Science*'s particular take on the horrible – a conflation of the scatological, the pre-social or anarchic child and tropes of horror fiction – is a large part of what signals the books as 'for kids', yet at the same time alludes to a sense of maturity. They look forward to gothic horror and back to scatological humour, thus providing a childlike horror both innocent and mature enough to appeal to the vicissitudes of generational identity tied up in the pre-teen book business.

Horrible and the Boy

Before I say anything on the topic of gender, I want to emphasise that *Horrible Science* is not a set of explicitly 'boy books'. They do, however, present themselves with a reasonably masculine air. *Horrible Science* does not suggest itself as masculine by way of excluding girls, but it does distance itself from certain ideas of femininity. As non-fiction books they are connected with both education and literature, which is often assumed will put off young men, seeking to formulate a masculine sense of self by disassociating themselves with anything so 'soft' (see discussion in Stephens, 2002). *Horrible Science*'s link with science perhaps makes it easier to attract boys, although at the same time it adds a complicating factor of needing to demonstrate its applicability to girls (without, at the same time, making them look like 'girl books'). If it is generally accepted that books put off boys, there is a similar consensus that girls need to be encouraged to feel comfortable in the generally male-dominated arena of science (for example, Whitelegg, 1992). I should also note that within fictional literature it is generally assumed that signals to 'boy space' do not put off girl audiences and thus books aiming for a multi-gender audience will emphasise their boyish credentials. The character Harry Potter's name

being larger on book covers than that of the author (which was printed as JK, not Joanne, Rowling) is the prime example. I do not know how much *Horrible Science*'s approach to gender is based on a desire to target either specific or general markets, and how much is rooted in more political/ moral desires to talk to girls and boys equally (or who in the development of the *Horribles* believes what degree of either). All I can say is that the brand appears to aim itself at both boys and girls and does so by exerting a (mild, implicit) sense of masculinity. I think it is also worth noting that the *Horribles* stem from the mid-1990s when the more overt gendering of non-fiction we can now see in the *Dangerous Book for Boys* was less socially acceptable.

According to Henry Jenkins (1999), traditionally the process of being outdoors (especially away from the control of their mothers) was a key way boys could exert their masculinity. Therefore the generally home-based play products offered to contemporary children have to find ways to articulate themselves as somehow outside of the domestic space, even while they exist within it (Jenkins, 1999: 268-70). Jenkins lists a range of ways in which 'boy space' is traditionally articulated within a maternally-framed home context: it will emphasise self-control and manual dexterity, apply scatological humour, it is hierarchical and aggressive, often including role-playing of adult males as well as stunts and daring to distinguish its inhabitants from the 'mamma's boy' (Jenkins, 1999: 271-274).[17] Like the fantasy spaces of alien battlefields or joyriding car-racing which computer game culture uses to bring boys' outdoor play to the child kept at home, *Horrible Science* offers to transform the mundane domesticities of school and home environments into more attractive, more appropriately masculine, vistas.

Vicious Veg (1998) is a good example of Jenkins's points, especially in the ways it presents a 'patterning' of science by invoking a sense of the horrible. Focused on the topic of botany, this book is largely 'outdoors' in its location, but at the same time is readily considered a 'girly science'. As Elizabeth Parsons (2007) notes in respect to eco-criticism for young people, flowers tend to denote 'sissy'. *Vicious Veg*, however, clearly signals its distance from any 'soft' flowery concerns, as it brands botany *Horrible:*

> You can learn nice little facts about leaves, seeds, fruits and pretty little flowers. But this book is different. It's about plants all right, but it's also about

[17] See also Nodleman (2002) for a similar typology applied specifically to literature.

> Horrible Science!
> [...]
> There really is a lot more to plants than silly seed, fancy flowers and limp leaves. Plants have loads more vicious secret and many VILE, VILLAINOUS, VIOLENT and VICIOUS tricks (*Vicious Veg,* 1998: 5, 7)

The latter part of this quote is accompanied by an image of a female teacher holding her ears, looking overwhelmed, if not scared. The book starts in a quite filmic manner, with an appeal to outdoor adventure produced by transforming images of domesticated flowers into a site for adventure and ironic bloodthirstiness:

> Welcome to another world. This is a green and terrifying world where horrible things happen every day. A world where death is an ugly tendril slowly reaching out to strangle its victim. A world where there are no rules and the only aim is to stay alive. Welcome to the vicious world of veg (*Vicious Veg,* 1998: 9)

The centre of this page shows a rather calm and quiet countryside scene, complete with bounding bunny rabbits, singing birds, sunshine and a grazing sheep. It is introduced: 'Looks quiet, doesn't it?' Maybe a little boring?'. Under the picture lies the reveal: 'Well, you couldn't be more wrong. Now take a closer look.' This is followed by another picture: of big plants stealing light from smaller ones, sharp dark fern leaves pointing down towards a small bunch of daisies, encased in tall blades of grass which are similarly painted as dark and imposing. The daisies have speech bubbles, screaming 'ARGH!, HELP!, I FEEL WEAK!' (*Vicious Veg,* 1998: 8). A series of three further reveals also use speech bubbles. Cross-sections and filmic magnification is applied to show trees 'stealing light', roots fighting for moisture and 'millions of guzzling bugs'.

Across *Horrible Science,* the experience of reading the book is posed as a challenge. This is extended to using the content, as if *Horrible Science* is an especially demanding science:

> So you want to be a botanist? Well, beware, being a botanist isn't about tiptoeing through the tulips and talking to the trees. Botany is a tough outdoor science. It's more likely to involve exploring horrible places such as stinking swamps in search of rare and vicious plants.

> And sinking up to your neck in mud that reeks of rotten eggs, and being eaten alive by blood-sucking bugs (*Vicious Veg,* 1998*:* 11)

This articulates the challenge through an especially outdoorsy sense, but we can see it applied more generally. The special on the history of science, *Suffering Scientists,* is perhaps the clearest example of this discourse at work. Early on, it refers to Aristotle dying of indigestion ('proves science can be a pain in the guts'), and from this turns to a rather visceral depiction of contravening the scientific method:

> But there's one thing even more painful if you're a scientist. More painful, even, than getting your answers wrong. And that's going about your job in the wrong way (*Suffering Scientists*, 2000: 34).

Or even more plainly, from the book's conclusion:

> So here's the BIG QUESTION. Do you really want to become a scientist? I mean, is it really worth all that *suffering*? (*Suffering Scientists*, 2000: 221. Emphasis as original)

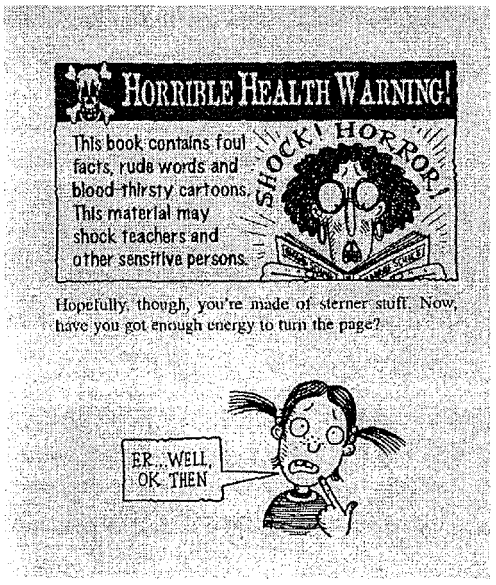


Fig. 4.6. Horrible Health Warning (*Killer Energy*, 2001: 3)

The books often finish the introduction with a 'health warning' suggesting that only those courageous enough will continue, the example shown in fig. 4.6 being an

especially gendered expression of this. Of the seven books whose introductions start with this sort of 'come and have a go if you think you're hard enough' challenge, three depict a girl looking scared, all with a similarly nervous expression (*Suffering Scientists,* 2000, *Killer Energy*, 2001, and *The Body Owner's Handbook*, 2002). There are four books that show pictures of a boy in a similar position. Crucially though, none of these depict the reader looking especially scared. *Frightening Light* (1999) shows a boy under the question 'are you bright enough to read on?', but the boy looks engrossed in the book, and there is an image of light exuding from him. *Vicious Veg* (1998) has a boy covered in vines, but he is looking at the book rather than out at the audience and although he looks slightly worried, his fear is not nearly so overt as in fig 4.6. By contrast, *Microscopic Monsters* (2001), *Painful Poisons* (2004) and *Evil Inventions* (2007) depict a boy (initially) looking slightly worried whereas the girl is much more excited by prospect of the horrible (see fig 8.6 for an example). From these 'health warnings' overall, I do not think that we can claim a clear-cut presentation of *Horrible Science* as a strictly masculine challenge in contrast to images of femininity depicted through representations of girls. However, some markers of an idea of masculinity by way of not being a girl do seem to be applied in the depiction of scared child-readers.

The sense of challenge is a common trope in horror. As Barker (1984) notes of the horror comics, they offer a social relationship with their readers who are 'dared to come in', using the stories as a test of courage and endurance (Barker, 1984: 11). However, applied to reading about science rather than fiction, such a challenge implies that those who have already overcome the challenge (i.e. members of the scientific profession) are particularly strong characters. This discourse not only fits into Jenkins's reading of boy culture in general, but constructs a sense of science as hard and rough. This hardness is often articulated as part of the attraction of science and mathematics for boys. Heather Mendick (2005) finds that A-level maths students generally articulate their choice of maths as a chance to prove something to others; as a 'hard' subject it shows off their intellectual ability more than others. Her research is especially interesting as she notes an application of this discourse by girls as well as boys. Considering the historical background to this, Donna Haraway (1997) argues a sense of science as a trial of great strength was produced in the 17th century to mitigate the less-masculine identity of a scientist 'modest' in respects to

nature (see Shapin & Schaffer, 1985).[18] Raewyn Connell (1989) applies feminist science studies to argue that the masculine nature of science can be constraining to boys' experience of science. Connell discusses a male graduate of zoology complaining that his university course was too dry and abstracted and subsequently re-fashioning forms of masculinity as he moved on to apply his studies to environmental activism (Connell, 1989: 297-8. See also Connell, 1995: 125-8). Attached to much of this is a sense that some kind of enlightenment or truth can be found at the end of suffering, whether tied to gender identity or not. It is this topic I finally turn to.

Authenticity of the Horrible

In many respects, there is a sense in which *Horrible Science*'s idea of the horrible, by way of being so fantastic, is somehow unreal. As I have already mentioned, Scanlon (2008) suggests that *Horrible Histories* author Terry Deary appears to equate his form of horrible with the truth. To some extent this issue will be dealt with in the chapter on realism, but it is worth discussing here some of the ways in which authenticity relates to the horrible. It does so largely through a variety of ways: by invoking a physical, 'spine-tingling' reaction; by suggesting itself as a 'middle-ground' perspective which acknowledges both the criticisms of science often seen to be inherent to horror genres, as well as more pro-scientific discourses; and by appealing to a sense of hidden or more honest knowledge which is generally 'glossed' over by children's and/ or commercial culture.

Spine-tingling Realism

Lynn Voskuil, in her study of 19th century sensation drama, argues that what most astonished the audiences was not the showiness of stage effects such as tumbling waterfalls, speeding trains and burning ships (including the technology which made them possible) but that the sensation seemed to be real (Voskuil, 2004: 62). Voskuil argues that these 'spine-tingling thrills' were enacted to be experienced in apparent spontaneity, to at least appear to be experienced as authentic rather than

[18] Haraway suggests this was achieved largely through appropriation of Arthurian and Clerical imagery of masculinity, and this is what gives Western science much of its (implicit) connection with religion, especially in a worshipful sense (Haraway, 1997: 30-1).

orchestrated, and as an individual, quite personal response (rather than going along with the crowd). This allowed them to be construed as 'natural', somehow above issues of either culture or class: 'Often wordless, sometimes breathless, ostensibly involuntary' (Voskuil, 2004: 84). For a more modern example, Leon Hunt (2005) argues that professional wrestling offers a 'spectacle of the real' within a context that everyone involved (including the audience) is very aware is staged. Although pro-wrestling mimics the styles of non-fiction television (i.e. sports, documentary, news reporting), its audience is comfortable that it is 'fake'. Crucially for the context of *Horrible Science*, Hunt particularly notes that the performance of the intensification of risk, damage and self-endangerment is a means of authentication within pro-wrestling. Thus, allusions to danger and pain (or a sense of the horrible) are what designates 'a search for the 'real' within the fake' (Hunt, 2005: 118).

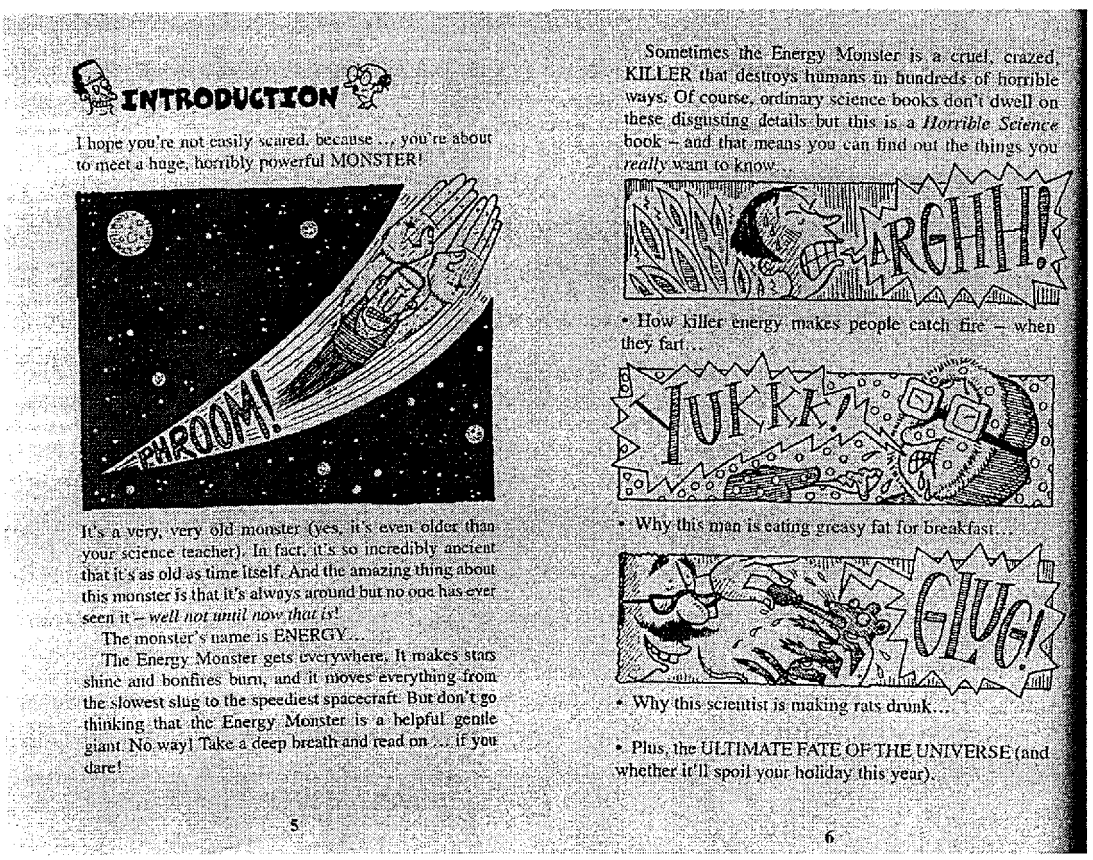


Fig. 4.7. Introducing the Energy Monster (*Killer Energy*, 2001: 5-6)

The introduction of the Energy Monster shown in fig 4.7 provides a nice example of the physicality of the horrible mobilised to find a sense of 'real within the fake'. For example, the face of first character on the right hand page is disfigured into a painfully broad scowl; with the one below him displaying a similarly pursed-in

mouth. The teeth of both these characters, and those of the Energy Monster, are clenched. Similarly, De Saulles manages to portray the extremes of hot and cold temperatures, further contrasted by the use of sharp lines for fire and rounded circles for cold. Even the sharpness of the speech bubbles suggests distress of some form. Although the third character in pain is an animal, the anthropomorphised 'ouch' and expressive drops of sweat communicate the discomfort of having a pipette pushed, clearly quite far, down ones mouth. Alliteration and changes in rhythm, such as 'the ULTIMATE FATE OF THE UNIVERSE (and whether it'll spoil your holiday this year)' act to suggest drama. Words are capitalised, suggesting shouting. The italicised text suggests a slightly softer, but still a change in, emphasis. Overall, the tone is one that appeals to the senses, but one more disturbing than soothing in nature.

The Realism of (everyday) Monsters

Marina Warner emphasises that the word monster comes from the Latin for 'to show' (Warner, 1992: 126) and John Law (1991), in introducing a sociology of monsters, notes that many social critics draw a claim to a privileged point of view by articulating some past experience of pain; being monstrous is part of the construction of insightful member of the dispossessed in contrast to unseeing bourgeois. John Clark (1991), in discussing grotesque satire in modern literature suggests that writers invoke the scatological as a way of demonstrating their lack of deference to social taboos (Clark, 1991). Indeed, as I discuss in chapter eight, any form of satirical laughter might be read as implying it can strip away layers of cultural 'baggage' to display a cleaner, more authentic state. Much of this point of view echoes Bakhtin's (1968) contrast of the 'grotesque realism' of the carnival with the falsities of 'the aesthetics of the beautiful' (Bakhtin, 1968: 29. See also Fiske, 1987: 248-250).

Yet, there is something reasonably domestic about all of *Horrible Science*'s references to the horrible. It is generally quite tame horror, either via the application or humour or because it is (comically) applying language of severe pain and suffering to something as mundane as homework. Although in some respects *Horrible Science* does distance itself from domestic space (as discussed earlier), it never seems to go that far. It is more a horrible twist on the mundane than outright fantasy. What Jonathan Coe, writing about the appeals of Hammer Horror, calls 'weird domesticity' (Coe, 1992: 138). Humour is often worked in *Horrible* with counterpoised extremes – the dramatic with the mundane, the apparently powerful with the traditionally

powerless – producing mixed characters which are half threatening monster, half fluffy-toy. A good example of the latter is the 'head-chopping machine operated by a sheep' mentioned on the back cover of *Evil Inventions* (2007, see fig 4.5). Similarly, *Shocking Electricity* (2000) starts with a suggestion to go on a 'horrible science holiday' to the electricity-free Island of Horra (an explanatory device to help readers consider how much they rely on electricity). This is presented as an advertisement, illustrated with an image of a turreted castle surrounded by lightning and silhouettes of sharply-branched bare trees. Underneath 'Horra' is written in a blood-dripping illustrated font, evocative of 1950s horror comics. Below all of this though is a picture of an old lady drinking from a delicate teacup. She is labelled as 'Mrs Edna Scruples (aged 97)' and quoted: 'There were none of those noisey CD thinummies – it was so peaceful I could hear my knitting needles click' (*Shocking Electricity*, 2000: 8).

Similarly, Picart believes Hammer Horror films produced their form of realism from its reference to the mundane, substituting the lush Victorian settings of gothic castles for shabbier laboratories (Picart, 2002: 101-2). In comparison, Coppola and Branagh's searches for 'pseudo-authenticity' seem overblown and wretched (Coe, 1992: 138). For an example based in non-fiction media, Francis Bonner argues in a study of medical operations on television, that a sense of reality can be achieved by playing on everyday aspects of the experience; the universalities and the mundane nature of both medical practice and the human body (Bonner, 2005: 106). *Vicious Veg* provides a good example of such a discourse of truth found hidden in the everyday, this time from its conclusion, although it is a trope we can track across all of *Horrible Science:*

> Even a boring little weed contains an awesome living chemical factory that can turn sunlight into food and make a cocktail of vicious poisons. It's enough to make a full-grown botanist weep with excitement and wonder. Ok, so vegetables are a bit slow to get going. But who cares? Once you know their secrets vegetables are horribly brilliant (*Vicious Veg,* 1998: 159)

Arguably, this idea of truth as outside of the everyday presentation of the world is particularly powerful in the context of children's literature, a space that is generally censored and sanitised. Moreover, it reinforces an oft-applied image of science as able to demystify the everyday whilst also making things seem magical through such processes of demystification (see Locke, 2005, Mosco, 2004, Davis, 2004, on such

contradictions).

Images of 'weird domesticity' celebrate the home, but with an ironic tone that allows the necessary distance to be taken seriously as a masculine space. Moreover, the close juxtaposition could be read as emphasising uglier undersides that 'glossier' images of the home (i.e. 1950s gleaming white housewife) traditionally choose to hide. *Horrible Science*'s love of the grotesque is often applied to laugh at a sense of adornment; self-conscious or fabricated beauty are generally ridiculed, with female teachers with make up and polished hairstyles depicted in a somewhat grotesque manner (too-large hair, too-much make-up); in terms of explicit discussion of the body, specific laughter is directed at dieting (*Body Owner's Handbook*, 2002: 79). In terms of the body books, it is part of *Horrible Science's* advice to readers to be at home with their bodies as they are. However, we can also see it as matter of depicting science as somehow outside of culture. Arguably, this is largely down to the sense of distrust for commercial culture, as the books suggest themselves as more trustworthy than the more obviously glossy forms.

Conclusion

Those concerned with maintaining good PR for science need not worry about *Horrible Science*'s gothic imagery painting science in a bad light; arguably the discourse of a 'horrible' science is nothing less than a rhetoric of the enterprise as both powerful and authentic. The brand's patterning may present school-science as horrible and show off the 'ickier' sides of scientific ontology. However, it also suffuses this notion of the horrible with spectacles of comedy, cartoon and fun, rendering it as a largely positive force, as the horrible is used as a form of celebration. Moreover, it should be noted that any negativity is largely directed at teachers, not professional scientists who form the knowledge in the first place. *Horrible Science* aims to show off 'the sick *side* of science', with the 'squishy bits *left in*' (emphasis added). Thus the horrible exists already, the squish is not added to the mix, implying that *Horrible Science* is an unsanitised account, in some respects made more truthful via the inclusion of the horrible.

Additionally, we should remember that the horrible of *Horrible Science* is a very flexible object, embodying a mix of references to the gothic, the yucky and a sense of pre- or anti-social anarchy. It samples discourses critical of science and

those which, in seeing the 'horrible' in science (e.g. the Energy Monster), are more reverent of it, without settling on either. In this way, *Horrible Science* is able to signal itself both culturally and counter-culturally authoritative. Thus, the patterning of the horrible to science pays lip service to critical, anti-authoritarian approaches to science education, but on the whole deploys its characters, styles and imagery for a rather traditionally pro-science approach to non-fiction publishing. Moreover, this rather mixed bag of 'the horrible' provides the brand with an ambivalent generational position; looking back to childlike toilet humour and forward to more grown-up horror. In many ways this suits the vicissitudes of generational identity in pre-teen literature (both that of authors and readers). This mixed-horrible also suits the challenge of dealing with gender identity in the context of learning about science (flowers, at that), largely by presenting itself as appropriately adventurous, outdoors, anarchic and most of all 'hard', yet always through the ambivalences of humour and without ever veering too far from the home. Through its aesthetic of weird-domesticity, the horrible ironically distances *Horrible Science*'s claims to truth both from over-sensationalised and over-censored (either way, glossy) images of the world.

Chapter 5
Styles of Narration

Introduction

How does *Horrible Science* choose to tell its science, how does it lead its readers through content, and in what guise? Although *Horrible Science* books look and feel like novels from the outside, they do not invite the reader to move around them as you would a traditional 'chapter book'. As discussed in chapter two, these books are a 'mix' of different types of content, applying a relatively frenzied, apparently disorganised structure that alludes to a diversity of media styles and samples a range of narrators. Pages are often made up to look as if they have come from elsewhere, as if the mock-up newspaper pages had been ripped out and pasted into the *Horrible Science* book. First there's the disembodied third-person narrator of scientific prose, then Baron Frankenstein, now it's a comic book, then a quiz, news reporting, an advertisement, instructions for a hands-on activity, next a historical story or scientific explanation, finally a filmic cartoon strip about a family of atoms.

We might argue that in this respect at least, *Horrible Science* epitomises the post-modern text, although it also reflects Secord's observations of the 19th century *Vestiges of the Natural History of Creation* as a In many ways a 'hybrid' text, 'a generic monster, the protgeny of all the literary experiments that made reading so exciting' (Secord, 2000: 522, 41). Within its contemporary competitors, by no means is *Horrible Science* is alone in sampling other media forms. If anything, one of the most striking aspects of contemporary children's non-fiction is a desire to sell itself by reference to other media, the output of Dorling Kindersley being a particularly good example. DK have produced a range of web-linked books, and several worked in conjunction with museums. In some respects, this is simply a reflection of cross-branding, and the increasingly cross- and multi-media nature of contemporary cultural products. However, both Katherine Gillieson (2006) and Buckingham and Scanlon (2003) have noticed the ways in which DK books do not just directly cite

other media institutions, but appear museum-like or magazine-like in their design. I understand the swapping and switching of *Horrible Science*'s narration as indicative of the series' ambivalence and variability towards the scientific community. The change in narration presents a range of viewpoints, thus showing positions both reverent to, and critical of, the scientific establishment. However there is a sense in which these different narrators are largely costumes for the author who himself takes on a caricatured persona. Despite the key role given to the illustrator, *Horrible Science* is largely a 'one-man show' that provides a sense of branded coherence amongst the range of voices taken on.

This chapter is split into two parts. The first focuses on issues of the organisation of knowledge into narrative plots and compares this with more magazine-like structures. The next section focuses on *Horrible Science*'s narrator; the mode of address that implies a conversation with the audience, and ways in which the narrator sometimes dresses up as other characters. With each of the comparisons to other media, I consider the ways in which the materiality of *Horrible Science* signals its narrative approach, as well as more literary or textually located clues. Additionally, I am largely concerned with how structure and associations with other media styles perform a sense of truth-telling and build up a sense of 'epistemic' cultural capital. I conclude by arguing that *Horrible Science* should neither be understood just as magazine or novel, nor conversation or scrapbook (or just a pantomime) but that the books allude to all of these as part of presenting a story that hangs loosely over the otherwise anarchic delivery of a range of very disparate content. *Horrible Science* walks a line between chaos and consistency.

The Plots of *Horrible Science*

This section will start with a brief theoretical discussion on the problems and advantages of plotting the communication of knowledge into some form of organising structure. Questions of realism are at the heart of any application of narrative to science communication, open to easy criticism that a sense of story might somehow damage a claim to tell the truth, and much of the discussion of this section feeds into chapter six. I then move on to some discussion of the more 'plotted' knowledge of *Horrible Science* (e.g. when it takes on storytelling styles), and contrast this with more apparently chaotic narrative approaches.

Plotting Knowledge

One of the key ways in which books signal the order in which their content should (or could) be considered comes down to design. Gillieson (2006) compares the typography of the *Eyewitness Guides* to 'glossy' travel or fashion magazines, arguing that such fashioning is part of what signals to the readers that they can 'dip into' the books, rather than reading linearly. With the comparisons to magazine styles, we should also remember the conventions of science textbook design, which similarly invite readers to look around a page and enter the book in a different order to the one the pages happen to be bound in. Contents pages and indexes are important to such publications as guides to where to find particular content, unless, of course, the publication's producers would prefer they were consumed more randomly. For example, *Pick Me Up* (Roberts & Leslie, 2006) was marketed as a 'shufflepedia'. Eschewing the linearity of the book to emphasise the interconnected-ness and discontinuous nature of knowledge, it draws on typographies of magazines and textbooks as well as games (computer and boxed), advertising and websites.

Despite such tendencies towards the 'dipped knowledge' of magazine structure, many (writers, researchers, educationalists) feel there is a pedagogical advantage to be had in the use of narrative. To Nick Arnold, it is central to his own personal theories of education:

> we are actually hardwired to put things into narrative anyway, it's something, it's actually genetically programmed in, in our brains. I mean, it's basically like. I mean supposing you didn't have that in your brain [pause]. You, you'd you'd be, you would be bombarded with impressions of your day, and if anyone asked you about them you'd find it very difficult to account for them or make sense (Arnold, 2006b)

Arnold is not alone in suggesting that a desire for narrative is inherent in people; indeed, it is a widely enough held view that several writers have aimed to debunk it (for an overview of such critiques see Cobley, 2001: 27-8). Ogborn et al think *all* science explanations are stories: they contain a world of protagonists (electrons, genes, etc) all with their own special powers; these powers allow the protagonists to enact a sequence of events (a current flows, proteins are made); and this sequence has an outcome, which is the phenomenon to be explained (a lamp lights, a cell develops) (Ogborn et al, 1996: 137; see also Miller & Osborne, 1998). Locating the

desire for storied-structures within philosophy of science, namely Hemple's (1965) insistence that explanans logically entail the explanandum, science for Ogborn et al is inherently plotted (see also Kubli, 2001).

Hayden White (e.g. 1981, 1992) argues, in the context of writing history, that the tendency to relay events as narrative arises out of a desire for coherence and closure. However, White argues, these are both illusionary. Moreover, the process of organising events coherently and imposing a neat ending imprint a moral take on the events described by a text, as the particular moral/political standpoint of a writer acts as the organising principle for the narration. Applying this idea to scientific contexts, Felicity Mellor has argued that the 'inexorable movement of a narrative towards a predetermined end' allows assumptions made by scientific writing to be glossed over and to go unchallenged (Mellor, 2007: 501). Nik Brown (2006) has also reflected on similar issues of implied inexorable progress in terms of invocations of the future in science policy. Still, narrative's sense of progression is arguably part of its rhetorical advantages; it can provide a spur for continued reading, whilst less-plotted popular science books are left unfinished. Russell Stannard provides a particularly clear application of this idea in his (1993) retelling of *The Arabian Nights* based around a set of science stories told by a schoolteacher (*World of 1001 Mysteries*). The teacher in this book ends each physics explanation with a hint of another, thus continually leaving her audience waiting for more.

Ron Curtis (1994) also applies White to science writing and argues that by structuring texts as a form of detective story, where revealing the truth provides narrative closure, writers employ a powerful rhetorical tool which help imbue accounts of scientific work with an appearance of certainty. Curtis advocates what he sees as a more 'Lakatosian' view of science as an 'ebb and flow' of questions and continual research. Curtis puts it memorably when he suggests that with narrative accounts of science 'we begin with unanswered questions. We end with unquestioned answers' (Curtis, 1994: 431). Perhaps in response to this sense of science as continual questioning, children's popular science has often been structured around presenting questions and answers. An interesting recent example of these 'dialogic' structures is Glenn Murphy's (2007) *Why is Snot Green?*, based on the 'sorts' of questions child visitors asked the writer when he worked in Science Museum's interactive galleries (its sequel aims to use actual questions). What makes this book especially interesting in terms of its narrativity (or lack thereof) is the way Murphy includes cross-referencing footnotes and citations to 'further reading' to

allude to a sense of continual learning and/or discovery outside the perimeters of a closed book plotted to conclusion. Stannard also builds his stories around the questioning of young children. As I have argued elsewhere, far from restraining a sense of science's 'ebb and flow', Stannard uses this to conclude his tightly-plotted narratives on a message of uncertainty, rooting his stories in the power of future questions from young people (Bell, 2007c).

Greg Myers provides a useful distinction between what he calls a 'narrative of science', which are stories about scientists going about their work (as Curtis is referring to) and a 'narrative of nature', where scientific entities such as molecules or trees are the protagonists (Myers, 1990: 142). In terms of the narrative of science, it is easy to start worrying about Whiggish approaches to the history of science and return to Hayden White to discuss how they are written to communicate a sense of inevitable progression. As Elizabeth Leane notes, popular science writers are increasingly aware and explicit in their provision of 'cleaned-up' versions of how a scientific idea came about. For example, she quotes John Gribbin saying 'To tell a coherent story, I have to make the account more orderly than science itself was at the time (quoted in Leane, 2007: 110). However, as I have argued elsewhere (Bell, forthcoming), subverting a linear history of science or technology does not necessarily make for social constructivism, as the idea that an object can work or be constructed out of its time can equally suggest a sense of objective 'timelessness'. The same arguably is true of scientific progress, as to remove or replace a scientific idea or character from its historical 'plot' is, to some extent, to decontextualise it. The history of science can be ordered to meet a range of ideological perspectives, especially when we include the rather temporally disruptive factor of the child.

Jon Turney (2001ab) has discussed narratives of nature and science in detail, arguing that the historical sciences are particularly suited to provide accounts of change over time (Turney, 2001b: 227. See also O'Hara, 1992). Martin Eger suggests that the emerging canon of popular science makes up a grand narrative in the form of the 'new epic' of science, but it does so collectively: 'So vast is this new epic, and so detailed, that no one book can encompass it' (Eger, 1993: 198).

> From Darwin's original theory, the lines of extension radiate downward to prebiotic (chemical) evolution as expounded by Prigogine and Eigen; to cosmic evolution as described by Weinberg, Paul Davies, and the astrophysicists; to human culture as Wilson

> explains in his theories of sociobiology; and finally, through the work of brain physiologists and AI researchers, to consciousness itself. (Eger, 1993: 197)

As such, a narrative of nature is arguably woven in to a narrative of science as the natural world is ordered through a reductive framework which imagines one set of scientific detail as inherently 'behind' another (e.g. that biology reduces to chemistry, and then to physics). Eger may suggest a multi-volume epic, but it is worth noting that single popular science books have tried to at least allude to such a scientific 'epic', arguably selling themselves on science's ability to present a coherent reduced narrative. The titles of some of the most popular books are indicative of this; from the seminal *Brief History of Time* to Bryson's echo with *A Short History of Nearly Everything* and *Horrible Science*'s *A Stunning Simple History of Everything.* These stories of the past and future development of the world, be they cosmological or genetic, are narratives of nature and of science which Turney (2001b) suggests provide secular alternatives to religious texts (see also Beer, 2000, Midgley, 2002).

Narrative Plots of Horrible Science

In many respects *Horrible Science* shares the same physical shape, size, ink and paper as a children's novel. This distinguishes the books from textbooks, the bulk of 'glossy' children's non-fiction and young children's picture books. There is also a cost element to this. The black and white paperbacks are much cheaper, accessible for children to buy themselves rather than have them bought as a gift, and there is perhaps a slightly different aesthetic in respect to class; *Horrible Science* does not look as 'posh' as *Eyewitness*. Arguably the 2008 rebranded books, with their more garish covers, summative quiz and index are slightly less novelistic in their materiality. However, overall the bulk of *Horrible Science* books on sale allude to children's novels in much of their design.

A sense of the novel (and its implications for narrative progression) is also engendered in Arnold's textual content. Increasingly, *Horrible Science* books will employ some form of 'story' to link the disparate parts of the book together, providing a loose sense of coherence amongst the otherwise more apparently messy structure of the books. For example, *The Body Owner's Handbook* (2002) has a sense of overarching narrative provided by the notion that the book is a handbook for using

the human body, which is further underlined by the character of Dr Frankenstein who uses his boy monster to show readers around the human body. A sense of recounting the lives of this doctor and his monster provides a (very loose) feeling of narrative drive. Notably, however, there is little resolution around these characters. The jigsaw special on dinosaurs (2007) also (again, loosely) follows the trip of two explorers, reminiscent of Doyle's *The Lost World* in what appears to be a deliberate intertextual reference. The exercise book-sized 'special' *Really Rotten Experiments,* which consists of a set of hands-on activities, introduces at its start students from 'Rotten Road School', a set of characters who 'helped test the experiments' and are used to present the activities in the book (both kids and staff are employed). School reports in fabricated schoolchild handwriting font provide commentary and background to the experiments. Such allusions to fictional stories and characters may provide some vague sense of narrative drive, but only very rarely will it actually produce an ending for the books. Indeed, several books finish pointing to the unknown future of science which, it could be argued, opens up their story of science for children to have a future role in. They can end rather abruptly, producing a sense of conclusion simply by saying goodbye (e.g. fig 5.1.), as if to say they had run out of time (again, reflecting television magazines).

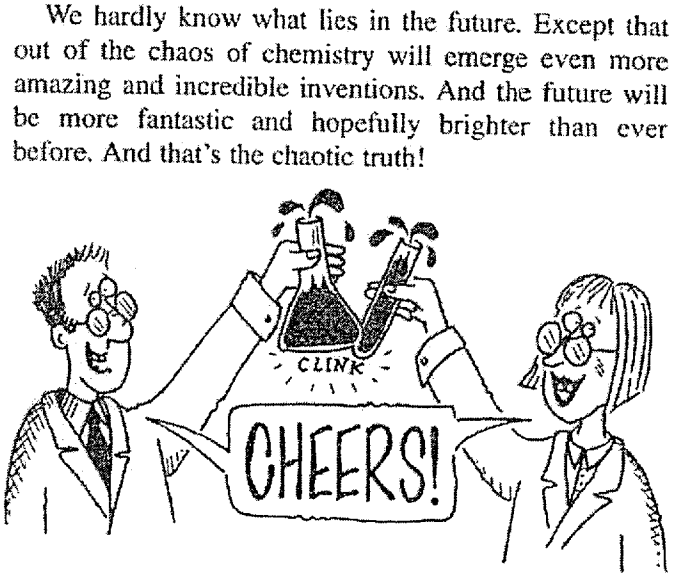


Fig. 5.1. Waving Goodbye (*Chemical Chaos*, 1997: 158)

The notable exception to this is *Angry Animals* which takes on the narrative conceit of a quest story. We might consider all popular science as a form of travel

writing; indeed we might argue all narratives take their audience on a journey of some form (Beer, 1996, Turney, 2001a). What is interesting here is that the book very explicitly provides a journey narrative, self-consciously structuring science as a quest for information. Quests are a very special journey in terms of describing movements to find or develop knowledge, with a particular sense of narrative 'drive'; they are, from the start, built around the notion of finding a conclusive end point. At the start of *Angry Animals* the readers are introduced to a competition to find the world's most cruel animal. The book then works as a journey narrative, with television naturalist 'Will D Beest' and his talking pet monkey, Mickey, trekking through the animal kingdom to examine each genus's cruel credentials. Because the competition is to compare animal with animal, this provides the book with ready-made distinctions between chapters. It also gives the book a neat conclusion, which in this case is a twist: the most dangerous animal is not any of those which Will or Mickey have looked at, but the human being. Thus, the book not only has a conclusion that emerges from the content of the book (rather than looking to the future) but it is a somewhat moralistic one.

Orders of Magazine Science

For all that *Horrible Science* has novelistic tendencies, it also owes something to serialised, illustrated publications such as the comic or magazine. In reading *Horrible Science* as a form of magazine, it is worth re-quoting Arnold's description of *Horrible Science* as 'an incredibly rich mixture [...] the mix is unique' (Arnold, 2006b). I want to emphasise that the books do not just apply a 'rich mixture' but make the combination of diverse content reasonably explicit. That is, the mix is not entirely seamless, and as such *Horrible Science* reflects Gillieson's (2006) idea of 'glossy science', albeit with a rather different aesthetic. Less glossy, and more a DC Thomson publication such as the *Beano* or *Dandy.* Although *Horrible Science* did not initially have an index, the 2008 re-brand has introduced them, inviting readers to look for specific information within the books or locate particular passages to re-read. Interestingly, they index in terms of subject matter (e.g. titles of scientific theories or names of famous people), not style of content; you could not look up the index to find the experiments or quizzes. The combination of text with image invites readers to explore pages in order to find jokes, asides or factual content. In this respect *Horrible Science* echoes picture-books and diagrammatic textbooks as much as magazines. This is probably most true of the jigsaw books, the *Horrible Science Annual* (2007)

and, to a lesser extent, *The Stunning Science of Everything* (2006), as the pages of most of the other books are dominated by a running commentary which links the rest of the content together.

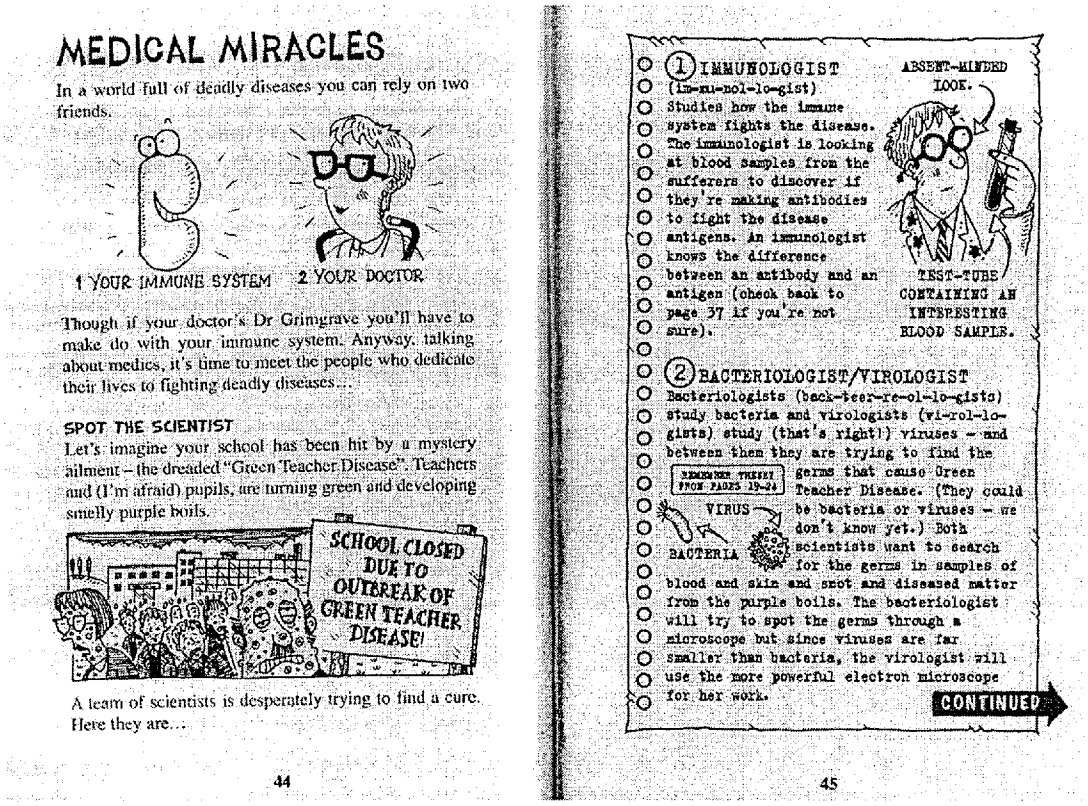


Fig. 5.2. Narrator in text (*Deadly Diseases*, 2008: 44-45)

Most of the pages of the central series of books are focused around a passage of text in plain font, distinct from handwritten or italicised sections, which will introduce, sum up or provide content on the topic, which I assume is what Arnold means when he talks about 'straight text' as part of the mix. We can see such commentary in fig 5.2, introducing the 'two friends' of the immune system, setting up the imaginary situation of a plagued school and directing us to a 'fact-file' segment. We might compare such sections linking the skits of *Horrible Science* to passages of text in a textbook or *Eyewitness* guide which surround images or instructions for activities and equally introduce, connect and provide an overview of an otherwise relatively disparate collection of information. It is also analogous to commentary in a picture-book. In their deconstruction of dinosaur books, Buckingham and Scanlon note that in older books, the text would frame or introduce pictures, whereas in more recent books there is a greater integration of text and image (Buckingham & Scanlon,

2003: 132-4; see also Kress & van Keeuwen, 2006, 30-33). Thus, *Horrible Science* could be classed with the old-fashioned science books, using its textual commentary as a surround. Arguably this is largely due to the novel-format size of most of the *Horrible Science* books; there simply is less space on the pages for browsing. Moreover, bound like novels, it is physically harder to dip in and out of the *Horrible Science* books. Their material makeup in many ways implies an ordered reading: even if the chapters tend not to provide a sense of progression and that order is somewhat arbitrary, it has still to be set.

Magazine television shows perhaps provide a better analogy for *Horrible Science* than the glossies. The lengthier, morning-long magazine shows such as *Tiswas* or *Live and Kicking* mixed a range of content (e.g. music video, interview, cartoon) into 'a seamless programme', perhaps to discourage channel hopping and predicated on assumptions of children's attention spans (Buckingham et al, 1999: 87, 110). As with staged variety shows, because they are presented in time (often live) the audience has to follow the order of content the producers have chosen. Thus, the sections of 'straight text' with their conversational style can be understood as the voice of the writer presented as a sort of continuity announcer. Buckingham's (1995) study of *Wacaday* presenter Timmy Mallett provides a valuable analysis of the ways in which presenters narrate these types of show. As Buckingham describes, Mallett 'lurches round the studio, gesticulating wildly as if attempting to encourage the participation of the imaginary studio audience'. Yet he retains control over the studio space, on occasion physically shoving his guests into position to deliver their lines, even holding up prompt cards for guests to read out, he 'leads the programme furiously from one item to the next, keeping up a steady stream of puns, jokes and catch-phrases' (Buckingham, 1995: 54-55). Presenters such as Mallett work an aesthetic of chaos, yet keep the programme in a workable, predictable order.

Another magazine-like comparison to *Horrible Science* is the *Funfax*. Published by DK, these are off-shoots of the Filofax and originated in the late 1980s /early 1990s. They are essentially ring-bound books, within which the readers shift content, taking pages in or out of the file. They generally invited readers to add some (predefined) information to content; either in the form of stickers or filling in personal information about themselves (favourite colour, height, best friend's name), and sometimes included diary and/or address book sections. Although now they are generally fan-based, fiction-connected franchises, in the past, *Funfax* users have been able to mix and match content, buying a range of short stories (generally 'pulp'

genres, horror or romance) or mini-versions of *Eyewitness* books which they could clip into their files and build an individual miscellany of information, entertainment and personal details.[19] The chapters of *Horrible Science* could, in the light of a *Funfax* comparison, be thought of as file dividers. The *Body Owner's Handbook* (2002) even includes fabricated hole-punches in its cover. Most of all, however, the *Horrible* books allude to a sense of a *Funfax*, or at least a scrapbook, through their continual reliance on what can best be described as fabricated historical documents (for example, see fig 5.4). We might also argue that in this respect *Horrible Science* alludes to a form of 'documentary'; not in the filmic sense, but rather because the books present themselves as a collection of documentation. Where the *Eyewitness* books suggest themselves as a museum in book form through their display of a collection of objects, the *Horribles* could be imagined as an archive.

Narratives Without Conclusion

The Stunning Science of Everything (2006) similarly introduces a set of characters at the start, but their situation does not provide logical progression or resolution to the book. This introduction to characters suggests a start to a story, and some uniformity across the middle of the book, but in practice provides no conclusive ending. Instead, the book introduces the idea of 'size-sorting' as a structure for the book, from the universe in the first second of its existence to the hugeness of life today, in all its complexity. This provides some narrative direction for the book (small to big), but it also focuses attention on scale to celebrate awesomeness of size:

> And the topics just get bigger and BIGGER until at last you get to see the BIG PICTURE OF EVERYTHING and the whole of science makes stunning sense! (*Stunning Science,* 2006: 4)

This framework, which moves the book from the science of the very small to the gigantic provides, not only an element of coherence but also a sense of order, perhaps even a sense of completion about scientific understanding of nature. There are several philosophers/ sociologists of science who regard such reductive patterning as a form of ideology (see, for example, Midgley, 2003) and might consider such plotting as analogous to the 'moralising' force White and Curtis

[19] The *Horrible Science* subscription magazine, like similar part-works, also included fact 'cards' subscribers could collect in a folder.

complain about. In many respects this echoes Eger's (1993) sense of the 'new epic' of popular science. Other books similarly echo this sense that there is an actual story in the science they present. *Evolve or Die,* the book not written by Arnold, actually starts by selling its special *Horrible Science* approach on this point:

> there's a much better way to learn about biology, if teachers would only use it. All they need to do is to stop ranting about so many sickening scientific facts, and turn it all into a story [...] There's a name for the story of life on Earth. It's called evolution. It's a story that's been going on now for 3,500 million years, and no one has any idea when it will end. Evolution is an epic adventure, on a scale that even Hollywood film directors could never contemplate. It's got disasters, surprises, villains, heroes, horror – and even sometimes a happy ending or two along the way. (*Evolve Or Die*, 1999: 5, 6)

With its references to the disasters, surprises and villains of the story of life on Earth, the writer, Phil Gates, seems to reflect the 'Epic of Nature', relying on the notion that there is a form of inherent plot provided by the 'Narrative of Nature'. Yet, we should note that they do not necessarily provide an ending. The Epic of Nature is one we are still living within. Interestingly the reductive frame of *Stunning Science* is 'bottom-up' in that it starts with the very small, and so ends on the hugest and most complex: a diagram of outer Space which requires fold-out pages to present its size.

Another form of 'ready-made' temporal narrative structure which the books adopt is that of the history of science. Interesting, these also lack a tightly focused ending. *Suffering Scientists* (2000), for example, is largely structured through a history of science timeline. It is somewhat Whiggish: although it follows the *Histories* in focusing attention on how great people got things wrong, it places this on progressive notions of the history of science, where the current is juxtaposed with the past to privilege the intellectual position of now. For example a document presenting 'Physics by Aristotle' is preceded by a 'Horrible Health Warning':

> Every "fact" you are about to read is WRONG. Not just mildly incorrect or even half-true. We're talking utter rubbish, drivel, clap-trap, humbug and poppycock. So copying this next bit for your science homework is about as clever as walking into a lion's den with a sign saying "HI I'M LUNCH". We've asked a boring scientist to add a few corrections

(*Suffering Scientists*, 2000: 32)

What is more, the book ends on a reasonably celebratory note; for all that Aristotle and Newton are laughed at, this is done with a reasonable amount of reverence. The idea that science progresses by disproving old ideas, with a future that no one knows, is central. The end of *The Terrible Truth About Time* (2002) is possibly the best example of this. This answers the question of 'the terrible truth about time' with 'it is still a mystery':

> But one thing's for sure. Slowly, scientists are unravelling time's riddle. And the answer is out there. Somewhere in the universe, somewhere in the cold and dark amongst the flittering stars is the key to the mystery. And one day we'll find it... OH YES, IT'S ONLY A MATTER OF TIME! (*The Terrible Truth About Time,* 2002: 143-4. Ellipses as original)

Thus, the books put the reader in a story with an end; but the book stops narration somewhere in the middle. If the books were to wrap everything up in a sense of certainty, we might imagine the child reader is left outside; Curtis's schoolchild sitting with unquestioned answers. Thus, *Horrible Science* employs a sense of uncertainty as an impetus for future study and involvement in science and in so doing provides a particular role for the child reader of popular science.

Buckingham's discussion of *Wacaday* notes that its recurring segments tended to be branded with a *Wacaday* house style, often with reference to the programme's title or the presenter's name e.g. *Wac-a-Make* or *Mallett's Mallet* (Buckingham, 1995: 55). As discussed in chapter three, *Horrible Science* similarly employs regular, self-branded segments. In the context of questions of narrative, what this self-reference repetition does is provide a sense of the consistency to the otherwise discontinuous content. It makes the use of an advert or newspaper article (whatever the device *Horrible Science* is using at the time) somehow its own and normalises its place in the book. It is common for literary critics to bemoan the repetition of what is generally dubbed 'series fiction', complaining that such texts repeat a formula rather than developing in any particular direction (e.g. Bixler & Agosta, 1984, Watson, 2000). At the same time, the lack of development towards a conclusion is part of its appeal to commercially minded publishers; a conclusion would mean the end of the franchise. In his critique of *Lemony Snicket's A Series of*

Unfortunate Events, Bruce Butt starts by comparing the books (unfavourably) to pulp fiction and soap opera, but concludes that their use of repetition is largely a pastiche of the traditional moralising of children's literature; its message is that there is no message at all (Butt, 2003: 284-6). Read in this light, the branded repetitions of a magazine or series might be considered an advantage, not a literary failure. Similarly, we might celebrate *Horrible Science*'s tendency to repeat formulae rather than to progress as a way of escaping the 'emplotment' of science.

Narrating Horrible Science

This section is concerned with the style in which *Horrible Science* is told to its audience. That is, it focuses more on the character of the narrator than the order of the narrative, although a sense of order (and disorder) is part of the consequence of the style of narration that *Horrible Science* employs, so we cannot leave questions of emplotment entirely. I consider the ways in which *Horrible Science*'s narrator 'dresses up' in the books; firstly in terms of the relatively muted costume of a 'down with the kids' address, then the more explicit garb of fictional characters and semi-fictionalised representations of historical actors.

Villains and Dames: Narrators in Drag

Buckingham's analysis of *Wacaday* concludes by suggesting that presenters like Mallett, who explicitly packaged themselves as 'down with the kids', were best understood as 'adults in drag' (Buckingham, 1995: 51). This is where we can start to locate the Dame character in this study of science as pantomime. There may be no gender-drag in *Horrible Science* (at least none of particular note), but there is a generational one. Just as Taylor describes the pantomime Dame (see discussion of pantomime in chapter two), the generational costume of *Horrible Science* does not lay itself on as thickly as Mallett's lurid clown drag-act. However, as with any form of role-play, it is dependent upon a particular idea of the characteristics of whomever one is dressing up like. Just as a male-to-female drag act presents a particular idea of femininity, *Horrible Science*'s address to young people assumes and replicates a particular image of the child.

It is worth noting that, from my interview data, Arnold is less keen to declare

himself 'a big kid' than *Horrible Histories* writer Terry Deary. When I asked Arnold whether he ever found it hard as an adult to write for children:

> [pause] you may be asking the wrong person. Yes, um I am an adult. I think. But I don't, I don't actually think of myself as being an adult. I just think of myself as being a person. I don't think of myself as being a particular age. I think of myself as being who I've always been and therefore when I talk to a child I don't make any distinction between how I'd talk to a child and how I'd talk to an adult. Of course there are some distinction and some things to bear in mind. For example the use of language. (Arnold, 2006a)

What I think this statement suggests is that Arnold sees some sense of continuity across generations even if, to some extent, he is censoring content for a young audience. Yet, from my reading of the *Horrible Science* books and watching Arnold perform *Horrible Science* shows on stage, I think there is an element of play-acting as a child. For example: 'This book has an 18 certificate (that's UNSUITABLE FOR PERSONS OVER 18)' (*Microscopic Monsters*, 2001: 8). The similarity between Arnold's mode of narrative address and those of the more frenetic television magazine presenters was especially noticeable when, during a stage show for the ten-year anniversary celebrations at Kew Gardens (the day of the interview), Arnold asked De Saulles up on stage as a volunteer. De Saulles remained relaxed and calm, staying quite still and very quiet. He smiled at the audience, but did little else. Meanwhile Arnold bounded around the stage, making jokes and shouting (sometimes screaming, admonishing and laughing) at the audience. This is not necessarily a bad thing. The audiences seemed to respond favourably to Arnold's style; they certainly cheered, jeered and laughed when he told them to.

It is not just the Dame who talks to the audience in pantomime, but also the Villain, and it is worth also considering the Villain's role to understand the way in which *Horrible Science* is narrated in respect to its audience. According to Dawn Lewcock (2003), the Dame talks to the audience in order to get them onside. She builds rapport by asking for their help and is largely a sympathetic character the audience warm to. In comparison, the Villain admonishes the audience. The Villain will make asides to tell the audience what they will do, but it is an approach rooted in Restoration prologues/epilogues where the audience were often deliberately insulted (or, 'flyted') and which, Lewcock argues, binds the audience together in mutual

dislike of the Villain (Lewcock, 2003: 139-141). What *Horrible Science* seems to do is conflate the two roles; admonishing the audience as part of making friends with them (Mallett would hit children over the head with a mallet, albeit a soft-toy one). As we saw in the discussion of 'health warnings', *Horrible Science* sometimes depicts children as scared, and as we shall see in chapter eight, children are often laughed at for being silly or ignorant. Moreover, a large part of *Horrible Science*'s 'we know what you kids like' pose is worked through declaring the assumption that children would rather be causing a mess, hurting people or reading about toilets than doing their homework. Although this idea of children as anarchic and naughty is celebrated in the books, the reference to it quite clearly reflects a traditional reprimanding of children. Thus, the Villainous Dame of *Horrible Science*'s narration fits the happily-horrible style of the books' positive-negativity. In some respects, through ironic pastiche, they laugh at the traditional didacticism of the ways in which adults traditionally address children. Yet, through the replication of pastiche, the narrative address retains a lot of implied power. It is worth reiterating that shoving audience members around is a way in which Mallett maintains control over the otherwise anarchic show. Similarly the narrative character of 'Nick', in his own ways, playfully admonishes his audience to keep them in their place.

We should note that for all that Nick the presenter made his presence known on stage in Kew, in some respects the character of the narrator is relatively absent from the books. We should acknowledge this because such gaps in the depiction of narrative character arguably have an equal rhetorical effect as 'generational drag'. It is implied that the 'straight text' of linking narration comes from that chap Nick Arnold we met in the author bios at the start of the book, but this preface page is the only place we actually see him (and then it is a cartoon sketch). At the end of *Painful Poisons* (2004) there is a picture of the author, but most of the face is obscured by a computer monitor (*Painful Poisons*, 2004: 143). At an early point in *Angry Animals* (2005) there is an interruption of an illustration from 'Nick' in form of an off-page, labelled speech bubble (*Angry Animals*, 2005: 14). This device is similar to the invisible power of a comic's 'ed'. Scott McCloud, in his analysis of comic art, suggests that the abstracted forms of comic-book illustration and language embody a sense of universal appeal; a photograph of a person refers to that single person, whereas a circle with two dots and a line could be just about anyone (McCloud, 1993: 31. See also Kress & van Leeuwen, 1996: 14). In Japanese cartooning it is common for artists to depict characters they want their audience to see as an Other (e.g. baddies) in detail in sharp contrast to the stylised images of the heroes

(McCloud, 1993: 43). Detail is alienating, and this, McCloud explains, is why he draws himself in a very simple style (the book is written as a comic strip with McCloud addressing his readers directly through speech bubbles). It means 'the messenger doesn't get in the way of the message', as McCloud puts it, he is 'just a little voice in your head'. Indeed, because the reader has filled in the gaps, 'I'm just a little piece of you' (McCloud, 1993: 37). Similarly, the ways in which 'Nick' is not in the audience's face as much as, for example, Timmy Mallett can be read as another way in which *Horrible Science* aims to connect itself with its audience. It is less the depersonalised all-seeing eye of a third-person narrator, but rather another way to suggest a sense of the reader's self in the telling of the narrative.

Narrating with an Audience

In many ways the 'straight text' sections of linking narration shown in fig 5.2 look similar to traditional depersonalised third-person narration, at least in terms of choice of typesetting (compared to the handwritten font *Horrible Science* sometimes employs). However, the rather conversational style of language means it does not sound like it. As Buckingham and Scanlon note of the *Horrible Histories,* a 'personal voice' is used extensively by the narrator, often addressing the reader directly as 'you' (Buckingham & Scanlon: 2003: 99-100). Similarly, as we can spot in the text of fig 5.2, *Horrible Science*'s linking text employs not only informal, but quite conversational, styles of language. The narrator is quite clearly talking to the reader as an individual, suggesting a sense of intimacy: 'if *your* doctor's Dr Grimgrave [...] Let's imagine *your* school' (*Deadly Diseases,* 2000: 44; emphasis added). There are contractions such as you'll or don't, as well as asides such as notes in parenthesis or 'Anyway, talking about medics' (*Deadly Diseases,* 2000: 44). In many ways this is a form of what Kress and van Leeuwen describe as representing a 'pseudosocial bond' with the audience (Kress & van Leeuwen, 1996: 26-7). As Kress and van Leeuwen argue, mediated communication may lose the 'immediate and actual reciprocity of face-to-face communication', but can still allude to it through cues to the direct address. A good example of this, which Kress and van Leeuwen reprint, is the image of Kitchener pointing out from the World War One recruitment poster, looking the audience directly in the eye as the banner reads 'Your Country Needs YOU'.

In *Horrible Science* there are also some explicit depictions of children, which could be taken as forms of implied readers. Buckingham and Scanlon note the

existence of sketches of children in the *Horrible Histories,* which they call a 'visual you' (Buckingham & Scanlon, 2003: 100. See also Scanlon, 2008). We saw such 'visual you' sketches in chapter four, shown scared in the introductions as they were about to start reading the content of the book. Buckingham and Scanlon cite Kress and van Leeuwen for this description of the 'visual you', but I think there is a distinction between the 'visual you' of the *Horribles* and the visual 'you' of the World War one poster. What Kress and van Leeuwen emphasise is the use of visual representations of narrators looking out at an implied audience (for a fuller description of the visual 'you', see Kress & van Leeuwen, 2006: 117-9). Both the 'visual you' and visual 'you' are used by *Horrible Science,* and Buckingham and Scanlon's note that the *Horribles* seem to enjoy showing representations of their readers is a salient one. Still, the difference between what they mean and what Kress and van Leeuwen describe is, I think, worth noting. The 'you' of the Kitchener poster is somebody situated outside of the text: the 'narratee'. Following McCloud's suggestion that detail potentially alienates in its lack of applicability, we might also argue that such direct address is more a matter of suggesting individual readers than sketches which rather aim to show the books are concerned with people 'like you'.

Crucially, the style of direct address not only suggests the narrator as a person on a stage (be it television or theatre) but implies an audience. In some ways both this, and the personal, conversational tone, reflect the dialogic style of presenting science so often used by 18th and 19th century children's publishing. Interestingly, the 'visual you' characters of *Horrible Science* are often depicted in conversation with scientists or their teachers, with cartoon speech bubbles presenting brief conversations (we shall see examples of these in chapters seven and eight). However, there is a key difference between an actual conversational event, where each participant has a hope of leading, predicting or pre-empting the other's speech, and one that is scripted by a single author. To put it another way, there is a difference between dialogue as an event and dialogue as a rhetorical structure. In a study of such dialogical approaches, Greg Myers suggests that although such a narrative pattern might seem 'a helpful corrective to the cult of scientific authority' in that it places the child as a questioner (Myers, 1989: 187), it is not a Platonic set-up where two opposing views are shown in relatively equitable debate. Rather, the characters represent either ignorance or knowledge and the hierarchical difference between the two is emphasised and emphasises that the children are the consumers, not the producers, of scientific knowledge (Myers, 1989: 198). Titles such as 'chemical catechism' or 'catechism of astronomy' give away how

much they are, in Myers's words, 'didactic dialogues' (Myers, 1989: 174). In the specific context of *Horrible Science*, although children are shown outsmarting teachers, as we shall see in chapter eight, they are generally shown as dumb in comparison with scientists. Moreover, the conversational tone of the narrator is largely one-way. 'Nick' talks to 'you' apparently personally, but there is no space for 'you' to respond. If narrative's emplotment is to be criticised for presenting ideology, the simple application of writing a dialogic structure is no easy escape. I am going to leave discussion of this issue here, however, as it will be picked up again in much more detail in chapter seven which, in exploring the quizzes and hands-on activities of *Horrible Science*, considers its largely pre-scripted allusions to audience participation.

More Dressing-Up: Fictional Narrators

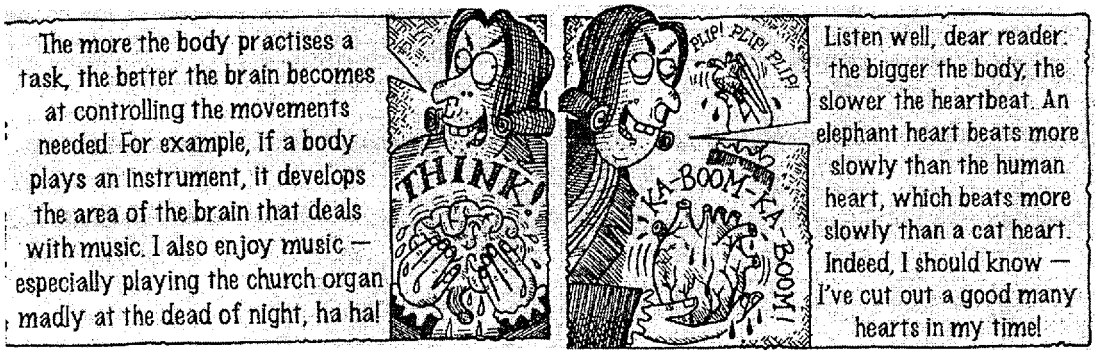


Fig. 5.3. Baron Frankenstein Explains (*Body Owner's Handbook*, 2002: 20)

Along with forms of generation drag (or hiding to allow you to fill in the gaps of a projected personality), the narration in *Horrible Science* will also occasionally take on the role of a fictional character. I will discuss the use of fictionalisation in more detail in chapter six, but at this point it is still worth reflecting on the ways in which fictionalised characters act not only as actors in short 'skits', but actually stand facing the audience, 'telling' the science. Fig 5.3 shows the way in which Baron Frankenstein's speech bubbles are used to present aspects of exposition. Such characters tend to relay facts, and are often identified by their professional status, although a finger-wagging self-taught Norbert Nerdworthy is also used (*Terrible Truth About Time*, 2002). As I will again discuss in the context of intertextuality in the next chapter, such characters come largely 'ready made', *Horrible Science* only needs to

sketch them to cue well-trodden cultural tropes.

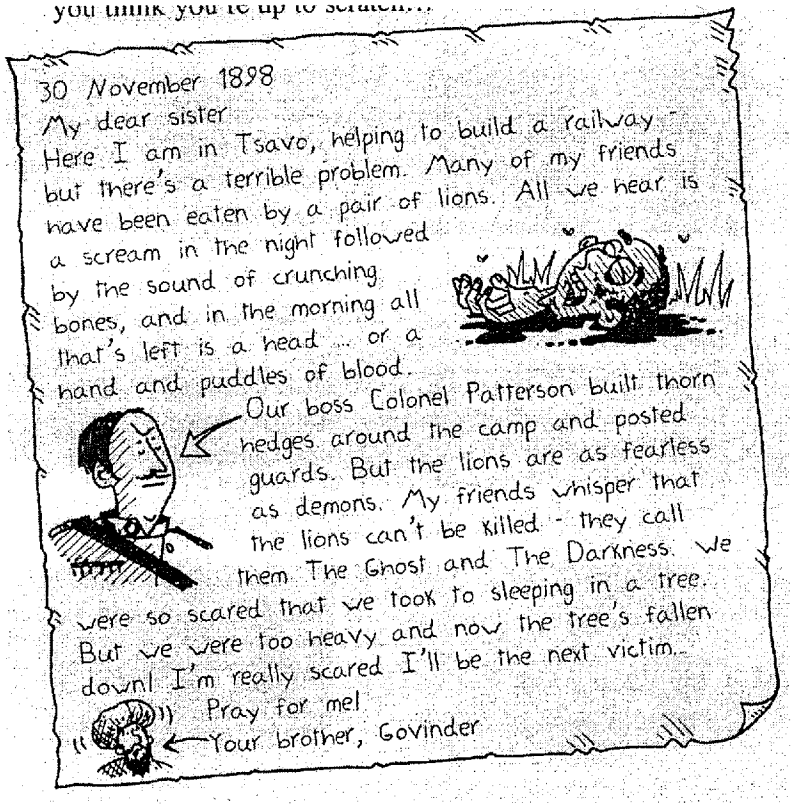


Fig. 5.4. Diary (*Angry Animals,* 2005*:* 100)

Returning to the *Wacaday* comparison, each episode also contained a location film, often a historical story in which Mallett dresses up to play all the major parts (Buckingham, 1995: 55). We could argue that this provides another form of *Wacaday* internal-branding; a sense of consistency is engendered as we continue to see Mallett's face across historical characters; a sense of singular narrative voice continues. Similarly, when the narrator of *Horrible Science* takes on the moniker of a fictional character, this is generally a loose disguise that is made quite obvious to the reader. For example, the character of Will D Beest, a take on a television naturalist in the Steve Irwin mould, is introduced thus:

> you won't catch *me* going near them [fierce animals] – so I've made up a character tough enough to tackle a touchy tiger with a touch of tummy-rumbles. Please put your hands together for top TV naturalist Will D Beast and his clever pet monkey, Mickey. (*Angry Animals,* 2005*:* 5)

To stick to the pantomime science metaphor, the narrator is here breaking through the 'fourth wall' of the stage to show off their mediated quality (c.f. Taylor, 2005). Thus, although we might think of fiction and 'dressing up' in characters as a form of constructing distance between the writer and what they are depicting, their connection is also made explicit and thus they enact a similar form of explicit internal branding as Timmy Mallett's face does for *Wacaday.* There is still a distance between 'Nick' and Will created. It is explicitly stated in the above quote. However, the construction of this distance is also made clear. Moreover, it alludes to a sense of collusion between narrator and audience, and this is one of the ways the Villain/Dame conflation of *Horrible Science* works: yes, I am admonishing you in the 'Villain' roles of scary scientist or nerdy geek, but at the same time I am inviting you into my space inside the acknowledgement of narrative conceit.

The Verisimilitudes of Multiple Narrators

Another form of narration can be found in the 'fabricated documents' the books are suffused with. Crucially, unlike *Eyewitness*, these documents are quite explicitly make-believe, but that does not mean they do not also present themselves with a sense of realism. The 'documents' are pastiches of primary historical sources, overtly demarcated as fictional but also suggesting a reasonably immediate sense of a witness account. Sometimes the voice will be a parody of a famous scientist, although it is more likely to be an imagined pet/niece/servant/friend acting as witness to them. When the historical moment is more events-based (e.g. an earthquake), rather than being about a discovery or person it is generally a child's perspective on events. In this approach *Horrible Science* follow the *Histories*, which uses fabricated documents to spoof self-important records of historical heroes (e.g. applying a sort of *Adrian Mole* style to a 'diary' of a famous King) and, via fiction, to present perspectives on history, such as children's or those of the working class, which have largely gone unwritten or have been destroyed.

It is important to note that none of these fabricated documents aim to exactly replicate original documents. They are clearly fictionalised, often comic and, on occasion, anachronistic. A recurring device throughout the *Horrible* books is to present a piece of pre-20th century history via a parody of sensationalised tabloid or entertainment magazine language. Yet, at the same time, some allusions to a sense

of the original historical artefact will equally be made apparent. Sometimes text appears in a handwriting font or over a background made up to look like aged paper. Often these documents suggest evidence that would not actually be available to contemporary historians; they tend to be paper-based (reflecting *Horrible Science*'s actual medium of the book) and are generally personal notes that would have been likely to have been hidden or destroyed (if they existed in the first place). Explanations of contemporary science will sometimes take the form of such documents, such as a 'strictly confidential' patient record to describe a disease (*Shocking Electricity*, 2000: 79). The diary shown in fig 5.4 is indicative of this; signalling forms of authenticity (e.g. aged nature of paper, first-person witness of handwritten font) all through and within the cartoon frame. It is not the photo-realism of *Eyewitness*, but forms of realism are still taking place.

From the same book as fig 5.4, a 'clipping' from a 1916 edition of 'Matawan News' tells the story of unexpected shark attacks (*Angry Animals*, 2005: 26-7). This is illustrated with cartoons representing a newspaper's photographs, with header and columns to evoke newspaper layout and even a reader's letter, which provides a form of witness report too. Notably, this is followed with some 'straight text' emphasising that the facts of these cartoon versions of clippings are true. There is also a newspaper for wolves, a 'Daily Dragon' problem page for komodo dragons (*Angry Animals*, 2005: 52-3), and 'Goodbye Magazine' (a celebrity magazine play on Hello!) provides an interview with 19th century explorer Charles Waterton (*Angry Animals*, 2005: 40-2). Indeed, the Goodbye Magazine example is followed by a note from the author saying the facts are true even if the character of the magazine interviewer was made up. There is a similar device alluding to television media with 'Dead brainy – the TV show where we interview dead scientists', where we see images of partially rotting corpses from the history of science talk about their discoveries and inventions (e.g. *Stars, Space & Slimy Aliens*, 2004: 84). As referred to in chapter three, another key genre of these documents is commercial ephemera as the recurring character of 'Honest Bob' appears to (comically) sell us a variety of used products, and to describe scientific or technological objects in the process: 'Honest Bob's plane products' (*Fearsome Fight for Flight*, 2004: 120-122), or 'Honest Bob's Used Planets' (*Stars, Space & Slimy Aliens*, 2004: 58, 86, 108). Bob even produces a children's science book within a children's science book with his 'kiddies book of snakes', a device for a comprehension-quiz as readers are invited to 'spot the porkies' of the character's inaccuracies (*Angry Animals*, 2005: 55-57. See also fig 8.4).

In discussing the relative 'open' and 'closed' nature of popular historical narratives for children, Buckingham and Scanlon note how the *Horrible Histories* present different points of view about one event. The particular *Horrible* book they look at, *The Rotten Romans,* shows an argument between a Roman and a Briton (Buckingham & Scanlon, 2003: 97). We can, on occasion, see similar multiple presentations in *Horrible Science*. For example a Bear's point of view is put up against a human's (*Angry Animals,* 2002: 93), or a set of mixed diaries of the same disease contrasting the perspectives of a rat, a flea, a human and a bacterium (*Deadly Diseases,* 2000: 223-5). However, it is significant that in these examples humans are juxtaposed with animals; the same device is much less likely to be used to show two scientists differing in opinion, and where differences of scientific opinion are shown they are generally historical. Moreover, there is epistemological capital to be made in the presentation of multiple points of view. Although the use of these fabricated documents might appear to subvert traditional claims of scientific realism, we can equally read them as a rhetorical device to give the appearance that the knowledge comes from a range of sources and viewpoints. They are a way of applying a form of relativism for realistic purposes, to suggest a multi-view is a more complete one. In this respect, *Horrible Science*'s scrapbook structure is reminiscent of a form of what Steve Shapin (1984) calls a 'literary technology' for replicating the experience of having viewed a scientific event first hand; a form of 'virtual witnessing'. Alison Winter applies Shapin's ideas to describe a scrapbook kept by a Victorian mesmerist which included letters, calling cards, advertising, publications, portraits, and both serious and satirical visual depictions of mesmeric events; as if breadth and quantity somehow reproduced a full picture (Winter, 1998: 157-8).

What makes the mesmerist's scrapbook such an interesting comparison with *Horrible Science* is that they both rely on a range of media sources (*Horribles* working to depict such media, the mesmerist simply collating them). I think this says something about *Horrible Science*'s sense of the use of media in finding knowledge. Bolter and Grusin's (1999) work on 'remediation', although largely rooted in digital culture, is a useful way of reflecting on this. They describe websites as 'riots' of media: text, graphics, video, comment functions, streaming 'in multiple panes and windows and joining then with numerous hyperlinks' (Bolter & Grusin, 1999: 6, 9). Such remediation is a form of hyper-reality, preoccupied with a double logic of 'immediacy' (the sense that mediation should disappear to leave the thing represented) and 'hypermediacy' (the replication, indeed showing off, of multiple

media forms). These may seem contradictory, but immediacy and hypermediacy not only coexist, but are mutually dependent. I find this a useful way of understanding pantomime science's self-referential style of drawing attention to its own constructed-ness, and I will return to remediation in the next chapter. For now it is worth emphasising that Bolter and Grusin suggest that hypermedia engenders its own form of verisimilitude via showing off its knowledge of the complexity of the world, a form of 'post-reductive' realism perhaps. In digital culture, hypermediacy often expresses itself through the multiplicity of windowed browsing (or, more recently, tabbed); where representation is not so much a window on to the world, as it is 'windowed' (Bolter & Grusin, 1999: 33). Similarly, *Horrible Science* is not so much narrated as it provides a cacophony of narrators.

Conclusion

As Arnold describes *Horrible Science*, 'the mix' is what makes the books special. This chapter has compared the narrative style of *Horrible Science* to a range of other media. However, no single *Horrible Science* book is best described by one or another of these media metaphors. Rather, *Horrible Science* alludes to a range of mediated forms, as the books draw on a loose sense of story hanging over an otherwise anarchic delivery of a range of very disparate content. Moreover, these media – be they magazine, stage-show, novel or scrapbook – are not just metaphors used to understand *Horrible Science*, but narrative styles that are explicitly alluded to, typographically or otherwise, in the makeup of the books; a form of 're-mediation'.

This mix of media references coupled with the allusion to documentary sources (even a kids' science book within a kids' science book), might prompt us to dub *Horrible Science* 'metatextual'. That is to suggest that *Horrible Science* self-consciously addresses the devices of textual communication, especially in respect to science, drawing attention to its own status as an artefact. However, I would argue than any metatextual work done by *Horrible Science* is largely at the level of allusion. Indeed, the documents provide an oddly postmodern pseudo-fictional reproduction of the power of empiricism and handling of primary sources. Moreover, they also allow the narrator to take on a different costume. These might be a fuller disguise than, for example, Will D Beast, which are more overtly games of dress up. The change of narrative form and narrative voice is part of what provides a sense of magazine-like, changing, perhaps anarchic structure. However, unlike most television, stage or

printed magazines, *Horrible Science* is not an especially collaboratively produced work. Under the skits presented by Will or Frankenstein is the role of the implied author, and because his role-taking is so explicit, a sense of consistency of narrative voice is engendered. However, the ways in which *Horrible Science* is, at once, both fictional and explicitly non-fictional (and also sometimes one by way of being the other) is a matter for the next chapter.

In my introduction to this chapter, I suggested that there were two opposing drives in *Horrible Science*: a chaotic one towards a magazine structure and an organisational one towards narrative plotting. I would like to finish by suggesting that neither drive necessarily wins. Rather, they work at the same time (though not necessarily together). The magazine-like aspects always seem to be subjected to some order; the order in turn is constantly interrupted, and thus unable to neaten up all the edges. The narratives of *Horrible Science* rarely have emplotted endings, and conversations are rhetorically produced (that is, they are didactic dialogues). Similarly, the style of narration also works a mix of two apparently contradictory forms of address. It takes on the characters of others, hides its actual face behind cartoons and a relatively depersonalised printed font and at the same time uses this font to relay highly conversational language and to address the audience directly, as if implicating itself as the readers' chum. Yet, it would be simplistic to just describe *Horrible Science* narration as contradictory. Rather, it is another way in which the brand performs itself as not one thing or another, but many.

Chapter 6
Fiction and Realism

Introduction

> I would be rather upset if someone put them [*Horrible Science* books] in a fiction section. Because it would be like saying Hamlet is a work of fact because it's about a real place. (Arnold, 2006b)

Horrible Science is quite clearly factual, yet it is also suffused with fiction. If anything, the more recent publications suggest *Horrible Science* is becoming more fictional, or at least more overtly so. They employ both implicit and explicit references to science fiction and horror texts. They also apply caricatures drawn from television, literature and film characters and personalities, and re-apply those already introduced in other books as a convenient ready-made framework on which to hang the loosely plotted components of the text. Humour, both textual and visual, and the use of cartoon imagery add to an already somewhat fantastical approach, as when characters are shrunk, via fictional devices, to climb up ladders of DNA, explore inside the human body or play with atomic particles. As we saw in the previous chapter, some *Horrible Science* books use a sense of story to provide a narrative arc for the books as a whole. And yet *Horrible Science* is largely a realistic text. As Ludmilla Jordanova describes science museums, they remain an 'engine of realism', even when powered by storytelling (Jordanova, 1993: 271). *Horrible Science* draws much of its aesthetic and practical appeal from a claim to communicate what is real about the world and the books therefore work hard to convince readers of their believability.

In chapter two, I mentioned some of the history of applying fiction to children's popular science; particularly Arabella Buckley's Victorian *Fairy-Land Science* and *Fairy-Land Through Magic Glasses* (see Gates 2003). Fiction in these books seemed to be used for three interlocking reasons: one, to attract their audiences with the promise of attractive characters and settings; two, by juxtaposing science with fiction,

to suggest the former was at least good as the latter, and perhaps better due to being 'really real'; and three, to apply fictional devices as a way of bypassing complex and lengthy scientific work which might require knowledge of special theory or inaccessible technical equipment. As we shall see, little has changed, and these three forms are also, on the whole, the ways that *Horrible Science* applies fiction. Every text has its own immediate historical context though, and aside from Buckley's fairy mania (compared to Arnold's predilection for *Hammer Horror*) we should remember that *Horrible Science* comes from the self-referential world of post/late-modernity and wears its fiction both overtly and ironically. In this respect, it is rather more 'pantomime' about its fairytale-telling than Buckley was, and as such it reflects the inconsistencies of Bolter and Grusin's (1999) 'double logic' of immediacy and hypermediacy in contemporary 'remediated' culture (as discussed in chapter five).

This chapter is split into three sections. The first provides some theoretical context, the next considers intertextuality, and the final section focuses on ways in which fictional devices can be used for explanation and engendering a sense of realism. Overall, I argue that fiction frames realism in *Horrible Science*, and as befitting panto-science, the frame is kept quite explicit. Fiction is used as a medium for the presentation of facts and is clearly signified as such. Moreover, fiction 'frames' as much as it emphasises the factual status, helping to produce effects of verisimilitude and acting as an 'other' from which *Horrible Science* can demarcate its truths.

Fiction and Reality in Science Communication

This section foreshadows the themes of the rest of the chapter with an exploration of some of the theoretical issues in combining science with fiction. I start with some brief notes on realism, in particular considering the special context of young audiences, before discussing the appeals of mixing fictional and non-fictional genres and finally looking at some of the problems for realism in science communication. It is worth taking time to discuss this issue at length theoretically since realism is such a key topic for my discussion of *Horrible Science*. I hope the issues discussed in this section not only help to provide some ways of thinking about *Horrible Science*'s treatment of fiction, but also tackle the (sometimes contrasting) ways a sense of reality is engendered through its style of narration (chapter five) and the instructions for a hands-on experience of science (chapter seven).

Distinguishing Realisms

Although this chapter tends to combine ideas of literary realism and scientific realism, they are distinctions worth keeping in mind. Literary realism tends to be about the production of a reality effect, and in literary cultures is often considered as occurring through detailed description of some individual action or perception (e.g. see Leham, 2005, Cobley, 2001). In contrast scientific realism is, broadly, more a question of attempts to find the truths hidden in nature and, in scientific cultures, is often claimed through the apparently universal applicability of theory (e.g. see Musgrave, 1985, van Fraassen, 1980). I combine these two ways of thinking about realism because many articulations of one tend to apply a degree of the other and, as we shall see, the realism of *Horrible Science* is predicated on both.

The way in which 'real' moments are framed within 'make-believe' texts is crucial; there is a world of difference between being taken in a spaceship by an eccentric teacher, falling into a dream (with or without rabbit hole), digging up a psammead at the end of the garden, walking through wardrobes, or using a magic knife to cut across worlds of a multiverse (c.f. Hunt: 1994: 185). Katherine Hume argues that rather than simply imagining the literary genre of fantasy as existing entirely outside of everyday life, fantasy always stems from a sense of reality: 'additive' fantasy worlds seem like our own, so we pass through into fantasy without noticing; 'contrastive' styles put fantasy and reality close together to allow comparison; and 'subtractive' approaches narrow the definitions of reality, leaving out large portions to emphasise one aspect of human experience (Hume, 1984: 83). Indeed, Hunt and Lenz go so far as to argue that 'realistic' literature could actually be seen as the most 'fantastic' of all; not because the events of such stories cannot or do not happen, but because they appear to make sense of things 'in a way that is unavailable in reality' (Hunt & Lenz, 2001: 10).

It is sometimes assumed that children are more likely to fall into the trap of confusing reality and fiction. Occasionally running alongside this is the idea that children should also be cushioned from the 'reality' of the world, protected within a coating of fairy stories; for example, Mediawatch's emphasis that 'the news is not children's programming' (Mediawatch, 2007: 7). However, I should stress that this is not the attitude taken by either Arnold or De Saulles. In interview, they both emphasised that they credited their young audiences with the ability to take cues and to sift fact from fiction.

David Buckingham's (1996) discussions with young people (aged 6-16) about factual and fiction television suggests that children are aware of degrees of realism, and eager to express an awareness of the processes of reconstruction and production of the real in television and film (with a keen knowledge of special effects and production methods). Buckingham works his questions through a nifty comparison: realist medical drama (*Casualty*); a factual crime programme that applies dramatic devices (*Crimewatch*); and a fake documentary on the supernatural which worked hard to replicate the cues to realism of conventional factual programming (*Ghostwatch*). He concludes that although children respond differently to factual and fictional material, they seemed to be very aware of the complexity of dividing one from the other and expressed quite intricate judgements based on degrees of realism. The children largely watched *Casualty* for pleasure rather than to find information, but a sense that it did not 'flinch from reality' and invited viewers to 'face up to the facts' was a key appeal. *Crimewatch* was defined as a factual programme and was seen as scarier because it was so real, yet its pleasure stemmed from appropriations of dramatic styles. Interestingly, although *Casualty* was seen as 'true to life', the children knew how programme makers made this realism (i.e. they had detailed knowledge of the processes of special effects). However, with *Crimewatch,* some said they forgot it was a reconstruction. In terms of *Ghostwatch*, the children noted the clever ways the programme had convinced them it was real, (e.g. a fake phone-in and that it lacked the slick realism of glossy Hollywood), presenting mistakes such as a dropped camera (Buckingham, 1996: 213-51).

Another point from Buckingham's study worth repeating is that children approached the factual and the fictional in rather different ways. Importantly, it was programmes explicitly packaged as drama where children sought entertainment; news provided something different and was about getting information (Buckingham, 1996: 198-9). In contrast to horror, the adult nature of news did not provide appeal to 'aspirational' young people and when talking about news, interviewees would emphasise that 'children don't like the same things that grown-ups do' (Buckingham, 1996: 180). This may be part of the reason why popular non-fiction such as the *Horribles* spend so much time emphasising the 'fun' of their books via allusions to entertainment media. It is not just due to the association of science or history with schoolwork (although that is arguably a large part of it) but also because of the status of information (compared to 'realism') in popular culture.

Telling Science Through Story

As I briefly discussed in chapter two, *Horrible Science* is far from unique in applying the styles and content generally associated with fiction to factual communication (c.f. the *Fairy-Land of Science, The Magic School Bus, Uncle Albert, Flatland*). Arguably, it is easier for a text for children to get away with such verisimilar liberties, but such fact-via-fiction approaches do appear in adult culture (though we might also argue it is a way of infantilising lay publics). Stannard's *Uncle Albert* books were inspired by George Gamow's (1965) *Mr Tompkins* stories. More recently, there are Robert Gilmore's (1994, 1996, 2001, 2003) science 'fables' or Stannard's (1999b) update of *Mr Tompkins*, as well as a range of theatre projects which see the dramatic stage as the perfect forum to attract the public to 'engagement' with science (see Shepherd-Barr, 2006). Aside from the book, and often aiming at an adult audience, there is also the increasingly prevalent genre of docudrama or at least the application of reproductions/re-enactments (sometimes via computer-generated imaging), in television and film documentary (see van Dijck, 2006, 2001, Ebbrecht, 2007, Darley, 2003).

Similarly, in science education we often find the rather vague suggestion that fiction makes learning fun (the 'sugar-coating' argument). Moreover, the juxtaposition of science with story can be applied to suggest that science provides all the benefits of story, with the added value of being 'really real'. Fictional devices can also be used as a sort of replacement for the processes which usually convince scientists of the reality of their ideas but are not readily available to a child reading in a classroom (e.g. experiment through highly complex techniques or equipment, maths, years of theoretical study). As Turney emphasises, we humans live in quite a 'medium size' world, only directly experiencing the range between a few millimetres and a couple of hundred meters. Scientific research, however, works to transcend these limitations, and considers speeds and sizes only brought within our reach via specialised equipment or sets of mathematically based models. What the more literary aspects of science writing can do is take the reader into 'realms beyond the normal human senses' (Turney, 2001a: 55). In many ways, these are analogous to the fictive '*CSI* shot' and its non-fiction twin, CGI animation in filmic documentary (see Tait, 2006), but they also have a history in the bookish communication of maths or theoretical physics (e.g. Gamow, *Flatland*). Fiction thus, perversely perhaps, offers a form of reality effect when, for whatever reason, science cannot. As José van Dijck puts it, animation sequences in documentaries are a way of rendering explanation

'visualizable' (van Dijck, 2006: 8). Or to put it another way, scientific realism is replaced by forms of literary realism.

What we might imagine to be the benefits of fact/fiction fusion largely depends on how we define 'story' and what agendas for science communication are being applied. For example, educationalist Joan Solomon (2002), a long-standing campaigner for STS-rooted science education, argues that science taught as stories provides a more 'human' side to knowledge; allowing students to use the human empathy she believes to be intrinsic to stories in considering both scientific discovery and the differing perspectives on science policy issues (see also Carter, 1993). We can see Solomon's ideas put into practice in a set of textbooks she produced (Solomon, 2000ab, 2001) and can trace similar ideas back to JB Conant's (1957) *Harvard Case Histories In Experimental Science.*

Indeed, an assumed ability of artists to consider, explore and interpret the more 'human' origins or consequences of science is often the argument made for the role of science literature in society (see, for example Haynes, 1994, Shepherd-Barr, 2006). The interpretations such literature provides are not just educational resources but, in places, have become iconic aspects of Western culture. As Turney (1998) concludes his study of the history of references to Frankenstein, we are never going to be rid of Mary Shelley's story, even if we want to be, as it continues to echo through all public discussions of sciences and scientists (Turney, 1998: 220). Fiction is not an 'add-on' to make science more digestible, but is a central part of the way science is understood, for scientists as much as their audiences (Mellor, 2003: 515. See also Mellor, 2007).

There is also an appeal to fact within fiction too. Historian of science fiction Gary Westfahl discusses the 'hard science fiction' movement that emerged in the 1950s. This, he argues, fetishised a connection to 'real' science to the extent that some works would further demarcate themselves as 'hardcore science fiction' (Westfahl, 1996: 24, 14). The term 'faction', stories which, like Stannard's or Gamow's, aimed to keep the ordinary man up to date with scientific developments, was coined in 1930 by Hugo Gernsback and thus emerged from fiction-publishing communities rather than scientist-led organisations (Westfahl, 1996: 7). Although Gernsback seemed to prefer faction to more fictional stories, Westfahl reports that it never really caught on. Yet, similar terms, which also aimed to distinguish texts through their relative association with scientific accuracy – 'scientific fiction',

'scientifiction', 'gadget story', 'scientific problem stories', 'Engineer's story', 'solid science fiction', ' straight science fiction' or 'real science fiction' – have been proposed throughout the 20th century (Westfahl, 1996: 5, 9, 11).

Science's Reality Problem

Still, it would be wrong to assume mixing science with fiction is easy work. Virtually any example we may find will exhibit at least slight insecurity in its mix of fact and fiction. Westfahl's listing of so many different terms for 'types' of scientifically-orientated fiction is indicative of this, as is Arnold's suggestion that he would be 'rather upset' if *Horrible Science* was placed alongside fiction. Gamow, wary of the moniker of 'science fiction', preferred to dub his *Mr Tomkins* stories 'scientifically fantastic' (Gamow, 1965, xi), and the dustjackets of the *Uncle Albert* books describe the stories as 'science adventures'.

Arguably, the anxiety on the part of science writers about being openly fictive comes down to concerns that fiction and other forms of 'make-believe' (even metaphor or narrative) somehow damage science's claims to the real. Baudouin Jurdant (1993) suggests that this contradiction is at the heart of all science writing. He argues that science has its status chiefly because it eschews all relationships with the fabricated qualities associated with the literary (Jurdant, 1993: 370). Robert Lambourne's (1999) criticism of the 'deliberate hokum' of some science fiction, which 'misleads' its audience into believing all sorts of fantastical ideas, is indicative of the anti-fiction attitude of much of the scientific community, as is the assumption that the 'public' will simply take fiction as factually applicable. David Kirby (2003b) notes that a desire to put the record 'straight' is a key driver in scientists agreeing to act as consultants for the fictional film industry (most do the work for free). Fiction is thus seen as dangerous to scientific claims to reality. Discussions over metaphor are some of the most illuminating in terms of showing the attitude towards even the smallest use of figurative language, let alone the introduction of characters or whole allegorical worlds. Metaphors can be a 'source of embarrassment' for many academic communities (de Man, 1978: 11) as they acknowledge imprecision in the description of technical matters. Interestingly, complaints about the potential menace of scientific metaphors on the public mind do not just come from within the scientific community (e.g. Nelkin & Lindee, 1995, on metaphors of genetics, and Condit's, 1999, response).

A particularly influential moment in the history of truth appears to have happened during the formation of the Royal Society in 17th Century Britain. As Steven Shapin describes, Robert Boyle and the experimentalists of the time offered up the notion of the fact as an item of knowledge that it was possible to be certain about and that could be validated by the witnessing of its demonstration. The key legacy of this is the idea that the more people can see something, the stronger its claim to truth:

> If that witness could be extended to many, and in principle to all men, then the result could be constituted as a matter of fact. In this way, the matter of fact was at once an epistemological and a social category. (Shapin, 1984: 484. See also Shapin & Schaffer, 1985)

Shapin suggests there were several types of witnessing, including the 'virtual witnessing' provided by published reports of experiments which could, potentially, extend the number of witnesses universally.[20] The gendered language in the above quote is worth noting. There was a tight boundary constructed over who counted as an acceptable witness. The public was 'very precisely defined and very rigorously policed' (Shapin, 1984: 508 & 496. See also Winter, 1998, and Haraway, 1997) and this sense of 'a social category' of truth is readily connected to both Gieryn's (e.g. 1999) idea of 'boundary work' and Bourdieu's (e.g. 1988) descriptions of the construction of 'cultural capital' within specific 'cultural fields' that I discussed in chapter one.

Virtual witnessing produces for the reader a mental image of an experimental scene well enough that they do not feel the need to actually directly witness it. As such, it is 'a technology of trust' and will apply a large range of culturally-specific modal cues to appear trustworthy to its audience (Shapin, 1984: 491). This included a rather 'naked' writing style which aimed to display a sense of 'humility' to portray the author as a disinterested observer and very detailed diagrams to suggest that nothing was hidden from the witness (Shapin, 1984: 497). In particular, these accounts constructed a distinction between 'artefact' (man-made) and fact (the very mirror of nature). Boyle et al aimed to shift the apparent agency of phenomena to nature as grounds for universal assent, since to identify the role of human agency in the making of an item of knowledge is to suggest we could produce it another way

[20] See also Kirby, 2003a, for application of virtual witnessing to contemporary fiction film making.

(Shapin, 1984: 507-8).

One of the central conclusions of Shapin and Schaffer's analysis is that declaring something as 'real' is a highly political act. Indeed, Latour suggests it is time we abandon the notion that explanation is 'somehow good for the health and better than just story-telling' (Latour, 1988: 157). Following the idea of science communication as a 'literary technology' for a virtual witness experience, it is easy to connect issues about the reality of science to more 'literary' ideas about realism. In recent years several scholars have noted the ways in which literary and/or fictive devices are employed by scientists to rhetorically construct cultural authority, when talking both within and outside the scientific community (e.g. Leane, 2007, Mellor, 2007, Beer, 2000, van Dijck, 1998, Doyle 1994, Myers, 1990). The key point is less that scientific realism can be replaced by forms of literary realism, but that it was always so.

Intertextuality

Horrible Science is highly intertextual. We have already encountered this in discussion of the books' use of fictional characters as narrators and their allusions to collections of historical documents (chapter five), the construction of 'Horrible' produced by allusion to the horror genre (chapter four) and references to consumer culture (chapter three). As we have seen, these references to outside texts have been largely explicit, often knowing. Allusions to Baron Frankenstein are played for a laugh, as is the use of sensationalised and apparently 'formulaic' language. When accounts of historical witness are presented, it is generally through a comic and/or fictional frame, sometimes an overtly anachronistically one. These are exercises in high camp and *Horrible Science* most clearly in pantomime mode, taking extreme characterisations of already relatively extreme tropes. Intertextuality seems to be a guilty pleasure for *Horrible Science.*

In this section I continue to explore the ways in which *Horrible Science* connects and situates its relationships with other texts. My focus here is on references to fiction, but as I develop an understanding of their intertextuality in general I will also discuss references to real people (and the semi-fictionalised accounts of the fabricated historical documents). I start with some general discussion of intertextuality and the particular, sociological approach I wish to take to intertextual

analysis. I then discuss the ways in which the books simultaneously 'other' and connect themselves to fiction, before finally considering the self-referential and parodic frame that much of *Horrible Science*'s intertextuality is enacted through.

The Politics of Referencing

The term 'intertextuality' largely stems from a 1960s re-reading of Bakhtin by Kristeva and study of the subject has been adopted widely across cultural and literary studies, largely influenced by semiotics (i.e. the study of signs and their interpretation). As Cancalon and Spacagna describe, an awareness of intertextuality suggests texts as 'a galaxy of signifiers [...] an open, dynamic playground where the endless process of signification takes place' (Cancalon & Spacagna, 1994: 1). Intertextuality is often considered in the context of fiction, but virtually all discourse can be considered in this way. It is, however, easy to get carried away with the applicability of intertextuality and rather lost in those 'playgrounds of endless signification'. As Graham Allen introduces the subject, intertextuality is one of those words 'underdetermined in meaning and overdetermined in figuration' (Allen, 2000: 2). Thus, rather than simply tracking the intertextuality of *Horrible Science* as an exercise in noting the nature of texts as 'galaxies', I want to focus on the politics of referencing other works.

Intertextuality is an inherently social process, making connections not just between writer and audience, but a set of others. When intertextuality is presented explicitly, it allows the symbolic declaration of location in, amongst, or opposed to a range of cultural fields. Norman Fairclough emphasises this in his analysis of the quite everyday intertextual experience of surrounding text in quote marks to symbolise 'an outside voice'. They might show a term as new and tentative; they can provide protective distance from something assumed to be distasteful; or they might find an anchor of authority in quoting another source (Fairclough, 1992: 119-20). But they all imply some distance (and relationship across the distance) between the narrator of the main text and that which is 'placed in the marks'.

To explore intertextuality as an anchor of authority in a bit more detail, Latour (1987) shows us this in action within the scientific community with an image of a scientific paper as a heavily linked network, full of citations showing off its social power, up against an un-networked individual (Latour: 1987, 38). Mellor (2003)

considers the intertextuality of popular science books though Bruce Lewenstein's (1995) 'web model' for understanding the multi-actor and multi-media movement of ideas about science. In contrast to a Latourian network, Lewenstein's model, rooted in a study of the Cold Fusion case, suggested that the inclusion of media actors destabilised its claims to authority (e.g. the news was reported in the press before it was published in journals). Yet Mellor argues that the intertextual surrounds of many popular science books have a 'stabilising' effect on the science (Mellor, 2003: 517-518).

The extended networking of intertextuality works not just between the writer and various authority figures; a sense of connection can also be suggested between the writer and their audience, through reference to cultural experiences they share. As Ted Cohen (1978) discusses in reference to metaphor (which similarly relies upon a mutually understood referent) it is a way of engendering 'intimacy' between reader and writer, as the meaning of a reference is 'inaccessible to all but those who share information about one another's knowledge, beliefs, intentions and attitudes' (Cohen, 1978: 7). Taylor argues that the intertextuality in pantomime is largely a matter of constructing a sense of shared space between the actors and audience, with the power of a sense of community underlined because the audience feel empowered by the sense that their cultural referents are valuable to be articulated on stage (Taylor, 2007: 136, 142). Indeed, we could track the intertextual construction of generational drag. Arguably, the intertextuality of *Horrible Science* acts in both ways, connecting itself to the authoritative value of both shared space and that which exists externally. However, that their intertextuality does both is indicative of the way *Horrible Science* emphasises its connections both to esoteric expertise and to the everyday voices of schoolchildren in a playground (c.f. Fairclough on the intertextual ethos of medical professionals, 1992: 166).

The processes of using references to shared culture are arguably different in adult-to-adult communication and the generational cultural clashes of children's media. Indeed, Stephens and McCallum (1998) argue that literature for children, compared to literature in general, has always contained a large proportion of retold stories. Stephens argues then that intertextuality in children's media is largely a matter of acculturating the audience. Under the guise of offering children access to new and exciting worlds, the intertextuality of children's books serve to initiate children into a specific cultural heritage (see also Stephens, 1992: 84-6). Ross Chambers makes similar points with respect to adult texts, concluding that most

audiences are willing to be 'complicitous' in congratulating a writer's intetextual reference even when we do not understand in-jokes: 'we play our role by being excluded from them' (Chambers, 1990: 158). Intertextuality seen in this light is a way of constructing a sense of distance between the writer and the audience, perhaps even leading the reader to outside texts. By Stephens's reading, the intertextuality of children's literature is less a matter of stabilising its content, and more a matter of making the referent more stable through assimilating it as something worth referencing. It is a compilation 'for further reading' rather than a list of sources.

We could read *Horrible Science*'s intertextuality through Stephens's view. The references to historical and scientific texts are clearly pointing, if not towards specific lists for 'further reading', at least further study. However, it is arguably inappropriate to apply Stephen's sense of insidious acculturation to the open didacticism of non-fiction literature. When it comes to *Horrible Science*'s fictional references, many are more familiar to the writer and illustrator than to their audience. Honest Bob seems rooted in 1980s British sitcom, and the *Bash Street Kids*-style characterisation of teachers may still be in existence today but dates from the 1950s. It is worth noting the lack of references to digital culture in *Horrible Science*. Still, I do not think we should read this as *Horrible Science* acculturating today's youth to '80s TV. Moreover, Stephens's analysis does not really address the intertextual processes of 'generational drag'. *Horrible Science* cannot simply tell its readers that the texts it references are worth reading, because its own authority (both scientific and in terms of being 'down with the kids') is too unstable. Yet, arguably, the Saturday-morning TV-magazine style of being 'down with the kids' is perhaps somewhat out of date for today's 7-11 year olds, and thus could be considered as outmoded as Honest Bob. *Horrible Science* seems to combine a failure to match the cultural references of its young readers with a mix of what Mellor or Latour read in adults' scientific texts (i.e. referencing to collect epistemic capital) and what Stephens sees in children's literature (referencing didactically).

Intertextual References to 'Other' Fiction

When it comes to intertextual references to fiction, *Horrible Science* seems to display a rather mixed attitude to the referent; one that both celebrates and eschews the apparent characteristics of fictional communication. This reflects what Mellor (2003) sees in adult-orientated, less explicitly fictional popular science books. As Mellor

notes, the growing sub-genre of popular science, 'science-of' books, provides a fascinating example of some of the ambiguities of fact and fiction boundaries at work. The field of science-of is reasonably diverse, both in subject matter and attitude to what a scientific rendering of fiction might mean: *The Science Of Christmas,* or *Harry Potter* (Highfield, 1998, 2002), *Superheroes, Anime* (Gresh & Weinberg, 2005), *Discworld* (Pratchett et al, 1999) or *His Dark Materials* (Gribbin & Gribbin, 2005), *The Computers of Star Trek* (Gresh & Weinberg, 2001), or *The Truth Behind the Series of Unfortunate Events* (Gresh, 2003). Like *Horrible Science,* science-of books all tend to utilise references to the characters and plotlines of fictional narratives well known to their audience as a starting point for more traditional, non-fictional exposition. We might compare them to the Victorian tradition of working scientific explanation around a study of a single everyday object (e.g. see Gregory & Miller on Faraday's candle, 1998: 133-139).

Interestingly, science-of books tend to deal with branded fictions or series and, although aimed at adults or teenagers, will reference stories from children's media (or at least genres typically associated with children). Fiction in such texts is generally something explicitly external, created by another writer. Accompanying this externality is the suggestion that the fiction is in some way inferior; that the injection of scientific commentary provides a greater layer of authenticity, just as Faraday transformed the mundane candle. As Mellor describes, the fiction in such books is largely set up as 'the other' from which science's superiority is declared (Mellor, 2003: 525). Yet, at the same time, science-of books require their fictive others. They are, after all, reliant on the fictional books they base themselves upon and often require a fan's knowledge of the stories.

Horrible Science's more direct references to science fiction books and films generally suggest stories as 'fun', but are somewhat dismissive about this. For example, in *Frightening Light* (1999), a shortened version of Wells's *Invisible Man* is followed with the statement that it is 'only a story' (*Frightening Light*, 1999: 112-113). This is a common tag. It obviously acts to mark some distinction between the fiction and *Horrible Science*'s explanatory content and thus can be taken as a reasonably straightforward form of 'boundary work'. One book starts with a retelling of *The War of the Worlds*, concluding with the note: 'Cool story?!' (*Deadly Diseases*, 2000: 155). We could see such a celebration of a story as 'cool' in contrast to *The Invisible Man* being 'only' one. However, the 'cool story' tag still has dismissive power in the use of the word 'story', especially in the explicitly non-fictional setting of *Horrible Science*.

The 'cool' denotes fun and entertainment, which clearly *Horrible Science* wants to associate itself with, but at the same time would also like to suggest itself as embodying 'more' than.

Another form of storied-other comes in the form of non-scientific descriptions about the universe, such as those told by ancient civilisations, which are also largely painted as 'a story'. For example, *The Terrible Truth About Time* (2002) starts with a two-page comic strip based around the Greek God Kronos and the birth of his son, Zeus. That it is treated as a comic strip should not in itself be taken as simply presenting the narrative's fabricated nature (as we shall see later, scientific ideas that we asked to take credulously are similarly depicted). More important is the specific description of it as a story in the section of text that follows the cartoon:

> Today we know that these stories were as sensible as trying to teach opera to a tom cat – but they do show how people tried to make sense of time. Scientists, of course, have taken a more scientific approach. *(The Terrible Truth About Time*, 2002: 12)

As the quote above shows, such 'stories' tend to be framed as sensible for the time, yet ridiculous now ('trying to teach opera to a tom cat' as opposed to 'a more scientific approach'). These are clearly different from references to Wells because they constitute beliefs that have been (and are) taken as truth; they are not narratives made up for a fictional book market. *Horrible Science* reflects that distinction, noting that this was 'how people tried to make sense', but still applies the term story in a way that both dents their claim to truth, and suggests a definition of story as something constructed by people rather than taken from nature.

Allied to this dismissal of stories is a sense that the 'horrible' take on nature the books promise to provide exists in contrast to the more censored 'soft' versions in make-believe. It is a way of distancing the horrible approach from the childishness (and arguably, girlishness) of fairytale:

> [the monsters of this book] make made-up monsters in stories appear lovable and fluffy. And make no mistake – the monsters in this book are as REAL as you are! At this very second they're strolling on your skin and snuggling into your bed and scoffing your sandwiches and splashing about in your toilet! (*Microscopic Monsters*, 2001: 8)

The word story, or at least an explicit sense of make-believe, is sometimes employed as part of the introductory 'health warnings' about the books, goading the readers to prove a form of playful courage in their ability to take the 'truth'. This is often performed in a very comical manner though, laughing at the readers' (and even narrator's) desire to hide behind the comfort of a story, as in the explicit construction of the character of Will D Beest in *Angry Animals* (2005) because 'you won't catch *me* [the narrator]' going near fierce animals (*Angry Animals,* 2005*:* 5). Similarly, at the start of another book where the narrator is listing its 'horrible' credentials: 'don't panic it's only a story' (*Bulging Brains*, 1999: 9).

Writers of stories are not the only people laughingly dismissed; so are those 'nitpickers' who like to spoil the fun by pointing out its inaccuracies. For example, expert Norbert Nerdworthy interrupts a story with a wagging finger to let us know it is all wrong and made-up (*Terrible Truth About Time*, 2002: 134). Similar fingers are wagged in *Space, Stars and Slimy Aliens*, but, as the following quote shows, the *Horrible Science* books aim to take their readers further than either telling a story or dismissing it, to suggest a combinational mid-point where science presents the best of both worlds:

> Space movies are great, aren't they? Don't you just love the speeding spacecraft, perishing planets and slimy slobbering aliens. And isn't it a pity when some tedious teacher says, "Oh, but it's all made-up"? But what they don't tell you is that real-life outer space is even more scary than the scariest space movie (*Stars, Space & Slimy Aliens*, 2004: 5).

This introduction continues to emphasise that although aliens may be all made up, 'the rest is really real' (*Space, Stars & Slimy Aliens*, 2004: 7). Thus we see *Horrible Science* celebrating the advantages of fiction and other stories that, at least to modern (western) science, are considered inaccurate, but then moving on to argue that science can beat make-believe at its own game, providing the excitement of space movies *and more*. This can be seen as an example of the 'cartography' of science (Gieryn, 1999), but enacted as a declaration of both shared and distinct space. As such, it is not simply a matter of 'having your myth and relativizing it'; putting the two together has a rhetorical power of its own which is greater than the sum of the parts.

Framing Fiction Through Ridicule and Parody

Although intertextuality has long been a part of children's culture, as Buckingham describes, there is something new about the postmodern 'raiding' of existing cultural resources 'in a fragmentary and often apparently parodic manner' (Buckingham, 2000a: 89). This fragmentary and parodic style perhaps describes *Horrible Science*'s take on cultural referencing. It is part of how the ambivalent attitude to story is managed, as it applies a rather postmodern ironic pose to suggest a love of story alongside an awareness of its problems. Indeed, Allen suggests that contemporary intertextuality is inherently ironic, as post/late modern culture seeks to enjoy the past 'non-innocently', not just towards the fiction it 'raids' but also towards itself (Allen, 2000: 195; see also Eco, 1985).

One of the ways *Horrible Science* applies parody is to draw attention to its fictional qualities. It is a reasonably straightforward way of signalling boundaries between the real and unreal in the books. For example, the character of Baron Frankenstein is not a straight sampling of Mary Shelley's monster, but one with 'mad eyes', dripping blood with a rather 'cuddly' and child-like monster (who himself has mad eyes and dripping blood, as is the domestic horrible aesthetic of the books). As discussed in chapter four, this is Frankenstein in the vein of late 20th century camp retellings, with a focus on gore and shocking horror, rather than the understated early films or the Mary Shelley original. Being part of the trope of Frankenstein rather than a specific text involves its own odd set of further intertextual connections; Baron Frankenstein is constructed through a mix of references across horror and science fiction. What is striking is not just that this extends intertextual references quite broadly, but that the books seem aware of the slightly ridiculous and playful nature of it. It is as if *Horrible Science* is saying that the inherent fictional baggage we carry in thinking about science is ridiculous; let's enjoy it and note it for its ridiculousness so we can get on with more realistic work later. The uses of alien characters are also illuminating, especially considering aliens' unstable status as not just fiction, but 'pseudo science'. As we can see in fig 6.1, these characters are all tentacles, drool and odd names, owing more to *The Simpsons* than to Roswell-inspired imagery suggesting itself as fact. This is not a finger-wagging form of boundary work, but it is no less dismissive of cryptozoology.

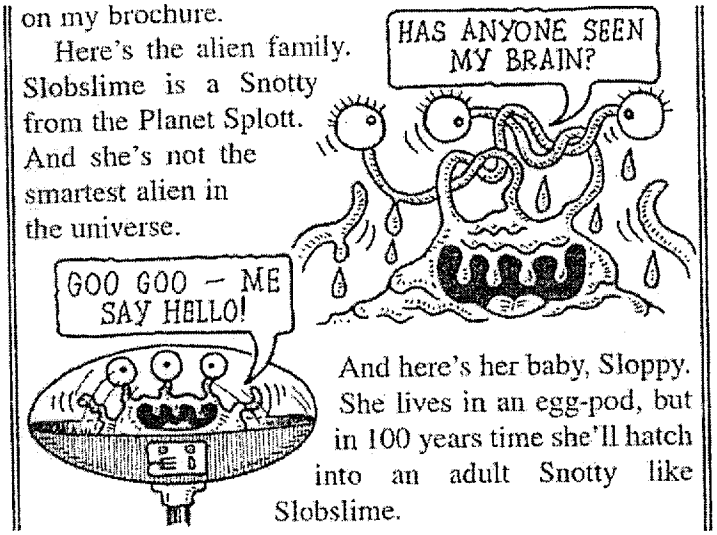


Fig. 6.1. Aliens of *Horrible Science* (*Space, Stars & Slimy Aliens,* 2003: 18)

However, as we saw in chapter five, many of these characters are used to narrate *Horrible Science*. By rendering its narrators in such extreme forms, we might argue that *Horrible Science* is emphasising its own constructed nature. This is one of the key places where the pantomime metaphor is of use. As Taylor emphasises, pantomime's comic treatment of its own use of fictional stories is indicative of the form's desire to show off the 'fourth wall' of theatre. For example, one of the key intertextual aspects of pantomime is its casting of actors whose other roles or personal lives are well-known to the audience, thus emphasising that they are only playacting (Taylor, 2007: 138). Pantomimes will also make jokes about scripts or props going wrong, the need for rehearsals or shifting scenery (Taylor, 2005: 335-337). However, whereas Taylor's analysis largely sticks to the entertainment value of such frame-breaking, in panto-science I think we can see it as a rhetorical form for building a sense of authority. In chapter five, I introduced Bolter and Grusin's (1999) double logic of 'immediacy' (direct, unmediated experience of the world) and 'hypermediacy' (the replication, indeed showing off, of multiple mediation). We can connect this to Shapin's (1984) reading of Boyle's 'technologies of trust' to provide audiences with a virtual witness experience of natural phenomena. Whereas Shapin noted that Boyle's use of detailed illustration and rather heavy-handed use of language served to suggest the frame of mediation was not in existence, *Horrible Science* by contrast uses its high-camp application of fiction to appear to break through the frame. Bernadette Flynn sees a similar effect at work in contemporary reality television. She argues that such programmes construct realism with a nod to postmodernist critiques by combining 'fly on the wall' effects with those that explicitly

acknowledge the more constructed nature of documentary; they rhetorically 'splice' neutrality with subjectivity (Flynn, 2005: 130-1). Just as Gauntlett (1996) reads in apparently critical environmentalist media in the early 1990s, *Horrible Science*'s parodic approach to fiction can be seen, at least partly, as a 'non-innocent' nod to the greater sophistication and cynicism the books assume in their audiences.

Picturing Reality

The cartoons of *Horrible Science* are not the dispassionate diagrams of textbook illustrations. To follow Shapin's study of Boyle, they are in many ways 'artefactual' rather than factual, with overtly make-believe surrounds. Yet, at the same time, the more explanatory images appear to sample scientific illustration and as such appear very realistic in their own way (c.f. Kress & van Leeuwen, 2006, on Newton: 173-4). As we see in figs 6.2-6.6, textbook conventions of the cut-away or cross-section, labelling and abstraction coexist reasonably comfortably within more comic-book approaches which add to the sense of 'artefactuality' with extreme characters and visual metaphors, yet at the same time still retain a claim to realistic communication. This section explores this comic/textbook style by connecting ideas about the use of abstraction previously discussed in chapter five (e.g. McCloud, 1993, Kress & van Leeuwen, 1996/2006) with Hume's (1984) emphasis on the role of reality in fantasy fiction, and Shapin's (1984) 'literary technologies' for the virtual witnessing of science. I start with some discussion of the relative 'reality effects' of detailed images compared to simplified images, before reflecting on the specific context of comic-art inspired styles of illustration and finally discussing the ways in which fantastical devices can be used, in writing, to provide readers with a sort of eyewitness-by-proxy view of scientific worlds.

Detail vs. Simplicity

As Shapin describes, Boyle's illustrations were extremely detailed. Similarly, his language was somewhat verbose, employing a rather ornate sentence-structure with appositive clauses piled on top of each other, as if quantity was the route to verisimilitude (Shapin, 1984: 495). Boyle devoted great attention to the manufacture of the engravings of images. These were to be mimetic devices, aiming to provide a vivid impression of the experimental scene that 'allayed distrust and facilitated virtual

witnessing' (Shapin, 1984: 492). A good contemporary example of the sort of realistic aesthetic applied by Boyle are DK's *Eyewitness* guides, which in many ways appear to be at the opposite end of the fictional/realistic spectrum from *Horrible Science*. Focused around a set of generally photographic images, the books prefer to stick with the anonymity of a brand rather than specify authors and are often cross-branded with a museum. Yet, it would be naïve to assume that *Eyewitness* provides some form of direct witness experience. These books are heavily mediated; they just try not to look it. These paradoxes are as applicable to *Horrible Science* as they are to *Eyewitness*; the two brands may sit at opposite ends of a spectrum, but it is the same spectrum, and in some respects they are simply different responses to the same issue.

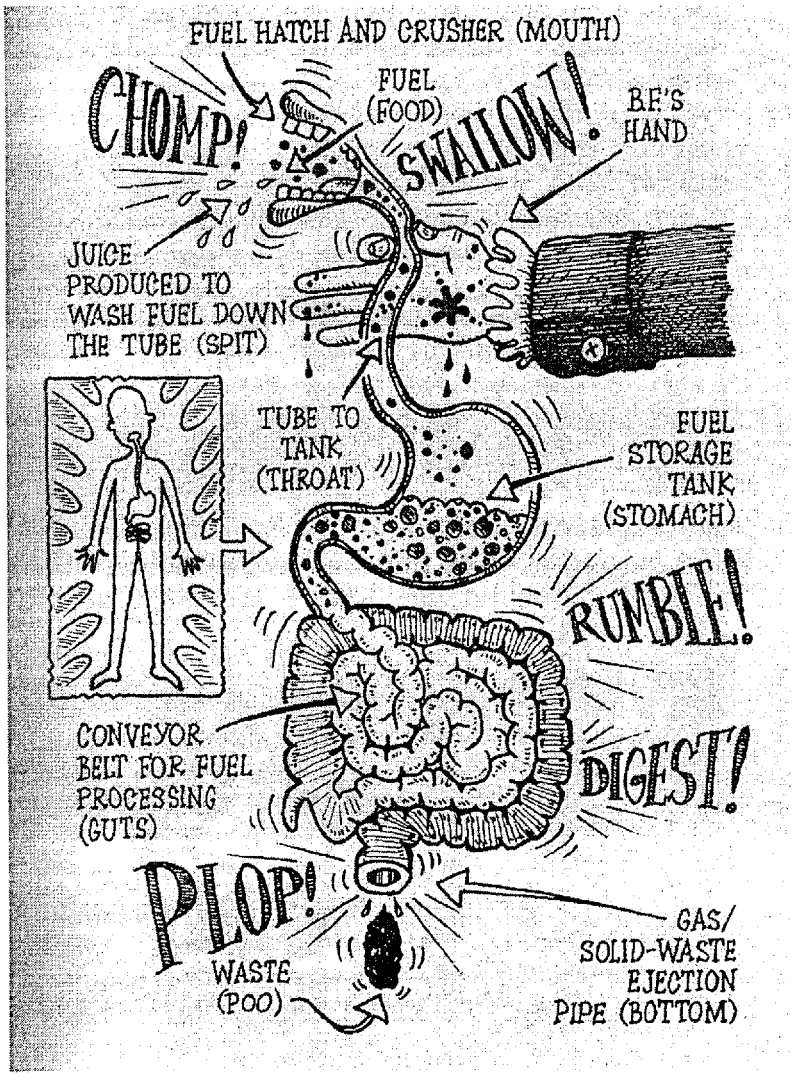
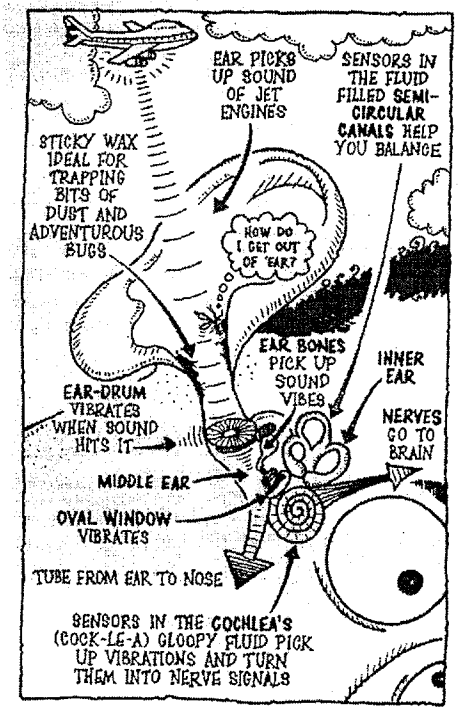


Fig. 6.2. Comic/ textbook fusion (*The BodyOwner's Handbook*, 2002: 23)

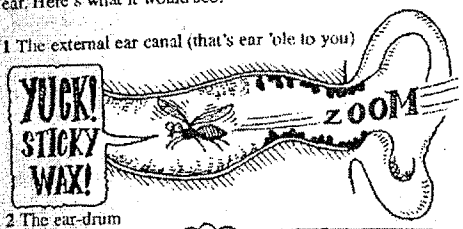
How sounds get into your head



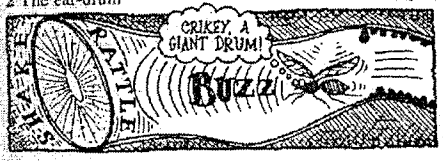
And here's the ear in action...

Imagine a wandering ugly bug, say a fly, sneaked into the ear. Here's what it would see.

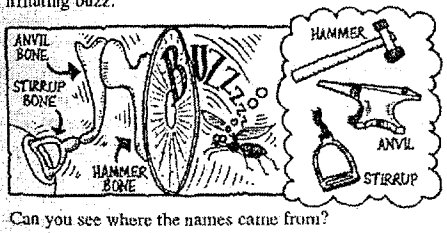
1 The external ear canal (that's ear 'ole to you)



2 The ear-drum

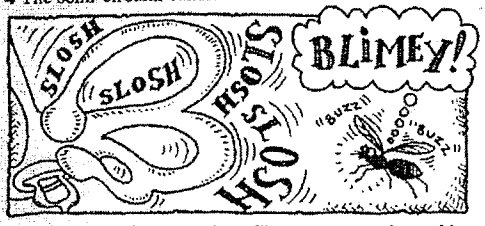


3 Meanwhile, in the middle ear the ear bones are doing their castanets impression by passing on the fly's irritating buzz.



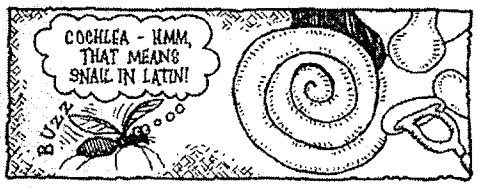
Can you see where the names came from?

4 The semi-circular canals



Scientists use the word "canal" to mean any long thin space in the body.

5 Cochlea



That fly's a genius. That's where the name comes from.

6 And the nerves are buzzing with sound messages for the brain.

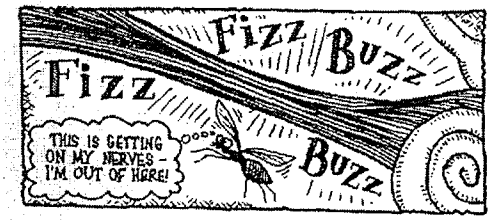


Fig. 6.3. Fly's Eye View (*Sounds Dreadful*, 1998: 22-4)

In chapter five, I referred to comic artist Scott McCloud's contention that the abstracted forms of cartoon illustration and language embody a sense of universal appeal (McCloud, 1993: 31). Kress and van Leeuwen also suggest, from a reading of children's picture books, that abstracted images allow more discussion around them, inviting their audiences to find their own specific examples, whereas an 'ostensibly less processed, more realistic' style of detailed illustration provides the specific, prescribed ways of reading the image (Kress & van Leeuwen, 2006: 28. 1996: 14). To McCloud, cartoon styles are 'simplified reality'; we are not eliminating details as much as focusing on specific ones (McCloud, 1993: 30). The mid-20th century Isotype movement, highly influential in children's non-fiction book illustration, aimed to simplify visual information down to only the most necessary lines, colours and shapes (Gillieson, 2008a). Isotype makes a particularly interesting comparison with Boyle's use of detail, as the project was spearheaded by Otto Neurath, a logical positivist whose epistemology was, quite explicitly, focused more on the ability to reduce scientific ideas to logically-based, universally applicable rules rather than Boyle's more empirical sense-data. Still, as Shapin is keen to emphasise, it would have been impossible for Boyle to refer to all contingencies and complexities; his accounts, too, are 'stylised' information in their own way (Shapin, 1984: 495).

In some respects, *Horrible Science* sits somewhere between *Eyewitness* and the Isotype books, as they abstract scientific information down to the centrally important parts, but then re-humanise it with details such as faces, dripping bodily fluid or handwritten text which provide forms of sound effects. In fig 6.2, the image is focused on the key objects of the digestive system, with only occasional references to details such as bodily fluids. This diagram, like much anatomical illustration, works not just by taking away references to a specific body, but by removing many of the objects of any body. It makes fun of this abstraction process – 'conveyor belt for fuel processing (guts)' – but it nonetheless applies it. A feature that such abstractions can convey, which single still photographs cannot, is a sense of change over time (see Carrier, 2001, Eisner, 1985). This is especially useful for mechanical scientific explanations that have a temporal dimension and provides the *Horrible Science* books with a sense of movement and three-dimensional space even on the printed page. In fig 6.2, the sense of the processes of digestion is underlined by a simple implication of up-to-down organisation, emphasised by arrows. I should also underline that a cartoon rendering does not necessarily imply either simplification or traceable movement through time, as we can see in the relatively complex chaos of fig 6.4, (not by Tony De Saulles); these are just some of the representational devices

available to cartoon-based illustration. There is a range of techniques and cultural connotations that cartoon-imagery makes available to *Horrible Science*; the next section will discuss this specific genre of the abstracted image in slightly more detail.

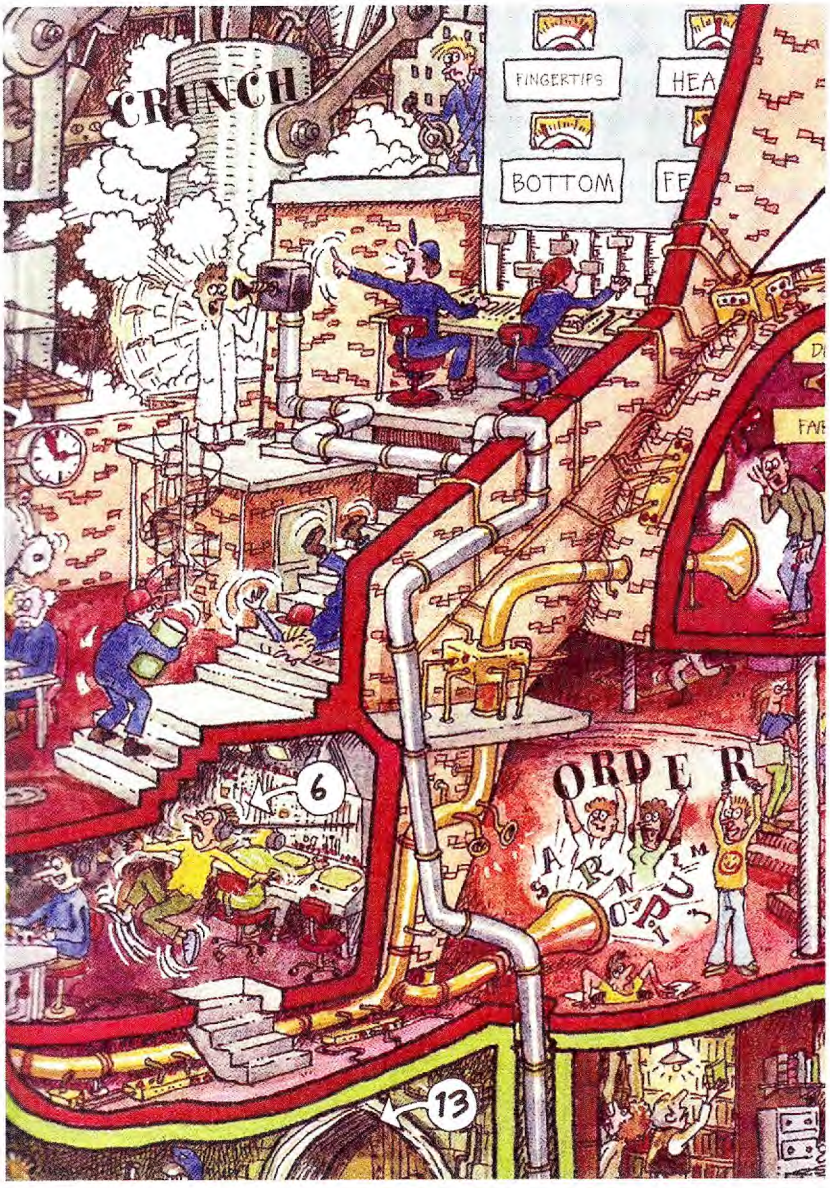


Fig. 6.4. Inside the Human Mind (*2008 Horrible Science Annual,* 2007: 7)

Comic-Book Science

The cultural capital of comic art varies from country to country and may, even within a single national culture, equally be critiqued for supporting the status quo, sub-cultures or revolutionary politics (MacAllister et al: 2001, 4, 6-7. Also Barker, 1989,

1984). Comic-book style information communication was not invented with the *Horribles*. Will Eisner (1985), a specialist in educational cartooning, shows several examples of mid-20th century US Department of Defence cartoons (Eisner, 1985: 142-3. Note also the *Introducing* books, e.g. McEvoy & Zarate, 1996).

Eisner distinguishes between 'technical' information cartoons, which aim to teach audiences how to do something or how something works and use speech or thought balloons, frames and simplified images to do so, and 'attitudinal' ones, which are more about how to approach something and apply characters and a sense of drama, utilising the 'exaggeration' of comic styles (Eisner, 1985: 142-145). *Horrible Science*'s visuals are a particularly good example of the use of thought bubbles and sound effects for 'technical' purposes. For example, in fig 6.2, the 'Plop' and 'Chomp' provide a form of 'sound effect' which not only provides an allusion to familiar bodily movements relevant to the explanatory purpose of the image, but also helps distinguish between specific points in the diagram. In fig 6.3, the 'slosh slosh' text around canals and 'buzz, buzz' around nerves are used to similar effect, but in a rather less familiar setting. Additionally, the fly's thought bubble allows a visual underlining of the connection between the names of the bones in the ear and the shapes that provide their names, a form of visual metaphor we can see more extensively (applied to workings of the brain) in fig 6.4.

In terms of 'attitudinal' cartoons, although the bulk of the images of *Horrible Science* are of people showing an attitude of some sort, this is generally for the sake of comedy rather than explanation (or a mix of the two). Such images might be of school children sleeping in front of boring teachers or a figure in the history of science looking smug. They tend to signal the book's irreverent humour and so we might dub them attitudinal in that respect. However, allied to the use of thought bubbles and sound effects discussed above, one of the interesting aspects of *Horrible Science* images is the way in which they use a sense of human perspective to depict not so much the attitude readers should take to a scientific process, but how emotion or attitudes are part of what they are communicating. In interview, Tony De Saulles discussed how he likes to add some sense of perspective to dry abstract or mechanical explanations, if only to 'inject some humour', and will often draw a dog or a fly with a thought bubble to allow some commentary, even if it is only by way of the ironic look on their face (De Saulles, 2006). A clear example of this is the fly's perspective on travelling though the ear (fig 6.3), or the inclusion of Baron Frankenstein's hand grasping the digestion diagram (fig 6.2). Although De Saulles

talked about this in terms of adding humour, I do not think it is only an entertainment tool. For example, in figs 6.5. and 6.6 allusions to human emotional reactions help underline the meaning of the anatomical processes depicted.

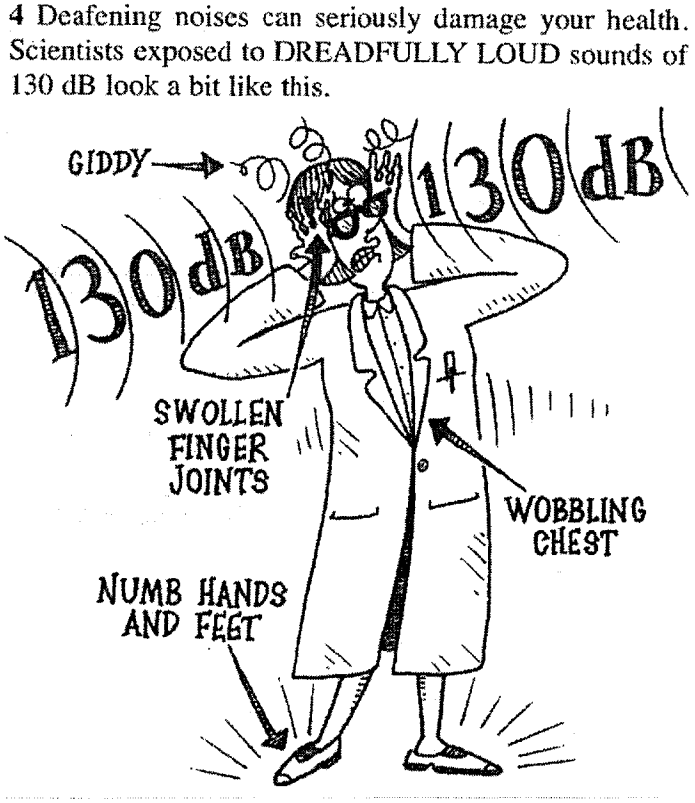


Fig. 6.5. Dreadfully Loud (*Sounds Dreadful* 1998: 65)

Part of the consequence of the comic style is not just an abstraction of visuals, but also of people. Characters such as Norbert Nerdworthy and Baron Frankenstein are stereotypes. Eisner (1996) suggests that comics use stereotypes because they require shorthand. He notes that a good comic artist knows their audience's stereotypes, but also (somewhat unreflectively, I think) suggests that there are some 'universal' ones, such as the geek with owl-like glasses or the con man with a fox-like nose (Eisner, 1996: 18-20). We could critique *Horrible Science* for replicating such crass social typologies, but that would miss the point: *Horrible Science* draws attention to its characters' crassness and laughs at it. Indicative of this is the use of wordplay around the names (e.g. Nerdworthy) or the manner in which they are introduced ('the one and only madly famous, famously mad scientist'). It seems that *Horrible Science* is following a stereotyping style similar to Eisner's, but also making fun of it. Eisner does also give examples of such parodic play (e.g.

Eisner, 1996: 60); arguably, comics' abstraction of people always had to be performed with a degree of 'non-innocence'. Yet, whether *Horrible Science* follows or comments on comic art to show its non-innocence, its use of such styles (compared to 'straight' abstract diagrams) is part of the liminal positioning that runs through all of *Horrible Science*'s intertextual relationship to fiction. This comic stylising also has an impact on the depiction of more readily 'real' characters (such as 'visual you' children and figures from the history of science), but I will leave discussion of this for chapter eight.

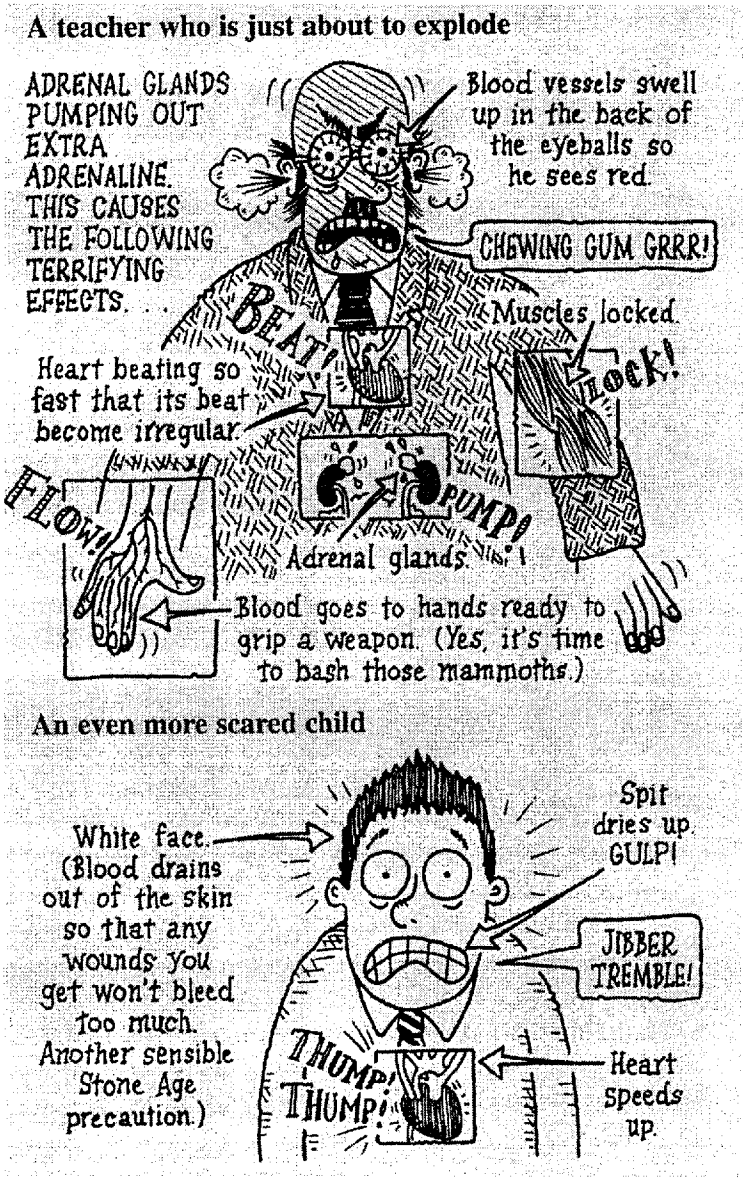


Fig. 6.6. Teacher Vs. Pupil (*Bulging Brains*, 1999: 120)

Fantastic Voyages

The final type of fictionally-mediated realism I want to discuss is that of taking the reader on a form of 'fantastic voyage'. This is analogous to the 1966 film, in that it applies a fantastical device to transport fictional characters into spaces humans would not be able to go (see Tait, 2006, for comparison of *CSI*, CGI documentaries and the *Fantastic Voyage* movie). There is a long history of such devices in the communication of science, especially physics, and in some respects it is a scientifically acceptable form of fictionalised representation. Such 'fantastic voyage' devices are interesting because they apply both narrative structure and the fantastic in a very self-consciously 'real' way. Such stories are quite explicitly fantastic, yet at the same time they employ fiction to allow the characters a form of eyewitnesses (sometimes hands-on) experience of places which science constructs via the application of either theoretical/mathematical models or experimental machines (e.g. through the lens of a telescope, not by standing on the planet Mars itself). There is therefore an odd second-hand, fictive construction even to empirical realism.

We can see an example of such a device in fig 6.3, which tells a loose story of the journey of a fly. In some respects what the fly's perspective does is simply slow down the progression of a sound wave, which is the central explanatory purpose of the illustration. However, through anthropomorphism of the fly character, it also provides a sense of discovery and allusion to eyewitness perception. It renders the abstract diagrams of inside the body we are all familiar with from textbooks with a form of the kinds of first-hand perception we have of the body's outsides. One of the most recent examples of this device in *Horrible Science* can be seen in the recurring characters of the 'Shrinking Scientists' who are used throughout *The Stunning Science of Everything* (2005). We see these characters holding atoms, jumping into a toilet to hold water molecules, into a mouth to investigate bacteria, amongst the stems of flowers, climb up ladders of DNA and go into space (*Stunning Science*, 2005: 10, 24, 29, 47, 52-6, 58, 86). MI Gutzache, Private Eye has been a recurring character since he was introduced in *Disgusting Digestion* (2001) to be shrunk small enough to explore inside a living human body (*Disgusting Digestion*, 2001: introduced on 17). Time-travel provides a similar device to discover dinosaurs in the (2006) jigsaw book and in some ways *Angry Animals'* (2005) use of a television naturalist character to adventure across the Earth in search of dangerous animals is another example. It is worth noting that none of the characters who go on these fantastic journeys in *Horrible Science* are actually children. MI Gutzache could,

perhaps, be described as a pseudo-kid as he looks very much like someone playing dressing-up (over-big clothes) and is thus perhaps more a form of dressed-up 'visual you' than dressed-up narrator. However, crucially, he is instructed in what to do by a scientist on 'ground level'.

It is worth noting how overt the fiction is in these examples. A shrinking scientist or talking fly are quite clearly ridiculous, as is Ml Gutzache's punning name and overly cartoonish costume, and to some extent *Horrible Science* plays on this. In this respect, the 'fantastic voyage' allusions to eyewitnessing are very different from the much more immediate appeals to hands-on perception of science that the books make when describing instructions for 'experiments'. We might argue that this makes the fantastic voyage device appear less real than empirical work, yet at the same time the imaginative qualities of fiction make these hands-on-by-proxy experiences somehow more powerful through their ability to provide a sense of human point of view. The talking fly may appear ridiculous, but it does give a point of view to latch on to when reading the insides of an ear that a more abstract image of a sound wave moving through an ear would not. Bolter's sense of the contradictions of remediation is again useful in considering this. For example, virtual reality talks about 'Wizard of Ozzing', as participants in virtual reality development projects are constantly asked to 'ignore the man behind the curtain' (Bolter & Gromala, 2003: 43). Importantly, this man behind the curtain is in the mould of the showman of Frank L Baum's original; the technology of virtual reality requests invisibility, but at the same time is quite overtly present, even showing itself off (paradoxically) as the facilitator of this invisibility. Similarly, *Horrible Science*'s use of fictional devices are shown off not only to present an 'honest' image of the presentation of nature (i.e. admitting their conceit), but also in their own right as ways into a reconstructed reality which may not be precisely as the world exists, but is nonetheless a powerful, exciting and useful version of it.

Another point worth emphasising about this use of fiction as a replacement for more traditional scientific ways of constructing knowledge is that it brings the results of the science to the readers, but cares rather little about how these results were produced. This is, arguably, a positive attribute in terms of extending access to scientific ideas, as it does not require special knowledge, language or complex equipment. However, it also acts (deliberately or otherwise) to obscure this non-specialist audience's knowledge of the processes of construction of science. This is a criticism which might also be made about metaphor, and the fictional or comic-book

illustration wrapping of the 'documentary' sources I discussed in chapter five. Buckingham and Scanlon suggest that because the *Horrible Histories* question the idea that history is about uncovering 'facts' and generally invite readers to challenge their teachers, they could be seen as relatively 'open', exploratory texts. However they also 'close' access to knowledge because they do not quote sources (Buckingham & Scanlon: 2003: 97). Similarly, the fictional wrapping of science keeps the production of science at arm's length. Thus, in some respects the fantastical frame of the fictional devices and comic-book illustrations constructs a distance between reader and source. The fantastic journeys, metaphors and fabricated documents are explicitly not real, they are a sketch, and so do not offer the readers much opportunity to challenge their content.

Conclusion

I split this chapter's analysis in two: one section on the 'externally' created fiction of intertextual references; the other on more internally constructed uses of fiction such as cartoon or 'fantastic journeys' devices. In my conclusion, I want to emphasise that both these approaches to fiction exist in the series, often within a single text. As with science-of books, the link between fiction and fact is there to show off similarity as much as to distinguish. Similarly, *Horrible Science* wears its fictional devices on its sleeve. The fiction-for-fact aspects of metaphor or 'fantastic journeys' are jocular, grotesque even, highly camp and very obvious. *Horrible Science* loves fiction, referencing and using it throughout the books, but also nods to its deficiencies to suggest the factual content is fiction-and-some. Further, it draws attention to its own constructed nature, and makes a joke out of it. Realism remains at the centre of *Horrible Science*; any fantastical elements are only there to celebrate claims to the real. Fiction produces the books' reality effects, and acts as the other by which fact distinguishes itself.

Such a combination of realist and anti-realist (or post-realist) addresses should not be understood simply as a form of post modern cop-out. The desire to 'have your myth and relativise' it, has its own rhetorical effect in engendering, maybe not realism, but trust. As with Flynn's (2000) Australian reality TV shows, *Horrible Science* asks us to trust its content because they appear aware of the problems of a straight realist address. This form of realism is, arguably, also reflected in *Horrible Science*'s slightly anarchic, grotesque humour and their nods to alternative histories

of science which paint the heroes of discovery warts and all. It is both Bolter's double logic of contemporary (im/hyper)mediacy and, in some respects, a form of the 'modest' scientist repackaged for the context of 21st century children's books; a full-on example of the realist eye that aims to somehow cancel out its necessary human self by acknowledging it.

Chapter 7
Audience Participation

Introduction

It is a characteristic of much contemporary edutainment that products are sold on a promise of being 'interactive' (for discussion see Buckingham, 2007, Buckingham & Scanlon, 2003). Although *Horrible Science* does not often use the word 'interactive' explicitly, the books do strongly emphasise the possible involvement of the audience. As I discussed in the chapter on narration, they often explicitly address 'you', the reader. Moreover, *Horrible Science* asks 'you' questions. It does not necessarily listen to your response, but it does ask. At times *Horrible Science* even suggests you should put the book down and, to paraphrase an old BBC children's television programme, 'do something more interesting instead'. Raid the kitchen cupboard for props and try out a scientific 'experiment' of your own; see with your own eyes science in action.

This chapter argues that *Horrible Science*'s sense of interactivity is best understood as pantomime-style 'audience participation'. It is scripted. Moreover, it assumes the audience follows rules that have been previously set by pre-defined experts; there is no real opportunity for readers to shape this knowledge. One of the forms of reader interaction most used by *Horrible Science* is the quiz and, as with most quiz-questions, these have correct or incorrect answers. The sticker books allow readers to peel off and physically move objects around the page, but are largely a matter of shifting shapes to pre-determined spaces; one of the consequences of the simplicity of cartoon illustration is that each visual image has a very exact place to be. As for the so-called 'experiments', these tend to be demonstrations drawing on the apparent realism of hands-on and firsthand experience rather than the open-ended discovery of doing an experiment.

As in the rest of this thesis, the association with pantomime should not

necessarily be read as derogatory. The familiarity of shouting 'he's behind you' can be fun, as can testing your knowledge against an expert or having something explained to you. Still, it is worth noting what type of audience involvement is at work. Moreover, because *Horrible Science* addresses its young audience as potential scientists as well as potential or current publics, what form of interactivity it chooses to invoke has implications both for ideas about the public's participation in science, and for portrayals of how science is or should be constructed. The interactive moments of *Horrible Science* invite the readers to do some of the work of science. What are they saying about such work, and with that, what are they saying about the appropriate construction of scientific knowledge?

The chapter starts by providing an overview of the types of invitations to interactivity that *Horrible Science* provides. It then breaks from the case study for a brief theoretical exploration of notions of interactivity and its associated terms such as participation, action, engagement, occasionally within the specific histories of children's and science media (and children's science media). I then take two forms of *Horrible Science*'s invitations to interactivity to consider in detail; first experiments, then quizzes. In many ways these imply quite distinct forms of interaction, yet, as we shall see, they largely present a similar view of knowledge. There is a right and a wrong way of finding science in *Horrible Science*; the opportunities for reader involvement only perpetuate this. Following Myers (1989), these are 'didactic dialogues' where the audience is very much situated as the consumer of knowledge.

Inviting Action in *Horrible Science*

To start by reflecting on a point made in chapter five, children exist aplenty within *Horrible Science*. However, these generally take the form of a presumptive 'visual you' (i.e. cartoons of schoolchildren present an assumption of what 'you' look like) rather than direct addresses to 'you'. When there is a direct address, its purpose is usually either to instruct or to tease (as with the narrator in Villain/ Dame mode). Still, I should note that in interview Arnold talked at length about the importance of audience feedback to his work, noting not only the quantity of letters he receives but the particular use of live events for gauging children's reactions to his work. We should also note that the pre-packaged medium of the book or boxed game is, inherently, a fairly closed medium. This section aims to provide an overview of *Horrible Science*'s moments of audience participation. I start with 'experiments', then

quizzes, before finally reflecting on some other forms of action that *Horrible Science* readers are invited to take.

Most of *Horrible Science*'s central series of books contain a few 'experiments', often under the title 'dare you discover'. The number of experiments varies from subject to subject. This is to be expected; some science topics are more readily rendered empirical than others – the topic of forces provides many more simple activities based on a falling ball or whizzing balloon than, for example, zoology, poison or cosmology. That said, one of the most interesting aspects of *Horrible Science*'s use of activities is that they also reference thought experiments (e.g. *Famously Foul Experiments,* 2008: 87), even if they are packaged empirically. There is also a range of object-orientated experiment kits (sold through GALT toys) either in large boxes or smaller 'bags'; two experiments-based 'specials', *Explosive Experiments* (2004) and *Really Rotten Experiments* (2003); and a set of experiment-based *Horrible Science Handbooks* which were released as part of the recent re-brand. The most important point to note about *Horrible Science*'s 'experiments' is the quantity of explanation that accompanies them. They prescribe what equipment is needed, what to do and how to enact the project, and explain what should happen (and why).

It would be unfair to single out *Horrible Science* for misappropriating the word 'experiment'; it is the approach taken throughout children's science culture. *Chemical Chaos* (1997) even explicitly alludes to this when the introduction suggests that the book's content might help you do your school 'experiments' correctly (*Chemical Chaos*, 1997: 7). In some respects, *Horrible Science* relays a more honest image of 'experiments' than its competitors. By including a large quantity of historical exposition, *Horrible Science* suggests that experiments are done by people, require special conditions and equipment, and tend to go wrong. However, as we shall see, many of these stories of scientists doing experiments rely on a rhetoric of scientific discovery which assumes that the empirical 'scientific method' can discern incontrovertible truths.

As for quizzes, the books are suffused with them; they recur throughout the series (including in the more 'experiments' based products) and are a key addition to the 2008 re-brand. This might seem odd in a brand so determined to extricate its non-fiction identity from associations with teachers. However, it is indicative not just of *Horrible Science*'s actual strong link to school education, but also of the

entertainment-based nature of the quizzes, which are more quiz-show than pop-quiz. *The Awfully Big Quiz Book* (2000) asks you to keep track of your score and check your results at the end of each chapter. It then produces a scoreboard reminiscent of magazine psychology quizzes, suggesting that the reader's score relates to their inherent personality traits (fig 7.1). Yet, when it comes to the questions, they are rarely ones the readers could be expected to know the answers to. Neither are they likely to be that useful in working in or with science. For example: What was Albert Einstein's favourite hobby? In the 1840s a ship from Uruguay fired balls of cheese to beat off an attacking ship, true or false? Does the chocolate beetle only eat chocolate? (*The Awfully Big Quiz Book*, 2000: 40, 24, 72). As I have argued elsewhere (Bell, 2008), and will elaborate on later in this chapter, this is the reward system of *University Challenge* (i.e. awards for academic knowledge) worked through the question delivery of *QI*; subverting the former by way of counter-intuitive answers and celebrating apparently useless trivia.

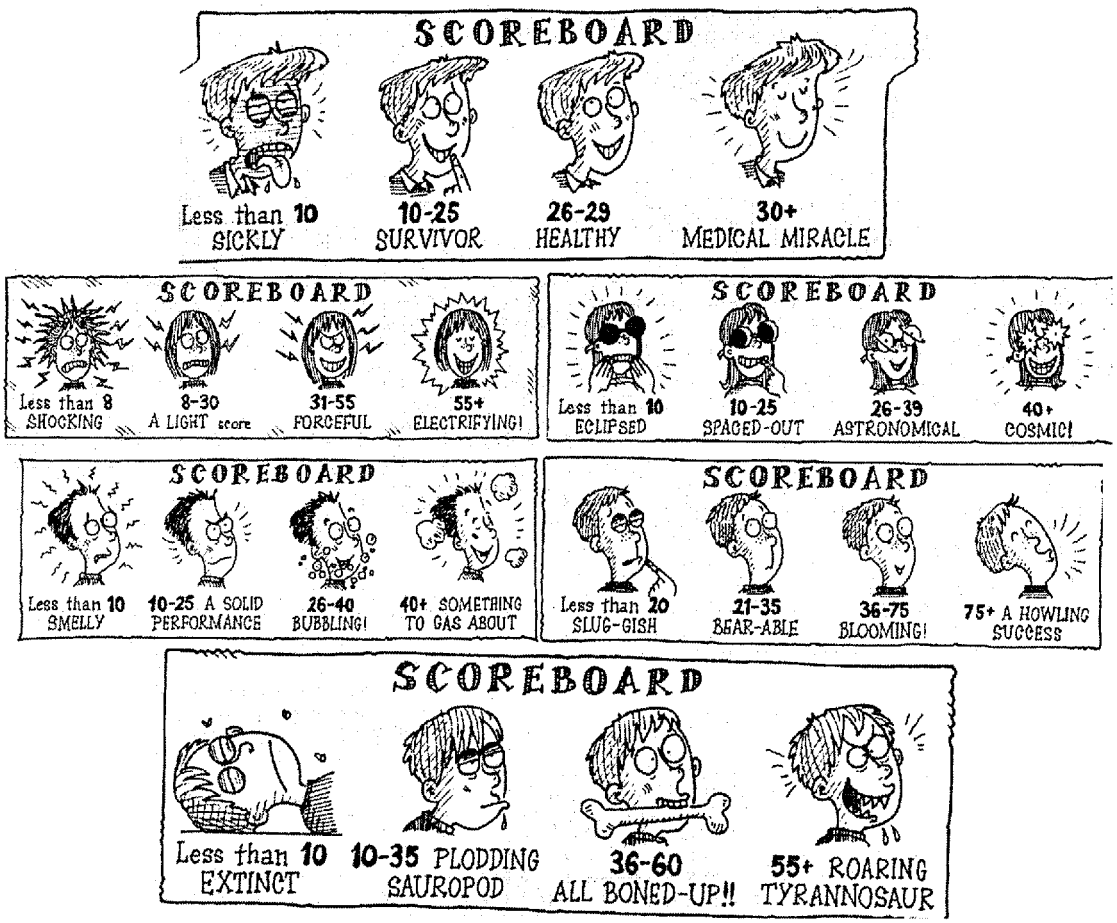


Fig. 7.1. Scoreboards (*The Awfully Big Quiz Book*, 2000: 19, 35, 49, 64 85, 99)

Still, it would be unfair to suggest that all *Horrible Science*'s quizzes are merely delivery systems for trivia. Some of *Horrible Science*'s answers are ones the books might expect readers to know (the new quizzes added to the end of the re-branded books are an example of this) and it is also worth emphasising that some of the quizzes include quite long answers, especially compared to the other medium for trivia found in the books: a simple list of facts. There is also a degree to which the questions allow readers to play around with the concepts they are trying to learn. For example, the counter-intuitive element in the answer that glass is a dense liquid (not a solid) could be seen as helping underline chemical state distinctions (*The Awfully Big Quiz Book,* 2000: 62-63). The other key point to make about *Horrible Science* quizzes is that many of them are, explicitly at least, directed at the educational establishment (rather than coming from them), and are often branded inside the books as 'test your teacher'.

Considering invitations for possible reader involvement beyond those of quizzes or experiments, there is little or no space for the child to make a mark on the books, not even a 'this book belongs to' frontispiece. The large boxed *Explosive Experiments* set is perhaps the most surprising example of this. This is a sort of play on the idea of a chemistry set which includes equipment for several activities (with an emphasis on making a mess) and a mini-booklet entitled 'Top Secret Lab Book'. When first investigating this kit, I assumed the Lab Book would be a place for users to keep a note of their observations, a way of training children in scientific styles of 'writing up results'; to me it looked and felt a little like a notebook. However, it is purely a step-by-step guide to using the activities. The only place a reader is asked to write anything is to note the local poisons unit's phone number.

The jigsaw books (*Dinosaurs*, 2006, and *Ugly Bugs,* 2008) provide another interesting example. Priced just under £10, these are very much gift-book versions of the series. They are the size and depth of a small toy box but made up of pages within which small jigsaws are set.[21] A brief narrative on the left-hand pages takes readers through the content (a sort of mini-*Horrible Science* book), while each right-hand page comprises a full colour cartoon jigsaw, the pieces of which cover a *Horrible Science* 'mix' of quizzes with facts given below. Take the cartoon scene apart, try not to lose the pieces while you read the page of the book, then solve the jigsaw to cover it up again (see fig 7.2). The *Ugly Bugs* edition also includes a model

[21] There are also *Horrible* jigsaws sold through GALT, which are more complex and come with an '8 page loony leaflet' of *Horrible Science* book content.

'bug' to piece together from thick cardboard cut out of a page which would otherwise be a jigsaw, reminiscent of model-pieces given away with part-works. In contrast to Usborne versions of Dinosaur jigsaw books (Turnbull, 2003[22]), the shapes of the jigsaw pieces owe nothing to the content; the puzzle connects only very tangentially to the topics covered by the book. Further, although in some respects the jigsaws allude to lift-the-flap devices (and with that, to a sense of exploration and discovery in science), they do not really follow this through by connecting the jigsaw surface explicitly to the content it covers; for instance, it would be easy to show a diagram presenting the chemistry of a leaf under a picture of a leaf, or a fossil of a dinosaur under a Jurassic Park-style visualisation. Thus, the interactive element of the jigsaw acts as a sort of decorative interface over the pages of the book, even obscuring the educational messages underneath.



Fig. 7.2. Photograph of Jigsaw-ed Pages

Meaning Interaction

With the widespread use of hypertext, public policy emphasising citizen engagement and, latterly, web 2.0 interaction, media content is increasingly focused on what the audience brings; infamously, *Time Magazine*'s 'Person of the Year' 2006 was 'you'.

[22] Note this is aimed at slightly younger children than *Horrible Science*.

Spiro Kiousis (2002) argues that with the advent of New Media not only are we seeing the convergence of media types (i.e. of text with image) but also a convergence of definitions of interactivity; or perhaps conflation rather than convergence, as these different ideas about interactivity overlap and mix without much discussion over shared meaning, the result being an even more muddled and multiplicitous sense of what 'interactivity' might mean. With a slightly more critical view on such definition conflation, Heath and vom Lehn (2008) argue that the so-called 'interactives' of science museums offer only tightly constrained sequences of action. They suggest that the sense of 'interaction' and the 'user' applied by science museums is largely rooted in computer-based systems. Moreover, 'interactivity' has been conflated with 'social interaction' so rather pedestrian exhibits may take on the sparkle of association with terms such as 'co-participation', 'public engagement' or 'collaboration'.

Such conflation of ideas around interaction is nothing new. As we saw in chapter one, the 'Discovery Learning' movement may have presented itself as a relatively egalitarian approach to teaching science (pupils find knowledge for themselves rather than being instructed), but in practice students were coerced and led to particular conclusions by their teachers with any anomalous results accounted for. As Atkinson and Delamont (1976) put it, such projects dressed up 'cold' (decided) knowledge as if it were 'hot' moments of discovery (see also French, 1989, Driver, 1989). Although discovery learning is supposed to be accessible to everyone by way of producing an 'open' space free of the ideological shackles of prescribed didacticism, it tends to rely on students' ability to perform pre-established knowledge which will not (at least explicitly) be provided by the teacher. It is therefore those students who are privileged enough to have been exposed to the ideas in advance who are at an advantage (c.f. Bourdieu and Passeron, 1977, Bernstein, 1975).

Projects inviting public interaction may aim for greater democratization (be this of knowledge or cultural products), but they cannot really cope with the relativism this entails. Su Holmes sums it up well in noting there are tensions between calls for viewer 'empowerment' through interactivity and the critic's cry against 'dumbing down' (Holmes, 2004: 216). Arguably, this is a particular issue for the boundaries of expertise surrounding children and science. Thus we could read the problems of discovery learning less as an insidious plot against schoolchildren, but rather as an inability to shake off the sense that children's findings on the natural world are less likely to be true than, for example, Newton's. As I mentioned in chapter one, one of

the advantages of applying Bernstein's reading of invisible pedagogies as he seeks to uncover the reproduction of social inequalities within educational programmes which their well-meaning producers are themselves unaware of.

There are various taxonomies available for analysing 'interaction' either in general or specific contexts (see Kiousis, 2002, Buckingham & Scanlon, 2003, or Schott, 2006, for overview of some). Buckingham and Scanlon note that such categorisations tends to be rooted in hierarchical scales, from low didacticism to high user-led content, and assume interactivity somehow leads to emancipation (Buckingham & Scanlon, 2003: 115). There are several problems with such a hierarchical set up. Firstly, the sense of emancipation is often largely illusionary even with the 'higher' scoring forms of interactivity (see, for example 'invisible pedagogies'). Moreover, it glosses over the diverse types of interactivity and reasons for invoking it. For example, science museum 'interactives' may sit within a context of an institution playing up its engagement/dialogue identity but, historically, they owe a lot more to Exploratorium-style science centre exhibits which root interaction within educational psychology and emphasise kinaesthetic learning (see Pizzy, 1987, Quinn, 1989, Hein, 1990).

Science education is not the only place where we can see apparently 'open' interactive media which is actually highly structured by its producers. Buckingham and Sefton-Green note that playing Pokémon requires active participation on the part of its fans but this participation is tightly structured: 'The rules of these games are not open to negotiation' (Buckingham & Sefton-Green, 2004: 12). Similarly, Nicholas Burbules (1998) draws our attention to the rhetoric of the hypertext link (where exactly it is placed and where it transports the user to) and warns against letting the speed of moving from one page (or site) to another render this rhetoric somehow invisible. None of this is necessarily that new. Bridget Griffen-Foley (2004) contrasts early 21st century 'interactive' reality television with *Tit-Bits* magazine (founded in 1880s London) which, she argues, applied audience involvement as a rhetorical tool to make the readership feel included and thus loyal enough to commit to continued custom. Importantly, I think these three examples point us towards some of the appeal of interactivity for audiences, as well as noting hegemonic action on the part of the producers. In terms of *Tit-Bits*, it can be exciting to form a connection, however small, with a mass-media product and the rest of its audience. In terms of Pokémon, Buckingham and Sefton-Green are keen to emphasise that we should not demonise it out of hand; indeed, the game inspires a large quantity of user-to-user interaction.

In terms of the rhetoric of the hyperlink, it can be interesting to see what a hypertext writer has chosen to link to. This is not to argue that media should be 'top down', just that audiences may find something appealing in 'didactic dialogues'. We should also be careful about assuming that audiences innocently follow invitations to interaction.

Alongside the rhetoric of apparent agency or possible democratization, a sense of interaction may equally apply a rhetoric of activity, especially in the context of children's play. Stephen Wagg suggests that the basis of much of BBC children's programming is a Baden-Powell inspired notion that 'the devil makes work for idle hands', with an emphasis on the moral worth of making and doing (Wagg, 1992a: 151-152). Similar arugments recur around the assumed moral worth of children's physical education and 'nature study' (see, for example, Toon, 2004, Keeney, 1992). There is also the suggestion that such activity is fun and therefore either more appropriate given the assumed playfulness of youth, or at least a way of sneaking in a bit of learning while the kids aren't looking. According to historian of toys, Gary Cross, since the late 17th century play has been seen as key to a child's development; hence the emergence of educational toys explicitly designed to encourage play (Cross, 1997: 18-19). As Buckingham notes, explicitly interactive 'edutainment' materials typically emphasise the curiosity or discovery of children's everyday life, perhaps to avoid associations with pushy parents pressing educational work on their children's free time. Thus, interactivity is part of what renders edutainment an 'acceptable leisure-time pursuit [...] a glamorous alternative to the apparent tedium of much school work' during which children can gain a competitive edge on their peers without even realising (Buckingham, 2007: 123-124).

There are similar assumptions about the implied worth of action in scientific contexts. There is a long history of hands-on, or at least eyes-on, demonstrations for young or otherwise 'lay' audiences (Sutton, 1985, Lightman, 2007b, Morus, 2007), some of these set-pieces are still performed (in various guises) today. Interestingly, in interview, Arnold claimed he was largely unaware of these traditions, suggesting that he constructed each activity from scratch. Indeed, several of the activities shown in *Horrible Science* do appear to be new (although by no means all). The styles of such demonstrations, even specific activities, are often woven through other media. Melanie Keene notes that 1920s and '30s science and engineering kits built on a much older tradition of toys, optical tricks, and natural magic, such as 19th century magic lantern shows (Keene, 2007: 270). For instance, John Henry Pepper's *Playbook* was based on his lectures, as were Buckley's *Fairy Science* stories,

although Gates (2003) notes that these were substantially rewritten to work on the page (Gates, 2003: vi). Children's science 'experiments' are often forms of toy, with craft and cookery comparisons, a point which stage conjurer turned children's science fiction writer, Norman Hunter, makes quite explicitly in his (1976) *Professor Branestawm's Do-It-Yourself Handbook* and which we can see reflected in the recent *Usborne Big Book of Science Things to Make and Do* (Gilpin & Pratt, 2007).

The 'Experiments' of *Horrible Science*

This section will provide some more detailed analysis of opportunities for hands-on interaction within *Horrible Science.* It first considers the ways in which scientific ideas are rendered into activities to make, or at least perform, science. It then covers some of the issues raised by turning experimental actions into a literary experience, before finishing with some discussion of the overarching appeals to a language of scientific discovery. I argue that although *Horrible Science* samples ideas from the social construction of science and appeals to the possible democratization of knowledge (through instructions for the audience to have a go themselves), these are largely mobilised within a discourse of science as empirical, and irrefutable because of it.

Things to Make and Do

For all of *Horrible Science*'s general semi-fantastical tone, there is something very empirical about the brand's take on knowledge. In the last chapter, I argued there was an appeal to the 'really real', and allied to this is a sense that the reader can actually see and/or apply *Horrible Science*'s content in everyday situations. Its promotional literature often implies that through *Horrible Science* readers can learn skills, have a go at something and find out how things work. Blurbs promise that readers will be able to: 'learn to dance like a skunk, eat like a chimp and chat in cat language' (*Really Rotten Experiments,* 2003); 'make your own toothpaste' (*Chemical Chaos*, 2008); 'Make your own drinkable blood! See through a giant eyeball! Breed some sewer rats!' (*Famously Foul Experiments*, 2007); or 'Create a sickening sneeze. Make a shrunken head! Pop an eyeball!' (*Beastly Body Experiments,* 2008). There are also allusions to the symbolic utility of the activities, such as references to uses of larger versions of thing you are about to make, for example after instructions on how to make a lever 'just like Archimedes', we are told about it being applied in

war against the Romans (*Famously Foul Experiments*, 2007: 18).

Even theoretical work is turned into an object-based lesson. For example, *Famously Foul Experiments* (2007) discusses Einstein's thought experiments: he 'didn't need a lab to do experiments – he did them in his head!' However, the book then explains this 'experiment' by asking the reader to make a mock-up of a black hole using cling film, a peppercorn and a tomato (*Famously Foul Experiments,* 2007: 87-8). This is quite explicitly a mock-up, a demonstration of phenomena rather too large to fit in the standard kitchen cupboard. Designating the peppercorn as 'your spaceship' and the tomato 'an alien planet' underlines this. The playful element is, however, balanced with statements such as 'Einstein's ideas have been proven again and again in experiments' (*Famously Foul Experiments,* 2007: 87). Although this references the power of empirical claims in the forming of scientific consensus, the activity itself is not really a matter of undertaking empirical action in order to replicate the processes scientists went through, so much as playing in order to understand the results. Indeed, in many ways it draws more on appeals of activity associated with children's play than it does on empiricism.

The 'experiments' of *Horrible Science* are often like the instructions for how to perform a magic trick or assemble a toy. The claims to empirical action suit *Horrible Science*'s general sense of performance and appeal to physical sensation as much as they do science's traditional claim to the hands-on experimental method. The activities which come in the *Horrible Science* boxed kits are indicative of this: balloon powered rockets, pouring vinegar and bicarbonate of soda together to make a 'volcano', or mixing PVA glue and borax with a bit of green food colouring to produce 'snot'. However, we also see similar appeals reflected in the books. *Fatal Forces* (1997) provides some of the most explicit examples of science for toy-making, explicitly positioning physicists as toy-makers, and providing instructions to make a cotton-reel car which moves a pencil slowly across a table and a simple 'bolas' ball-based weapon (*Fatal Forces*, 1997: 120, 98-98, 107-8).

To some extent the props provided by the boxed kits are nothing more than their audiences could find from simply raiding the kitchen cupboards, stationery box or garden shed. This presents the content as 'everyday science', viewable in an overtly simple way (not so much 'ready made' as 'readily made'). The *Horrible Science* toys may allude to the traditional (explosive) chemistry set, but kits providing obscure materials are long gone. In terms of the book content, *Freaky Food*

Experiments (2007) is not so themed because it describes food science but because it uses cookery-based equipment; the activities are utilised to explain a range of ideas from physics, biology and chemistry. Wagg suggests that the BBC constructed *Blue Peter* largely in response to the advent of commercial television and thus used its 'yoghurt pots and sticky-backed plastic' activities to emphasise a discourse of anti-consumerism, as it was hoped that children could 'resist the blandishments of the market' to create their own playthings (Wagg, 1992a: 163). Applying such 'yoghurt pots and sticky-backed plastic' styles to science, the implication is less that the child can subversively make their own toys, but rather that they can find their own knowledge.

Horrible Science's application of this idea of 'make your own science' is one of the key ways in which it reflects rather traditional approaches to experiments in children's science culture. As with Discovery Learning, it is ostensibly empowering, suggesting that even a child can make the science for themselves. However, again as with Discovery Learning, *Horrible Science*'s activities are largely an illusion of (or allusion to) discovery rather than an actual enactment of it. The instructions, as with any toy kit, are very specific. The reader is invited to play at being a scientist in such a way that emphasises (perhaps spuriously) that the central truths of scientific theory are simply there to be found.

Reading Experimental Action

As with all of *Horrible Science*, experiments tend to be displayed within *Horrible Science*'s 'mix' of content, linked to quizzes or providing a loose narrative 'wrapping', with breaks for trivia and explanation. At no point are they *just* a simple list of science fair recipes or *Blue Peter* style instructions to make toys. Neither are they dry third-person technical reports of research. Significantly, the new indexes which came with the re-brand do not list 'activities' or 'experiments'. They are largely structured around the book content (e.g. names of famous scientists, types of chemicals), rather than the form in which this knowledge is packaged. The great big *Horrible Science* stage show of jokes, storytelling and cartoons makes itself known, vying for attention above any sense the reader can find knowledge for themselves. This is particularly noticeable in the *Handbooks* because they present themselves as guides to discovery of a world outside the book, yet are, as recent publications, some of the most overtly narrative-based books in *Horrible Science*, re-applying fictional

characters from other books (MI Gutzache, the Frankensteins) who take the readers through the books and provide a sense of running narrative. Moreover, the chapter titles we find repeated on the contents page are unclear as to what equipment or ideas the experiments are based on; a reader either has to follow the plotted narrative through or take pot luck as to what activity they will try.

We might argue that such narration of experiments in *Horrible Science* is a contemporary form of *Tom Telescope*, providing a fictional setting to allow a science show to be packaged in book form, and in some respects the hands-on 'experiments' of *Horrible Science* are no different from the 'fantastic voyages' we saw in the last chapter. Indeed, we could even question whether the reader needs to try out the activities at all, given the detailed notes on how to conduct experiments along with images of children undertaking the activity and descriptions of what the results will be. Aileen Fyfe suggests that *Pepper's Playbook* includes several experiments that, in practice, would be hard to do (Fyfe, 2003: xix). I doubt this is true of the *Horrible Science* activities (I cannot claim to have tested them all, but I trust that Arnold has), and in interview Arnold stated quite strongly that he felt that doing the experiments was a key part of enjoying the *Horrible Science* experience and that he knew readers did them from letters he received. Still, in many ways these are literary representations of the experiment, explicit enough that we might choose to try the experiments if we wished, but entertaining enough in themselves that this is not necessary.

For example, *Chemical Chaos* (1997) asks 'dare you discover... how to stop a reaction with another reaction?' It then tells the reader to cut an apple in two and sprinkle some lemon juice over one half. It notes that the lemon-free half goes brown, and asks what happens to the other half. We are then shown a cartoon of a parent trying to interfere with a child's festering apple experiment and are offered a multiple-choice set of answers. The answer is then printed directly below, albeit in upside down print (*Chemical Chaos*, 1997, 114-5). Other examples also provide instructions for activities readers would never be expected to try. For example, *Painful Poisons* (2004), after asking readers to find all the poisons in their house and labeling them with skull and crossbones, provides 'instructions' for grave-digging for forensics tests. This is prefixed with an 'IMPORTANT MESSAGE!' that this 'part of your training' is very advanced and may have to wait until you have grown up and joined the police. It also goes on to parody the safety warnings made in earlier experiments by stating that readers should 'ask permission' before digging up dead bodies (lest they are

'chased around a graveyard by a vicious vicar) and by no means 'go digging up departed family pets' (*Painful Poisons*, 2004: 132-3). Thus, *Horrible Science* moves from activities it is implied the reader might actually do to ones that are only to be experienced via fictional reconstruction.

Another form of experiment description to be found in the books are those from the history of science. Interestingly, although the label 'experiments' in children's science culture generally denotes instructions for some sort of hands-on activity for readers to try out, *Horrible Science* often uses it to signal a discussion of other people's experiments, part of the series' fascination with the history of science. *Explosive Experiments* (2004) is indicative of this, its front page emphasising:

> This is a book *of* experiments for you to try and also a book *about* experiments and a book about *people* who perform experiments! And because *Explosive Experiments* is a Horrible Science book you'll be meeting quite a few horrible people, like...
>
> - The man who offered children dog poo to eat
> - The soldier who made his butler dodge bullets [break for illustration]
> - The scientist who turned bats into flying fire bombs
>
> (*Explosive Experiments*, 2004: 5. Ellipses and emphasis as original)

Indeed, it is not until page 32 (of 192, this is a bumper edition) that they offer an activity for readers to try out (a 2005 edition comes packaged with a set of cards, each with instructions for an activity). Thus, we might argue *Horrible Science* is unusually truthful about 'experiments', at least compared to the bulk of children's science culture: they are largely done by experts, using special equipment and they often go wrong. Moreover, *Horrible Science* emphasises the way hands-on experience of nature is heavily implicated with theory, history and 'the people who perform experiments'. Still, as we shall see, the dominant discourse of *Horrible Science* still seems to be one that puts a lot of faith in the ability of science's empiricism to provide incontrovertible truths.

Invoking a Rhetoric of Discovery

Horrible Science's activities may not always be actively 'experimental', but they are

packaged as a process of discovery that is open to all. A language of discovery is typically used to introduce the experiment specials:

> Science is about discovery. It's about finding out facts and uncovering strange secrets.
> And to help them, scientists have a secret weapon. It's called an "experiment". Thanks to experiments a scientist can tell you the answers to questions you haven't even thought of...
> And answers you probably never wanted to know... But why should experiments just be for serious-minded scientists? Surely they're far too much fun not to share around? (*Really Rotten Experiments*, 2003: 5; between line breaks are cartoon illustrations. Ellipses as original)

This discourse is appealing; it provides a democratic framework for science education and follows the (arguably utopian) Baconian ideals of an empirically rooted scientific method. Science generates a range of new ideas ('questions you haven't even thought of') that are potentially open to anyone ('they're far too much fun not to share'). Moreover these ideas are very powerful, conclusive even ('finding out facts', 'secret weapon', 'Thanks to experiments science can tell you the answers'). To some extent, the fictional wrapping of *Horrible Science*'s experiments also emphasise this sense of discovery. For example, the set of instructions shown in fig 7.3 packages its experimental notes as a write-up of classroom work done by students in a fictional school. This means the instructions are, through their fictional framing, placed in the past tense, and so alludes to a process of discovery a child (character) might have had. However, anyone repeating the *Horrible Science*'s activities will find the science ready-packaged for them, regardless of any allusions to this character's moment of discovery: the past tense also means we are provided with the answer.

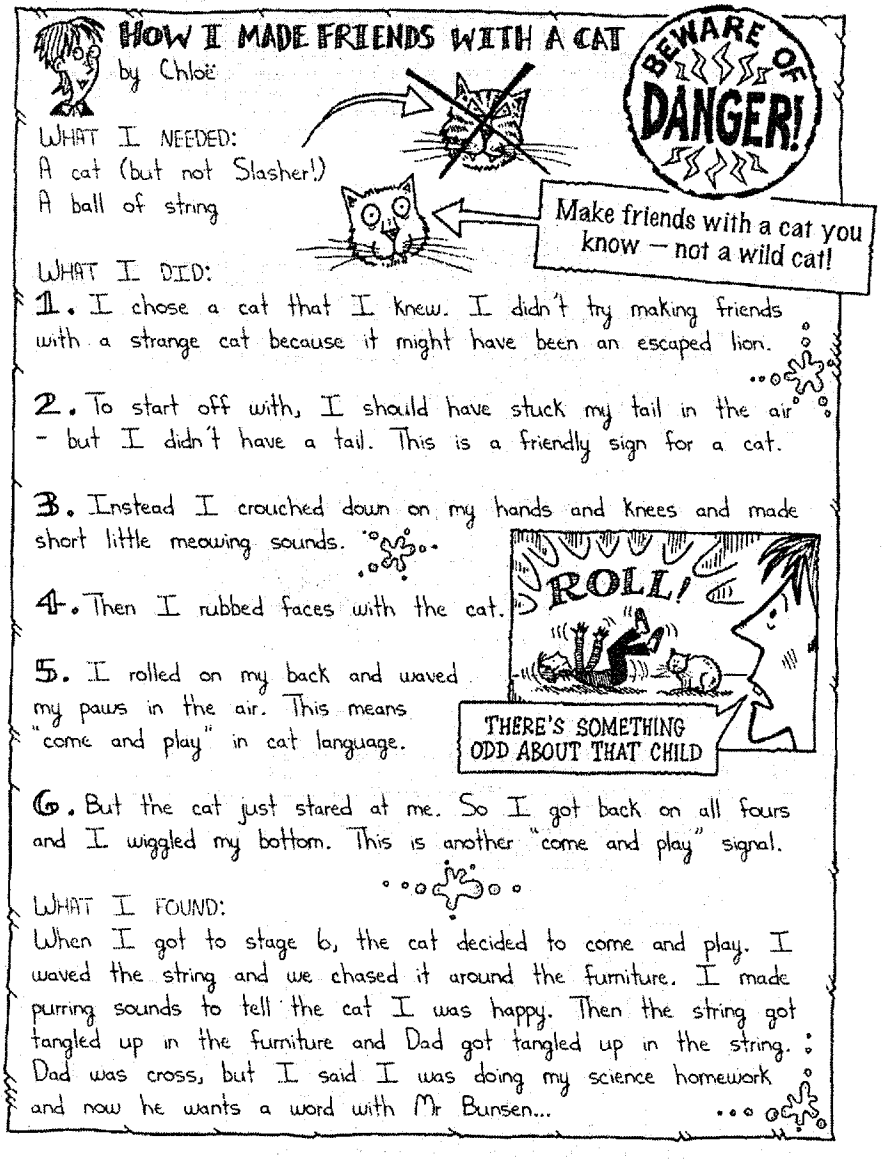


Fig. 7.3. How I made friends with a cat (*Really Rotten Experiments,* 2003*:* 52)

Harry Collins (2000) draws educationalists' attention to the sense of certainty that Discovery Learning constructs. Supposedly ideology-free pedagogies such as Discovery Learning enforce the idea that the science is true; after all we made it happen right in front of us. By suggesting a child can 'discover' a theory of science in class, science education creates the appearance that a lesson's work can accomplish a level of certainty that not only can take decades, but will itself ultimately be transitory (Collins, 2000: 170). Collins suggests there is a 'trilemma' at the heart of much science education: (a) it suggests that science liberates us from the 'shackles

of received knowledge'; and yet (b) it is itself received knowledge; and it must be so in order to (c) train scientists (even though at the same time such rhetoric does 'harm' to those who will grow up to be citizens) (Collins, 2000: 171). In response to Collins, I think that it is important to again emphasise that many of the *Horrible Science* books (including *Explosive Experiments*) conclude by invoking a sense of scientific uncertainty, which arguably open up the possibility for the child-reader's future role. Still, supporting Collins's concerns, experiment is often presented as a secure way of finding knowledge, even at the end of books (which will often 'open up' science for the child's potential future involvement). For example:

> Science is full of mistakes [...] Thank goodness for experiments and the great scientists who set them up and put everyone else right! The wonderful thing about an experiment is that you can't argue with the results (and if anyone tries to argue you can always repeat the experiment and check your results). And from the results come all the science in this book. (*Famously Foul Experiments,* 2007: 95)

Science may be full of mistakes, but the great power of 'great scientists' and their experimental method will also be able to put things right; 'you can't argue with the results', it is there in front of you, even in the kitchen-sink-science activities presented in the book.

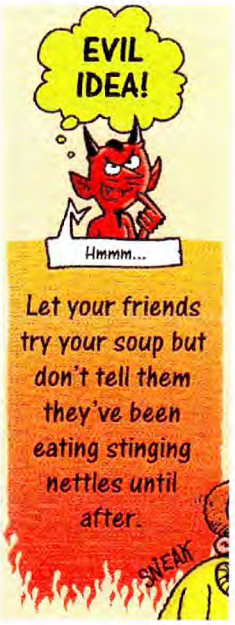


Fig. 7.4. An Evil Idea (*Freaky Food Experiments*, 2007: 32)

There is a sense, throughout *Horrible Science*, that doing experiments is part of the natural action of scientists. Scientists are often depicted in reference to experimental equipment (test tubes, lab coats, etc). Where the books invite readers to try experiments. *Deadly Diseases* warns that 'side effects' of the book include 'feeling an urge to try revolting experiments' (*Deadly Diseases,* 2008: 1). However, such warnings often allude to a horror movie 'evil genius' rather than a more traditionally celebratory depiction of scientific work. For example, the start of the *Fearsome Fight for Flight* warns the reader not to 'bother your brother with too many evil experiments' (*Fearsome Fight for Flight,* 2004: 42). *Freaky Food Experiments* (2007) has a recurring feature of tips for an 'evil' twist on the activities (complete with a devil icon (fig 7.4), albeit a rather tame one): cook nettles but do not tell your friends until they have eaten them, draw the face of someone you do not like on an egg you are going to put in a glass of water, get your 'pet adult' to drink a mix of juice and coffee (*Freaky Food Experiments*, 2007: 32, 40, 63). It is also worth noting that the children are often depicted as out of control. This is especially noticeable in *Really Rotten Experiments,* which is based around the reports of schoolchildren (e.g. fig. 7.3) who terrorise their teacher in a very *Bash Street* style. The character of Private Investigator, MI Gutzache – who presents a form of experiment-by-proxy in his 'Fantastic Voyages' into the human body – in some respects also alludes to scientific discovery produced outside the ordered rules of the establishment. However, as Elizabeth Leane (2007) has argued convincingly in the context of the (auto)biographical fashioning of scientist identities in popular science books, the scientist as Private Investigator provides an added sense of the outsider's claim to truth; bucking the trends, free from the cultural baggage and petty politics of mainstream thought (Leane, 2007: 149-150). From this point of view, the anarchic imagery of discovery in *Horrible Science* should not necessarily be seen as a message that science is in some ways accessible to all. As with the appeals to knowledge found in everyday kitchen materials, it is a quite straightforward (yet powerfully 'invisible') application of the idea of science as culture-free.

Pedagogies of the Quiz (Show)

I now want to turn to a different type of audience participation; being asked to answer the questions in a quiz. This is more explicitly closed and reliant on received knowledge than the 'experiments', but its approach to interaction is no less interesting. This section draws on several studies of television quizzes as well as

traditions in academic testing, reflecting the ways in which *Horrible Science*'s form of quizzes owe as much to entertainment styles as to classroom tests. I start by discussing some of the interactions offered by the quiz (and the later social interaction they purport to prepare for), then move on to discuss the approach to knowledge which quizzes imply, before finally focusing in particular on a sociology of the trivia-based knowledge *Horrible Science* tends to present.

The Interactions of a Quiz

In many respects, the quizzes of *Horrible Science* are quite overtly non-participatory. They do talk to the audience, assuming – perhaps invoking – some form of response, and yet, partly due to the medium of the book, they do not wait around for a response. Still, this is not especially different from the allusions to participation in the quiz show. According to Holmes (2006), the BBC tended to apply the term 'quiz show' to any form of 'audience participation' programming, but perceived actual question-and-answer quiz shows as soliciting particularly 'active' audiences because it implied viewer participation through invitations to 'play along at home' (Holmes, 2006: 61). The responses of each individual audience member are largely ones they track themselves. The quiz show invites the audience to action rather than interaction, but it is a form of action that alludes to a social relationship between audience and presenter, if only through identification with the actual contestant. It still matters what particular answer the audience member gives (or whether they do give an answer), even if how much it matters is decided by the audience member themselves and only themselves (or anyone who happens to be around) will be able to see if they make a mistake. Although the quiz-questioner will not correct each audience member individually, they can make general comments about getting answers right or wrong which individuals can apply to themselves (e.g. the scoreboards in fig 7.1) or make comments such as 'no cheating at home'.

In addition to the actual questioning itself, another form of 'implied' quiz-interaction that we can see in *Horrible Science* is an allusion to social interactions which may take place later in life. For example, many of the question and answer aspects of contemporary edutainment products are marketed to parents as keys to future career success. In contrast, the trivia-knowledge, odd stories or simple collections of miscellaneous facts that *Horrible Science* provides are aimed more directly at the children themselves and suggest a slightly different form of politics,

directing knowledge at the teacher (rather than providing knowledge for teachers). Several of the quizzes are introduced as 'test your teachers' (a recurring device throughout the series), and the start of the *Awfully Big Quiz Book* introduces itself thus:

> Science is full of facts and teachers seem to know them all... [break for cartoon] So wouldn't it be FANTABULOUS if there was a book with HUNDREDS of facts your teacher *didn't* know (*Awfully Big Quiz Book*, 2000: 5. Ellipses and emphasis as original)

Although *Horrible Science* readers have to go though the process of being the contestant while they are reading the book, the suggestion is that they can use what they have learnt from this interaction to turn the tables at school. There may not be any agency for the reader in quiz-interaction between them and the author, but the implication is that it could provide the reader with some agency in the classroom if they were to apply the knowledge they have learnt.

We could also argue that *Horrible Science*'s quizzes allude to social interaction amongst school children. Buckingham and Scanlon (2003) suggest that the attraction of knowledge in dinosaur books, with their reliance on facts and statistics, is largely that they embody a sort of legitimate form of Pokémon; collecting, swapping, doing battle with values (Buckingham & Scanlon, 2003: 127-128). In chapter three, I referred to some of the ways *Horrible Science* presents itself as providing social power for its audience. For example, the start of *Killer Energy* (2001) emphasises that thermodynamics might appear 'dead posh and impressive' but is, armed with *Horrible Science*, easy to understand: 'Don't tell anyone how easy, and with luck your friends will think you are a scientific genius!' (*Killer Energy*, 2001: 14). Read in this light, the trivia of *Horrible Science* can also be understood as knowledge which can be exchanged amongst friends and family as well as at school; a way of showing off to friends and doing intellectual battle with the readers' peers as much as with the educational establishment.

Knowledge and the Quiz

Although quiz shows have generally been aimed at predominantly poorer and older audiences (Holmes, 2004: 489), there are many ways in which their choice of

questions appeal to very middle-class ideas of general knowledge (see Hoerschelmann, 2000, for a 'cultural capital' reading of this). 1980s Britain saw the rise of quiz programmes relying on 'everyday' expertise, such as the price of domestic goods, sports or popular music, which some analysts have linked to Thatcherite appeals to the 'common sense' of 'ordinary people' (Whannel, 1992: 197-200; Holmes, 2004: 483; Holmes, 2006: 53, 64). Yet Holmes's (2004) analysis of *Who Wants To Be A Millionaire* in the late 1990s notes the presenter's exaggerated expressions of surprise when the 'Ask the Audience' lifeline is to be used at the top end of the monetary scale, with presenters making 'the playful suggestion' that the answers it provides should be treated with suspicion (Holmes, 2004: 491). Although the knowledge of *Horrible Science* quizzes is often about people, it should not be confused with the knowledge of 'everyday folk'. If anything, as already shown, it is presented as a way of distinguishing oneself, drawing on the appeals of history of science as esoteric trivia: Bacon died after trying to stuff a chicken with snow, Lavoisier was a tax collector, Newton invented the cat-flap. Thus the history of science is as decontextualised as scientific information (perhaps even more so – there are no joking images of historians of science on instructions on how to go about doing historical work). As discussed at the end of chapter six, the books do not quote sources, and in some respects the fictional framings make it harder to discern the writers' sources. This helps provide a very friendly tone, but it does also make the books' claims harder to refute.

Although *Horrible Science*'s questions are often trivia-based (a complicating factor I shall discuss later) there are also a few more conventional school exam-style comprehension tests, especially the new summative quizzes added to the end of the rebranded books. These tend to underline content already presented to readers, the implication being you *should* be able to answer the questions and that the purpose of reading the books was to learn some discernible, discrete, factual knowledge:

> If you've been paying attention while reading this book, you'll be as clever as those cunning chemists you've met along the way. Take this quick quiz to see just how much you've learnt (*Chemical Chaos*, 2008: 160)

The passing of these quizzes is explicitly tied to a sense of being able to progress in science, as each of these added-on quiz sections is introduced with a simple title page which re-prints the cover's cartoon title (but in black and white) with a very

simple sketch with the words '**QUIZ** [line break] Now find out if you are a **Chemical Chaos** [or **Disgusting Digestion**, etc] expert!' (emphasis as original).

Considering both quiz-shows and educational quizzing, John Tulloch (1976) argues that the question/answer set-up of a quiz suggests that knowledge is a thing which can be possessed and demonstrated in the use of facts. It 'abolishes explanation' (Tulloch, 1976: 6). Buckingham and Scanlon's (2003) study of edutainment computer software describes the preponderance of what they call 'drill and practice' packages, which take users through a range of repetitive tasks for mental arithmetic, spelling or multiple-choice questions for exam revision (albeit wrapped as science fiction quizzes or basic space-invader games). Through these games, the user is 'trained to follow the rules, and the rules are taken to be objective and indisputable' (Buckingham & Scanlon, 2003: 116-7). Further, such quiz-like quick questions and short, repetitive answers 'fetishize *performance*' in its own right, rather than emphasising the meaning or use of the information that such a performance provides (Buckingham & Scanlon, 2003: 123; emphasis as original). In the *Horrible Science* CD-ROMs, it is particularly hard to access the answers. You are simply told you are wrong, and so have to replay the question, clicking through each option before you can find out the correct answer. It would be unfair to draw conclusions about *Horrible Science* quizzes based on these items (which were, after all, given away with cereal). Still, in terms of the central book-series it is worth noting that the answers are generally given upside down. They appear as interruptions to the general narrative and are in some respects incidental to the rest of the content. Thus, in this respect they seem to celebrate the performance of being asked more than being able to repeat the correct answer.

Buckingham and Scanlon emphasise the context of government testing in the marketing and construction of such edutainment software. Gillborn and Youdell (2000) dub this the 'A-to-C economy' in post-1980s English schools, a metaphor they feel encapsulates the sense of competition as well as the language (such as currency) that the teachers and students use to talk about examinations, and the rather depersonalised way both are asked to articulate educational knowledge (Gillborn & Youdell, 2001: 74; see also Ball, 2001, theorising 'performative' education). Although *Horrible Science*'s way of presenting itself as 'down with the kids' tends to mean eschewing such a school-orientated approach, the new summative quizzes suggest the books are moving more explicitly towards the test-primer literature. Moreover, the A-C economy is one which *Horrible Science*

audiences will have grown up with (even at the series' origins in 1996). The scorecards shown in fig 7.1 may seem harsh, but in some respects they reflect the everyday context in which young people find scientific knowledge presented to them.[23] Indeed, we might read both this harsh testing and *Horrible Science*'s largely trivia-based quizzes as a carnivalesque satire on the emphasis on testing and performance currently required by the UK education system. I think this would be a rather simplistic reading of the rhetoric of trivia, as I will discuss in the next sub-section. However, it is still a context worth keeping in mind, as is *Horrible Science*'s apparently anti-school position in respect to this.

Towards a Sociology of Trivia

A format that all the social studies of the quiz show seem to ignore is the celebrity panel show structured around a quiz that, to some extent, parodies the quiz-show format itself. In particular, *QI*, short for 'Quite Interesting' (BBC television, since 2003), is a useful example here, as it awards fewer points for correct answers, and more for 'interesting' ones. Moreover, many of the questions are extremely obscure, with an implied assumption that the contestants will not actually know the answers. Points are deducted for an obvious yet wrong answer, especially one that is generally accepted as true but is, in fact, false. In a book accompanying the show, its producer and creator John Lloyd states:

> In the words of the man who didn't invent the light bulb, Thomas Edison, we don't know a millionth of one per cent about anything [...] This book is for the people who know they don't know very much. (Lloyd & Mitchinson, 2006: xvii)

Arguably, this is the approach to quiz questions that *Horrible Science* takes, with its highly esoteric trivia and hard-to-guess answers. There are echoes of this elsewhere in children's media culture; Marsha Kinder (1999) describes television show *Eek!stravaganza* which ends with a 'useless fact' to parody moralistic epilogues (Kinder, 1999: 190). Shows like *QI* (and similarly *Horrible Science*), however, do maintain their own celebration of being able to perform factual information, by celebrating the notion of 'quite interesting' and actively laughing not only at wrong

[23] See, for example, Millar & Osborn (1998) for critique of performativity of modern English science education.

answers, but also at those who are stupid enough to believe what everyone else does. It is not as simple or critical a parody as, for example, *I'm Sorry I Haven't a Clue* (BBC Radio 4, from 1972) but rather a mix of satire and earnest love of knowledge.

One of the consequences of reading *Horrible Science*'s quiz-mediated trivia in terms of the one-upmanship swaps of knowledge found on *QI* is to highlight the use of esoteric information as a form of cultural capital. The quizzing is done for a laugh, playing with competition, but is nonetheless itself competitive. Moreover, in *Horrible Science*, the quiz is still rooted in educational cultures and in the idea of the child as an ignorant character who is undertaking a progressive process of learning. We can see a visual reflection of this in the scoreboards in fig. 7.1. The 'winning' children are presented with powerful imagery: calm in their success, 'electrifying', 'cosmic' or 'howling' with achievement, a smug and shining 'medical miracle'. The winner on the dinosaur scoreboard is particularly interesting, taking on the image of the T-Rex, complete with vampiric fangs, suggesting some danger and destruction in its intellectual power. In comparison the 'losers' are sickly, frazzled, sluggish, blinkered, even 'extinct'. Perhaps most interestingly, the characters in between appear frustrated, suggesting they have an urge to work their ways up the ladder. *Horrible Science,* through its application of quizzes and more, celebrates the ability of scientific knowledge to distinguish oneself from others.

The other key point to make about the sorts of highly esoteric trivia within *Horrible Science* is the sense of randomness that it invokes. John Fiske (1987) draws on Levi-Strauss to distinguish between 'games', which sort participants into winners and losers, and 'rituals', which take differentiated groups and provide a sense of communality. As Fiske describes, quiz-shows start by introducing the participants – 'what's your name and where do you come from' – which, he argues, takes them from differentiated individuals to equal competitors, underlining how much they have in common both with each other and with the audience. The notion of game then takes over as this newly established equality is tested, suggesting that although the contestants had equality of opportunity, they might not have equality of ability (Fiske, 1987: 265-6). Shows that introduce a sense of luck (e.g. through the spinning of a wheel) not only minimize the personal sense of failure, but, more importantly, suggest that the rewards of the system are, in fact, available to all, thus taking the show back to a suggestion of ritual (Fiske, 1987: 270). The notion of randomness in such shows provides the elitist associations of competition with a

'democratic alibi', suggesting the prize is one 'available to everyone (given a little bit of luck)' (Fiske, 1987: 271). To Fiske this is a way in which the quiz-show, rooted in capitalistic ideology, can demonstrate that we all supposedly start off equal and progress via a naturalised idea of individual (decontextualised, inherent) ability (Fiske, 1987: 266).

This analysis might fit the working-class orientated shows that Fiske focuses on, with their randomly generated questions. It does not so readily fit the academic knowledge-based quizzes of *Horrible Science* and *QI,* which in some respects rely on randomly generated answers. Interestingly, *Horrible Science* appears to mix the 'ritual' luck basis of such randomness with the reward system of a 'game', reflecting the value judgements of an examination and other quizzes which utilise academic knowledge such as *Mastermind* or *University Challenge*. Such a conflation of 'bet you never knew' within an 'only the best will know' framework endows the academic knowledge of *Horrible Science*'s quizzes with the impression of 'naturalised ability' which Fiske sees in luck-based shows.

In many ways this brings us back to the forms of cultural 'invisibility' at work in Discovery Learning. Indeed, Gillborn and Youdell (2001) argue that the decontextualised factual testing of the A-to-C economy is exacerbating what they call a 'new IQism' where the word 'ability' replaces and encodes what we once called 'intelligence'. They note that the reintroduction of setting is largely articulated in a public-spirited sense that 'high-flyers' and 'slower learners' are helped most by different types of education (to take language from a 1997 Labour party report quoted by Gillborn & Youdell, 2001: 76). They also emphasise that this sense of 'ability' is generally constituted in ways that lead to the systematic disadvantaging of particular social groups, especially working-class students of Black/African-Caribbean heritage. To Gillborn and Youdell, 'ability', with its decontextualised sense of where knowledge comes from, acts as cover for social and cultural differences. People who would be shocked at the idea of educational policy based on *The Bell Curve* still utilise forms of its discourse, under a different name. In this context, it is worth returning, again, to the scoreboards in fig 7.1 and how naturalistic they are, especially the first one, which applies a medicalised sense of the ability to perform intelligence, from 'less than sickly' to 'a medical miracle'. In all the examples, the successful students seem blessed and gifted; puffs of smoke or a blaze of light only underline the apparent magic of their ability. In comparison the less successful are sluggish, sickly, smelly or extinct. The frame of a magazine personality test further

reinforces this naturalistic frame by alluding to psychological 'types'.

Conclusion

The various interactions offered by *Horrible Science* promise the reader's involvement, yet do not really allow much space for it. They present 'allusions' to interactivity which require audience participation but do not really allow for audience agency. This is the audience participation of pantomime; scripted, independent of the actual thoughts or reactions (or discoveries) of the audience members, loud, done for a laugh, and largely reliant on all actors having some familiarity with shared cultural codes.

The quizzes are the most obviously non-interactive. They go on regardless of what response the audience gives, only differing over what degree of clod/clever-clogs the readers are invited to imagine themselves as. We might even argue that the quizzes largely serve to show off to the readers how little they know. Yet they are framed as 'test your teacher' as much as they are test yourself; the implication being that having been through the (comically) humiliating experience of looking like a fool, you have learnt some new piece of esoteric knowledge whose cultural capital you can now use for your own gain. Competition runs through all of this; either because it is imagined that children, through interactive edutainment, will learn competitive skills for the workplace without realising it, or because knowledge is quite explicitly presented as a tool for winning in competitive action against others.

Discovery is not so much experienced in *Horrible Science* as talked about, and knowledge is presented as ready-made. The fast and snappy factoids of trivia provided by the quizzes may apply notes on scientists' lives, but largely present knowledge divorced of social context. Similarly, the so-called experiments, through their production of an apparently empowering sense of being doable by anyone, imply that knowledge is simply there to be found. There is, however, something slightly postmodern about *Horrible Science*'s approach to interaction. In both the experiments and quizzes, an anarchic and rebellious image of the child is depicted – children find and throw about knowledge out of the control of adults. The quizzes are generally counter-intuitive, with answers directed at the teacher rather than for them. Like *QI,* this is knowledge for those 'who know they don't know everything'. It is thus, perhaps, analogous with forms of subcultural capital, or constitutes a complex form

of cultural capital exchange around academic knowledge (c.f. Thornton, 1995, Bourdieu, 1988). Still, it does seem to suggest a back-and-forth of information, which although highly competitive, implies an opening up of the field of knowledge production to more than singular top-down 'deficit' processes. We should not mistake this for a utopian emancipation of children in respects to the hegemony of the scientific establishment, but it perhaps does suggest that adults writing for children are doing so with some awareness of the politics of children's involvement with science.

Chapter 8
The Uses of Humour

Introduction

At the end of chapter two, I argued that panto-science plays with connecting with the audience, but only plays. It plays with realism, but only plays. It plays with the idea of being counter-cultural, but, again, only plays: all points I hope to have explored in the last few chapters. Still, we should be careful of the 'only'. This chapter aims to take playfulness seriously through a sociological study of humour. I argue that *Horrible Science* uses humour for a range of social and educational actions. Jokes are applied didactically, challenging their audience to take on the point of view of the joke-teller, or simply to focus the audience's attention on a particular subject or to introduce new, technical, language. Comedy is also utilised to present particular images of science, often used as if in some opposition to an assumed seriousness in science. In more incongruous mode, humour in *Horrible Science* suggests a subversion of social norms, occasionally seeming to challenge scientific authority in order to include the child. There is also a multitude of jokes at the expense of 'stupid people'. Such characters are generally teachers, but can also be children. Notably, when they are scientists, such jokes are generally quite affectionately made.

The chapter starts with a brief overview of humour in *Horrible Science*, including some reiteration of what this thesis has already said on the topic. This is followed by another short section introducing the theoretical approach to humour I have chosen to take. The chapter then splits *Horrible Science*'s humour into two analytic themes. One section considers the use of humour for social distinction. The next continues with some of the issues of social distinction, but focuses more on the apparently rebellious appeals to nonsense, multiple realities and the carnivalesque. This section also covers unresolved issues from chapter four, on *Horrible Science*'s use of comic horror. As we shall see, *Horrible Science*'s use of humour may imply a sense of freedom and social dissonance, but it is equally (if not more) likely to

emphasise the status quo. The contradictions of this are, in many ways, the bedrock of their irreverently-reverent approach, and central to panto-science's invitation to 'have your myth and relativise it'.

The Humour of *Horrible Science*

Playfulness, irony and joking are all issues that this thesis has already referred to, and it is worth starting this chapter with a summary of what has already been discussed. In chapter three, in my discussion of commercial culture, I referred to the use of humour (especially ironic parody) to declare some distance from a cultural referent, especially popular commercial culture. Far from being subversive, I read such parody rhetorically as lending credibility through processes of distinction. Moreover, several of the examples seemed to display as much love for their referent as criticism of it, and in some respects comedy appeared to be applied to excuse the enjoyment of cultural forms that peers might consider inappropriate, silly or even taboo (or at least as an expression of ambivalence around the insecurity of enjoying such culture). In chapter four, on the nature of the horrible in *Horrible Science*, we saw a take on the horror genre that was more *Bugs Bunny* (or *Itchy & Scratchy*) than Stephen King. We also saw wordplay twists on the notion of 'horrible'. In chapter six, aspects of comedy were touched on in respect to questions of fiction and I referred to how Tony De Saulles talked of how he used cartoon characters (even if these were a fly or dog) with an ironic look on their faces simply to provide some life to drier scientific exposition (De Saulles, 2006). Further, the fictional framing of many of the 'fabricated documents' was signalled by the use of humour. These three themes, irony for some amount of distance, comic horror, and the disconnection between non-fiction and humour are all central topics in *Horrible Science*'s use of humour and will be fleshed out in more detail in this chapter.

The cover of *Suffering Scientists*, shown in fig 8.1, is a good introductory example of *Horrible Science*'s 'sense of humour', applying incongruity, language-based jokes, a focus on the body, a premise based on misunderstanding between characters and appeals to the grotesque, macabre, dangerous or painful. The central joke is one based around incongruity of meaning, a joke of misunderstanding (around 'cracked'), but its humour is also derived from the visual image of the character's skin going a lurid, grotesque, shade of green. The theme of this colour is worked throughout the picture; in the green of the chemist's face reflected in the fluid

of his broken flask, as well as in the container labelled as poisonous. The greens are further emphasised through juxtaposition with browns, oranges and reds, most notably in the chemist's unusually brown lab coat (*Horrible Science* tends to stick to the white coat convention), as well as brown hair, eyebrows and glasses, all of which sit on top of the green skin. It is noteworthy that this joke is constructed through both visual and textual elements, again indicative of the humour within *Horrible Science.*

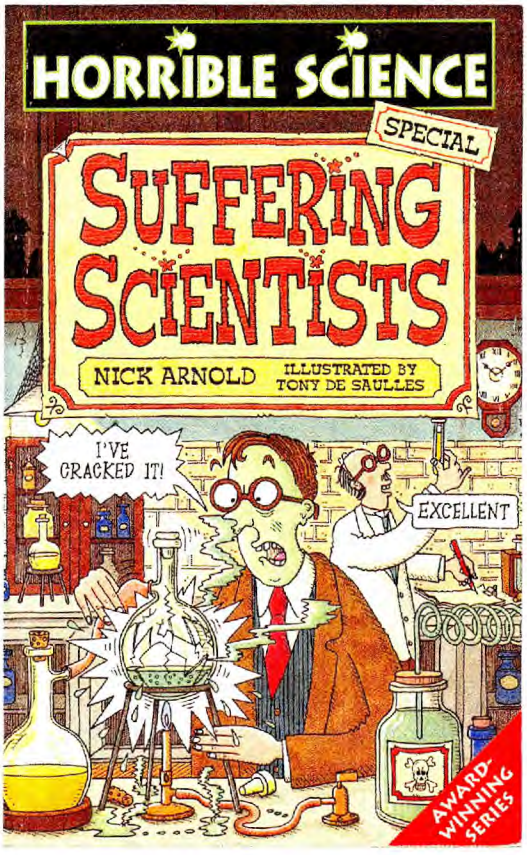


Fig. 8.1. Front cover of *Suffering Scientists* (2000)

Humour is a key part of the patterning of the *Horrible* brand. In many ways, it is an application of humour that distinguishes the series from other non-fiction books for children. In interview, both Arnold and De Saulles stressed the need for jokes in the series and discussed processes of joke-making in describing the construction of the texts. Jokes and joking are placed upfront in the books. Covers, at least before the re-brand, are based around jokes, often a pun (e.g. fig 8.1; see also figs 2.1, 4.1), and promises of humour are generally referred to in the books' introductions. These signals to humour tend to suggest themselves as unusual for science media; using a promise of humour to construct distance between *Horrible Science* and the experience of science in the classroom (see fig 8.2, to be discussed later). We can

see *Horrible Science* making some self-referential comments on its own joke-telling. *Painful Poisons* (2004), which has a passage on laughing gas, jokes under a large notice of 'IMPORTANT ANNOUNCEMENT' that:

> we would like to deny rumours that Horrible Science books have been sprayed with laughing gas in a pathetic attempt (ho ho!) to make you laugh at the painfully corny jokes (giggle, snort).
> This is a laughable, HA HA HEE HEE! Lie. (*Painful Poisons*, 2004: 51)

The book then goes on to tell an anecdote about a comedy club owner who tried something similar. It is also worth noting that the biographical sketch of Arnold, at the start of each book, tends to list 'thinking up corny jokes' as one of his three favourite hobbies (note that this sketch is written in the same ironic tone as the above quote). This self-awareness of the corniness of its jokes is also indicative of *Horrible Science*'s style of humour. *Horrible Science* often uses apparently self-deprecating humour to show self-awareness (as, to some extent, we saw in discussion of references to *Horrible Science* branding). This is part of the overall suggestion that we should not take anything, including the books themselves, entirely seriously.

Analysing Humour

Although humour is an under-researched topic, it is a disciplinarily rich one, as researchers from philosophy, psychoanalysis, literature, cultural studies, linguistics, social psychology and sociology have all, on occasion, taken an interest. The abstractions of philosophy can be reductive, but they make for a useful heuristics and a convenient starting point. For example, to answer the large question 'what is humour' reasonably simply, John Morreall (1983) characterises humour as a 'pleasurable psychological shift'. This is similar to Koestler's (1970) idea of 'bisociation'; that humour occurs during movement between, or an unexpected combination of, distinct interpretive frames. Morreall also catalogues theories of humour (i.e. those produced by other humour theorists) into three key areas: humour as a perception of incongruity, a form of psychological relief, or an articulation of superiority (all of which we can spot in the examples this chapter provides). However, if we are to take the study further than simply an analytical form of I-spy, we will need to flesh out these theories slightly more. I have chosen to focus on sociological analyses of humour. This helps us consider the use of humour for social distinction

(or community building) and, applying sociology in a phenomenological vein, on references to disorder and nonsense in the construction of knowledge.

As several researchers in social studies of humour have noted, the lack of research in the subject may be due, ironically, to the social status of humour itself. Humour is criticised as not being a serious subject, as unscientific (unable to be empirically understood) or, conversely, not a sociological subject but a topic to be left to physiological or psychological research (Davis, 1995: 328-9). Probably the largest problem is the first of these: the humorous and the serious exist as separate discourses, making the social processes of joking seem an inappropriate subject matter for the serious business of social research. Michael Mulkay (1988) further argues that because 'funny' tends to occur when we combine two divergent frameworks (in Koestler's terms, the combination of distinct interpretive frames), to explain the confusion is to separate them, and so to unravel the joke (Mulkay, 1988: 30). Thus, even if we do believe comedy is a topic worthy of sociological examination, humour research suffers from being seen to 'spoil' the joke; from seeming to take itself *too* seriously.

Mulkay's concern that sociologists of humour might be thought of as 'spoiling' the joke is an important one, and an issue that Michael Billig's (2005a) recent book on humour takes up earnestly:

> The idea of a critical approach to humour sounds somewhat sinister. It suggests bossiness or craziness. Either way, the prospect is not pleasant. (Billig, 2005a: 1)

Billig goes on to argue that social critics should not allow themselves to be worried by this; indeed, that it behoves social studies to examine the notion that 'the world might be changed by warm-heartedness, lots of hugging and a little more laughter' (Billig, 2005a: 11). As Billig puts it, this might appear anti-humour, 'but there are worse crimes', as a critique of humour allows one to escape being pressured into the idea that 'You've got to laugh. You've got to...' (Billig, 2005a: 9, 241).[24] This chapter will follow Billig in arguing that we should be wary of assuming humour as in any way inherently 'good'. Still, it is also worth emphasising that there is nothing necessarily wrong with *Horrible Science*'s use of humour as a tool in science communication

[24] A point he makes particularly cogently in his article on comic racism (Billig, 2005b).

either. In reading the humour of panto-science, we should not allow any assumed valorisation of either humour as a whole, or particular types of humour, to get in the way of our critical awareness of the social action at work, but equally there is no reason to demonise the practice.

Critiquing the Carnivalesque

For the purposes of analysing *Horrible Science* it is worth extending this scepticism to the books; celebrations of what is best considered under the broad remit of 'the carnivalesque'. As I introduced the carnivalesque in chapter one, the Bakhtinian carnival is characterised by parody, playfulness and nonconformity, especially the subversion of social hierarchies (Bakhtin, 1968). Bakhtin's study was a study of European folk culture in the Middle Ages, but can also be taken as a satirical attack on Stalinist repression (Morris, 1994). In Bakhtin's words, it was a 'temporary liberation from the prevailing truth and from the established order' (Bakhtin, 1968: 10). The carnivalesque also revels in incompletion and inconsistency. As Jerry Palmer (2005) describes, key to the carnival is the capacity to believe in something profoundly but also to enjoy parody of it; the capacity to believe in one thing and its opposite simultaneously without needing to worry about a sense of incoherence (Palmer, 2005: 91).

Although not explicitly part of carnivalesque literature, I think we can fold in Michael Mulkay's (1988) take on what he dubs 'pure humour'. Comedy, by Mulkay's reading, revels in the 'ambiguity, inconsistency, contradiction and interpretative diversity' that the serious considers problematic (Mulkay, 1988: 26). Jokes do have to make sense. They have to furnish an understandable connection between the punch line and the rest of the text, and thereby between the divergent frames of references juxtaposed within the joke. But, according to Mulkay, the range of interpretive connections allowed humorous space is much wider than what would be permissible in serious discourse. Compared to the apparently 'unitary' objectivity of serious discourse, such 'pure humour' has an ability to construct new and diverse views of the world (Mulkay, 1988: 33-5).

Stallybrass and White argue that carnival is now not only a ritual feature of European culture, but (having passed through Foucault and Bakhtin) is now 'a mode of understanding' and a 'positivity' at that (Stallybrass & White, 1986: 8). Humour in

the carnivalesque sense is often valorised for its revolutionary potential, but we should be careful of assuming too much of comedy's capacity for social change. Stallybrass and White work through a range of critiques of Bakhtin and emphasise that the carnival was always licensed and as such it was a brief, closed and single moment of freedom which allowed revolutionary tendencies to be made public and kept under control. To ban it would arguably allow an urge to transgression to build and thus to run throughout culture. In many ways, the carnival, as a singular moment of extreme transgression (largely symbolic at that) threatens the dominant ideology hardly at all (see also Shields, 1990, Jenks, 2003, and Medhurst, 2007).

Looking at the carnival in the specific contexts of children's books, John Stephens (1992) argues that carnivalesque texts, by breaching boundaries of normal behaviour, may explore social norms and assumptions over what is natural or real about the world. However, they do so without necessarily redrawing such boundaries. The carnivalesque, Stephens contends, acts as a 'time out' where children are allowed to transgress the rules that control their lives. Stephens' key example is E Nesbit's *Five Children and It*, where, he argues, the child characters are allowed to escape adult control, but only to show how incapable they are in dealing with the world on their own. Thus, the carnivalesque is used less to question the values of the official world, but more to convince us of their worth (Stephens, 1992: 137). We could argue that the carnivals of children's literature do not deconstruct in order to allow the construction of something new, but are performed to show young people why rules were built in the first place. They are part cautionary tale, part history lesson. Similarly, we could see the apparent transgressions of *Horrible Science* less as a challenge to scientific authority and more as a place where the desire to revolt can be played with. Further, it serves a rhetorical function of misdirection, letting the readers feel as if they have participated in something more revolutionary (c.f. Gauntlett's reading of Adorno).

We should also be careful of simplistically assuming that the topsy-turvy moments of the carnival are necessarily mobilised to be anti-establishment. Bakhtin's emphasis on a celebration of uncertain and multiple viewpoints in contrast to dictatorial 'closure' is in many respects very attractive, but just because this was anti-Stalin does not mean it was not supporting of another dominating ideology. As Murray S Davis argues in a critical review of the sociology of humour, comedy is as likely to be used for any one purpose as another: the left tend to complain that humour is too conservative, whereas the right are equally threatened by its radical

possibilities (Davis, 1995: 337). Similarly, Andy Medhurst uses a case study of Roy 'Chubby' Brown to point to what he largely sees as the class-based ideological assumptions of 'rebel-worshipping' humour studies (Medhurst, 2007: 187-203; see also Wagg, 1992, who blames satire for Thatcherism). As we shall see in later discussions of the twists and turns of *Horrible Science*'s wordplay, inversion can be utilised to emphasise or lead to the status quo as much as to critique it. We should also be wary of assuming that any opening up of multiple points of view which carnivalesque humour invokes is somehow liberating. For example, Matthews and Mendlesohn's (2000) analysis of gender in the sci-fi sit-com *Third Rock From the Sun* argues that because the show's producers want to attract a broad audience – for, against and apathetic to feminism – it references and laughs at each political discourse, providing conveniently inconclusive moments of comedy which ultimately challenge no-one (Matthews and Mendlesohn, 2000: 42, 47). Read thus, the ambivalences of humour are largely a commercially advantageous cop-out. This is not to say that humour, or *Horrible Science*'s application of it, cannot have some role in social critique, just that we should not assume that it is somehow on our own side, nor should we allow ourselves such an ideologically complacent position as to imagine the existence of 'pure humour'.

Excuses of Humour

A final point to make in terms of theorising humour is whether comedy somehow 'excuses' content by way of rendering it unreal: the question of whether comedy is 'only joking'. According to Tulloch and Alvarado's (1983) study of *Doctor Who*, the emphasis on comedy (largely in the 1970s) led to the odd compliment from a colleague of Mary Whitehouse that Dr Who's violence was 'acceptable' because it was so fantastic (Tulloch & Alvarado, 1983: 158). Similarly, Pickering and Lockyer (2005) suggest that Ali G or Mrs Merton provide a form of 'comic licence' for offensive statements via their parodic costumes (Pickering and Lockyer, 2005: 188). However, Claire Colebrooke (2004) emphasises, largely through discussion of *American Psycho* and *Reservoir Dogs*, that to use a discourse ironically still allows the continued articulation of that discourse 'even in quotation marks' (Colebrooke, 2004: 155-9). Irony may provide distance, but it can be a reasonably short distance. As Linda Hutcheon (1985) argues, postmodern ironic parody can be read as a way of dealing with history in a manner that both shows some acceptance, knowledge and celebration of the past as well as a desire to break from it (Hutcheon, 1985: 101,

112). Although humour might suggest unreality, as we saw in chapter six, forms of make-believe can have their own realism, and comic discourse can have equal, if not more, rhetorical capabilities as fiction.

To repeat Eco (1985), irony is applied to signal our 'non-innocence' in enjoying old stories. To some extent, we discussed the exploitation of this in chapter three, as irony provides advertisers with a 'cosy niche', anticipating customer resistance by appearing to be self-aware (Klein, 2000: 89. Wagg, 1992b: 281). We might question whether this is humour at all. Indeed, Jameson (1998) distinguishes between parody and what he argues is the dominant form of postmodern media, pastiche. As he puts it, 'Pastiche is blank parody, parody that has lost its sense of humour' (Jameson, 1989: 131). Although all parody involves some 'secret sympathy' for the original, Jameson feels that pastiche lacks satire's 'ulterior motive' of critique, and is largely applied by late 20th century commercial culture in order to simply repackage successful media of the past. Under these terms it is arguable that it is pastiche rather than parody which is the dominant form of cultural reproduction in *Horrible Science*, especially in its use of characters drawn from popular culture. Except this pastiche is largely played with at least an allusion to laughs: the overtly heavy-handed characterisation of pastiches of science fiction, non-fiction media or horror film tropes suggests that we should not take the project entirely seriously. It may not be highly critical satire, but that does not stop it from also being expressly comic. Overall, I think the 'short distance' suggested by Colebrooke, or Eco's sense of expressing 'non-innocence', are the most productive ways of conceptualising *Horrible Science*'s pastiche/parodies.

The Boundary Work of Humour

Processes of distinction and community construction are key to humour, not only in terms of who the humour concerns, but also in the process of its telling. Sociologist of humour Christie Davies (1988, 1998) argues that one of the outstanding features of humour in industrial societies is the popularity of jokes told at the expense of 'stupid people', a point I will discuss in detail here. As Billig's book emphases, it can be very hard to stand up against the social pressure to laugh; to be seen to 'not get the joke' is to risk dismissal. The first part of this section provides some theoretical overview on issues of 'getting' a joke which fleshes out the introductory statements made above on the sociology of humour. I then discuss in detail issues of implied

science/ humour boundaries and *Horrible Science*'s particular take on the 'stupid people' joke.

'Getting' a Joke

When considering the social actions of humour, many emphasise the need for a common 'discursive community' for comedy to be shared between individuals. As Giselind Kuipers starts her recent book on the sociology of the joke:

> The importance of a shared sense of humour is made obvious by its absence. It is almost impossible to build a relationship with someone who never makes you laugh, who never laughs at jokes you make or even worse: who tries really hard to be funny but insists on telling the wrong jokes. (Kuipers, 2006: 1)

The discomfort of a joke not 'got' is particularly pertinent to the use of humour in the kind of knowledge-based discourses I am concerned with. Discourses around science often include jokes that in some way police the borders of accuracy by pointing out the mistakes of others or poking fun at the ways in which distinct communities understand words differently.[25] Hutcheon argues in respect to irony, that if children do not get the humour of a particular statement, it is generally because they do not share the knowledge that allows the joke to work (Hutcheon, 1994: 96). She also makes a similar point through a fascinating study of a museum exhibition on the history of colonialism held in Toronto in 1989-1990. This exhibition aimed to use an ironic tone to self-referentially parody the imperialist traditions of museum exhibition design. However, to many of the 'new museum audiences' that the exhibition appealed to (i.e. those whom such imperialist traditions had previously excluded from museum culture), the irony was not apparent. Although aiming for a post-colonialist stance, the exhibition largely inverted the knowledge of a very white experience; it did not speak to the Black visitors. Interpreted by many as racist, the exhibition was picketed, the curator resigned from teaching and arrests were made after clashes between police and protesters.

What makes this example of a failed ironic exhibition so interesting, however,

[25] Folklorist Alan Dundes provides some fascinating examples of precision necessary in a collection of jokes told amongst mathematicians (Renteln and Dundes, 2005: 26, 28-30).

is how unusual it is. It is quite a brave person who can say 'that's not funny'. We may pretend to find something funny simply out of politeness, to avoid the discomfort Kuipers describes, but we also do it to avoid seeming 'out of the loop'. Discourse analyst Joel Sherzer (1985) draws out Freud's assertion that jokes have an aggressive component, to suggest there are two victims of jokes; those that they are aimed at, the butt of the joke, but also the audience. The latter group, by being joked *at* rather than *about* are 'suddenly being given a short intelligence test and being forced, whether they want to or not, to publicly display knowledge' (Sherzer, 1985: 219). Thus, to be seen not to get a joke is to display a lack of knowledge. Understood thus, we could consider the humorous references in *Horrible Science* as like the laughter tracks on broadcast comedy. The top panel in fig 8.2. is a quite explicit example of this, with the figure of the child laughing, overtly signalling to the child-readers that this is an occasion for laughter.

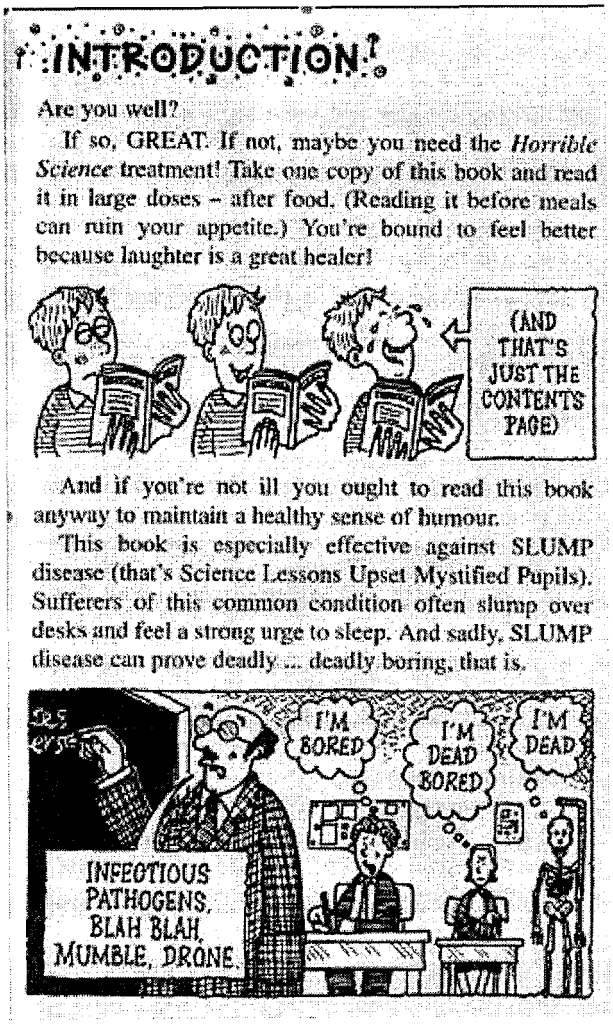


Fig. 8.2. SLUMP disease (*Deadly Diseases*, 2000: 149)

Children, perhaps more than others, are familiar with jokes they do not understand; learning what is appropriate to laugh at is a part of the processes of socialisation they engage in every day. It is worth noting that much humour works through some form of reference, whether it is a pun, a parody or irony. As discussed in chapter six, intertextuality works differently in children's culture; cultural references may lead didactically to new sources as much as they affirm a shared community. Kuipers notes children's jokes are often full of riddles, working as a test. She also notes the preponderance of 'dumbness' jokes and suggests this is to be expected from a social group whose cognitive skills are so constantly scrutinised (Kuipers, 2006: 162). A child not getting a joke in an educational setting may experience a feeling of exclusion, but rather than protesting (as in Hutcheon's ironic exhibition example) they are much more likely to act to change this by changing themselves, learning the hidden discursive code in order to 'get it'. Because humour works largely by being unquestioned (to do so would 'spoil the joke') we could consider it as a particularly powerful form of Bernstein's (1975) 'invisible pedagogy'.

However, this didactic use of comedy is unreliable. The audience may 'switch off', thinking they do not share the writer's sense of humour, or, more straightforwardly, simply refuse to accept a joke. To some extent, *Horrible Science*'s tone of being 'down with the kids' challenges the idea of the didactically-applied joke. The books appear to utilise the image of the 'adult who thinks he's funny', even against the books themselves (as we have already seen in the references to 'corny jokes'). Still, I think we can characterise such self-parody as largely defensive of the central implication that *Horrible Science* is funny, even if it is silly-ly so, and those who do not agree are a bit rubbish, open to be left behind.

Working Humour/Science Boundaries

To many humour theorists, the humorous is the opposite of the serious. To Billig, they are two sides of the same coin: 'humour and seriousness remain inextricably linked. Neither can abolish the other without abolishing itself' (Billig, 2004: 243). We can consider such a binary enacted within the context of those boundaries that define our sense of what science is, with serious/humorous boundaries constructed alongside those of science and non-science. If science wishes society to take it seriously, and humour in some way diminishes seriousness, then it is perhaps unsurprising that humour should be kept, in Gieryn's words, on 'the other side of the

Demarcation Mountains' (Gieryn, 1999: 6). Further, if we take Mulkay's (1988) view that humour is a space where our normal logic can be disturbed, we can expect science, so strongly implicated with logic, to distance itself from processes of joke-telling and anarchic laughter; thus associating itself with the side of serious discourse.

The presence of a humour/science boundary is reflected in *Horrible Science*'s use of humour. Fig 8.2, for example, is indicative of the way *Horrible Science* tends to start from the assumption that school-science is humourless and the promise that the books will provide something new. As discussed in chapter six, De Saulles suggested in interview that it can be harder to construct jokes on the physical rather than natural sciences, explaining that he often dealt with this by adding an allusion to animal life:

> Quite often use flies, hovering over something and you know a thought bubble from the fly. So you are, are thinking about the animal's perspective on something. Which has nothing to do, nothing to do with teaching about the actual animal, it's just a way of injecting a bit of humour. (De Saulles, 2006)

This suggests that active work has to go into making much scientific content funny (see Critchley, 2002, for philosophical/ historical articulation of this view). There are a few places where the *Horribles* appear to find the application of humour inappropriate though. Scanlon's (2008) study of the *Histories* notes a more 'somber' tone in the books on the Victorians and 'Blitzed Brits', where events are much closer and too much joking might appear crass. For *Horrible Science*'s part, it is noticeable that the pages go very blank when discussing chemical warfare, with relatively simple display of facts, with images left at basic runs of skull and crossbones as a 1/5 'vicious verdict' rating (*Painful Poisons,* 2004: 54-5).

Also worth considering in the context of *Horrible Science*, Jane Kenway and Elizabeth Bullen note the boundaries of humour around child/adult and fun/school. Kenway and Bullen bemoan the ways in which children's commercial culture continually constructs school spaces and people as:

> an old-fashioned, puritanical, drab and over-disciplined place where, dreadfully or ridiculously, children must be governed by others or be

self-restrained. (Kenway & Bullen, 2001: 71)

Their point is not simply to complain about the negative image of schools that such media present, although this is part of their grievance, but to argue it has been developed by commercial media largely to construct a specific child market for their products. *Horrible Science*, however, does not fit simply into this sort of portrayal of school as bad and alternative spaces of commercial culture as fun. As both commercial media applying the conventions of such a 'down with the kids' address and non-fiction, the Horribles are in a difficult position. They must appeal to a child-only space, for which the anti-school image has become a rehearsed and convenient short hand, but at the same time they must sell themselves on their ability to teach the reader something and so must retain a degree of didacticism, of communicating (adult) academic authority.

In dealing with this problem, *Horrible Science* plays with assumptions that science is the opposite of humour in a rather carnivalesque way, openly turning humour/science boundaries in on itself to reach an advantageously playful range of takes on the words. The key way in which this is achieved is through the use of 'horrible'. As we saw in chapter four, the word horrible is utilised very flexibly, at once applied with negative connotations to the tedium of school as well as to 'child-friendly' appeals to the grotesque. By calling science horrible and then simultaneously celebrating a rather comical idea of the horrible, with Hammer-style monsters or cartoon images of people catching fire when they fart, Arnold and De Saulles endow school science with fun. A dual use of 'horrible', both literally and conceptually, associates good and bad throughout the books, in part through their 'weird domesticity' aesthetic, but also as a consequence of the multiple meanings of comedic wordplay. Fig 8.2 is an especially nice example of this as it shows horrible as both disease and cure: the boredom of school could render you as dead as a skeleton; the laughter caused by reading the book will make you cry.

The boundary between serious and humorous, science and its outsides, is still a useful one for *Horrible Science*. The notion that *Horrible Science* provides something in opposition to the standard approach is a key promise made by the books, not only as an appeal to fun, but also as a possible distinction between the *Horrible Science* reader and those who stick to the standard curriculum. As already discussed in chapter four, the introductions to the books often suggest that they can provide not just the science you learn in school 'but the funny bits and the fascinating

bits, the bits you really want to find out about' (*Chemical Chaos*, 1997: 6). They imply access to an experience and/or knowledge previously hidden, which not everybody will have access to. This is produced in part through references to the grotesque and scatological humour, but similar points can be made about the use of irony to imply an alternative, privileged view of the world. As such, the carnivalesque rendering of 'the horrible' is both an appeal beyond serious discourse and to the advantages held within it. We should not imagine that the dual use of the word horrible somehow conflates boundaries entirely. Again, Gieryn's (1999) cartographic metaphor of boundaries is useful here as maps not only show us where two bounded groups are separated, but also show shared space; performing, at once, similarity and distinction.

'Stupid People' Jokes

According to Christie Davies (1988, 1998), one of the outstanding features of humour in industrial societies is the popularity of jokes told at the expense of 'stupid people'. His work is based on an analysis of jokes about ethnicity,[26] but can be easily mapped to scientific boundaries. Davies argues that 'stupidity jokes' are normally aimed at those close to the joke-teller but on the periphery of their exact social group: 'The people at the centre are thus laughing at what appears to them to be a slightly strange version of themselves' (Davies, 1998: 1). He suggests that this has increased with the development of industrial society; as notions of rationality become more highly prized, we increasingly tell jokes which distinguish ourselves from apparently less rational others. From this it is easy to see how science can become implicated and associated with comedy, despite any of the serious-science/ humour boundaries. Of particular interest to science studies, Davies discusses the use of jokes about 'stupid people' made by astronauts and other aeronautical or highly technically-skilled workers who deal with possibilities of mortality (Davies, 1998: 146). Surgeons are another example where professional sense of intelligence is a matter of life or death: 'Where a community has to live by its wits, stupidity is likely to be a despised, feared and widely mocked characteristic' (Davies, 1988: 8).

[26] A warning to anyone chasing up this work: Davies does not, I think, reflect enough upon the racist nature of such jokes, a point Billig (2005b) takes him to task for.



Fig. 8.3. Misunderstandings (*Fearsome Fight for Flight*, 2004: 46, 128)

In *Horrible Science* we can see this in terms of the children confusing scientific terms shown in fig 8.3. The confusion around the word 'dense' is particularly interesting, as the child mistakes it as an insult to their intelligence. The (bespectacled) child character, rather pompously, states 'I'm quite brainy, actually', the upside-down box below scolding 'say that and the scientist really will think you're dense stupid' (*Fearsome Fight for Flight*, 2004: 46). It is worth noting that the schoolchildren are not on the periphery of the social group of the readership (they are the readership) in the way that Davies finds. They are, however on the periphery of science. Unlike in Davies's examples, where peripheral 'stupid people' are ridiculed to keep them at a distance, *Horrible* Science's children may some day be part of this group. This is a key difference between a child's relationship with popular science and adult audiences. Thus jokes based on a child's stupidity are more

commonly applied as an impetus for further study; a threat of potential future dismissal to the periphery. Turn the book upside down to read the correct answer and you will not seem as foolish as the child who mixes up a turbine with a turnip or assumes a slang meaning of 'dense'. Here the narrator plays an interesting role, he is not simply the centre laughing out, but an outsider with implied impartiality, sitting between science and the 'periphery' of future-science, facilitating communication.

In general, teachers are the key target of 'stupid people' jokes in *Horrible Science.* The image of the teacher at the bottom of Fig 8.2 is typical. Here the content of his speech bubble is left largely unfinished with 'blah, blah, mumble, drone' showing disrespect for what he might say. The reflection in his glasses obscures his eyes, emphasising the lack of relationship between this character and the outside world. The extreme patterning on the jacket suggests bad fashion sense. This, along with the baldness, fatness, flushed cheeks, and slightly pained expression, gives him a rather ridiculous, grotesque appearance. Frequently, humour is applied in this way to diminish the epistemic authority of a teacher, as, for example, when the size of a teacher's brain is compared to a microbe (*Microscopic Monsters*, 2001: 7).

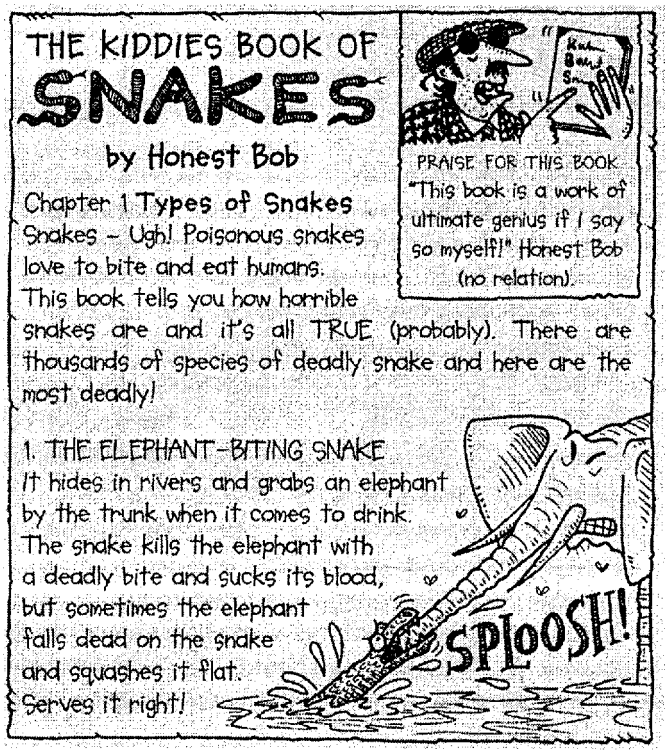


Fig. 8.4. Kiddies Book of Snakes (*Angry Animals*, 2005: 55)

Other targets of the 'stupid people' joke tend to come from popular culture. Used-car salesman 'Honest Bob' is one of the most interesting examples, especially as he is not only laughed at for being stupid, but as in fig 8.4, readers are actively asked to exercise their own superiority by spotting his mistakes. I think it is important to note that Honest Bob is not necessarily shown as stupid to believe in, for example, the deadliness of snakes, as much as he is stupid to assume the readers might believe him. These are 'porkies' as much as mistakes and if anything he is presented as laughably stupid for imagining his audience is simple enough to believe in his crass and fault-ridden products. Thus, the readers are not only asked to enact intellectual superiority in respect to this 'Kiddies Book of Snakes' but to declare their intelligence against being patronised as stupid.

Davies follows his analysis of 'stupid people' jokes to argue that such jokes are reflected by a similar preponderance of jokes at the expense of those seen to be 'too rational', which Davies describes as jokes about the 'canny'. Jokes about the canny take similar forms to those about stupid people and suggest that apparently over-rational people actually exhibit a lack of rationality in their over-enthusiastic application of the post-industrial work ethic. As Davies puts it, 'There lurks in all these jokes a distinctly subversive message about the value and purpose of work and about the rationality of being a hustling American workaholic' (Davies, 1988: 13). Many of the jokes made at the expense of scientists can be understood in this sense; for example, the chemist in the background in fig 8.1, who is too absorbed in his own work to notice his colleague being poisoned. It is also humour against 'the canny' which is a large component of the jokes targeting teachers, especially in respects to their 'blah blah' dull speech. Geek character Norbert Nerdworthy is similarly laughed at for boringly complaining about fantastical elements in science fiction (*Terrible Truth About Time*, 2002: 134).

It should be noted that jokes at the expense of scientists tend to be more affectionate compared to those directed at teachers. We could even argue that there is a sense of reverence rather than dismissal in these jokes. The chemist in the background of fig 8.1 is in many ways a clear reflection of Rosalind Haynes's image of the scientist as 'stupid virtuoso'; a character who has forgotten the normal social rules of behaviour in the quest for knowledge. The flipside of these characters, however, is the more romantic depictions of 'the unfeeling scientist', one that is often admired 'as the inevitable price scientists must pay to achieve their disinterestedness' (Haynes, 1994: 3). For example, *The Fearsome Fight for Flight*

(2004) starts by emphasising that humans are not meant to fly, laughing at those who tried, both in terms of the incongruity of people flying and in some ways suggesting they were too stupid to know this. However it *ends* on a much more celebratory stance and it is those who doubted and laughed at the first aeronautical mechanics, including the narrator of the introduction, who are now revealed as the stupid people. Because we are laughing with incongruity at these odd people doing things we never would (and because these odd people were successful) a sense that the achievers of science and technology are special is constructed. They are not normal, which makes them funny, but it also gives them power. Jokes about the canny in *Horrible Science* are, therefore, not simply dismissive but reverent of the scientific establishment. They construct distance between scientists and other people and work the boundaries of popularised science in a very traditional way.

Humorous Transgression

As discussed in my overview of theories of humour, the carnivalesque and nonsense jokes are often celebrated for their ability to present alternative and multiple views on reality (Mulkay, 1988, Bakhtin, 1965), but we should be wary of assuming too much of comedy's capacity for social change. This section examines the chaotic and transgressive moments of *Horrible Science*'s humour, and looks in detail at how such an approach to comedy is used in a range of normative and pedagogical directions, many of which fit neatly with the very school-science the books appear to eschew. The first part, on wordplay, considers comedy's potential to construct new or multiple meanings. I then unpick some of the ways in which *Horrible Science* reflects and applies connections between comedy and horror, with some specific comments on the use of comedy to poke fun at fears.

Wordplay and Multiple/Alternative Realities

Much of the humour in *Horrible Science* has a linguistic basis, with the extensive use of puns, assonance and alliteration. This is immediately apparent in the books' titles: *Evil Inventions, Sounds Dreadful, Frightening Light, Deadly Diseases* and *Ugly Bugs.* Linguistic play occurs within the texts as well, sometimes as a break from scientific

exposition.[27] Such wordplay provides entertainment and allows Arnold and De Saulles to show off their semantic dexterity. However, the puns utilised when introducing scientific terms that are assumed to be new to the reader also help disentangle the origins and meaning of such words (c.f. the call to consider linguistics of science education in Sutton, 1992). To some extent we saw this in fig 6.3, with the fly's thought bubble imagining an anvil in a human ear to explain the names of the bones in the inner ear. The play on amplitude/ample in fig 8.5 is a particularly good example of such educational punning (and of the several visually-worked puns in *Horrible Science*). The wordplay around ample/amplitude works in part by ridiculing the character for eating in excessive quantities and with excessive noise, but is also reflected in the expository image of the sound waves emphasising the loudness of the character's eating. His 'ample' frame feeds into the sound waves of the amplitude and the image applies a pun to connect abstract scientific explanation with a specific example.

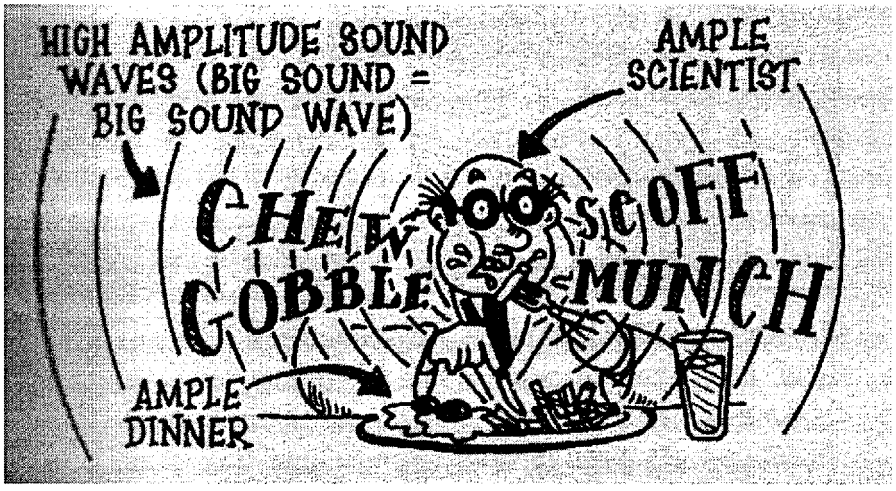


Fig. 8.5. 'An ample scientist' (*Sounds Dreadful*, 1998: 9)

Joel Sherzer argues that puns are a particularly interesting form of humour. They work on semantics as well as simply noises, they allow words to simultaneously combine two unrelated meanings, with the possibility of constructing a new one (Sherzer, 1985: 213). The same can be said for rhyme, assonance and other linguistic play. We can see this at work in one of the first *Horrible Science* books, with a play on the use of the word 'body' to make links across (and apparently subvert) ideas of the ownership of science:

[27] E.g. 'Urine for a wee test young man' (*Measly Medicine*, 2006: 55).

> [science] belongs to everybody, because everybody's got a body – and you've got every right to know what's going on in yours (*Blood, Bones & Body Bits*, 1996: 5).

Yet such 'constructive' use of wordplay is fairly unusual; it is more likely to show similarity between words in order to emphasise the meaning of one of them (as in ample/amplitude). Moreover, where wordplay is used to present an alternative view, it tends to be applied to social comment, rather than used to construct new ways of looking at the natural world. *Horrible Science* does not seek to follow Mulkay's social-constructivist approach to scientific knowledge, only to challenge forms of scientific dissemination.

We might consider the jokes made around scientific terminology as embodying a form of political resistance, or at least a critical voice, using humour to show up the ways in which scientific jargon acts to construct epistemic boundaries. *Nasty Nature* (1997) starts with a complaint about 'the odd words scientists use', which, the book suggests, 'leave a nasty taste in your mouth – when you can understand them' (*Nasty Nature*, 1997: 133). *Fatal Forces* starts with a 'translation' of a teacher's comment, suggesting that the teacher really means to 'blind you with science' to stop students asking questions (*Fatal Forces*, 1997: 6). Still, it would be erroneous to imagine that *Horrible Science* is opposed to scientific language. It is worth considering another key form of humour around technical language, those based on misunderstandings, fig 8.3 being a good example of this. Such didactic examples provide the standard application of linguistic humour in *Horrible Science*. Even when the implied readers are not threatened with ridicule, wordplay on scientific terms (as with amplitude) emphasises particular words, putting them on show to make them more memorable, deconstructing them to highlight both their pronunciation and meaning through links to more familiar sounds and imagery. This is an expository approach which Ogborn et al (1995) describe as 'creating difference'; inspiring learning by pointing out what the student does not yet know about.

Similarly, incongruous connections made in *Horrible Science*'s joking (wordplay or otherwise) are most likely to laugh at how ridiculous a combination might be; joking at the impossibility of something and emphasise the status quo. For example, the 'incongruous' talking skeleton at the bottom of fig 8.2 shows a dead

person talking, but it only works as a joke because the audience recognises it as unbelievable. As Jerry Palmer argues, it is the resolution of a joke which we laugh at; the punch line, a feeling of relief when order is restored (Palmer, 1994: 95). Jokes of incongruity may suggest alternative views, but they also require normalised, sometimes naturalised, ideas of reality and will always replicate these in their telling, even if their aim is to criticise. The joke of a skeleton talking and the reality that dead people are not conscious are co-defined within this joke; the existence of incongruity only acts to emphasise the realist message. Jokes based on misunderstanding are a particularly good example of this. Where misunderstanding takes place, we are presented with some form of contest over the perception of reality. However, a value judgement tends to be made one way or the other; there is a difference between *mis*understanding and 'understandings'. In the case of the child thinking a turbine is a turnip (fig 8.3), we could equally berate the scientist for using language their audience cannot understand. However it is the child who is made to appear foolish and blamed for the incongruity; the implication being that the reader should learn the language of the scientist so not to allow themselves to be equally open to ridicule.

Comic Horror

As already established, *Horrible Science* presents a reasonably 'cosy' form of horror. The 'squishy' of the 'science with the squishy bits left in' tagline onomatopoeically suggests various biological oozes, but does so through 'squishy' synonyms such as bogeys, poo, or puke (rather than more 'adult'/ scientific terms). Moreover, 'squishy' also implies soft, suggesting toys as much as bodily fluids. It is the cartoon depiction of dismembered bodies, blood and viscera, somehow removed from actual human pain. We might also argue that the image of scientific work presented by *Horrible Science* is similarly comically violent. By performing a sort of ironic parody of science as tough and combative, the swapping of facts becomes analogous to a form of pantomime stage fight.

As I stated at the start, I do not think that when analysing humour we can take it as an 'excuse' for violence, but it is interesting to note that the idea that humour cushions forms of 'the horrible' is referenced by *Horrible Science* itself. For example, fig 8.2 shows the introduction of *Deadly Diseases* (2000) playing with the topic of disease and healing to present the book metaphorically as a cure for 'SLUMP'

(Science Lessons Upset Mystified Pupils). Billig (2005) argues that such medicalised associations with laughter provide a large part of the generally unquestioned power of comedy. In Billig's reading, because humour is seen as providing a form of psychological relief, we assume it is an inherently good thing, which is part of what makes it so hard to argue against the idea that 'you've *got* to laugh'. Playing on the notion that laughter and joking are a natural, important part of being a healthy, functioning human which Billig is so critical of, fig 8.2 suggests that if you are not ill, you 'should' read this book to maintain a healthy sense of humour. As a play on medicine and the 'relief' of laughter, the humour here is to some extent pun based. However, we can see such a link between the jokes of *Horrible Science* and notions of relief or respite made outside the medically themed books; for example:

> There is some science in this book, but it's been cushioned with lots of jokes to stop it damaging your brain too much (*The Fearsome Fight for Flight*, 2003: 6)

Again this references the theme of the particular book in question, playing with a discourse of safety associated with flight, but it is worth noting how often *Horrible Science* finds a way to make a link between care and humour. Still, I want to emphasise that the child in fig 8.2 is *crying* with laughter. The bodies generally presented in *Horrible Science* are not exactly a conventional picture of health: the green-skinned chemist in fig 8.1; the messy eater in fig 8.5. We might take all of this as a challenge to Billig's analysis, but rather I think it is indicative of *Horrible Science*'s carnivalesque aesthetic and the ways in which the books not only suggest that humour helps with allusions to pain (be it Frankenstein's monsters, descriptions of poison or boring science homework) but that the allusions to pain are in some way comic in their own right (e.g. fig 4.5 of blood-soaked guillotine).

To start to understand these connections between comedy and horror, we might argue that horror is inherently comic, or at least that there is some strong link between the two. We could frame this as a relatively psychoanalytic view; that dealing with horror is necessary and humour allows us the emotional relief or distance to do so. Alternatively, we could see this as part of a late-modern inclination to what Kuipers calls a 'hardening of humour', indicative of a broader cultural trend towards shocking entertainment (and current affairs) content, noting how young people happily disconnect the offensiveness of a joke from how funny it is (Kuipers, 2006: 146, 155). We might also see the comic/horror connection as necessary in the

working of horror into an entertainment form. In his study of horror comics, Martin Barker (1984) suggests that the ambivalence of humour is central for the success of horror as fun. If it was 'really real', the horror would not be nearly so pleasurable. As such, Barker continues, the horror genre has to be self-conscious, as audiences are continually presented with the constructed nature of their stories, kept uneasy as to whether it might be true. In this respect, horror is 'necessarily unstable', inexorably sliding into parodies of itself, satire and self-mockery (Barker, 1984: 131-3; c.f. Taylor, 2003, on pantomime drawing attention to its 'fourth wall').

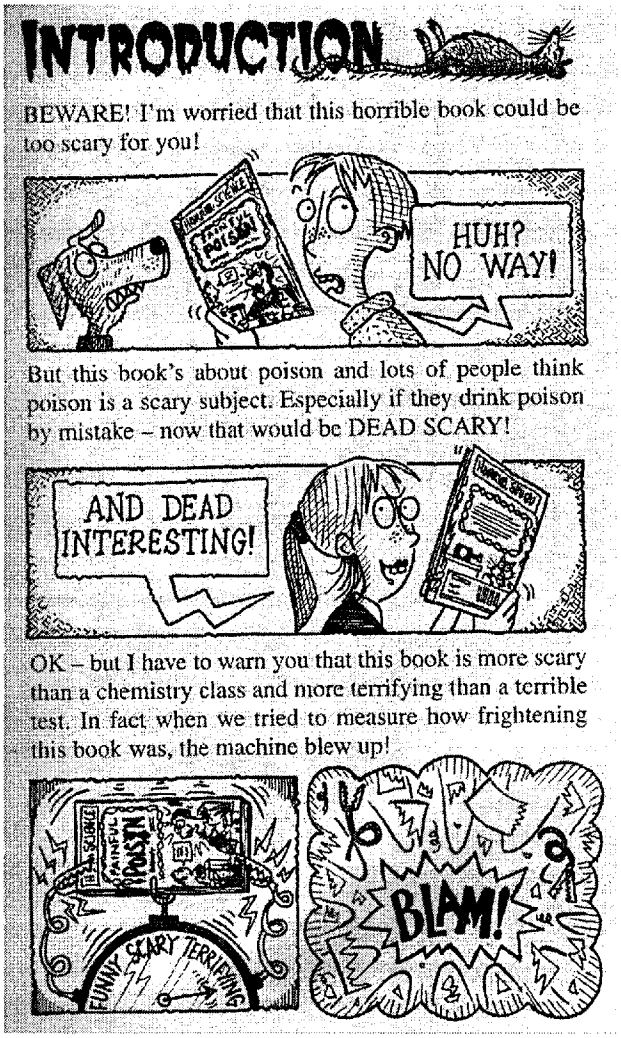


Fig. 8.6. Beware! DEAD SCARY (*Painful Poisons*, 2004: 5)

We can also understand the comic horror more historically, as part of the intertextual history of the horror genre. Just as there is a legacy of links between science fiction and horror, *Horrible Science* is working within a context of connections

between comedy and horror. For example, *Horrible Science*'s intertextually-formed characters, whether from horror (e.g. Baron Frankenstein and his monster) or a detective thriller (e.g. MI Gutzache), seem to have been forged in pre-spoofed replications as much as they are a replication (spoof or otherwise) made by *Horrible Science* themselves of any pre-parody originals. Buckingham's discussions with young people about watching horror are again illuminating, as he notes that many of his interviewees seem to see violence as intrinsically comic but that in some respects this reflected the subject's desire to show they recognised the formulaic and unrealistically sensationalist nature of the genre (Buckingham, 1996: 127-9). Barker's point that the horror comic inevitably slides towards self-parody as it presents itself in a 'self-conscious' way is in many ways a useful analysis, but the horror comics can equally be read as self-aware parodies of Victorian gothic literature and early cinematic horror. Equally, *Horrible Science*'s parodies of comic horror can be understood, post-horror comics (post-*Bugs Bunny*, post-Hammer Horror, post-*Itchy & Scratchy*), as simply the way we now 'non-innocently' consume the tropes of horror.

There is also a significant recent history of treatments of comic horror for children. For example, Leo Baxendale, creator of the *Bash Street Kids* and *Minnie the Minx*, talks of a desire to depict 'scruffier' and more anarchic children and the influence of watching the comic blood, death and explosions of 1940s Warner Bros animations. He contrasts both of these with the more 'soft' fairytale images which the *Beano* applied up until the 1950s, and depicts himself as an advocate of a more realistic approach to children (Baxendale, 1989: 12-13, 10). To *Horrible Histories* author Terry Deary, the social acceptability of the *Horribles* is largely due to the legacy of Roald Dahl who, according to Deary, made the use of horror and black comedy in children's books acceptable (Deary, 1999: 97). In science-specific contexts, the image of the child causing explosions with their chemistry set has an even longer history (Al-Gailani, 2007). This is particularly true in the UK where the image of the childlike 'Professor Branestawm' and his anarchic, often highly destructive experiments had enduring influence through the 20th century (i.e. Hunter, 1933, 1974, 1983). *Fungus the Bogeyman* (Briggs, 1977) is also worth remembering in terms of *Horrible Science*'s rendering of the horrible as 'yucky' (especially their make your own snot activity). Reflecting on such a history, we can understand *Horrible Science*'s use of comic horror as not only socially acceptable because of the others that went before it (i.e. it is not about to incite the reaction that the horror comics did in the 1950s) but also because such comic horror has become part of the accepted currency of how to suggest fun to children. The introduction to *Painful*

Poisons (2004), shown in fig 8.6, is a particularly good example of this. It works a goading application of the horror comic alongside 'visual you' images of scared and fearless children in a similar way to the 'health warning' notices discussed in chapter four, but with images of children actively demanding the scary content.

Carnivalesque Bodies: Safe Monsters?

It is worth considering in detail *Horrible Science*'s use of comic horror in the specific context of images of the child's body, as the books often aim to say something about anatomy, not only to implicate it in comedy making. Other children's literature will play with toilet humour, but for *Horrible Science* this is a topic, as are spots, spiders and mould. Arnold and De Saulles are choosing to dwell on such topics, and in a particular way, as part of their approach to child-orientated entertainment but it is also a substantive part of what they aim to teach something about.

In many ways, *Horrible Science*'s particular take on the 'horrible' (a conflation of toilet humour, anarchy, and the monsters of horror fiction) means that the books are populated with the types of grotesque bodies indicative of the carnivalesque. The bodies of Bakhtin's carnival were typically depicted as 'multiple, bulging, over- or -under-sized, protuberant and incomplete', with dwarves, giants, farting and feasting, as a sense of incompletion, a lack of control is emphasised over more stable, 'glossy', official images of closure and polish (Stallybrass & White, 1986: 9). Again, the rather 'unhealthy' bodies of the green-skinned chemist or 'ample' scientist provide good examples, as does the use of Frankenstein's monster as an explanatory tool for the child's body (fig. 8.7) or alien characters (fig 6.1). Grotesque and unhealthy they may be, but they are all also comical. They embody a 'happily horrible' form of monstrous images, and as such are rendered relatively 'cute'. *Horrible Science*'s take on the Frankenstein monster is typical of this: childlike, with big eyes yet lacking the size or muscular strength of many other depictions of this character. In some respects, the alien characters are similarly 'sweet'.

John Stephens (1992), while discussing the carnivalesque, takes Maurice Sendak's *Where the Wild Things Are* as a case study and argues that it presents a form of particularly child-friendly 'safe horror', its monsters all with relatively rounded shapes reminiscent of a baby. As Stephens argues, Sendak's take on the grotesque is 'comic and droll, rather than frightening', and yet the monstrous form it laughs with

is still important to the story's telling:

> since one way in which the book invites to be read is as a coming to terms with the potential wildness of one's own inner being. By giving comically grotesque forms to inner fears, the illusions image the defeat of that fear (Stephens, 1992: 136).

I think we can apply Stephens's analysis to the way in which the body is considered in *Horrible Science*, substituting a relationship with the 'inner being' for more external ones, turning fears young people might have about their own body into 'safe monsters'.

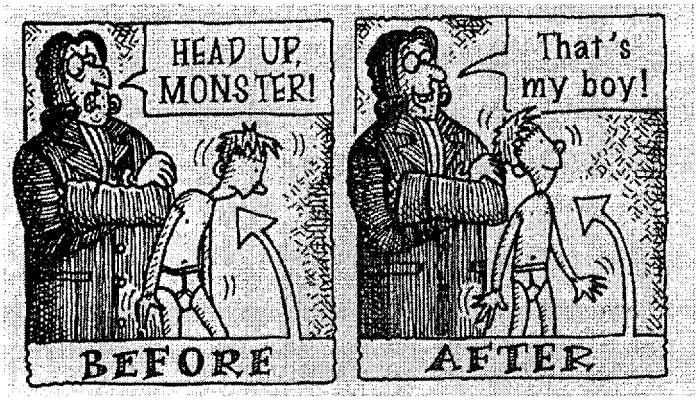


Fig. 8.7. Frankenstein Child (*The Body Owner's Handbook*, 2002: 67)

For example, in chapter six we saw a *Horrible*-style cartoon rendering of the sorts of diagrams of the digestive system frequently reproduced in school textbooks and exam papers (fig 6.2). In some ways the cartoon form provided distance from the actual digestive system (compared to, for example, a photograph), but it also makes it very personal, with a sense of immediacy partly implied by a cartoon hand of a doctor character holding the example by its neck. Further, there is the sound of 'plop' (in a friendly, handwritten-style font) along with the childish, slightly twee term of 'poo'. This is juxtaposed with comical language which simultaneously pokes fun at, and applies, the conventions of talking indirectly about excretory matter; 'solid waste ejection pipe' and 'conveyor belt for waste processing'. In this respect, we could argue *Horrible Science* has as much in common with books for the very young about coming to terms with using a toilet (e.g. *Everybody Poos,* Gomi, 2002), as it does those aimed at 7-11s appealing to a scatological 'child only' space (e.g. *Magic of Pants,* Poskitt & Reeve, 2004).

I want to emphasise that I am not applying this notion of safe monsters because I think we should read *Horrible Science*'s comic horror in terms of 'humour as psychological relief', but because I think it is this idea that is being applied by the books. *Horrible Science* seems very aware of the power of humour to dissolve problems and of an educational need to dissipate children's fears of scientific topics. Put simply, *Horrible Science* seems to be applying comic horror not only to appeal to young people, but because they have a commitment to the idea that children are scared by aspects of science and that a comic-horror rendering into 'safe monsters' might be an appropriate pedagogical approach for dealing with this. Possibly the best example of this is *Painful Poisons* (2004), which starts by stating that 'lots of people think poison is a scary subject', then goes through a goading, pantomime device of implying you don't really want this, do you, parodying a patronising adult voice (*Painful Poisons*, 2004: 5-6. See fig 8.6), and concludes by emphasising that poisons are everywhere and although it is 'easy to be scared' the best way to deal with poisons is with knowledge rather than fear (*Painful Poisons*, 2004: 143-4). We can see similar shifts, from the fear 'some people' irrationally hold, and towards knowledge and a delight in the horrible nature of the scientific object, in *Angry Animals* (2005) and *Chemical Chaos* (1997). We might also apply this reading to the twists around the word 'horrible': *Horrible Science* seems conscious that its readers find science work painful in some way and by applying a comic horror approach it pokes fun at the idea that we might be scared of science. Again, this is an example of humour enacted in support of the scientific establishment, even when it appears to be employed irreverently towards it.

Conclusion

I hope the examples presented in this chapter demonstrate that comedy in *Horrible Science* is not a simple matter of 'sugar coating', but is made in, with, and about scientific content as much as to decorate. The ways sound waves act to emphasise the messy eating of the scientist in fig 8.5 is a particularly good example of this. Overall, humour help build s sense that *Horrible Science* has a privileged view compared to the rest of the world. This view is one which the readers are invited to participate in, although only if they accept and take on the premise of these jokes. *Horrible Science* remains the joke-teller and science remains the stamp of authority; children are positioned as recipients of both.

Horrible Science seems to apply humour alongside horror, connecting the two as if horror is inherently funny (and vice versa), perhaps working within an understanding that 'dark humour' is a particularly effective or usual way for adults to affably address children. With the examples of comic horror we can also see *Horrible Science* appearing to apply a notion of comedy as a form of 'psychological relief'; a few jokes made about the 'horror' of scientific objects or the 'suffering' of scientific work are applied to dissipate distaste or fear of such subjects. Still, as we shall see in the next chapter, horror is also invoked by *Horrible Science* to emphasise respect for nature, technologies and scientific work. Such respect is not entirely dissipated by the use of comic horror and, arguably, a reason for using comic horror (as opposed to simply being comic) is not only to recognise a child's initial fears of, for example, poisonous chemicals or 'angry' animals, but also to reflect a sense that these objects perhaps should be understood as 'terrible'.

Overall, when *Horrible Science* appears to be placing science as the butt of the joke, it is more likely to support scientific authority than to deconstruct it. As in Stephens's (1992) analysis of the carnival as a moment of 'time out', humour is used to throw rocks at science only to prove how well they bounce back, rather than anything more revolutionary. *Horrible Science* requires, and relishes, scientific authority; as with fiction, its application of humour does not diminish it in any way. Some of the most overt examples of associations between science and comedy are present in jokes dismissing 'stupid people'. There is also the more phenomenological possibility that the incongruities of humorous discourse can open up new or multiple constructions of reality, a way of critiquing scientific authority. *Horrible Science* references the ability of humorous discourse to provide alternative, perhaps additional, views of the world, revelling in a carnivalesque identity that celebrates the epistemological advantage of the outsider. However, in practice, it is more likely to apply the juxtaposition of multiple points of view in order to emphasise one (generally that of scientific authority) over others or simply to escape having to tie itself down to a single ideology. Just as Billig argues we should not assume comedy is necessarily a 'good' thing because it makes us laugh (thus, beware of clowns in medical clothing), I would like to add that we should not be wary of the misdirection of humour as necessarily subversive and/or inclusive (thus, beware of politicians in clowns' clothing).

Chapter 9
Appeals to Wonder

Introduction

This is the point in the thesis where *Horrible Science*'s anthologising of a broad range of cultural references is at its most clear, as I shift from the last chapter's topic of the ridiculous to discussing allusions to the sublime. It is also the point where I tackle a reasonably traditional style of popular science, wonder, which appears to have been anthologised in with *Horrible Science* more postmodern moments of fiction, parody horror and commercial culture.

Horrible Science frequently appeals to a sense of wonder and curiosity, and combines this with the sometimes sensational notion of 'the horrible' to promise to 'blow your mind' with boggling, awesome, fascinating, fearsome, amazing magnificence. We might consider such language as a consequence of *Horrible Science*'s ironic homage to commercial culture. However, this style of language also has a history in the discourse of wonderment, which is widespread in educational and popularised science contexts. Students learn to display a sense of enthusiastic, wide-eyed wonderment in educational encounters. Often utilised by way of loose explanation for the delight in scientific study, the feeling of wonder becomes performance; a way of demonstrating membership of an intellectual group. I want to emphasise that, as with any community construction, there is an element of boundary work involved here, making wonder a way of excluding people. Moreover, allusions to wonder are not only a particularly strong way of articulating the superiority of science, but one that invites the compliance of audiences.

This chapter seeks a critical framework for considering discourses of wondrous science. I understand appeals to wonderment as a rhetorical device of science communication; a way of signalling and performing identity or meaning. Wonder is an unwieldy, flexibly applied term; and it is therefore useful to also

consider the overlapping terms of curiosity, fascination, marvel, mindboggling, awesome and fantastic (to name but a few). Because, in *Horrible Science,* we often find a sense of wonder enacted in terms of awe in a large and/or violent manner, the sublime is particularly useful. Reflection on the sublime also provides us with some useful philosophical approaches for approaching a critical analysis of wonder, developing Jon Turney's (2004) discussion of appeals to the sublime in popular science literature.

This chapter starts with a brief introduction to *Horrible Science*'s use of wonderment as exemplified by the hardback 'special', *The Stunning Science of Everything* (2005). I then provide an overview of theories of wonder and associated terms, especially regarding children, with a particular focus on the sublime. The rest of the chapter then divides into two key themes: firstly how are the audience invited to position themselves with respect to science (both its objects and people) in the context of encountering wonder; secondly, whether such a 'potpourri' of wonders (worked alongside humour) can still be discussed in the context of the sublime.

The 'Stunning' Science of Everything

The discourse of wonderment in *Horrible Science* is perhaps most explicit in the large-format hardback 'special' brought out for the gift-book Christmas market, *The Stunning Science of Everything* (2005). Its chapter titles are indicative of an appeal to the hugeness and wonder of nature as told by (horrible) science: the Stunning Start, Brain-Boggling Big Bang, Awesome Atoms, Mighty Microbes, Explosive Earth and Unbelievable Universe. The language and illustrations throughout suggest a sense of studying science as something physically, psychologically and intellectually overwhelming, in part because of the wonder of what they are looking at (e.g. the earth) but also because of the complexity, difficulty or reach of the scientific ideas (and scientists) themselves. The introduction starts by stating that science is about everything:

> But that's the problem there's too much science! Too much to learn, too much to remember. I mean, how can any normal person ever make sense of science?
> Well, you could try building a super-powerful computer, program it with every science fact in the universe and plug it into your brain. But this

might have unpleasant side effects (*Stunning Science*, 2005: 4).

This is followed by an image of a brain being blown up (see fig 9.1). As with all *Horrible Science* allusions to horror, this is comical and light-hearted with little emphasis on the fact the character *died*, but this use of comedic tone does not stop the message of the blown mind having some metaphorical significance.



Fig. 9.1. Exploding brain (*Stunning Science*, 2005: 4).

On the following page, a section discussing thought experiments for conceiving the start of the universe is accompanied by similar images of a taxed brain, with droplets of bodily fluid (it is not clear which) dripping from it, along with the words 'think', 'imagine', 'dream' and 'calculate' (all in capitals, with exclamation marks). 'WARNING!' the narration states: 'These experiments are guaranteed not to make a mess, but don't think too hard or brain juice might squirt from your ears' (*Stunning Science*, 2005: 6). Again, a joke, but the implication is that thinking about science is difficult. As often alluded to in *Horrible Science*, there is the suggestion of science as an extreme sport. The beginning of the universe is then presented via a parody of a sensationalist news story. Under an 'exclusive' headline – 'the universe is born!' – there is a large picture of a red explosion with dust, lightening and rocks flying out of a central white-hot ball (*Stunning Science*, 2005: 7). This acts to add comedy through the slight mocking of news language, but at the same time appropriates this discourse to add drama and a sense of sensational wonder to the event. Wonder is not only invoked in reference to astronomical entities. The chemistry chapter includes a double-page spread on 'The Wonder of You':

> Awesome, isn't it? Somehow a collection of molecules got together and arranged themselves to make you. And it's stunning to think that you're only alive because such tiny things do their jobs (*Stunning Science*, 2005: 26)

This extends the sense of being mindboggled to biology. Similarly, elsewhere the body is described as 'the most marvellous machine in the universe' (*Stunning Science*, 2005: 52). Again, as we continually see in *Horrible Science*, this quote asks the reader to stop in stunned awe. They are not asked to think further than to go 'wow'. In this respect, wonderment acts as a stopping mechanism.

The introduction then goes on to suggest that the book solves the problem of readers' brains exploding by providing a 'new way' of doing science: 'size sorting'. As discussed in chapter five, this is a reductive framework implying particle physics sits at the centre of understanding. In terms of this chapter's interests, I think this structure connects a feeling of awe at the wonder and vastness of the universe with one of the ability of science not only to comprehend such vastness, but also to extend our view to see this vastness and even explain and organise it. By the end, the epilogue congratulates the reader for managing to get through this 'long journey from the tiny big bang through ever more sizable science to the giant goodbye of the enormous universe' (*Stunning Science*, 2005: 92), before opening out into a lavishly illustrated colour timeline of 'Everything'. This five-page, double-sided pull-out conflates astronomical and futuristic timelines, along with those from natural history and the history of science to produce a far-reaching narrative suggesting a completeness which literally stretches and transcends the boundaries of standard sized pages of a book (*Stunning Science*, 2005: 94-8).

In two places in *Stunning Science*, Arnold interrupts the size-sorting device, once in terms of the big bang, then again for DNA, but this is largely for dramatic effect, emphasising extremes and (reductive) power through juxtaposition:

> This chapter is meant to be about the most tiny thing ever, but it's suddenly got STUNNINGLY big [...] In that all-important instant the new-born universe grew from a tiny dot to a fireball billions of kilometres across
> But you never saw [in the 'shrinking scientists' tour of the body] what the body is *really* made of. Your body has more than 50 million million (50,000,000,000,000) cells [...] Inside the cell, there are over 20,000 different types of protein molecules – perhaps 100 million in all. I wonder who counted them?
> But the most amazing secret lies inside the nucleus. That amazing DNA stuff is actually a secret code – but what does it mean? (*Stunning*

Science, 2005: 8, 57. Emphasis as original)

Both quotes emphasise nature as the object which we are meant to be in awe of, but this is nature quite clearly mediated by science, as evidenced by the language used, especially in the second quote (proteins, cell, DNA), as well as the rhetorical question posed: 'I wonder who counted them?' These moments of deviation from the size-sorting structure could be read as a deliberate break in a reductive framework, a warning against being lulled into the comfort of neatly packaging things into intellectual sets. I think these moments are taken to celebrate science's capacity for opening up visions of nature and to suggest a form of wonderment in the complexity and uncertainty of science (as common a rhetoric of science as that of reductionism). Also important in this passage is the 'never saw', which emphasises that this wonder is something which is hard to see.

Studying Wonder

As with the chapter on humour, here I happily undertake the task of un-weaving some 'rainbows' of children's and science media. This section will provide a brief introduction to the etymology of wonder, including specific discussion of associations with children, as well as some philosophical discussion of the sublime. The sublime is a particular form of wonder, the aesthetics of which are especially dominant in *Horrible Science.* Moreover, the particular philosophical approaches taken to considering the sublime are useful in my analysis of wonderment in general, helping us consider how appeals to wonder position audiences, nature, experts, ideas and technology with respect to one another, especially through the function of awe.

A Brief History of Wonder

Wonder is one of those especially elastic, flexibly applied terms that work around the boundaries of science. Historian of etymology Neil Kenny (1998) argues that the allied concept of 'curiosity' shares much with other notions enacted to construct knowledge or the desire for such knowledge: interest, wonder, marvel, strangeness, subtlety, secret and rarity being the few he flags up. He also emphasises that all these terms have a particularly notable plurality of meaning (see also Marr, 2006: 2-3). Kenny argues that boundaries of curiosity were, throughout the Early Modern

period, 'in a constant process of being not only inscribed but also dissolved'. It was unlikely that curious and useful would be at once linked and dissociated within a single page, but not unheard of (Kenny, 1998: 109). Similarly, 'interesting' achieved prominence in the latter half of the seventeenth century, gradually displacing curiosity as the Enlightenment got underway (Kenny, 1998: 143). The history of 'interesting' is as complex as that of curiosity and it is equally possible to trace multiple, occasionally contradictory, meanings. Echoing Gieryn's (1995, 1999) take on the ways in which the terms around science are formed, Kenny argues that such semantic twists arose largely because the terms reflected aspiration and self-interest (Kenny, 1998: 144).

It is worth reflecting on the connections between religious discourse and allusions to wonder, curiosity and the sublime. As Marjorie Hope Nicolson (1959) argues, the first writers on the sublime were 17th century explorers who sought a vocabulary to express the new experiences and vistas they discovered. Trained in the classics and the Bible, these were, understandably, the discourses they applied; they 'read into mountains emotions once reserved for God' (Nicolson, 1959: 271, 224). Kenny emphasises that 'curiosity' had a slightly different history with respect to religious discourse from that of 'wonder', generally being seen more pejoratively. However, he also notes that by the middle of the seventeenth century, the concept had, outside of religion, been strikingly transformed into one considered to have a morally good, or at least neutral, quality (Kenny, 1998: 14-15). To express this another way, there is a difference between the scientist in the Faustian model, and those imagined as romantic or 'heroic adventurers' of the natural world, driven by a somehow depoliticised curiosity (Haynes, 1994). It is worth following Kenny's point to note the ways in which science, even in more Faustian guises, continually draws justification via association with curiosity. In the contemporary context of appeals to the sublime in digital technology, Vincent Mosco (2004) argues that references to the wonder work as Barthesian myths. That is they 'purify' the power of the sublime object, making them appear innocent, natural or neutral, 'depoliticised speech'. Alexander Marr suggests another dimension to the ways in which a sense of wonder, through religious associations, provides science with power. He argues that discourses of wonder invoke a passion, an urge to work, which could be seen to echo missionary zeal (Marr, 2006: 3), a point which we could perhaps find reflected in *Horrible Science*'s continual assertion that science is 'worth the suffering'.

There are, of course, differences between Early Modern forms of wonder and

curiosity, and those we see today. Yet, as both Mosco (2004) and Erik Davis (2004) emphasise in the context of allusions to the sublime in contemporary digital culture, some very old attitudes to knowledge and nature echo through contemporary culture within science and technology's appeals to wonderment. In contrast, George Rousseau (2006) argues that, aside from the occasional 'bland attribute ascribed to Newton-style geniuses', the vogue for curiosity in science ended with the Victorians (Rousseau, 2006: 254). By arguing for the prevalence of discourses of curious wonderment in contemporary popular science, I do not necessarily argue against Rousseau. Rather, I suggest that it is not just historians who retrieve a sense of curiosity from the past; a range of people commenting on science today apply a sense of 'good old wonder' nostalgically (e.g. *The Dangerous Book for Boys*). Moreover, Jon Turney, discussing allusions to the sublime in contemporary popular science, suggests that those qualities noted by the first writers on the sublime have only been amplified by the ideas of modern science: 'The universe has become larger, older, and more violent' (Turney, 2004: 94).

One important context to consider is the scientific community's gradual break with religion. However, we should be careful of assuming that this break is either total or straightforward. As several critics have discussed, there are many ways in which scientific discourse, even when pitting itself against religion, takes on religious content, style, rhetoric or appeals (e.g. Midgley, 2002, Turney, 2001b). What I think we can see in contemporary scientific discourse are vestiges of histories of science being about the sublime and wondrous curiosity, as well as those of science being too serious and rational for any such mystical nonsense. This is basic scientific 'cartography' at work; showing distinction and shared space at once, as we have also seen applied in terms of fiction and, to a lesser extent, humour. As Simon Locke's (2003) study of 'enchantment' around images of science in superhero comics emphasises, this may seem contradictory, but it is a normal everyday part of the multiple meanings and feelings towards science which we all carry around. As we shall see later in this chapter, such contradictions are quite readily visible within *Horrible Science*'s appeals to wonder.

Children's Wonder and Curiosity

A sense of wonder and curiosity is particularly dominant in children's science culture. Indeed, when wonder is applied to grown-up science it is often with more than a hint

of the childlike, nostalgic or otherwise. To some extent we have already explored this when discussing Victorian publishing for children in chapter two. In terms of some contemporary trends, the word wonder is explicitly referenced in the titles of several children's science books (e.g. the *Eye Wonder* series, a spin-off of *Eyewitness*) as well as discussions of, and advertisements for, museums and science centres (e.g. Pearce, 1998). As with the fold-out section at the end of *Stunning Science*, wonderment in children's science is often across grand scales or abstract planes such as time or space (e.g. Peter Ackroyd's, 2003ab, *Voyages Through Time* series). Such a discourse of wonderment is frequently reductive, although, as we saw in *Stunning Science*, it may also simultaneously celebrate complexity and confusion.

As with humorous discourse, wonderment generally works by not being explained, but this sense of inexplicability is not only useful rhetorically, but is a point of explicit celebration. For example, Mary Midgley, in an essay on a scientist's social responsibility, invokes childlike wonder when describing a scientist's first interest in their subject; implying it is a natural, more sensible state which grown-up scientists should (re)aspire to. In their youth, she suggests, a scientist would not see a gap between the identity of scientist and that of citizen:

> at that time, too, the appeal of chemistry was probably linked with some kind of wonder at the world, some delight in the way it is put together, which would naturally seem relevant to the project of helping to defend it, and to the danger of blowing it to pieces. It does not seem wild to suggest that, if a child or adolescent could see this connection, a responsible adult might be able to grasp it (Midgley, 1989: 57-8)

Here, as elsewhere, we see wonder loosely applied as a positive, an inherent and unquestioned good, something perhaps given greater strength via Romantic images of the child's link to nature. This sense of the childlike is in some respects hard to find within *Horrible Science*'s more boisterous anarchic image of the child. However, we could argue that such anarchy is still articulated with an appeal to 'natural' childlike curiosity (e.g. fig 4.4); the image of unfettered childish play with science is a form of celebration of unfettered curiosity. It is curiosity in a more 'Faustian' mad-scientist sense (e.g. fig 7.4), but, as discussed in chapters four and eight, this is largely articulated in a 'happily-horrible' celebratory way. The mad scientist is to be aspired to in *Horrible Science* not demonised and in some respects is justified by a sense of 'natural' curiosity. Indeed, Julia Mickenberg discusses the way in which 20th century

American left-wing writers, working under McCarthyism, would express appeals of science under a sense of its apparently ideologically-free 'deep fascination' (Mickenberg, 2006: 189).

The association between the childlike and scientific wonder is two-way; not only appropriated from children, but also applied to sell science to young people. For example, this quote from 20th century educationalist Eric Roberts, compared below with a line from the conclusion of a *Horrible Science* book:

> the scientist's chief feeling is one of enjoying finding out and enjoying gaining a wider understanding of Nature [...] He shares with our earliest ancestors a sense of curiosity and feelings of wonder and delight [...] You can share that with him (Jennison & Ogborn, 1994: quoting Roberts in frontispiece)

> there's one BIG reason why people become scientists. It's a feeling shared by every scientist in this book. It's because they think science is fascinating. And even when it's horrible, it's horribly fascinating, amazing and even exciting (*Suffering Scientists*, 2000: 224)

Although again *Horrible Science* here ties a sense of wonder to a form of the 'happily horrible', it is still a quite traditional appeal to the sublime. In many respects this is a sensational appeal of popular science, in that it dramatises and alludes to an emotional feeling. Yet, unlike many of *Horrible Science*'s other moments of sensationalism, it is more socially acceptable.

The Sublime

For our purposes, the sublime is probably best introduced as a sense of being near greatness, an aesthetic experience of finding something beautiful, but one that is mingled with awe. Traditional examples come from the experiences of 17th or 18th century explorers. As Marjorie Hope Nicolson's (1959) study of the sublime emphasises, it is generally associated with large scales, evoked in reference to grand scale views such as those from and over mountain ranges (Nicolson, 1959). Such large scales can refer to both time and space; the point is that the sublime object is so great it is (almost) inconceivable as it takes over the subject's ability to

comprehend. As Nicholson's book suggests, the sublime describes the sense of majesty we might feel when faced with a mountain range. Rainforests or waterfalls are also classic examples, as is the night sky. This sense of the subject's senses being overtaken by the sublime is central to my analysis of wonderment in *Horrible Science*. It is, I believe, a key way that the mind is 'boggled', as a sense of awe of the sublime object is invoked.

Formalised ideas of the sublime date back to the 18th century philosophical work of Edmund Burke (1756) and Immanuel Kant (1760), although a sense of postmodern sublime is also discussed by Lyotard (1984). Burke associates the sublime with a sense of terror, using this as a distinction between beauty and the sublime. Kant distinguishes between what he dubbed the 'dynamic' and the 'mathematical' sublime. The former is akin to Burke's notion of transfixing terror; the latter, however, extends notions of the sublime to something more abstract. In the presence of a large scale, of a sense of apparent infinity, Kant's subject experiences the feelings of weakness and insignificance which go with being in awe. Yet, crucially, as the mathematical sublime is slightly more conceptual than the dynamic sublime, the subject then recovers a sense of superior self-worth with the thought that their mind was able to conceive something so large and powerful. As David Nye (1994) neatly puts it in his inspiring book *American Technological Sublime*, 'the subject passes through humiliation and awe to a heightened awareness of reason' (Nye, 1994: 7). What I want to emphasise here is that the pleasure of experiencing the sublime, including this sense of intellectual superiority that comes with it, relies upon maintaining a sense that you are inferior to the sublime object. It is this necessity to construct the superiority of the sublime object that is at the centre of the politics of being mindboggled.

There are many ways in which the sublime is political. It can be used, as with any articulation of aesthetics, to construct a sense of shared community, and alongside that to invoke social distinction (c.f. Bourdieu, 1984). Moreover, because of the feelings of awe and insignificance tied up in the experience of a sublime presence, allusions to the sublime ascribe power to the sublime object, or at least admit power and formalise it to some degree. Nye (1994) suggests a 'bifurcation' at the heart of sublimes invoked by technologies. By this he means that the technological sublime invites the observer to interpret the power of technology as an expansion of human power and thus an achievement they can feel linked to. No longer do they necessarily feel like an insignificant human with respect to the power

of nature. What makes this contradictory is that, simultaneously, the technological sublime invites the observer to a sense of individual insignificance and powerlessness: 'One is both the all-seeing observer in a high tower and the ant-like pedestrian inching along the pavement below' (Nye, 1994: 285). Nye suggests that the subject can either be 'outside' of the sublime object, terrified by speed and the noise of the railway, or they can be part of it, riding triumphantly over the landscape. Crucially to the bifurcation of the technological sublime, they can be both at once.

Positioning Actors with Wonder

At the start of the last section I emphasised that one of the advantages of the literature on the sublime is that it helps us consider how appeals to wonder position audiences, nature, experts, ideas and technology with respect to one another, especially through the function of awe. As I discussed in the last few paragraphs, enjoying a feeling of wonder can rely upon maintaining a sense that you are inferior to the sublime object. Here, I return to some close analysis of *Horrible Science* to argue that the sense of wonder in nature is, in these books at least, connected to a sense of wonder in science. As such, *Horrible Science* endows science with a sense of sublime as much as it does natural objects. Consequently, it invites readers to be in awe of science (and as such, I argue, in awe of other people). This section starts by exploring the wonder of seeing new things. It then considers the sublime in a sense of the mysterious and some of the contradictions *Horrible Science* displays around this. Finally, it discusses distinctions (and connections) between seeing the sublime in nature and seeing it only through the eyes of science.

New and Mysterious Views

The sublime is traditionally invoked in response to new vistas. Its development in the 17th century was intimately connected to exploration narratives (Nicolson, 1959) and a sense of novelty is a key way in which the sublime, wonder and curiosity intersect. As we saw in chapter six's discussions of 'fantastic voyages', *Horrible Science*'s journeys into 'new vistas' are provided by scientific ideas, scientific apparatus and (in the end) scientists. We can see this especially strongly in descriptions of the very small, where the microscope or magnifying glass allows scientists insight into what we might metaphorically call 'new worlds', places the human eye would otherwise be

unable to see. For example, 'this book is more than just a book... IT'S A MICROSCOPE!' (*Microscopic Monsters*, 2001: 10).

In places, *Horrible Science* compares itself fairly explicitly to travel literature, as in 'trek' in the first quote below. More broadly, it also makes an appeal to the discovery of new places to look at and to new ways of seeing:

> Any good book will carry you away to other times and distant places. But this book takes you far, far further on a trek through time and space to seek out some of the strangest science ever (*The Terrible Truth About Time*, 2002: 6)

> In a moment, we'll blast into space to boldly go where no science book has gone before. Our mission is to find out why space is so scary [...] So who needs movies? Just grab your popcorn and settle down in your seat. The show is about to begin! (*Space, Stars and Slimy Aliens*, 2004: 5, 7)

This last quote is particularly interesting in terms of its reference to film. The specific film it references, with 'to boldly go', is one which overtly references space travel fiction, a topic which, as Campbell argues, has been intimately associated with notions of wonder since the 17th century, overlapping with religious discourse on the sky, narratives of exploration of the 'New World', and sublime depictions of cosmology (Campbell, 1999: chapter five). There is, however, also a sense of wonder evoked by watching a film in itself, especially in the cinematic context referred to here (seat, popcorn). Metaphorically, a film is a journey into some place new, as with any other narrative, but also in a sense of wonder often invoked by cinema industry in its symbols, jingles and logos (e.g. stars). There is also a sense, especially in the first quote, that the imaginatively-produced vistas are in some way more special than more prosaic, tangible ones.

Allied to the notion of the book as a travel guide are the sorts of appeals to the sense of discovery we saw in chapter seven, such as the promise that experiments can 'tell you the answers to questions you haven't even thought of' (*Really Rotten Experiments*, 2003: 5). Disinterested interaction with nature promises to provide new information and challenges us to form new ways of thinking about the world. Crucially, the sense that science is a continual mystery to be incessantly

questioned implies a possible future role in science for the child reader; they may (if they grow up to work in science) have a chance to find out new information. For example: 'And, best of all, there's much, much more to find out' (*Space, Stars and Slimy Aliens*, 2004: 143). One book finishes with a quote from Einstein, portrayed in cartoon form as an old man, saying:

> we are the position of a little child entering a huge library whose walls are covered to the ceiling with books in many tongues... The child does not understand the languages... He notes a definite plan in the arrangement of the books, a mysterious order which he... only dimly suspects (*Terrible Truth About Time*, 2002: 144. The ellipses are Arnold's edits)

In some respects the above quote humbles science by way of connection with the image of the child. However, it can also be read as a rare example of *Horrible Science* (via Einstein) employing a rather Romantic view of childhood that celebrates the sort of purity of purpose in childlike discovery.

The Un- or Nearly-Knowable

The allusions to mystery are often accompanied by a sense of the unknowable; a notion of something hard to comprehend, at the edges of knowledge, or at least the hard to know, or the so-far unknown. There are few areas of knowledge so exclusive as those not yet discovered, making allusions to the nearly-knowable quite attractive to those seeking to enact a sense of their intellectual capital. Unsurprisingly, perhaps, a sense of the unknowable has become something associated with the sublime. In some respects, it follows from the history of the sublime invoked by novel experiences or vistas the audiences did not yet have a vocabulary for. As Joseph Tabbi argues, 'the powerfully significant failure to signify has always characterized the rhetoric of the sublime' (Tabbi, 1995: 13). Similarly, Hugh Silverman explains the sublime in Lyotard's postmodern sense as 'subliminal' because it is 'below the line, underneath the level of evidence, inconspicuous to direct seeing' (Silverman, 2002: 228). My point here is that if accompanied by a belief that science might help us get around inconspicuous nature, to someday allow us to see below the line, then such sublime mysteries can be a useful rhetorical tool in the construction of science as providing a privileged view on the world.

In emphasising a them-and-us sense to being able to see below (or at least around) the inconspicuous, *Horrible Science* will occasionally refer to those 'other' minds unable to comprehend as much as readers of the books, for example:

> some people find the whole idea of time so amazing that they spend years trying to understand or measure it, or just get their heads round it (*The Terrible Truth About Time*, 2002: 143).

This passage then goes on to state, in a special, illustrated font, that 'The ultimate truth about time is that we don't understand it at all'. In many ways, this is an appeal to the most 'mindboggling' form of the sublime. Here, the 'heightened awareness of reason' the subject might recoup from the experience is that they can cope not only with the hard-to-understand but with the possibility that things cannot be understood. By suggesting that knowing is impossible it stops those searching for knowledge in their tracks. When expressed in the postmodern sense of Silverman, this is largely a matter of 'incredulity of meta-narratives' (c.f. Lyotard, 1984). However, I do not think *Horrible Science* is, when discussing the unknown of time, acting in a postmodern sense. It does not equally eschew what is previously thought to be true. *Horrible Science* relays what is known about the concept of time, but then ends with a powerful allusion to the mindboggle; rendering confounded those readers it had previously empowered with knowledge. Thus, such appeals to the 'ultimate truth that there is no truth' act to support the status quo, making it harder for new truth-claims to be put forward.

There is, however, still a sense that science may one day 'grow up' and have mastery of Einstein's library. A secret, after all, has a special, particular point to be hidden (as opposed to something nobody knows). As already mentioned in chapter six, this epilogue on time concludes by suggesting that 'Somewhere in the universe, somewhere in the cold and dark amongst the glittering stars is the key to the mystery' (*Terrible Truth About Time*, 2002: 144). There is no end *yet*; but it is within sight. Mystery enacted in this way personifies nature somewhat, suggesting not only a sense that it works in a way that humans can possibly understand, but that it is, admittedly metaphorically, hiding a secret, weaving riddles (see Findlen, 1990, for a discussion of nature's 'jokes'). As already suggested, an enactment of mystery holds a particular appeal in children's science culture as it suggests a role for the young readers as future-scientists. In *Fatal Forces* (1997), a section on Newton ends by referring to his famous 'shoulders of giants' quote, finishing with: 'the great ocean of

truth lay all undiscovered before me' (*Fatal Forces*, 1997: 25). However, rather than taking this as a reference to a constant search for truth which the child might join in, the book moves on to provide some ready-made ideas: 'There are loads more fatally fascinating facts about forces. You'll find them in the next chapter' (*Fatal Forces*, 1997: 25), suggesting a closed book or happy state of 'normal science'. Alongside the idea of 'standing on the shoulders of giants' there is a sense that science is a continuous practice; the construction of future knowledge is not seen, at least here, as a revolutionary action.

Contradicting this somewhat, there is in several of the books a sense that science should be simple; a discourse quite explicitly against mysticism. For example, one introduction translates a teacher saying 'you can't break the laws of physics' as 'You're asking too many questions. I'll try blinding you with science' (*Fatal Forces*, 1997: 6). Elsewhere, *Horrible Science* links chemistry's 'chaotic' nature (here meant negatively) with its alchemical heritage (*Chemical Chaos*, 1997: 8 onwards); casting secrecy, mystery and archaic language in the sense that it might be seen as 'anti-science'. We can see such contradictions even within one book, or even one page. For example, the last page of *Shocking Electricity* (2000) starts with 'most people still find electricity mysterious, but hopefully having read this book you won't be one of them' (*Shocking Electricity*, 2000: 160), suggesting some benefit in distancing oneself intellectually with those who find electricity mysterious. However, it then goes on to celebrate how 'amazing' and 'totally gobsmacking' the force is in shaping the whole universe. Thus, not only invoking a sense of force as much more powerful than the observer, but so powerful we are 'gobsmacked' by it, mindboggled; incapable of further detailed explanation of how it goes about this (i.e. in some respect at least, we are enjoying its mystery). Perversely perhaps, *Horrible Science* promises its reader distinction from 'other people' because they now do not think electricity is mysterious, yet at the same time implies a sense of the mystery of electricity as part of the prize for having achieved the apparently superior perceptive stance.

The introductory page of *Ugly Bugs* takes a similar starting point as *Shocking Electricity,* suggesting that science should be criticised when it appears to be mysterious, part of what makes it 'horrible':

> what do scientists do all day? Ask a scientist and you'll just get a load of scientific jargon [...] It all sounds horribly confusing. And horribly

> boring. But is shouldn't be. You see, science isn't about all-knowing experts in white coats and laboratories and hi-tech gadgetry. Science is about **us** (*Ugly Bugs*, 1996: 7).

Yet, in *Frightening Light* we see this discourse inverted, almost celebrating how much more complicated the world is when understood scientifically:

> Science is frightening. Frighteningly confusing. Take the topic of light. You see light every day in sunshine and light bulbs so you might think that the science of light would be light work. But you'd be wrong. It's hard... Light = instant confusion! (*Frightening Light*, 1999: 5. Ellipses as original)

Thus, despite eschewing the mystification of science by the establishment, there is also a sense in which it is celebrated. As the introduction of the very first *Horrible Science* book asks 'Confused yet? You will be' (*Ugly Bugs*, 1996: 9), a promise as much as a threat, challenging the reader to say the Latin name for ladybird 'with a mouthful of popcorn' or sorting 350,000 species of beetle into matchboxes (*Ugly Bugs*, 1996: 10). Hence, there is a sense in which the mystery and seemingly unknowable qualities of science are presented chiefly as a challenge, analogous to the articulation of *Horrible Science* as a challenge which we saw in 'health warnings' in the introductions, or the play-fights with trivia.

Epistemological Sublimes

Behind much of what I have discussed so far lies a distinction between believing science is wondrous, and seeing wonder in what science looks at. We could describe it as a difference between appeals to the *epistemologically*-sublime compared to those to a sublime object. Sometimes the appeal to wonder is directed at the object of scientific discovery, for example space is beautiful and brain-boggling, insects are dazzling, time is a mystery or electricity is amazing. However, we should not assume that this is to ascribe power to nature rather than to the work of scientists. Although electrical action is a facet of the natural world which could be considered wondrous without recourse to science, it is one largely colonised by scientific discourse and, notably, *Horrible Science* chooses to focus our attention on how 'astonishing' the blips of 'electrons and atoms' are, highlighting the scientific entities involved

(*Shocking Electricity*, 2000: 160; I discuss this passage in more detail later). A combination of wondrous appeals to both the process of discovery and what is discovered is, according to Kenny, a central element of appeals to curiosity. He suggests that, in the 17th century, curiosity developed 'a strange capacity' to start denoting desired (rather than the process of desiring) objects. Such framing of both subject and object, way of knowing and what we see, 'under the same conceptual roof' constructed our sense of curiosity as 'a blissful place' where cravings for curiosity could be sated by what became known as 'curiosities' (Kenny, 1998: 15; see also Rousseau, 2006, for discussion of combination of curiosity/ies).

Feedback is a useful metaphor here; the sublimity of the scientific object helps instil the process of finding said object with a similar sublimity, and in turn this newly imbued way of knowing will act to extend the sense of wonderment in that object (and so on). In the fast-paced style of *Horrible Science*, such feedback is easy to find. For example:

> outside the classroom there's a great big world bursting with sound. A huge exciting vibrant world alive with loud, shocking, shrieking, spectacular noises, and thanks to science it's getting more amazing all the time. (*Sounds Dreadful*, 1998: 159)

Here we see the sense of wonder initially constructed in reference to the topic of sound which could be a school-science topic or (as the quote implies) just everyday noise. The central part then moves us to quite naturalistic noises – 'exciting vibrant world [...] shrieking, spectacular noises' – which we could perceive without recourse to scientific work. This, in turn, is then built upon with the suggestion that 'thanks to science' it is becoming 'more amazing'. Thus, sound is interesting because the world is interesting, and the scientific study of sound makes it more so.

The wonder of both phenomena and the process of discovery are often co-produced in *Horrible Science*, with each relying upon each other. However, there are degrees to this, with some books focusing wonder much more upon epistemology than the actual object, and vice versa. Tracking the series as a whole, I have noticed that in the natural sciences we see reference to the greatness of nature (bugs, animals, plants, etc), with study of it being fun because you get to find out about these natural objects. For example, the most thing amazing about 'vegetables' is not scientists and their discoveries, 'It's to do with the vegetables themselves' (*Vicious*

Veg, 1998: 159). In contrast, in the physical science titles we can see a greater emphasis on the sublime nature of the ideas. The idea may come in the form of an object. Here, it may appear that the sublime is ascribed to nature (rather than its study) but, crucially, its theoretical nature will be emphasised. We can see references to the scientific amplification of the sublime at work in *Horrible Science*. For example, the end of *Frightening Light* starts with the suggestion that because light is all around us we do not realise how amazing it is, but:

> the more you discover the more magical it seems. It's incredible that a humble light bulb makes photons and that these astonishing blips of energy can light the sky in the day and at night you can see stars because their photons have travelled for millions of years to reach you. It's even more astonishing to thinking that it's photons that give colour to a daffodil or power to a laser. And it's gobsmacking to peer in a mirror and know that you can only see yourself because every second billions of photons are bounding off the mirror to create an image made of light (*Frightening Light*, 1999: 152-3).

Here we start from the idea of the natural object as something everyday transformed, via the use of special (exclusive) knowledge into something more beautiful. The way in which processes of 'discovery' are implicated in making light appear more wondrous, the explicit references to lasers and photons, as well as allusions to scientific concepts such as 'light years' or quite scientific reductions in the form of diagrams of the reflection of light, all act to emphasise the requirement of scientific mediation in the construction of the sublime.

Thus, to ascribe wonder to either scientific process or entities found via these processes is to ascribe it to the scientific community. Nye (1994) argues that the feeling of encountering the sublime is different when confronting technological objects compared to natural ones such as mountains. To Nye, because people make technologies we all collectively feel some sense of pride in human mastery over nature. This is what leads to Nye's point on the 'bifurcation' of the technological sublime; we feel both powerful as humans who can construct such machines, but also privy to a sense of individual insignificance and powerlessness in comparison to the technology. We are both 'the all-seeing observer in a high tower and the ant-like pedestrian inching along the pavement below' (Nye, 1994: 285). What I feel is lacking in Nye's analysis is an awareness that the feeling of inferiority with respect to

the technologically-sublime object is also connected to particular people; the people who made and owned the technology.[28]

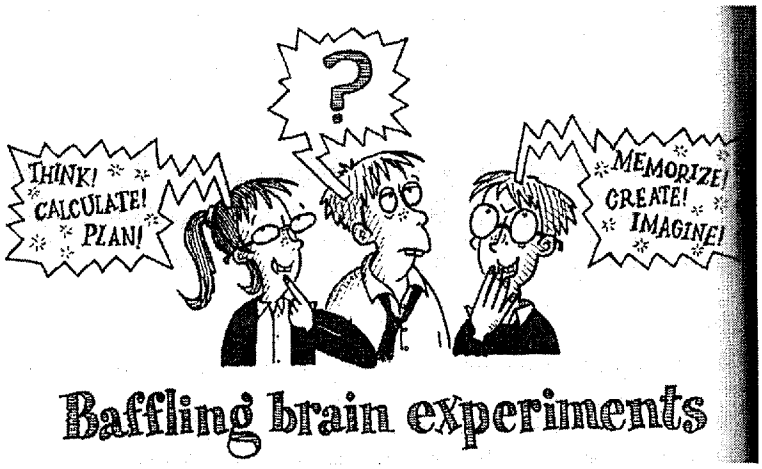


Fig. 9.2. Distinction within audiences (*Really Rotten Experiments*, 2003: 28).

This is equally true when we apply the sublime to scientific entities or processes. Sublimes of epistemology, of scientific entities and of technologies all render people (or at least social identities) sublime. As a scientific object, our knowledge of its existence relies on some meditation by scientists. Indeed, we could go as far as to suggest contemporary scientific forms of the sublime, such as those expressed in *Horrible Science*, make people sublime objects. Thus, if we follow Nye in applying Kant's sense of the mathematical sublime, but do so with a full recognition of social constructivism, the experience of the sublime in science is reliant on the audience's compliance in constructing reverence for the scientific community. Invoking the sublime is therefore largely another form of the 'dominant concern' of popular science which would construct science with the 'epistemological equivalent of the right to print money' (Hiltgartner, 1990: 534). Crucially, however, this is not exactly the 'deficit model', constructing a sense of science as hierarchical by labelling popular science audiences as an ignorant public. Rather, it labels the scientists as superior, by way of enlisting their audiences to help label another group entirely (those too stupid even to read the book) as especially ignorant. The readers then sit in the middle, exchanging inferiority (in comparison to the writer and science) for superiority (from other 'lesser mortals' around them).[29] This perhaps suggests a

[28] That is, I mean to fold in a 'social construction of technology' critique (e.g. MacKenzie & Wajcman, 1999).
[29] Analogous to what Bourdieu (1988) spots in universities (Bourdieu, 1988: 112-3), as referred to in chapter one.

tiered notion to science-public relations; science at the top, those 'stupid people' we all make jokes about at the bottom and, someplace between, what Steve Rayner (uncritically) dubs the 'scientific connoisseur' (e.g. see Bell & Turney, 2002), an appeal I think we can see (comically) alluded to in fig 9.3.

Horrible Sublimes

As should be established by now, the aesthetic of *Horrible Science* is one which not only draws on a range of cultural products but appears to relish and show off its 'mix' of content. As these last two chapters illustrate, *Horrible Science* not only takes its readers from the ridiculous to the sublime, but happily applies both styles at once; appeals to wonder in *Horrible Science* often come with fart-joke attached. Thus, we might question whether the allusions to the sublime in *Horrible Science* are only that; 'just' allusions and not actually the sublime at all. I argue that for our purposes it does not really matter (I am not in the business of policing the purity of wonderment), but *Horrible Science* does perhaps challenge us to consider what the scientific sublimes of late/postmodernity consist of. This section first briefly tackles Nye's (1994) contention that postmodern media which 'anthologise' the sublime are not really sublime at all. I then consider questions of size and argue that *Horrible Science* makes appeals to the sublime of the very small as much as it does the very big. Finally, I return to *Horrible Science*'s aesthetic of 'weird domesticity' and being 'happily horrible' to consider issues around the need for terror in the sublime.

Anthologising the Sublime

Nye (1994) has very little positive to say about what he dubs the 'consumer sublime' and argues that it is a 'contradiction in terms', citing Las Vegas as a chief offender:

> the landscape of capitalist surrealism, where a man-made order seems to replace the natural order entirely. Visitors experience a potpourri of the technological sublime in a synesthesia of lights, heights, illusions, and fantastic representations. (Nye, 1994: 294)

Such entertainment spaces, he continues, 'anthologise' sublime effects; mixing allusions to fairy tales, history, advertising, novels and movies to 'create a

dreamscape of disconnected signifiers' (Nye, 1994: 294-6). This is, perhaps, another place where commercial non-fiction challenges our assumptions about the role of knowledge in postmodern society, as *Horrible Science* aims to do the work Nye believes the technological sublime of the 19th and early-mid 20th century did (i.e. appeal to rationality, work and domination of the natural world) but via a very playful sign-orientated style which is readily comparable to his description of Las Vegas.

Nye does reflect on commercial non-fiction, critiquing the idea of having an IMAX film of the Grand Canyon. He argues that such packaging of awesome vistas or experiences, even on a screen which itself could well be described as sublime, denies the 'exaltation, the danger, the difficulty, the immensity, and the otherness of the wild' which he feels is central to the sublime: 'as if the unrepresentable could be projected on a 20 foot screen' (Nye, 1994: 289-290). To Nye, the failure of such IMAX films is largely a matter of the distance provided by fabrications of (postmodern) media culture. Dismissing Lyotard's reading of the postmodern sublime, Nye argues that a painting, unlike a volcano, cannot kill the observer; remove such an immediate sense of terror and the mind is not transfixed (Nye, 1994: xx). Yet, it is possible to argue that a painting of a volcano is *more* sublime than one actually erupting; else it really is simply terrible. First-hand disaster is not something one contemplates consciously, one acts or runs, but the sublime experience is one of reflection when dealing with something so awesome. Luc Boltanski argues that the 'distant suffering' of much contemporary news media provide a sense of moral superiority to their audiences in a way analogous to the Kantian sublime, as they recover from the (mediated) second-hand experience of pain (Boltanski, 1999: 115). Again, such suffering only has its power via a sense of distance; those who are part of the disaster being reported are more likely to be dominated by a much more cogent sense of loss (and not simply intellectual loss at that).

The very open construction of Will D Beest in *Angry Animals* (2005) is a good example of this. As previously discussed in chapters five and six, Arnold explicitly applies the character because 'you won't catch *me* going near' any fierce animals (*Angry Animals,* 2005*:* 5). This does not mean that the fearsome animals are not relayed to the readers in any less depth; if anything the comic frame enables the presentation of images and information which in a more 'photo-realist' context might not be seen as socially acceptable for young audiences. Further, Nye argues that 'the sublime is not merely a matter of vision', although the eye is dominant, movement, noise, smell, and touch are also important (Nye, 1994: 284). In *Horrible*

Science such senses can be brought into play by the often sensational use of language, not to mention descriptions of eyes-on (hands-on, noise-on and ears-on) practical activities.

With my focus on the literary articulation of wonder, I inevitably concentrate on sublimes that are described rather than materially felt. Indeed, the fact that the sublime has been first mediated (by scientists) is intrinsic to the arguments about the politics of the sublime made in the previous section. I do think that Nye makes a very useful comparison between the ways in which the sublime exists in late/postmodern culture and the ways in which he saw it evoked in early decades (and, importantly, draws attention to the sense of authenticity implicit in invoking the sublime). However, I think we should accept that the 'consumer sublime' does have connections to the experience Kant and Burke spoke about. For my purposes at least, the sublime is not simply a way of presenting a value judgement over a particularly powerful form of wonder, but both an analytical category and a cultural aesthetic with its own history. As with any cultural aesthetic, it can change over time. If the sublime can be contemplated in the context of machines, as Nye demonstrates so convincingly, the sublime can also be understood in the context of play.

Magnitudes of Size

Arguably, part of constructing an aesthetic of 'terror' in *Horrible Science* is related to matters of scale. A key phrase from Nicolson (1959) is that the sublime is a matter of 'Aesthetics of the Infinite'. This is perhaps understandable in a book about mountains but, in the broader arena of *Horrible Science*, we see evocations of the sublime not only in respect to the giant but also in discussion of the very small.

> This world can be very incredible, and very beautiful (they say small is beautiful don't they?).
> [...]
> Some people think BIG. Big plans, big ideas, big money and they often have big heads to match. Other people think small and amongst them are many scientists who believe that microscopic technology holds the tiny little key to our future (*Microscopic Monsters*, 2001: 7, 137)

There is, however, also a sense of magnitude at work in sublimes of the small. What

is more, the size of a mountain is great in physical size, but the size of an atom is great in its applicability. The mountain may seem to be everywhere, but an atom or a gene, so we are told, *is* everywhere. For example:

> Electricity is amazing. Amazing in its power and the limitless variety of the task that it can perform. And it's totally gobsmacking to think that the power behind this incredible force comes from astonishing blips of energy and matter – electrons and atoms. Yep, the same electrons and atoms that help a pelican find its way home and make your heart beat and give shape and substance to everything in the universe. Including You. (*Shocking Electricity*, 2000: 160)

Similarly, the 'Energy Monster' (see fig 4.7), an analogy applied at the start of *Killer Energy* (2001), is not only sublime because he is a terrifying killer, but because there is no escape from his power.

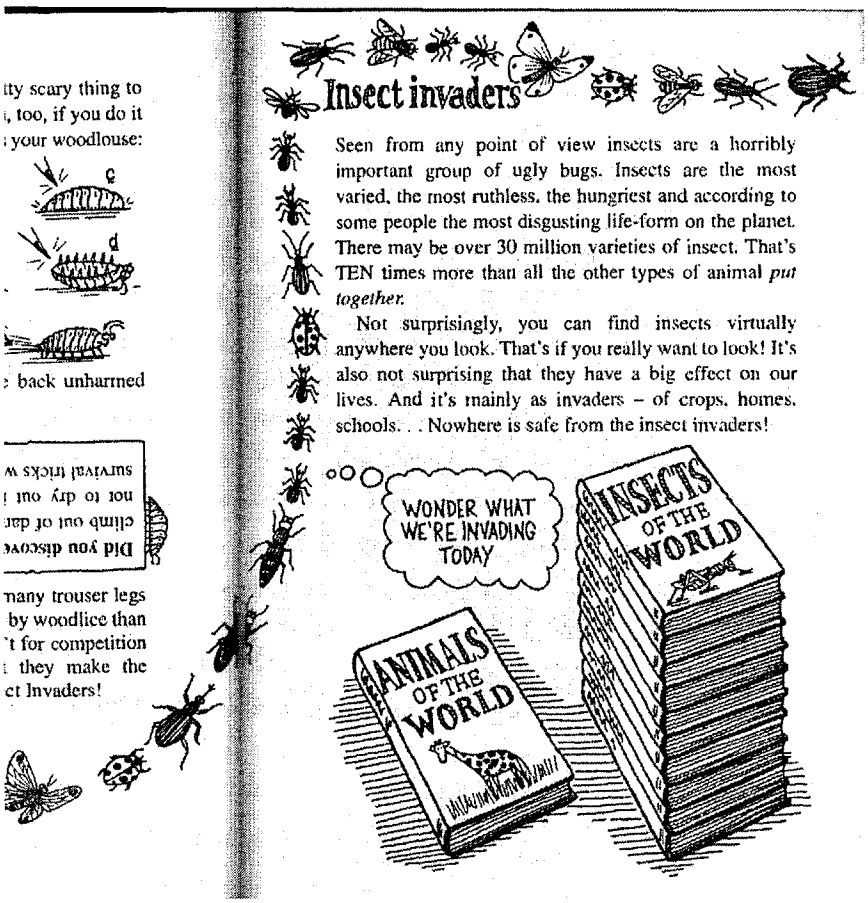


Fig. 9.3. Crawling Bugs (*Ugly Bugs*, 1996: 54-5)

In contrast to sublimes of reduction, *Horrible Science* also applies a sense of wonder invoked through allusions to complexity. Although the complexity of some scientific illustration which seeks to evoke the sublime through refined detail is not something readily reflected in more simple line drawings favoured by the Horrible brand's cartoon style, the book on insects is full of pictures of tiny 'bugs' drawn crawling across page boundaries, out of control of the author and illustrator (e.g. fig 9.3). Allusions to complexity may come in reductive forms too though, for example where link between geocosm and microcosm are invoked. For example: '[Insects] are also beautiful, fascinating and splendid in their dazzling variety' (*Nasty Nature*, 1997: 287). Here the insects are described as 'dazzling', alluding to apparent complexity in reference to imagery of stars in the (physically huge) night sky.

Terror/Beauty

Another respect in which *Horrible Science* might be seen as somehow not having (or challenging) a sense of the sublime is its rather cosy approach to 'the horrible' which alludes to the huge, terrifying, distressing and disgusting, but via a joke, or balanced with a reference to something apparently very unthreatening or mundane: for instance, the 'head-chopping machine operated by a sheep' cited on the back-cover blurb of *Evil Inventions*, or the large-eyed and floppy-haired version of Frankenstein's monster. I explored the sense of humour in these images at the end of the last chapter, but here I want to re-establish something of their horrible referents.

One of the advantages of the sublime for *Horrible Science* is its ability to form an aesthetic which allows some distance from the conventionally beautiful. As discussed in chapter four, this allows *Horrible Science* to present an image of the series as both masculine and apparently less fabricated or crass than much of commercial culture. Significantly, there are only occasional references to beauty in *Horrible Science*: 'Cute little algae' (*Microscopic Monsters*, 2001: 59-61); 'beautiful, fascinating and splendid in their dazzling variety' (*Nasty Nature*, 1997: 287). References to beauty tend to be juxtaposed soon afterwards with a reference to horror, as if only used to accentuate the grotesque nature of the topic, for example:

> This world can be very incredible, and very beautiful [...]
> But it can also be very *horrible*! (*Microscopic Monsters*, 2001: 7)

> Science facts are lovely... Lovely, fascinating, horrible, gruesome, funny and above all useful (*Awfully Big Quiz* Book, 2000: 100. Ellipses as original)

The second quote is a particularly interesting application of the word lovely; not only does it stand out as rare, but note how it is balanced by the addition of 'horrible' and 'gruesome'. Similarly, the reference to the 'dazzling variety' of nature quoted above follows discussion of the animals' need for 'brute force' to survive (*Nasty Nature*, 1997: 286). Such juxtaposition does also occur the other way around:

> [Space is] big and dangerous and it goes on and on for ever. But space is also beautiful and brain boggling. (*Space, Stars and Slimy Aliens*, 2004: 143)

Here, the fact that space is beautiful is almost used as a soothing mechanism, a way of making the horror 'safer' via the sublime's sense of distance. Although we should also note that the sentence finishes with an articulation of awe, with the reference to 'brain boggling' nature of space.

As already implied, we might track gendered discourse here. This is not to argue that this is necessarily to the exclusion of female readers, but that the aesthetic of *Horrible Science* is one that emphasises its connection to a particular form of cultural identity, the history of which is generally associated with the construction of masculinity. As we saw in chapter four, a horrible aesthetic transforms the 'soft' girlie science of botany into a matter of '*Vicious Veg*'. To re-quote from the book's introduction:

> You can learn nice little facts about leaves, seeds, fruits and pretty little flowers. But this book is different. It's about plants all right, but it's also about Horrible Science!
> [...]
> There really is a lot more to plants than silly seed, fancy flowers and lip leaves. Plants have loads more vicious secret and many VILE, VILLAINOUS, VIOLENT and VICIOUS tricks (*Vicious Veg,* 1998: 5, 7)

We can read this as an appeal to a form of the sublime, not just to terror alone; the notion that the plants are spectacular and, in their more masculine way, beautiful is underlined throughout the book. Yet, importantly it is beauty in a terror-invoking form

rather than one more readily associated with the female. As the book concludes:

> [plants are] incredible living beings. Even a boring little weed contains an awesome living chemical factory that can turn sunlight into food and make a cocktail of vicious poisons. It's enough to make a full-grown botanist weep with excitement and wonder. (*Vicious Veg*, 1998: 159)

One of the particularly interesting points about the above quote is not just that it presents botany as beautiful, but it even includes a referencing to crying. To the expressively tough, masculine and grown-up world of *Horrible Science*, surely 'weep with excitement' would be seen as a bit 'soft'? To some extent this can be explained as an appeal to humour, part of *Horrible Science*'s style of balancing sensation with references to something more mundane. However, I also think that the use of such a childish or girlish characteristic fits within parameters of the 'horrible' style because this is weeping with wonder. As such it is an expression of the power of scientific ideas and of scientific ways of seeing nature (not to mention the 'horrible suffering' required to be a scientist). It is entirely part of the way in which allusions to wonder are a culturally acceptable aesthetic for *Horrible Science*.

Conclusion

When *Horrible Science* declares something wondrous or points us to particular areas of study as inherently curious, it ascribes some value to these entities. To take Nicolson's example of mountains, we are more likely to wish to preserve forms of the natural world if they are imbued with the various powers of wondrous discourse. This chapter has argued that when *Horrible Science* ascribes wonder to natural objects it often does so through the lens of scientific work, and thus also endows scientific practice (and by extension, its people) with similar power. Turney's (2004) point that the advances of modern science have made nature appear even more sublime is a very pertinent one. My argument here has been that such amplification of the sublime, in *Horrible Science* at least, appears to be made quite consciously, emphasising the role of science in increasing the sense of wonder about the world and using this as a way of selling scientific knowledge, study and people to its audience. This chapter also argued that appeals to wonder may be 'anthologised' in *Horrible Science*, worked amongst (even via) humour, fiction, ironic references or language which balance the sublime with something more mundane, but they do all

still allude to wonder. Perhaps, just as Eco (1985) talks about the need for irony to 'non-innocently' enjoy historical fiction, the humour and 'weird domesticity' of *Horrible Science* is simply a matter of non-innocently experiencing the sublime in late/postmodernity.

In some respects, to be mindboggled is to accept defeat. To be confounded is to pause your own investigation and simply stand back in reverent awe. In reading the sublime in popular science, it is worth remembering the Kantian concept of the 'mathematical sublime', where subjects experience first a feeling of 'passing through humiliation' before recovering a sense of self-worth at the idea that they managed to comprehend something so large. We may feel content at the 'heightened awareness of reason' when we understand even highly abstracted and difficult scientific ideas, but we only reach this having first been through the experience of 'humiliation and awe' at the scientists' sublime abilities. If the pleasures of popular science, for young and old, come from that later feeling of 'recuperating' self worth, the subject must necessarily invest belief in the sublime powers of the object. Sublime feelings rely on veneration; it is necessary for the subject to invest belief in the sublime powers of the object. We often think of the hierarchical set-ups of science in society as something done to non-scientists, as in critiques of the deficit model. In appeals to wonder, as with humour, we see an aesthetic of popularised science that works through an audience happy to help build a sense of science as superior, so that they might feel some sense of (albeit lesser) superiority through reflected glory.

Conclusion
Science as Pantomime

This conclusion provides an overview of each of the analytical chapters before outlining some conclusions on how this study can help develop theories of popular science. I then finish the thesis as a whole with some statements on the pantomime nature of *Horrible Science.*

My initial introduction to *Horrible Science* as a 'branded book' (chapter three) explored some of the ways in which consumer culture is referred to within the content of the books. I concluded that one of the consequences of *Horrible Science* as a brand was the emergence of a number of inconsistencies relating to ideas or feelings towards science which, articulated through applications of irony and irreverent-reverence, leads to liminal positions for both the narrator and the implied audiences. I suggested that *Horrible Science* takes up a sort of parasitic outsider/insider identity in respect to science, perhaps working to draw those who would think of themselves as outsiders into the central brand (and thus into science). Moreover, I suggested that thinking of the audiences of popular science as consumers invited us to consider what forms of symbolic capital were on offer to them when buying into *Horrible Science*, a point that is more fully developed at the end of this conclusion.

Regarding the notion of the horrible which defines this particular brand (chapter four), I wanted to emphasise that those concerned with maintaining good PR for science need not worry about *Horrible Science*'s gothic imagery painting science in a bad light. I considered how much of a flexible object the horrible of *Horrible Science* is; how it embodies a mix of references to the gothic, the yucky and a sense of pre/anti-social anarchy. Such a mixed bag of 'the horrible', I argued, provides the brand with an ambivalent generational position, with feet in both childlike scatological humour and grown-up horror. It also suits the challenge of dealing with gender identity in the context of learning about science, by presenting itself as appropriately adventurous, outdoors and most of all 'hard', yet always

through the ambivalences of humour and without ever veering too far from the home. Thus, the horrible ironically distances *Horrible Science*'s claims to truth both from over-sensationalised and over-censored (either way, glossy) images of the world. Further, the mix of fictional genres within this multi-anchored sense of the horrible allows *Horrible Science* to sample tropes of (traditionally reverent) science fiction alongside (traditionally critical) 'mad scientist' stories, without necessarily settling on either. In doing so, *Horrible Science* signals itself as both culturally and counter-culturally authoritative.

My exploration of *Horrible Science*'s styles of narration (chapter five) discussed the 'generational drag' style of narration which applies conversational language and addresses the audience directly, as if implicating itself as the readers' chum. In terms of plot, I concluded that *Horrible Science* worked through two opposing narrative drives: one towards a reasonably chaotic magazine structure, and a second, more organisational one that veers towards the narrative plotting of a storybook. I also suggested that although we could read *Horrible Science* as metatextual in its self-referential appropriation of a range of media forms, any metatextual work done by *Horrible Science* is largely at the level of allusion. Indeed, the fabricated historical documents which, scrap-book like, make up much of the books' content provide an oddly postmodern pseudo-fictional reproduction of the power of empiricism and handling of primary sources. Moreover, they also allow the narrator to take on a different costume. The change of narrative form and narrative voice is part of what provides a sense of magazine-like, changing, perhaps anarchic structure, as the books are not so much narrated as they imply a cacophony of narrators.

I suggested that fiction frames realism in *Horrible Science* (chapter six), and befitting panto-science, this frame is kept quite explicit. *Horrible Science* seems to revel in its fictional moments, referencing and using fiction throughout the books, but it also nods to the deficiencies of fiction to suggest that the factual content is fiction-and-some. *Horrible Science* wears its fiction on its sleeve, focusing attention on the constructed 'only a story' aspect of fiction to contrast with the claims of scientific explanation to be 'really real'. Yet, at the same time, it shows off its fiction to make its scientific explanations seem more real. Such a mix of apparently contradictory attitudes towards fiction (both central to identity and rhetorically Othered) should not be understood simply as a form of postmodern cop-out. Firstly, it reflects ways in which science applies both a norm and a counter-norm at once, as we find in

Gieryn's (1999) 'cartographic' approach to the boundaries of science. Moreover, the desire to 'have your myth and relativise it' can be read as having its own rhetorical effect in engendering trust. *Horrible Science* asks us to trust its content by appearing to be aware of the problems of a straight realist address. This form of realism is, arguably, also reflected in *Horrible Science*'s slightly anarchic, grotesque humour and its nods towards alternative histories of science which paint the heroes of discovery with warts and all. It is both Bolter and Grusin's (1999) double logic of contemporary (im/hyper)mediacy and, in some respects, a form of the 'modest' scientist (c.f. Shapin & Schaffer, 1985) repackaged for the context of 21st century children's books; a full-on example of the realist eye which aims to somehow cancel out its necessary human self by acknowledging it.

My discussion of *Horrible Science*'s audience participation (chapter seven) argued that the books may imply the possibility of a child's involvement with science, but they do not really allow much space for it. They provide 'allusions' to interactivity, but allow little space for audience agency. This is the audience participation of pantomime; scripted, independent of the actual thoughts or reactions (or discoveries) of the audience members, loud, done for a laugh, and largely reliant on all actors having some familiarity with shared cultural codes. Discovery is not so much experienced in *Horrible Science* as talked about, and knowledge is presented as ready-made. Quizzes, with their clear sense of true and false, provide an example of some of the most obviously non-interactive forms of audience participation. Furthermore, the quiz answers are generally counter-intuitive, with answers directed against the teacher rather than for them. This is knowledge for those 'who know they don't know everything', and is perhaps comparable to forms of subcultural capital (Thornton, 1995), or at least the complex form of cultural capital exchange of the higher education industries (Bourdieu, 1988), the implication being that having been through the (comically) humiliating experience of looking like a fool, you have learnt some new piece of esoteric knowledge which you can now use as cultural capital for your own gain.

Chapter eight, on humour, argued that comedy in *Horrible Science* is not a simple matter of 'sugar coating', but is made in, with, and about scientific content as much as it decorates it. Overall, when *Horrible Science* appears to be making science the butt of the joke, it is more likely to support scientific authority than to challenge it. *Horrible Science* draws on the ability of humorous discourse to provide alternative, perhaps additional, views of the world, revelling in a carnivalesque

identity that celebrates the epistemological advantage of the outsider. However, in practice, it is more likely to apply the juxtaposition of multiple points of view in order to emphasise one view (generally that of scientific authority) over others or simply to escape having to tie itself down to a single ideology. In many ways, humour helps build the sense that *Horrible Science* has a privileged view compared to the rest of the world. This view is one that the readers are invited to participate in, although only if they accept and take on the premise of these jokes. Additionally, as we have seen throughout the thesis, *Horrible Science* applies humour alongside horror, connecting the two as if horror is inherently funny (and vice versa). Here I argued that *Horrible Science*'s application of comic horror suggests a use of comedy as a form of 'psychological relief'; joking about the 'horror' of scientific objects or scientific work in order to dissipate fear or distaste of them.

The final chapter, on wonder, argued that *Horrible Science*'s anthologised, fabricated and often ironic allusions to the sublime could still be read as an expression of wondrous awe; its humour and 'weird domesticity' a matter of non-innocently experiencing the sublime in late/post modernity. I also suggested that the experience of scientific sublimes is reliant on the audience's compliance in constructing reverence for the scientific community. Invoking the sublime could therefore be read as a form of the 'dominant concern' of popular science; endowing the scientific community with enormous epistemic capital (Hilgartner, 1990). Crucially, however, this is not exactly the 'deficit model', constructing science as hierarchical by labelling popular science audiences as an ignorant public. The readers sit in the middle, exchanging inferiority (in comparison to the writer and science) for superiority (from other 'lesser mortals' around them). This presents us with a tiered notion of science-public relations; science at the top, those other 'stupid people' we all make jokes about at the bottom and, someplace between, the now-enlightened *Horrible Science* reader.

I want to now move on to some statements about how this case study in children's science culture can help us consider popularised science in general. Firstly, a recap on the frameworks for thinking about popular science already available. As discussed in chapter one, science studies researchers tend to think of popularised science as an 'ideological labour' enacted for the benefit of the scientific community. Science communication products and events may explicitly exist to connect disparate cultural spaces, but their very existence acts to emphasise the separation: as if the scientific community only invited the public to 'interact' in order to

reinforce a powerful boundary between the two groups. Advocates of critical PUS pointed out the problem of such a 'deficit model' approach: firstly suggesting that true scientific literacy might be more a matter of teaching people the philosophies and sociologies of science to explain how it 'really works' (Durant, 1993); then moving towards avoiding anything as prescriptive as scientific literacy in favour of more participatory projects articulated under the terms of 'engagement' or 'dialogue' (House of Lords, 2000). And yet, popularised science continues; purporting to tell people things in a way very similar to deficit model set-ups.

Children's science culture in particular provides examples of the durability of such didacticism. The challenge this presents to theories of science communication are the key reasons for choosing a case study from child-orientated media. The knowledge politics surrounding children is, arguably, different from that for adults. We might, for example, suggest that whereas the deficit model is a problem because it treats adult publics as kids, there is nothing wrong with treating kids as kids. However, I think the problem of using a didactic framework as a means for increasing the prestige of professional communities still remains, even in educational contexts. By this I do not necessarily mean to advocate that we 'de-school' society (c.f. Illich, 1971); only that the politics of education should be recognised. Moreover, *Horrible Science* is, at least explicitly, a cultural product to be enjoyed at some distance from the classroom. The fact that *Horrible Science* is children's culture might explain the social acceptability of its more didactic moments, but it does not necessarily excuse it. Moreover, it does not explain the appeal to the child. *Horrible Science* does not provide scientific knowledge to its reader by appealing to their need for such knowledge; as more overtly curriculum linked forms of edutainment arguably sell themselves to parents. Rather, it suggests itself as fun and productive in itself.

The *Horrible Science* example reveals two further problems with a 'spot the deficit model' approach to popular science. Firstly, forms of popular science which are largely PR for the scientific community can still sample a more critical voice without veering into any 'anti-science' waters; as we saw in the odd double-use of the word 'horrible' in *Horrible Science*. Secondly, not all popular science is produced or controlled by the scientific community. In the case of *Horrible Science*, neither De Saulles nor Arnold is a scientist. Neither are they the sorts of professional science journalists Nelkin (1995) describes, cultivating an especially close relationship to the scientific community. Nor, to the best of my knowledge, are they, as Mackinberg (2006) describes in her study of cold war children's books, politicians using the

various rhetorics of science to bolster either Marxist or capitalist propaganda. So what is their agenda? We might argue that they are exploiting the rhetorics of science for commercial gain, and there is probably some scope in such an argument. However, I also think that De Saulles and Arnold (and a host of similar writers) are best read as aligned with their readers. Despite my critique of the books' attempts at 'generational drag' in order to appear 'down with the kids', *Horrible Science* is, in my opinion, a form of public-to-public popular science. As such, I believe, the books are an expression of the sorts of appeals popular science has for its consumers, pointing us towards ways in which 'top down' PUS discourses can be appealing for non-scientists. *Horrible Science*'s irreverent-reverence might be read as a sort of clever conspiracy: an apparently critical discourse masking a traditionally PUS approach and a sort of carnivalesque re-claiming of the mad scientist image. Although I think that reading is part of what is going on in *Horrible Science,* to leave it at that would be simplistic. Rather, *Horrible Science* seems to suggest that a 'non-innocent' performance of scientific ideas is the most powerful one to adopt. *Horrible Science* offers the cultural power of scientific knowledge to its readers, and, perhaps appropriately for a product of late modernity (c.f. Beck, 1992, Giddens, 1991), part of this knowledge is being slightly suspicious of itself.

One important alternative to the 'spot the deficit model' approach to popular science is Fyfe and Lightman's (2007) image of empowered consumers of popular science. As I discussed in chapter one, Fyfe and Lightman put forward the idea of the marketplace not only as a description of what was happening in popular science, but as a metaphor for thinking about expertise. In Fyfe and Lightman's view, the consumers of scientific culture in the 19th century were increasingly aware of the range of forms of expertise and the different, competing, ideas on offer. As well as choosing which products to partake of, such consumers had the ability to choose which ones to trust and how far (Fyfe & Lightman, 2007: 12). This is an approach to the consumer I only partially subscribe to. As I have previously stated, I worry that Fyfe and Lightman are applying a slightly utopian idea of consumer power. As a solution, perhaps we should take a lesson from *Horrible Science* and apply, at once, both Fyfe and Lightman's view of consumer choice and a reading of popular science as ideological labour.

Just as Lantham (2002) reads a child's place in consumer culture as 'vampiricly' disempowered, empowered, disempowering and empowering, popular science is probably best understood as a product through which interaction between

and across cultural fields allows a range of actors to, simultaneously, share social power, declare their own cultural status, and fall prey to the hierarchies of science in society. Quite simply, Bourdieu's sense of cultural capital, so often applied to 'high art' such as art galleries, can be readily applied to those places which often complain, CP Snow style, that they are seen as 'low culture'. In *Horrible Science*, I identified the offering of an exchange of cultural capital, as audiences are invited to join in the building of boundaries between science and the rest of the world so they can take some of the reflected glory for themselves. Much of contemporary popular science (for young and old) can be understood as inviting its readers to take up a position in between the 'great and the good' of the scientific community and an unenlightened Othered 'public'. The knowing-ness of the non-innocent stance and pantomime-style fourth-wall breaking of *Horrible Science* is indicative of the ways in which popular science strives to appeal to consumers' desires to acquire symbols of intellectual superiority over their peers.

In summary then, as a form of public-to-public popular science, *Horrible Science* provokes us to re-consider the deficit model as our only explanatory framework for understanding the pro-science stance of the genre. The ways in which *Horrible Science* appears to appeal to its audiences suggests 'the public' may find a social advantage within the hierarchical boundaries around professionalised science which also exclude them. This side of some public-to-public popular science might also help us understand some of the reasons for the enduring appeal of top-down popular science. In terms of my aim to find more developed ways to consider children and science (as well as popular science in general), understanding the possible appeal of being a member of a knowledgeable public helps avoid the analytical problems of applying 'spot the deficit model' critiques to traditionally didactic contexts.

I hope that understanding these appeals of popular science also points us towards some avenues for further research. The big gap in this thesis is the actual audience, and I would hope that the next step for this work would be to investigate the meanings those flesh and blood children I chose to ignore actually draw from their science culture. What do audiences, young or old, enjoy about participation in the more didactic forms of popular science? How are identities constructed around participation in science culture, which might also include more apparently democratic 'engagement' work as well as openly didactic popularised science? Do audiences and participants of science communication find they construct a middle identity of

someone who is not a scientist but is somehow more informed than other publics, and do they ascribe cultural value to that? Or are such cultural capital games just something offered by *Horrible Science*; actually unappealing to the audiences of most science culture? The 'non-innocent' public voice, one that is not necessarily anti-science or pro-science, but explicitly sitting on the edge, is particularly worth exploring within this.

Such questions would be difficult to study; it is not easy to ask people if they think they are better than other people. Such work might need to adopt some 'creative' methodologies for the investigation of social identity (c.f. Gauntlett, 2007). Keeping to a study of young people, I think there is also scope for comparative work between students who have taken the *21st century science* GCSE and/or are enrolled on a Science & Society A/S (i.e. courses inspired by Millar & Osborne, 1998) and those enrolled in more traditional science courses. This would take advantage of both the science/non-science division built into the English educational system and recent attempts to reconfigure this (at least in terms of assumed relationships between science and 'publics'). The potentially liminal identity of Science & Society A/S students might be especially interesting in terms of learning more about how a mix of critical and reverent images of science construct personal identity with respect to the scientific community, especially at a stage of life when people are often quite aware of social identity construction.

I will end with some more general comments on science as pantomime which I hope reflect back on the content of the thesis as a whole. Science as pantomime is science as a show. It is spectacular, happily sensational and, crucially, constructed with a sense of the desires of its audience quite firmly in mind. As with pantomime, *Horrible Science* is a variety show; its 'mix' of content is what makes it special for its author, as it anthologises a range of approaches, stances and styles. As pantomime, *Horrible Science* samples well-known fictional tropes (most noticeably horror fiction), but it also samples scientific ideas and stories from the history of science. Through its (sometimes ironic) intertextual references, *Horrible Science* simultaneously introduces, reflects upon and draws forms of cultural capital from other sources. Moreover, panto-science plays a variety of games with its audience, laughing at everything and everyone, including itself, drawing attention to itself as constructed, falling through the 'fourth wall' between audience and performer. Yet, the role of the audience is largely pre-scripted, despite rhetorically invoking feelings of both involvement and chaos. Panto-science plays with connecting with the audience, but

only plays. It also plays with realism, but again, only plays, as its claim to a connection to the truth (that it is 'really real') is as important as its claim to be entertaining. Panto-science anthologises not just media spectacles of jokes, horror and the camper ends of fiction, but also quite traditional approaches to popular science; celebrating the wonder, delight, beauty and, above all, the empirical authority of science. Finally, but crucially, as pantomime *Horrible Science* is a product of consumer culture, playing its games to provide entertainment for the audience.

Overall, what I think my exploration of this example of pantomime science has taught me (and that I would like to pass on) is two key points. Firstly, apparent irreverence can be a function of quite traditional public relations for the scientific community. Moreover, by referencing both critical and reverent discourses, a sort of non-innocent enjoyment of science can be offered by popular science. Secondly, the social advantage critics have suggested PUS-style public relations work gives to the scientific community (i.e. the ability to make themselves appear above and separate from ignorant publics) can also be an appeal for some members of science's 'publics', as they are offered a middle-place within a tiered notion of science-public relations; with science at the top, those other 'stupid people' we all make jokes about at the bottom and, someplace between, the enlightened popular science consumer.

References

Primary:

Abbott, Edwin A (1884) *Flatland*, Penguin World Classics 1998 edition (London: Penguin).

Ackroyd, Peter (2003a) *Voyages Through Time Series: Escape from Earth* (Dorling Kindersley: London).

Ackroyd, Peter (2003b) *Voyages Through Time Series: The Beginning* (Dorling Kindersley: London).

Aigner-Clark, Julie (2006) *Ten Stars Twinkle* (London: Scholastic).

Alton, Steve & Nick Sharratt, (2007) *Chewy Gooey, Rumble, Plot! A Deliciously Disgusting Pop-Up Guide to the Digestive System* (New York: Dial Books).

Andrews, Georgina & Kate Knighton (2004) *Usborne 100 Science Experiments* (London, Usborne).

Arnold, Nick (text) & Clive Goddard (illustrations) (2001) *The Knowledge: Awesome Archaeology* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (1996a) *Horrible Science: Blood, Bones and Body Bits* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (1996b) *Horrible Science: Ugly Bugs* (London: Scholastic) version used is 1999 two-in-one edition with *Nasty Nature*.

Arnold, Nick (text) & Tony De Saulles (illustrations) (1997a) *Horrible Science: Fatal Forces* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (1997b) *Horrible Science: Chemical Chaos* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (1997c) *Horrible Science: Nasty Nature* (London: Scholastic) version used is 1999 two-in-one edition with *Ugly Bugs*. Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (1998a) *Horrible Science: Sounds Dreadful* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (1998b) *Horrible Science: Vicious*

Veg (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (1999a) *Horrible Science: Frightening Light* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (1999b) *Horrible Science: Bulging Brains* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (2000a) *Horrible Science: Suffering Scientists* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2000b) *Horrible Science: Deadly Diseases* (London: Scholastic) version used is 2004 two-in-one edition with *Microscopic Monsters.* Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (2000c) *Horrible Science: Shocking Electricity* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (2000e) *Horrible Science: Awfully Big Quiz Book* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2001a) *Horrible Science: Disgusting Digestion* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (2001b) *Horrible Science: Killer Energy* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2001c) *Horrible Science: Microscopic Monsters* (London: Scholastic) version used is 2004 two-in-one edition with *Deadly Diseases.*

Arnold, Nick (text) & Tony De Saulles (illustrations) (2002a) *Horrible Science: The Body Owner's Handbook* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2002b) *Horrible Science: The Terrible Truth About Time* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2003) *Horrible Science: Really Rotten Experiments* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2004a) *Horrible Science: Space, Time and Slimy Aliens* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2004b) *Horrible Science: Explosive Experiments* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2004c) *Horrible Science: Fearsome Fight for Flight* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2004d) *Horrible Science: Painful Poisons* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2005a) *Horrible Science: Angry Animals* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2005b) *Horrible Science: The Stunning Science of Nearly Everything* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2005c) *Horrible Science: Explosive Experiments*, edition with box of cards (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2006a) *Horrible Science: Measly Medicine* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2006b) *Horrible Science Jigsaw Special: Dinosaurs* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2006c) *Horrible Science Sticker Special: Ugly Bugs* (London: Scholastic). Also re-brand (2008) edition.

Arnold, Nick (text) & Tony De Saulles (illustrations) (2006ds) *Horrible Science Sticker Special: Disgusting Digestion* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2007a) *The Serious Squishy Science Book* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2007b) *Horrible Science: Evil Inventions* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (lead illustrator) (2007c) *Horrible Science: Annual 2008* (London: Scholastic).

Arnold, Nick (text) & Dave Smith (illustrations) (2007d) *Horrible Science Handbooks: Famous Foul Experiments* (London: Scholastic).

Arnold, Nick (text) & Dave Smith (illustrations) (2007e) *Horrible Science Handbooks: Freaky Food Experiments* (London: Scholastic).

Arnold, Nick (text) & Dave Smith (illustrations) (2008a) *Horrible Science Handbooks: Beastly Body Experiments* (London: Scholastic).

Arnold, Nick (text) & Tony De Saulles (illustrations) (2008b) *Horrible Science Jigsaw Special: Ugly Bugs* (London: Scholastic).

Bingham, Jane (1991/ 2006) *The Usborne Science Book of Science Experiments* (London: Usborne).

Branzei, Sylvia (text) & Jack Keely (illustrations) (1995) *Grossology: the science of really gross things* (Reading, Mass: Addison Wesley).

Branzei, Sylvia (text) & Jack Keely (illustrations) (2003) *Hands On Grossology: really gross science experiments* (New York: Price Stern Solan).

Branzei, Sylvia (text) & Jack Keely (illustrations) (2004) *Naked Grossology: really gross things about your body* (London: Puffin).

Birggs, Raymond (1977) *Fungus the Bogeyman* (London: Hamilton).

Bryson, Bill (2003) *Short History of Nearly Everything* (London: Doubleday).

Cassidy, John (1992) *The Explorabook: A Kid's Science Museum in a Book* (Palo

Alto: Klutz).

Cole, Joanna (text) & Bruce Degen (illustrations) (1989) *Magic School Bus: Inside the Human Body* (New York: Scholastic).

Cole, Joanna (text) & Bruce Degen (illustrations) (1999) *Magic School Bus: Explores the Human Senses* (New York: Scholastic).

Collins, Harry & Trevor Pinch (1993) *The Golem – what everyone should know about science* (Cambridge: Cambridge University Press).

Conant, James B & Leonard K Nash (1957) *Harvard Case Histories in Experimental Science* (Cambridge MA: Harvard University Press).

Connolly, Sean (2007) *Wholly Irresponsible Experiments!* (Cambridge: Icon).

Connolly, Sean (2008) *Wholly Irresponsible Exploits!* (Cambridge: Icon).

Cox, Phillip (2002) *Miss Galaxy's Space Lessons* (London: Scholastic).

Cox, Michael (text) & Chris Goddard (illustrations) (2003) *Dead Famous: Leonardo Da Vinci and His Super-Brain* (London: Scholastic).

Deary, Terry, Barbara Allen (text) & Phillip Reeve (illustrations) (1999a) *Spark Files: Dark Forces* (London: Faber).

Deary, Terry, Barbara Allen (text) & Phillip Reeve (illustrations) (1999b) *Spark Files: Light and Wrong* (London: Faber).

Deary, Terry (text) & Martin Brown (illustration) (2004) *The Mad Miscellany* (London: Scholastic).

DK Publishing (2004) *e.explore: Human Body* (London: Dorling Kindersley).

Enright, Dominique, Sarah Jones (text) & Niki Catlow (illustrations) (2005) *Children's Miscellany, Volume 2* (London: Buster Books).

Enright, Dominique, Guy Macdonald (text) & Niki Catlow (illustrations) (2006) *The Boys Book: How to Be the Best at Everything* (London: Buster Books).

Farnam, John (1992) *The Very Bloody History of Britain Without the Boring Bits* (London: Red Fox).

Farnam, John (1999) *History in a Hurry: The Future* (London: Macmillan Children's books).

Farnam, John (2001) *The Short and Bloody History of Spies* (London: Red Fox).

Gamow, George (1965/ 1993) *Mr Tompkins in Paperback*, Canto edition (Cambridge: Canto).

Ganeri, Anita (text) & Mike Phillips (illustrations) (1999) *Horrible Geography: Stormy Weather* (London: Scholastic).

Ganeri, Anita (text) & Mike Phillips (illustrations) (2000) *Horrible Geography: Intrepid Explorers* (London: Scholastic).

Ganeri, Anita (text) & Mike Phillips (illustrations) (2008) *Horrible Geography*

Handbooks: Wicked Weather (London: Scholastic).

Gates, Phil (text) & Tony De Saulles (illustrations) (1999) *Horrible Science: Evolve or Die* (London: Scholastic). Also re-brand (2008) edition.

Gilmore, Robert (1994) *Alice in Quantumland* (Wilmslow: Sigma Science).

Gilmore, Robert (1996) *Scrooge's Cryptic Carol: Visions of Energy, Time and Quantum Nature* (New York: Springer-Verlag).

Gilmore, Robert (2001) *The Wizard of Quarks* (New York: Copernicus).

Gilmore, Robert (2003) *Once upon a Universe: Not-so-Grimm tales of cosmology* (New York: Copernicus).

Gilpin, Rebecca, Leonie Pratt (text) & Josephine Thompson (design & Illustration) (2007) *The Usborne Big Book of Science Things to Make and Do* (London, Usborne).

Goldsmith, Mike (text) & Chris Goddard (illustrations) (2003) *Dead Famous: Scientists and Their Mind-Blowing Experiments* (London: Scholastic).

Goldsmith, Mike (text) & Daniel Postgate (illustrations) (2004) *The Knowledge: Fantastic Future* (London: Scholastic).

Gomi, Taro (2002) *Everybody Poos,* trans. Mayer Stinchecum, Amanda (London: Frances Lincoln).

Gresh, Lois (2003) *The Truth Behind a Series of Unfortunate Events: Eyeballs, Leeches, Hypnotism, and Orphans, exploring Lemony Snicket's World* (Griffin, New York).

Gresh, Lois & Robert Weinberg (2001) *The Computers of Star Trek* (New York: Basic Books).

Gresh, Lois & Robert Weinberg (2002) *The Science of Superheroes* (Hoboken NJ: John Wiley & Sons).

Gresh, Lois & Robert Weinberg (2005) *The Science of Anime: Mecha-Noids and AI-Super-Bots* (New York: Thunder's Mouth Press).

Gribbin, John & Mary Gribbin (2003) *The Science of Philip Pullman's "His Dark Materials"* (London: Hodder Children's Books).

Hamer, Martyn (2000) *Smelly Science... science with all the dull bits taken out!* (Bath: Parragon).

Hammond, Richard (2006) *Can You Feel the Force?* (London: Dorling Kindersley).

Hawkin, Lucy, Stephen Hawkin & Garry Parsons (2007) *George's Secret Key to the Universe* (London: Simon & Schuster).

Hibbert, Claire (2005) *JLA Reader Level 4: Green Lantern's Book of Inventions* (London: Dorling Kindersley).

Highfield, Roger (1998) *Can Raindeer Fly: The Science of Christmas* (London:

Metro).
Highfield, Roger (2002) *The Science of Harry Potter* (London: Headline).
Hindley, Judy & CJ Rawson (1975) *How Your Body Works* (London: Usborne).
Hunter, Norman (text) & W Heath Robinson (illustrator) (1933) *The Incredible Adventures of Professor Branestawm* (London: John Lane).
Hunter, Norman (text) & Derek Hughes (illustrations) (1974) *Professor Branestawm's Great Revolution and Other Incredible Adventures* (London: Bodley Head).
Hunter, Norman (ed) & Jill McDonald (illustrations) (1976) *Professor Branestawm's Do-It-Yourself Handbook* (London: Bodley Head).
Hunter, Norman (text) & Gerald Rose (illustrations) (1983) *Professor Branestawm's Hair-Raising Idea* (London: Bodley Head).
Iggulden, Conn & Hal Iggulden (2006) *The Dangerous Book for Boys* (London: Harper Collins).
Knife & Packer (2004a) *Captain Fact: Space Adventure* (London: Egmont).
Knife & Packer (2004b) *Captain Fact: Creepy-Crawly Adventure* (London: Egmont).
Knife & Packer (2005) *Captain Fact: Human Body Adventure,* (London: Egmont).
Lloyd, John & John Mitchinson (2006) *A Quite Interesting Book: The book of general ignorance* (London: Faber & Faber).
MacDonald, Guy (text) & Niki Catlow (illustrations) (2005) *Children's Miscellany, Volume 3* (London: Buster Books).
MacLeod, Jilly (text), Lisa Sterling & Ralph Lazar (illustration) (2006) *How Nearly Everything Was Invented, by the Brainwaves* (London: Dorling Kindersley).
McEvoy, JP & Oscar Zarate (1996) *Quantum Theory for Beginners* (Trumpington: Icon).
Morgan, Matthew, Samatha Barnes (text) & Niki Catlow (illustrations) (2004) *Children's Miscellany, Volume 1* (London: Buster Books).
Morgan, Nicola (2005) *Blame My Brain!* (London: Hodder).
Murphy, Glenn (2007) *Why Is Snot Green?* (London: Macmillan Children's Books).
Petty, Kate, Jennie Maizels & Corina Fletcher (2005) *Global Garden* (Cornwall: Eden Project Publishing).
Petty, Kate & Jennie Maizels (1996) *The Great Grammar Book* (London: Bodley Head).
Petty, Kate & Jennie Maizels (2002) *The Super Science Book* (London: Bodley Head).
Poskitt, Kjartan (text) & Trevor Dunton (illustrations) (1999) *Murderous Maths* (London: Scholastic).
Poskitt, Kjartan (text) & Philip Reeve (illustrations) (2000) *Murderous Maths:*

Fractions and Averages (the mean and vulgar bits) (Scholastic, London).

Poskitt, Kjartan & Philip Reeve (2004) The magic of pants: a conjuror's compendium of underpants tricks to delight all ages (and sizes) (London: Scholastic).

Pratchett, Terry, Ian Stewart, Ian & Jack Cohen (1999) *The Science of Discworld* (London: Ebury).

Roberts, Jeremy & David Leslie (2006) *Pick Me Up* (London: Dorling Kindersley).

Russell, James (text) & Øivind Hovland (illustrations) (2007) *How to Turn Your Parents Green* (Bath: Tangent).

Sabuda, Robert & Matthew Reinhart (2005) *Encyclopaedia Prehistorica Dinosaurs: The Definitive Pop-Up* (London: Walker Books).

Sabuda, Robert & Matthew Reinhart (2006) *Encyclopaedia Prehistorica: Sharks and Other Sea Monsters* (London: Walker Books).

Schott, Ben (2002) *Schott's Original Miscellany* (London: Bloomsbury)

Singh, Simon (2004) *The Cracking Code Book* (Harper Collins Children's Books: London).

Solomon, Joan (ed) (2000a) *Biology* (Cheltenham: Nelson).

Solomon, Joan (ed) (2000b) *Chemistry* (Cheltenham: Nelson).

Solomon, Joan (ed) (2001) *Physics* (Cheltenham: Nelson).

Stannard, Russell (1989) *The Time and Space of Uncle Albert* (London: Faber & Faber)

Stannard, Russell (1992) *Black Holes and Uncle Albert* (London: Faber & Faber).

Stannard, Russell (1993) *World of 1001 Mysteries* (London: Faber & Faber).

Stannard, Russell (1994) *Uncle Albert and the Quantum Quest* (London: Faber & Faber

Stannard, Russell (1998) *Ask Uncle Albert: 100 ½ Tricky Science Questions Answered* (London: Faber & Faber).

Stannard, Russell (1999b) *The NEW world of Mr Tompkins* (Cambridge: Canto).

Stannard, Russell (text) & Bill Ledger (illustrations) (2001a) *Lab Cats on the move: what makes things move* (London: Marshall).

Stannard, Russell (text) & Bill Ledger (illustrations) (2001b) *Lab Cats Let Up Steam: what things are made of* (London: Marshall).

Stannard, Russell (text) & Bill Ledger (illustrations) (2001c) *Lab Cats See the Light: Light and Sound* (London: Marshall).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2004a) *Horrible Science Teachers' Resources: Electricity* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2004b) *Horrible Science Teachers' Resources: Human Body* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2004c) *Horrible Science Teachers' Resources: Animals* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2004d) *Horrible Science Teachers' Resources: Forces* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2005a) *Horrible Science Teachers' Resources: Light* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2005b) *Horrible Science Teachers' Resources: Mini-beasts* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles y (illustrations) (2005c) *Horrible Science Teachers' Resources: Sound* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2005d) *Horrible Science Teachers' Resources: Plants* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2006a) *Horrible Science Teachers' Resources: Micro-organisms* (London: Scholastic).

Tomlinson, David, Nick Arnold (text) & Tony De Saulles (illustrations) (2006b) *Horrible Science Teachers' Resources: Earth and Beyond* (London: Scholastic).

Turnbull, Stephanie (2003) *The Usborne Dinosaur Jigsaw Book* (London: Usborne).

Vorderman, Carol (2002) *Carol Vorderman's Maths Made Easy Ages 6-7 Key Stage 1 Beginner* (London: Dorling Kindersley).

Walker, Richard (2007) *Alive: The Living, Breathing, Human Body Book* (London: Dorlington Kindersely).

Walker, Robert (text), Lisa Sterling, Lisa & Ralph Lazar (illustration) (2007) *How the Incredible Human Body Works, by the Brainwaves* (London: Dorling Kindersley).

Winston, Robert (2004) *What Makes Me, Me?* (London: Dorling Kindersley).

Secondary :

Adorno, Theodor (1991) *The Culture Industry,* edited and with an introduction by J.M. Bernstein (London: Routledge Classics).

Al-Gailani, Salim (2007) 'Cultures of magic, science and masculinity in twentieth-century toy chemistry sets', paper presented at 2007 BSHS annual meeting, University of Manchester, June 2007.

Allen, Graham (2000) *Intertextuality* (London: Routledge).

Applebaum, Noga (2006) 'The Myth of the Innocent Child: the Interplay Between Nature, Humanity and Technology in Contemporary Children's Science Fiction', *The Journal of Children's Literature Studies* vol. 3(2): 1-17.

Applebaum, Noga (2005) 'Electronic Texts and Adolescent Agency: Computers and the Internet in Contemporary Children's Fiction', in Kimberley Reynolds (ed) *Modern Children's Literature: An Introduction* (Basingstoke and New York: Palgrave).

Arnold, Nick (2006a) Interview with Alice Bell. Held at Kew Gardens, London, 2nd September 2006.

Arnold, Nick (2006b) Interview with Alice Bell. Held at hotel in Bloomsbury, London, 2nd October, 2006.

Arvidsson, Adam (2005) 'Brands: A Critical Perspective', *Journal of Consumer Culture*, vol. 5(2): 235–258.

Atkinson Paul & Sara Delamont (1976) 'Mock-ups and Cock-ups: The Stage-Management of Guided Discovery Instruction', in Martin Hammersley & Paul Woods (eds) *The Process of Schooling: A Sociological Reader* (London: Open Univ. Press). 133 – 142.

Bakhtin, Mikhail (1965) *Rabelais and His World*, trans, Helane Iswolsky (Cambridge MA & London: MIT Press).

Balen, Rachel et al (2006) 'Involving Children in Health and Social Research: 'Human becomings' or 'active beings'', *Childhood,* vol. 13(1): 29-48.

Ball, Stephen J (2001) 'Perfomativities and Fabrications in the Education Economy: Towards the Performative Society', SJ Ball (ed, 2004) *The RoutledgeFalmer Reader in Sociology of Education* (London: RoutledgeFalmer) 143-155. First published in Denis Gleeson & Chris Husbands (eds) *The Performing School: Managing, Teaching and Learning in a Performance Culture* (London: RoutledgeFalmer) 210-26.

Ball, Stephen J (2003) *Class Strategies and the Education Market: The Middle Classes and Social Advantage* (London & New York: RoutledgeFalmer).

Barker, Keith (1998) 'Prize-fighting' in Kimberly Reynolds & Nicholas Tucker (ed) *Children's Book Publishing in Britain Since 1945.* (Aldershot: Scolar Press) 42-59.

Barker, Martin (1984) *A Haunt of Fears: The Strange History of the British Horror Comics Campaign* (London & Sydney: Pluto).

Barker, Martin (1989) *Comics, Ideology, Power and the Critics* (Manchester: Manchester University Press).

Barker, Martin (1993) 'Seeing how far you can see: on being a 'fan' of 2000 AD'. In David Buckingham (ed) *Reading Audiences: Young People & The Media.* (Manchester & New York: Manchester University Press) 159-183.

Barnes, Emm (2006) 'Captain Chemo and Mr Wiggly: Patient Information for

Children with Cancer in the Late Twentieth Century', *Social History of Medicine* vol19, 3: 501-519.

Barthes, Roland (1977) *Image - Music - Tex.* (London: Fontana Press) Selected and translated by Stephen Heath.

Baudrillard, Jean (1981) *For a Critique of the Political Economy of the Sign*, trans. Charles Levin (New York: Telos Press).

Baudrillard, Jean (1994) *Simulacra and Simulation*, trans. Sheila Faria Glaser (Ann Arbor: University of Michigan Press).

Bauman, Zygmunt (1999) *Liquid Modernity* (Cambridge: Polity).

Bauman, Zygmunt (2007) *Consuming Life* (Cambridge: Polity).

Baxendale, Leo (1989) *On Comedy: The Beano and Ideology* (Stroud: Reaper Books).

Beck, Ulrich (1992) *The Risk Society: Towards a New Modernity,* trans. Mark Ritter (London: Sage).

Beer, Gillian (1996) *Open Fields: Science In Cultural Encounter* (Oxford: Clarendon).

Beer, Gillian (2000) *Darwin's Plots: Evolutionary Narrative in Darwin, George Eliot, and Nineteenth-century Fiction,* 2nd edition (Cambridge: Cambridge University Press).

Bell, Alice & Jon Turney (2002) *Report of Science Communication Conference.* Downloadable at http://www.copus.org.uk/pubs_reports_scc2002.html (last accessed 15th June, 2008).

Bell, Alice (2004) *Constructing the Scientific Citizen.* MA dissertation (Sociology of Education), Institute of Education, London.

Bell, Alice (2007a) 'Chasing the Cheshire Cat: 'Invisible' Boundaries of Credibility in Children's Science Literature'. In Jenny Ramone & Gemma Twitchen (eds) *Boundaries* (Newcastle: Cambridge Scholar's Publishing): 48-65.

Bell, Alice (2007b) 'The Branded Book: Power, Children's Literature and the Logos of Consumer Culture', *Journal of Children's Literature Studies*, vol. 4(2): 88-106.

Bell, Alice (2007c) 'What Albert Did Next: The Kuhnian Child in Science Writing for Young People', in Pat Pinsent (ed) *Time Everlasting: Representations of Past, Present and Future in Children's Literature* (Staffordshire: Pied Piper Publishing) 250-267.

Bell, Alice R (2008) 'The Childish Nature of Science: Exploring the child/science relationship in popular non-fiction', in Alice R Bell, Sarah R Davies & Felicity Mellor (eds) *Science and Its Publics* (Newcastle: Cambridge Scholars Publishing) 79-98.

Bell, Alice R (forthcoming) 'The Anachronistic Fantastic: Science, Progress and the

Child in 'Postnostalgic' Culture', *International Journal of Cultural Studies.*

Bernstein, Basil (1971) 'On the classification and framing of educational knowledge, in Michael D Young (ed) *Knowledge and Control: New Directions for the Sociology of Education* (London: Collier Macmillian).

Bernstein, Basil (1975) 'Class and Pedagogies: Visible and Invisible', in *Class, Codes and Control*, Vol3. (London: Routledge and Keengan Paul), 116-156.

Billig, Michael (1996) *Arguing and Thinking: A Rhetorical Approach to Social Psychology,* 2nd edition (Cambridge: Cambridge University Press).

Billig, Michael (2005a) *Laughter and Ridicule* (London: Sage).

Billig, Michael (2005b) 'Comic Racism and Violence' in Sharon Lockyer & Michael Pickering, (eds) *Beyond a Joke: The Limits of Humour* (Basingstoke & New York: Palgrave Macmillian) 25-44.

Bixler, Phyllis & Lucien Agosta (1984) 'Formula fiction and children's literature: Thornton Waldo Burgess and Frances Hodgson Burnett', *Children's Literature in Education,* vol. 15 (2): 63-71.

Blanchet-Cohen, Natasha & Brian Rainbow (2006) 'Partnership between children and adults? The experience of the international children's conference on the environment', *Childhood,* vol.13 (1): 113-126.

Bloor, David (1976) *Knowledge and Social Imagery* (New York & London: Routledge and Kegan Paul)

Blumenreich, Megan & Margori Siegel (2006) 'Innocent Victims, Fighter Cells, and White Uncles: A Discourse Analysis of Children's Books about AIDS', *Children's Literature in Education,* vol. 37(1): 81-110.

Bodmer, Walter (1985) *The Public Understanding of Science* (London: The Royal Society).

Boltanski, Luc (1999) *Distant Suffering: Morality, Media and Politics*, trans. Graham Burchell (Cambridge: Cambridge University Press).

Bolter, Jay David & Diane Gromala (2003) *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency* (MIT Press: Cambridge, Mass).

Bolter, Jay David & Richard Grusin (1999) *Remediation: Understanding New Media* (Cambridge MA: MIT Press).

Bonner, Francis (2005) 'Looking Inside: Showing Medical Operations on Ordinary Television', in Geoff King (ed) *The Spectacle of the Real: From Hollywood to Reality TV and Beyond.* (Bristol and Portland, OR: Intellect Books) 105-115.

Booth, Michael R (1981) *Victorian Spectacular Theatre 1850-1910* (Boston, London & Henley: Routledge & Keegan Paul).

Bourdieu, Pierre & Jean Claude Passeron (1977) *Reproduction in Education, Society*

and Culture, trans. Richard Nice (London: Sage).

Bourdieu, Pierre (1984) *Distinction: A Social Critique of the Judgement of Taste*, trans. Richard Nice (London: Routledge and Kegan Paul).

Bourdieu, Pierre (1986) 'The Forms of Capital', trans. Richard Nice in John G Richardson (ed) *Handbook of Theory and Research for the Sociology of Education* (Westport, Con: Greenwood Press) 241-58.

Bourdieu, Pierre (1988) *Homo Academicus*, trans. Peter Collier (Cambridge: Polity Press).

Bowker, Geoffrey & Susan Leigh Star (1999) *Sorting Things Out: Classification and Its Consequences* (Cambridge, Mass: MIT Press).

Broks, Peter (2006) *Understanding Popular Science* (Maidenhead & New York: Open University Press).

Brown, Nick (2006) 'Shifting tenses – from "regimes of truth" to "regimes of hope"', *SATSU Working Paper No 30*, downloadable at http://www.york.ac.uk/org/satsu/OnLinePapers/OnlinePapers.htm (last accessed 15th June, 2008)

Bucchi, Massiniano (1998a) 'Images of science in the classroom: wallcharts and science education 1850-1920', *British Journal for the History of Science,* vol. 31(2): 161-81. Special volume on 'Science and the Visual' edited by JV Field and AJL James.

Bucchi, Massiniano (1998b) *Science and the Media* (London & New York: Routledge).

Buckingham, David (1995) 'On the Impossibility of Children's Television: The Case of Timmy Mallet' in Cary Bazalgette & David Buckingham (eds) *In Front of the Children: Screen Entertainment and Young Audiences* (London: BFI Publishing), 47-61.

Buckingham, David (1996) *Moving Images: Understanding Children's Emotional Responses to Television* (Manchester & New York: Manchester University Press).

Buckingham, David (2000a) *After the Death of Childhood: Growing Up in the Age of Electronic Media* (Cambridge: Polity).

Buckingham, David (2007) *Beyond Technology: Children's Learning in the Age of Digital Culture* (Cambridge: Polity).

Buckingham, David, Hannah Davies, Ken Jones & Peter Kelly (1999) *Children's Television in Britain* (London: BFI).

Buckingham, David and Margaret Scanlon (2001) 'Parental pedagogies: An analysis of British "edutainment" magazines for young children', *Journal of Early*

Childhood Literacy, vol.1(3) 281–299.

Buckingham, David & Margaret Scanlon (2003) *Education, Entertainment and Learning in the Home* (Buckingham: Open University Press).

Buckingham, David & Margaret Scanlon (2005) 'Selling learning: towards a political economy of edutainment media', *Media, Culture and Society*, Vol. 27(1): 41–58.

Buckingham, David & Julian Sefton-Green (1994) *Cultural Studies Goes to School: Reading and Teaching Popular Media* (London: Taylor & Francis).

Buckingham, David & Julian Sefton-Green (2004) 'Structure, Agency, and Pedagogy in Children's Media Culture' in Tobin, Joseph (ed) *Pikachu's Global Adventure: The Rise & Fall of Pokémon* (Durham & London, Duke University Press) 12-33.

Bullen, Elizabeth & Elizabeth Parsons (2007) 'Dystopian Vision of Global Capitalism: Phillip Reeve's *Mortal Engines* and M.T Anderson's *Feed'*, *Children's Literature in Education*, vol. 38(2):127-139.

Burbules, Nicholas C (1998) 'Rhetorics of the Web: Hyperreading and Critical Literacy', in Ilana Snyder (ed) *Page to Screen: Taking Literacy Into the Electronic Era* (London: Routledge) also published online at: http://faculty.ed.uiuc.edu/burbules/papers/rhetorics.html (accessed last on 6th March 2008).

Burke, Edmund (1757/ 1987) *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful*, edited by James T Boulton (Oxford: Basil Blackwell).

Burn, Andrew (2005) 'Potter-Literacy – from book to game and back again; literature, film and cross-media literacy', *Papers: Explorations into Children's Literature,* vol. 14(3): 5-17.

Butler, Judith (1990) *Gender Trouble: Feminism and the Subversion of Identity* (London: Routledge).

Campbell, Colin (1987) *The Romantic Ethic and the Spirit of Modern Consumerism* (Oxford: Blackwell).

Campbell, Mary Baine (1999) *Wonder and Science: Imagining Worlds in Early Modern Europe* (Ithaca: Cornell University Press).

Cancalon, Elaine D, & A. Spacagna (ed) (1994) *Intertextuality in Literature and Film* (Gainsville, FL: University of Florida Press).

Carrier, David (2000) *The Aesthetics of Comics* (University Park, Pennsylvania, Pennsylvania State University Press).

Carter, Kate (1993) 'The place of story in the study of teaching and teacher education', *Educational Researcher,* vol.22 (1) 5-11.

Cerini, Bobby, Ian Murray, Ian, & Michael Reiss (2003) *Student Review of the Science Curriculum*. (London: Science Museum and NESTA) Downloadable at:

http://www.planet-science.com/sciteach/review/Findings.pdf (last accessed 16th June, 2008).

Chambers, David Wade (1983) 'Stereotypic images of the scientist: the draw a scientist test', *Science Education*, vol. 67: 255-265.

Chambers, Aiden (1985) 'The Reader in the Book' in Peter Hunt (ed) (1990) *Children Literature: The Development of Criticism* (London: Routledge) 91-114.

Chambers, Ross (1990) 'Alter Ego: Intertextuality, Irony and the Politics of Reading' In Michael Worton & Judith Still (eds) *Intertextuality: Theories and Practices* (Manchester: Manchester University Press) 143-158.

Chalmers, Alan F (1999) *What is this Thing Called Science?* 3rd edition. (Buckingham: Open University Press).

Chaney, David (1993) *Fictions of Collective Life: Public Drama in Late Modern Culture* (London & New York: Routledge).

Clark, John R (1991) *The Modern Satiric Grotesque* (Lexington, Kentucky: University of Kentuncky Press).

Cobley, Paul (2001) *Narrative* (London: Routledge).

Coe, Jonathan (1996) 'Hammer's Cosy Violence'. Republished in Kim Newman (ed) (2002) *Science Fiction/ Horror: A Sight And Sound Reader* (London: BFI Publishing), 134-138.

Cohen, Ted (1978) 'Metaphor and the Cultivation of intimacy', in Sheldon Sacks (ed) *On Metaphor* (Chicago & London: University of Chicago Press) 1-10.

Colebrook, Claire (2004) *Irony* (New York & London: Routledge).

Collins, Harry (2000) 'On Beyond 2000', *Studies in Science Education*, vol. 35: 169-173.

Collins, Harry & Trevor Pinch (1982) *Frames of Meaning: The Social Construction of Extraordinary Science* (London: Routledge and Keagan Paul).

Condit, Celeste (1999) 'How the public understands genetics: non-deterministic and non-discriminatory interpretations of the "blueprint" metaphor', *Public Understanding Of Science,* vol. 8(3): 169-180.

Connell, Raewyn W (1989) 'Cool Guys, Swots and Wimps: the inter-play of masculinity and education', *Oxford Review of Education*, vol. 15 (3): 291-393.

Connell, Raewyn W (1995) *Masculinities* (Cambridge: Polity).

Cook, Daniel Thomas (2005) 'The Dichotomous Child In and Of Commercial Culture', *Childhood,* vol. 12(2): 155-159.

Cook, Daniel Thomas (2004) 'Beyond Either/ Or', *Journal of Consumer Culture,* vol. 4(2): 147-153.

Corrigan, Peter (1997) *The Sociology of Consumption* (London: Sage).

Critchley, Simon (2002) *On Humour* (London: Routledge).

Cross, Gary (1997) *Kids' Stuff: Toys and the Changing World of America Childhood* (Cambridge, MA & London: Harvard University Press).

Curtis, Ron (1994) 'Narrative Form and Normative Force: Baconian Story-Telling in Popular Science', *Social Studies of Science,* vol. 24(3): 419-61.

Darley, Andy (2003) 'Simulating Natural History: Walking with Dinosaurs as Hyper-real Edutainment', *Science as Culture,* vol. 12 (2): 227–56.

Davies, Christie (1988) Stupidity and Rationality: Jokes from the Iron Cage. In Chris Powell & George EC Paton (eds) *Humour In Society: Resistance and Control* (Basingstoke: MacMillan Press) pp 1-32.

Davies, Christie (1998) *Jokes and their Relation to Society* (Berlin & New York: Mouton de Gruyter).

Davies, Sarah R (2007) *Scientists and the Public: Studies in Discourse and Dialogue.* PhD thesis, Imperial College, University of London.

Davis, Erik (2004) *TechGnosis: Myth, Magic and Mysticism in the Age of Information*, 2nd edition (London: Serpents Tail).

Davis, Murray S (1995) 'The Sociology of Humour: A Stillborn Field', *Sociological Forum*, vol. 2 (June): 327-339.

Deary, Terry (1999) 'Bloody Scotland/ Shakespeare Stories', in James Carter (ed) *Talking Books: Children's authors talk about the craft, creativity and process of writing* (London & New York: Routledge) 88-112.

de Man, Paul (1978) 'The Epistemology of Metaphor', in Sheldon Sacks (ed) *On Metaphor* (Chicago & London: University of Chicago Press) 11-28.

De Saulles, Tony (2006) Interview with Alice Bell. Held at Kew Gardens, London, 2nd September 2006.

Dornan, Christopher (1990) Some problems in conceptualizing the issue of 'science and the media', *Critical Studies in Mass Communication*, vol.7: 28-71

Doyle, Richard (1994) 'Vital Languages', in Carl F Cantor (ed) *Are Genes Us? The Social Consequences of the New Genetics* (New Brunswick, NJ: Rutgers University Press) 52-68.

Driver, Rosalind (1989) 'The Construction of Scientific Knowledge', in Robin Millar (ed) *Doing Science: Images of Science in Science Education* (London: Falmer Press) 83-106.

Durant, John (1993) 'What is scientific literacy?' in John Durant & Jane Gregory (eds) *Science and Culture in Europe* (London: Science Museum) 129-138.

Ebbrecht, Tobias (2007) 'Docudramatizing history of TV: German and British docudrama and historical event television in the memorial year 2005', *European*

Journal of Cultural Studies, vol. 10(1): 35-53

Eco, Umberto (1985) *Reflections on The Name of the Rose*, trans. William Weaver (London: Secker & Warburg).

Eger, Martin (1993) 'Hermeneutics and the New Epic of Science', in Murdo William McRae (ed) *The Literature of Science: Perspectives on Popular Scientific Writing* (Athens, Georgia & London: Georgia University Press) 186-209.

Eisner, Will (1985) *Comics and Sequential Art* (Tamarac, FL: Poorhouse Press).

Eisner, Will (1996) *Graphic Storytelling and Visual Narrative* (Tamarac, FL: Poorhouse Press).

Ereaut, Gill & Nat Segnit (2006) *Warm Words: How are we telling the climate story and can we tell it better* (London: IPPR) downloadable at http://www.ippr.org.uk/publicationsandreports/publication.asp?id=485 (last accessed 16th June, 2008).

Esmonde, Margaret P (1982) 'From Little Buddy to Big Brother: The Icon of the Robot in Children's Science Fiction', in Thomas P Dunn & Richard D Erlich (eds) *The Mechanical God: Machines in Science Fiction* (Westport and London: Greenwood Press), 85-98.

Fairclough, Norman (1992) *Discourse and Social Change* (Cambridge: Polity).

Fairclough, Norman (1995) *Media Discourse* (London & New York: Edward Arnold).

Featherstone, Mike (1982) 'The Body in Consumer Culture', in Mike Featherstone, Mike Hepworth & Bryan S. Turner (eds) (1991) *The Body: Social Processes and Cultural Theory* (London, Newbury Park, New Delhi: Sage), 170-196. First published in *Theory, Culture & Society* vol. 1(1): 18-33.

Featherstone, Mike (1986) 'Towards a Sociology of Postmodern Culture' in Hans Haferkamp (ed) *Social Structure and Culture* (Berlin & New York: Walter de Gruyter) 147-172.

Featherstone, Mike (1992) 'Postmodernism and the aestheticization of everyday life' in Scott Lash & Jonathan Friedman (eds) *Modernity and Identity* (Oxford & Cambridge, MA: Blackwell) 265- 290.

Featherstone, Mike (2007) *Consumer Culture and Postmodernism*, 2nd Edition (London: Sage).

Findlen, Paula (1990) 'Jokes of Nature and Jokes of Knowledge: The Playfulness of Scientific Discourse in Early Modern Europe', *Renaissance Quarterly*, vol. 43(2): 292-311.

Fisher, Marjorie (1972) *Matters of Fact: Aspects of Non-fiction for Children* (Leicester: Rockhampton Press).

Fiske, John (1987) *Television Culture* (London & New York: Metheun).

Flynn, Bernadette (2005) 'Docbricolage in the Age of Simulation', Geoff King (ed) *The Spectacle of the Real: From Hollywood to Reality TV and Beyond* (Bristol & Portland, OR: Intellect Books) 129-138.

Foucault, Michael (1977) *Discipline and Punish: The Birth of The Prison*, trans. Alan Sheridan (London: Allen Lane).

Frayling, Christopher (2005) *Mad, Bad and Dangerous to Know: The Scientist and the Cinema* (London: Reaktion Books).

French, Jane (1989) 'Accomplishing Scientific Instruction', in Robin Millar (ed) *Doing Science: Images of Science in Science Education* (London: Falmer Press) 10-37.

Frow, Gerald (1985) *"Oh Yes It Is!" A History of Pantomime* (London: British Broadcasting Corporation).

Fyfe, Aileen (2000) 'Young Readers and the Sciences' in Marina Frasca-Spada & Nicolas Jardine (eds) *Books and the Sciences in History* (Cambridge, Cambridge University Press) 276-90.

Fyfe, Aileen (ed) (2003a) *Science For Children* (Bristol: Thoemmes Press), volumes 1-7, including introduction to series in vol. 1: xi-xxii.

Fyfe, Aileen (2003b) 'Introduction to Evenings at Home', in Aileen Fyfe (ed) *Science For Children* (Bristol: Thoemmes Press), vol. 1: xxiii-xxviii.

Fyfe, Aileen (2003c) 'Introduction to Wonders of the Waters & The Starring Heavens', in Aileen Fyfe (ed) *Science For Children* (Bristol: Thoemmes Press), vol. 4: v-ix.

Fyfe, Aileen (2007) 'Reading Natural History at the British Museum and the *Pictorial Museum*' in Aileen Fyfe & Bernard Lightman (eds) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago & London: University of Chicago Press) 196-320.

Fyfe, Aileen & Lightman, Bernard (eds) (2007) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago & London: University of Chicago Press).

Gates, Barbara T (2003) 'Introduction to The Fairy-Land of Science', in Aileen Fyfe (ed) *Science For Children* (Bristol: Thoemmes Press), vol. 7: v-ix.

Gaull, Marilyn (2003) 'Pantomime as Satire: Mocking a Broken Charm', in Steven E. Jones (ed) *The Satiric Eye: Forms of Satire in the Romantic Period* (New York & Hampshire: Palgrave Macmillan) 207-224.

Gauntlett, David (1995) *Moving Experiences: Understanding Television's Influences and Effects* (London, Paris & Rome: John Libby).

Gauntlett, David (1996) *Video Critical: Children, the Environment and Media Power*

(Luton: John Libby Media).

Gauntlett, David (1998) 'Ten Things Wrong with the "Effects Model"', in Roger Dickinson, Ramaswani Harindranath & Olga Linne (eds) *Approaches to Audiences* (London: Arnold).

Gauntlett, David (2007) *Creative Connections: New approaches to identities and audiences* (London: Routledge).

Giddens, Anthony (1991) *Modernity and Self-Identity* (Cambridge: Polity).

Gieryn, Thomas F (1995) 'Boundaries of Science', in Shelia Jasanoff et al (eds) (1995) *Handbook of Science and Technology Studies* (London: Sage) 393-443.

Gieryn, Thomas F (1999) *Cultural Boundaries of Science: Credibility on the Line* (Chicago: University of Chicago Press).

Gillborn, David & Deborah Youdell (2000) *Rationing Education: Policy, Practise, Reform and Equality* (Buckingham: Open University Press).

Gillborn, David & Deborah Youdell (2001) 'The New IQism: Intelligence, 'Ability' and the Rationing of Education, in Demaine, Jack (ed) *Sociology Of Education Today* (Hampshire: Palgrave) 65-99.

Gillieson, Katherine (2006) 'Glossy Science', unpublished paper given at the inaugural 'Science and Public' conference, Imperial College, May 20th 2006.

Gillieson, Katherine (2008a) *The Parrish Isotype Books*, unpublished paper given at 'Discussing Popular Science', Imperial College, February 22nd 2008.

Gillieson, Katherine (2008b) *A Framework for Graphic Description in Book Design.* PhD Thesis, University of Reading.

Goffman, Erving (1959) *The Presentation of Self in Everyday Life* (Cambridge: Cambridge University Press).

Gravett, Paul & Peter Stanbury (2006) *Great British Comics: Celebrating a Century of Ripping Yarns and Wizard Wheezes* (London: Aurum Press).

Gregory, Jane & Steve Miller (1998) *Science in Public: Communication, Culture and Credibility* (New York & London: Plenum).

Griffen-Foley, Bridget (2004) 'From *Tit-Bits* to *Big Brother*: a century of audience participation in the media' *Media, Culture and Society*, vol. 26(4): 533–548.

Hampshire, James (2005) 'The Politics Of School Sex Education Policy in England and Wales from the 1940s to the 1960s, *Social History of Medicine,* vol. 18(1): 87-105.

Haraway, Donna (1985) 'A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century' in (1991) *Simians, Cyborgs and Women: The Reinvention of Nature* (New York & London: Routledge) 149-181.

Haraway, Donna (1997) *Modest_Witness@Second Millennium.*

FemaleMan©_Meets_OncoMouse™ (London & New York: Routledge).

Harvey, Matthew (2007) 'Citizens in Defence of Something Called Science', *Science as Culture*, vol. 16(1): 31-48.

Haynes, Rosalind (1994) *From Faust to Strangelove: representations of the scientist in western literature* (Baltimore: Johns Hopkins University Press).

Heath, Christian & Dirk vom Lehn (2008) 'Configuring 'Interactivity': Enhancing Engagement in Science Centres and Museums', *Social Studies of Science,* vol. 38(1): 63-91.

Heeks, Peggy (2004) 'Information Books', in Peter Hunt (ed) *International Companion Encyclopaedia of Children's Literature* (London: Routledge) vol. 2: 433-442.

Hein, Helen (1990) *The Exploratorium: the museum as laboratory* (Washington DC: Smithsonian Institution Press).

Hemple, Carl (1965) *Aspects of Scientific Explanation* (London: Free Press).

Herring, Susan C (2008) 'Questioning the Generational Divide: Technological Exoticism and Adult Construction of Online Youth Identity' in David Buckingham (ed) *Youth, Identity, and Digital Media* (Cambridge, MA: MIT Press) 71-92.

Hess, David J (1993) *Science in the New Age: the paranormal, its defenders and debunkers, and American culture* (Madison/ London: University of Wisconsin Press).

Higonnet, Anne (1998) *Pictures of Innocence: The History and Crisis of Ideal Childhood* (London: Thames and Hudson).

Hilgartner, Stephen (1990) 'The Dominant View of Popularization: Conceptual Problems, Political Uses, *Social Studies of Science,* vol. 20(3): 519-539.

Hilgartner, Stephen (2000) *Science on Stage: Expert Advice as Public Drama* (Stanford, CA: Stanford University Press).

Hintz, Carrie & Elaine Ostry (eds) (2003) *Utopian and Dystopian Writing for Children and Young Adults* (London & New York: Routledge).

Hoerschelmann, Olaf (2000) 'Beyond the Tailfin: Education and the Politics of Knowledge on Big Money Quiz Shows', *Journal of Communication Inquiry,* vol 24(2): 177-194.

Holland, Patricia (2004) *Picturing Childhood: The Myth of the Child in Popular Imagery* (London: IB Taurus).

Hollins, Martin (2001) 'Keeping school science in step with the changing world of the 21st century', *Education in Science*, vol.194: 22-23.

Holmes, Su (2004) "But this time *you* choose!' Approaching the 'interactive' audience in reality TV', *International Journal of Cultural Studies,* vol. 7(2): 213–231.

Holmes, Su (2005) 'Not the final answer: critical approaches to the quiz show and Who Wants to Be A Millionaire', *European Journal of Cultural Studies,* vol. 8(4):483-503.

Holmes, Su (2006) "The Question Is – Is It All Worth Knowing?' The cultural circulation of the early British quiz show', *Media, Culture & Society* vol. 39(1): 53-74.

Holt, Douglas (2006) 'Jack Daniel's America: iconic brands as ideological parasites and proselytizers', *Journal of Consumer Culture,* vol. 6(3): 355-377.

Horkheimer, Max & Theodor W Adorno (1973) *Dialectic of Enlightenment,* trans. Cumming, John (London: Allen Lane).

House of Lords (2000) *Third Report: Science and Society* (London: The Stationery Office).

Hume, Kathryn (1984) *Fantasy and Mimesis: Responses to Reality in Western Literature* (New York and London: Methuen).

Hunt, Leon (2005) 'Hell in a Cell and Other Stories: Violence, Endangerment and Authenticity in Professional Violence', in Geoff King (ed) (2005) *The Spectacle of the Real: From Hollywood to Reality TV and Beyond* (Bristol and Portland: Intellect Books) 117-127.

Hunt, Peter (1994) *An Introduction to Children's Literature* (Opus, Oxford).

Hunt, Peter and Millecent Lenz (2001) *Alternative Worlds in Fantasy Fiction* (London: Continuum).

Hutcheon, Linda (1985) *A Theory of Parody: The Teachings of Twentieth-Century Art Forms* (New York & London: Methuen).

Hutcheon, Linda (1994) *Irony's Edge* (London: Routledge).

Irwin, Alan & Brian Wynne (1996) *Misunderstanding Science? The Public Reconstruction of Science and Technology* (Cambridge: Cambridge University Press).

James, Allison & Alan Prout (1997) 'Re-presenting Childhood: Time and Transition in the Study of Childhood', in (eds) *Constructing and Reconstructing Childhood: Contemporary Issues in the Sociological Studies of Childhood,* second edition (London & New York: Routledge) 230-250.

Jameson, Fredric (1991) *Postmodernism* (London & New York: Verso).

Jameson, Fredric (1998) 'Postmodernism and Consumer Society' in Hal Foster (ed) *The Anti-Aesthetic: Essays on Postmodern Culture* (New York: The New Press) 127-144.

Jenkins, Henry (1999) '"Complete Freedom of Movement": Video Games as Gendered Play Spaces' in Justine Cassell & Henry Jenkins (eds) *From Barbie to*

Mortal Kombat: Gender and Computer Games (Cambridge MASS & London: MIT Press) 262-297.

Jenks, Chris (2003) *Transgression* (London & New York: Routledge).

Jenks, Chris (2005) *Childhood,* 2nd edition (Routledge, Abingdon).

Jennison, Brenda & Jon Ogborn (1994) *Wonder & Delight: Essays in Science Education in Honour of the Life and Work of Eric Rogers, 1902-1990* (Bristol & Philadelphia: Institute of Physics Publishing).

Jordan, Beryl (1992) *Science, Technology and Young People: the changing presentation of science and technology in Non-Fiction between 1900-1949,* unpublished MPhil thesis, University of Teeside, department of Humanities.

Jordan, Tim (2004) 'The Pleasures and Pains of Pikachu'. *European Journal of Cultural Studies,* vol. 7(4): 461-480.

Jordanova, Ludmilla (2003) 'Museums: Representing the Real?' in George Levine (ed) *Realism and Representation: Essays on the Problem of Realism in Relation to Science, Literature and Culture* (Madison and London: University of Wisconsin Press) 255-278.

Jurdant, Baudouin (1993) 'The Popularization of science as the autobiography of science', *Public Understanding of Science,* vol. 2(3): 365-73.

Kant, Immanuel (1760/ 1960) *Observations on the Feeling of the Beautiful and Sublime,* trans. JT Goldthwait (Berkeley: University of California Press).

Kapur, Jyotsna (1999) 'Out of Control: Television and the Transformation of Childhood in Late Capitalism'. In Marsha Kinder, (ed) *Kids' Media Culture* (Durham: Duke University Press) 122-136.

Keene, Melanie (2007) '"Every Boy & Girl a Scientist": Instruments for Children in Interwar Britain', *Isis* 98 (3): 266–289.

Keeney, Elizabeth B (1992) *The Botanizers: Amateur Scientists in Nineteenth-Century America* (Chapel Hill, NC & London: University of North Carolina Press).

Kenny, Neil (1998) *Curiosity in Early Modern Europe Word Histories* (Wiesbaden: Harrassowitz).

Kenway, Jane & Elizabeth Bullen (2001) *Consuming Children: education-entertainment-advertising* (Buckingham & Philadelphia, Open University Press).

Kinder, Masha (1995) 'Home Alone in the 90s: Generational War and Transgenerational Address in American Movies, Television and Presidential Politics', in Cary Bazalgette & David Buckingham (eds) *In Front of the Children: Screen Entertainment and Young Audiences* (London: BFI Publishing) 75-91.

Kinder, Marsha (1999) 'Raging with power on the Fox Kids Network: Or, Where on Earth is Children's Educational Television?' in Marsha Kinder, (ed) *Kids' Media*

Culture (Durham, NC: Duke University Press) 177-203.

Kiousis, Spiro (2002) 'Interactivity: a concept explication', *New Media and Society*, vol. 4(3):355-383.

Kirby, David (2003a) 'Science Consultants, Fictional Films, and Scientific Practice', *Social Studies of Science*, vol. 33(2): 231-268.

Kirby, David (2003b) 'Scientists on the set: science consultants and the communication of science in visual fiction', *Public Understanding of Science*, vol 12(3): 261-278.

Klein, Naomi (2000) *No Logo* (London: Flamingo).

Koestler, Arthur (1970) *The Act of Creation* (London: Pan).

Kress Gunther & Theo van Leeuwen (2006) *Reading Images: The Grammar of Visual Design*, 2nd edition (London: Routledge). Also, first edition, 1996 (Victoria: Deakin University Press).

Kubli, Fritz (2001) 'Can the Theory of Narratives Help Teachers be Better Storytellers?', *Science & Education,* vol. 10: 595-599.

Kuhn, Thomas (1970) *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press).

Kuipers, Giselind (2006) *Good Humor, Bad Taste: A Sociology of the Joke* (Berlin & New York, Mouton de Gruyter).

Labinger, Jay A & Harry Collins (eds) (2001) *The One Culture? A Conversation About Science* (Chicago & London: University of Chicago Press).

Lambourne, Robert (1999) 'Science Fiction and the Communication of Science', in Scanlon, Eileen et al (eds) *Communicating Science: Contexts and Channels* (London: Routledge) 146-157.

Lamont, Michele & Virag Molnar (2002) 'The Study of Boundaries in the Social Sciences', *Annual Review of Sociology* 28:167-95.

Lantham, Robert (2002) *Consuming Youth: Vampires, Cyborgs, and the Culture of Consumption* (Chicago: University of Chicago Press).

Lathan, Peter (2004) *It's Behind You! The Story Of Panto* (London: New Holland).

Latour, Bruno (1987) *Science in Action: Following Scientists Through Society* (Cambridge, MA: Harvard University Press).

Latour, Bruno (1988) 'The Politics of Explanation', in Steve Woolgar (ed) *Knowledge and Reflexivity: New Frontiers in the Sociology of Knowledge* (London: Sage) 155-176.

Law, John (ed) (1991) *A Sociology of Monsters: Essays on Power, Technology and Domination* (London & New York: Routledge).

Layton, David (1994) 'STS in the School Curriculum: a Movement Overtaken by

History?', in Joan Solomon & Glen S Aikenhead (eds) *STS Education: International Perspectives on Reform* (New York: Teachers College Press, Columbia University) 32-44.

Leane, Elizabeth (2007) *Reading Popular Physics: Disciplinary Skirmishes and Textual Strategies* (Hampshire: Ashgate).

Leham, Richard (2005) *Realism and Naturalism: The Novel in an Age of Transition* (Madison: University of Wisconsin Press).

Lewcock, Dawn (2003) 'Once Upon a Time: The Story of the Pantomime Audience' in Susan Kattwinkel (ed) *Audience Participation: Essays on Inclusion in Performance* (Westport, CT & London: Praegar) 133-147.

Lewenstein, Bruce (1995) 'From Fax to Facts: Communication in the Cold Fusion Saga', *Social Studies of Science,* vol. 25(3): 403-36.

Lightman, Bernard (2007a) *Victorian Popularizes of Science: Designing Nature for New Audiences* (Chicago: University of Chicago Press).

Lightman, Bernard (2007b) 'Lecturing in the Spatial Economy of Science', in Aileen Fyfe & Bernard Lightman (eds) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago & London: University of Chicago Press) 97-132.

Locke, Simon (1999a) *Constructing 'The Beginning': Discourses of Creation Science* (Mahwah, NJ: Lawrence Eribaum Associates).

Locke, Simon (1999b) 'Golem Science and the Public Understanding of Science: From Deficit to Dilemma', *Public Understanding of Science*, vol. 8(1): 75 - 92.

Locke, Simon (2005) 'Fantastically Reasonable: Ambivalence in the Representation of Science and Technology in Super-hero Comics', *Public Understanding of Science*, vol. 14 (1): 25-46.

Long, Marilee, & Jocelyn Steinke (1996) 'The thrill of everyday science: images of science and scientists on children's educational science programmes in the United States', *Public Understanding of Science,* vol. 5(1): 101-119.

Luckhurst, Roger (2005) *Science Fiction* (Cambridge: Polity Press).

Lury, Celia (2004) *Brands: the Logos of the Global Economy* (Abington and New York: Routledge).

Lyotard, Jean-François (1984) *The Postmodern Condition: A Report On Knowledge*, trans. Geoff Bennington and Brian Massumi (Manchester: Manchester University Press).

MacKenzie, Donald & Judy Wajcman (eds) (1999) *The Social Shaping of Technology*, 2nd edition (Buckingham: Open University Press).

Mackey, Margaret (2001) 'The Survival of Engaged Reading in the Internet Age: New Media, Old Media, and the Book', *Children's Literature in Education*, vol. 32(3):

167-189.

MacLeod, Anne Scott (1984) 'Secret in the Trash Bin: on the Perennial Popularity of Juvenile Series Books', *Children's Literature in Education*, vol. 15(3): 127-140.

Mares, Marie-Louise, Joanne Cantor & James Burr Steinbach (1999) 'Using Television to Foster Children's Interest in Science', *Science Communication,* vol. 20(3): 283-297.

Marr, Alexander (2006) 'Introduction', in, RJW Evans & Alexander Marr (eds) *Curiosity and Wonder from the Renaissance to the Enlightenment* (Aldershot & Burlington: Ashgate) 1-20.

Marriot, Stuart (2002) 'Red in Tooth and Claw? Images of Nature in Modern Picture Books', *Children's Literature in Education,* vol. 33(3): 175 – 183.

Matthews, Nicole & Farah Mendlesohn (2000) 'The Cartesian Novum of *Third Rock from the Sun*: Gendering Human Bodies and Alien Minds', in Elyce Rae Helford (ed) *Fantasy Girls: Gender in the New Universe of Science Fiction and Fantasy Television* (Lanham, Maryland: Rowman & Littlefield) 41-59.

McAllister, Matthew P, Edward H Sewell Jr & Ian Gordon (eds) (2001) *Comics and Ideology* (New York: Peter Lang).

McCarron, Kevin (2001) 'Point Horror and the Point of Horror' in Kimberly Reynolds, Geraldine Brennan & Kevin McCarron (eds) *Contemporary Classics of Children's Literature: Frightening Fiction* (London: Continuum) 19-52.

McClintock, Anne (1995) *Imperial Leather: Race, Gender and Sexuality in the Colonial Contest* (London: Routledge).

McCloud, Scott (1993) *Understanding Comics: The Invisible Art* (Princeton: Kitchen Sink Press).

Mead, Margaret & Rhoda Métraux (1957) 'The image of the scientist among high-school students: a pilot study', *Science*, vol. 126: 384-390.

Meakin, David (1995) *Hermetic Fictions: Alchemy and Irony in the Novel* (Keele University Press: Keele).

Mediawatch (2007) *Children and the Media: Learning from Example?* 2nd edition downloadable from http://www.mediawatchuk.org.uk/ (last accessed 1st June 2008).

Medurst, Andy (2007) *A National Joke: Popular Comedy and English Cultural Identities* (London & New York: Routledge).

Meek, Margaret (1996) *Information and Book Learning* (Stroud: Thimble Press).

Mellor, Felicity (2001) 'Gender and the communication of physics through multimeida', *Public Understanding of Science*, vol. 10(3): 271-291.

Mellor, Felicity (2003) 'Between Fact and Fiction: demarcating science from non-

science in popular physics books', *Social Studies of Science,* vol. 33(4): 509-538.

Mellor, Felicity (2007) 'Colliding Worlds: Asteroid Research and the Legitimatization of War in Space', *Social Studies of Science*, vol. 37(4): 499-531.

Mellor, Felicity, Sarah R Davies, & Alice Bell (2008) 'Solverating the Problematising', in Sarah R Davies, & Alice Bell & Felicity Mellor (eds) *Science and Its Publics* (Newcastle, Cambridge Scholars Publishing) 1-14.

Mendick, Heather (2005) 'Mathematical stories: why do more boys than girls choose to study mathematics at AS-level in England?' *British Journal of Sociology of Education*, vol. 26 (2): 235-251.

Mendlesohn, Farah (2007) 'With Meccano to the Stars!', in Pat Pinset (ed) *Time Everlasting: Representations of Past, Present and Future in Children's Literature* (Staffordshire: Pied Piper Publishing) 215-231.

Mendlesohn, Farah & Zara Baxter (2007) 'Science Fiction readers, Science and Science Education', paper presented to the British Society for Literature and Science, University of Central England, Birmingham, 29th March 2007.

Mendlesohn, Farah (forthcoming, 2009) *The Inter-Galactic Playground: Children and Science Fiction* (Jefferson NC: McFarland Press).

Merton, Robert (1973) *The Sociology of Science: Theoretical and Empirical Investigations,* edited with an introduction by Norman W Storer (Chicago: University of Chicago Press).

Michael, Mike & Brown, Nik (2005) 'Scientific Citizenships: Self-representations of Xenotransplantation's Publics', *Science As Culture,* vol 14(4): 39-57.

Mickenberg, Julia L (2006) *Learning from the Left: Children's Literature, the Cold War and Radical Politics in the United States* (Oxford: Oxford University Press).

Midgley, Mary (1989) *Wisdom, Information and Wonder: What is Knowledge For?* (London & New York: Routledge).

Midgley, Mary (2002) *Evolution as a Religion: Strange Hopes and Stranger Fears* (London: Routledge).

Midgley, Mary (2003) *The Myths We Live By* (London: Routledge).

Mills, Alice (2006) 'Harry Potter and the Terrors of the Toilet', *Children's Literature in Education*, vol 37(1), 1-13.

Millar, Robin (1996) 'Towards a science curriculum for public understanding', *School Science Review*, vol. 77(280): 7-18.

Millar, Robin & Jon Osborne (eds) (1998) *Beyond 2000: Science Education for the Future* (London: Kings College, London).

Milner, Andrew (2005) *Literature, Culture & Society*, 2nd edition (London & New York:

Routledge).

Mohr, Richard D (1996) 'The Paedophilia of Everyday Life', in Steven Bruhm & Natasha Hurley (eds) (2004) *Curiouser: On the Queerness of Children* (Minneapolis & London: University of Minnesota Press) 17-30.

Morreall, John (1983) *Taking Laughter Seriously* (Albany, NY: State University of New York).

Morris, Pam (ed) (1994) *The Bakhtin Reader: Selected Writings of Bakhtin, Medvedev and Voloshinov* (Edward Arnold: London & New York). Section Four: Carnival Ambivalence, pp194-244.

Morus, Iwan Rhys (2007) '"More the Aspect of Magic than Anything Natural": The Philosophy of Demonstration', in Aileen Fyfe & Bernard Lightman (eds) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago & London: University of Chicago Press) 336-370.

Mosco, Vincent (2004) *The Digital Sublime: Myth, Power, and Cyberspace* (Cambridge, MA & London: MIT Press).

Mulkay, Michael (1988) *On Humour* (Cambridge: Polity).

Musgrave, Alan (1985) 'Realism versus Constructive Empiricism', in Paul M Churchland & A Hooker Clifford (eds) *Images of Science* (Chicago: University of Chicago Press).

Myers, Greg (1989) 'Science for Woman and Children in John Christie and Sally Shuttleworth (eds) *Nature Transfigured: Science and Literature, 1700-1900* (Manchester, Manchester University Press), 171-200.

Myers, Greg (1990) *Writing Biology: Texts in the Social Construction of Scientific Knowledge.* (Madison, The University of Wisconsin Press).

Myers, Greg (1995) "The Power is Yours' Agency and Plot in 'Captain Planet", Cary Bazalgette & David Buckingham (eds) *In Front of the Children: Screen Entertainment and Young Audiences* (London: BFI Publishing), 62-74.

Nadesan, Majia Holmer (2002) 'Engineering the Entrepreneurial Infant: Brain Science, Infant Development Toys, and Governmentality', *Cultural Studies*, vol. 16(3): 401-432.

Nelkin, Dorothy (1995) *Selling Science: How the Press Covers Science & Technology,* 2nd edition (New York: WH Freeman).

Nelkin, Dorothy & M Susan Lindee, (1995) *The DNA Mystique: The Gene as a Cultural Icon* (New York: WH Freeman)

Newman, Kim (ed) (2002) *Science Fiction/ Horror: A Sight And Sound Reader* (London: BFI Publishing).

Nicolson, Marjorie Hope (1959/ 1997) *Mountain Gloom and Mountain Glory*, (Seattle

and London: University of Washington Press).

Nodleman, Perry (1985) 'Out There In Children's Science Fiction: Forward into the Past', *Science Fiction Studies*, vol. 12: 285-295.

Nodleman, Perry (2002) 'Making Boys Appear: the Masculinity of Children's Fiction' in John Stephens (ed) *Ways of Being Male: Representing Masculinities in Children's Literature and Film* (London & New York: Routledge) 1-14.

Nye, David (1994) *American Technological Sublime* (Camb, Mass: MIT Press)

Ogborn, Jon, Gunter Kress, Isabel Martins & Kieran McGillicuddy (1996) *Explaining Science in the Classroom,* (Buckingham: Open University Press).

O'Hara, Robert J (1992) 'Telling the Tree: Narrative Representation and the Study of Evolutionary History', *Biology and Philosophy,* vol. 7(2): 135–60.

Osborne, Jon, Richard Duschl & Robert Fairbrother (2002) *Breaking the Mould: Teaching Science for Public Understanding* (London: Nuffield Foundation).

Outram, Dorinda (1996) 'Professor Branestawm and Friends' review of Haynes' From Faust to Strangelove, in *Studies in the History and Philosophy of Science,* vol. 27(1): 109-114.

Palmer, Jerry (1994) *Taking Humour Seriously* (London: Routledge).

Palmer, Jerry (2005) 'Parody and Decorum: Permission to Mock' in Sharon Lockyer & Michael Pickering (eds) *Beyond a Joke: The Limits of Humour* (Basingstoke & New York: Palgrave Macmillian) 79-97.

Parsons, Elizabeth (2007) 'Animating child activism: a comparative analysis of environmentalism and class politics in Ghibli's *Princess Mononoke* (1997) and *Fox's Fern Gully* (1992)', unpublished paper given at the IRCSL conference '*Power and Children's Literature: Past, Present and Future*' Kyoto, August, 2007.

Pearce, John (1998) *Centres for Curiosity and Imagination: When is a museum not a museum?* (London: Calouste Gulbenkian Foundation).

Picart, Caroline Joan (2002) *The Cinematic Rebirths of Frankenstein: Universal, Hammer, and Beyond* (Westport, CT & London: Praeger).

Pickering, Michael & Sharon Lockyer (2005) 'The Ambiguities of Comic Impersonation', in Sharon Lockyer & Michael Pickering (eds) *Beyond a Joke: The Limits of Humour* (Basingstoke & New York: Palgrave Macmillian) 180-197.

Pizzey, Stephen (ed) (1987) *Interactive Science and Technology Centres* (London: Science Projects Publishing).

Popper, Karl (1963) *Conjectures and Refutations* (London: Routledge and Kegan Paul).

Postman, Neil (1994) *The Disappearance of Childhood*, vintage edition (first published 1982) (New York: Vintage Books).

Prout, Alan (ed) (2000) *The Body, Childhood and Society* (Hampshire and London: Macmillan).

Prout, Alan (2005) *The Future of Childhood* (London & New York: Routledge Falmer).

Quart, Alissa (2003) *Branded: The Buying and Selling of Teenagers* (London: Arrow Books).

Quinn, Melanie (ed) (1989) *Sharing Science: Issues in the development of Interactive Science & Technology Centres* (London: Nuffield Foundation).

Renteln, Paul, & Alan Dundes (2005) 'Foolproof: A Sampling of Mathematical Folk Humor', *Notices of the American Mathematical Association,* vol. 52(1): 24-34.

Reynolds, Kimberly (1998) 'Publishing Practices and the Practicalities of Publishing', Reynolds, Kimberly & Tucker, Nicholas (eds) *Children's Book Publishing in Britain Since 1945* (Aldershot: Scolar Press) 20-41.

Reynolds, Kimberly & Nicholas Tucker (ed) (1998) *Children's Book Publishing in Britain Since 1945* (Aldershot: Scolar Press), introduction.

Reynolds, Kimberly (2001) Introduction to Kimberly Reynolds, Geraldine Brennan & Kevin McCarron (eds) *Contemporary Classics of Children's Literature: Frightening Fiction* (London: Continuum) 1-18.

Rose, Jacqueline (1994) *The Case of Peter Pan: Or the Impossibility of Children's Literature,* 2nd edition, (Macmillan: Basingstoke).

Rousseau, George (2006) 'Curiosity and the *lusus naturae*: The case of 'Porteus' Hill' and Epilogue in, RJW Evans & Alexander Marr (eds) *Curiosity and Wonder from the Renaissance to the Enlightenment* (Aldershot & Burlington: Ashgate) 213-250, 251-254.

Rowland, Greg (2007) 'Changing the Physics Brand' *Physics World*, Institute of Physics, June 2007: 16-17.

Sands, Karen & Marietta Frank (1999) *Back in the Spaceship Again: Juvenile Science Fiction Series Since 1945* (Westport, CT: Greenwood Press).

Sandvoss, Cornel (2005) *Fans: the Mirror of Consumption* (Cambridge: Polity).

Sarland, Charles (1994a) 'Attack of the Teenage Horrors: Theme and Meaning in Popular Series Fiction', *Signal*, vol. 73(1), 49-61.

Sarland, Charles (1994b) 'Revenge of the Teenage Horrors: Pleasure, Quality and Canonicity in (and out of) Popular Series Fiction', *Signal*, vol. 73(2), 113-131.

Scanlon, Margaret (2008) *Popular Histories: A Study of Historical Non-fiction Books for Children.* PhD thesis, Institute of Education, University of London.

Schiebinger, Londa (1999) *Has Feminism Changed Science?* (Cambridge, MA: Harvard University Press).

Schott, Gareth (2006) 'Agency in and around Play' in Diane Carr, David Buckingham, David, Andrew Burn & Gareth Schott (eds) *Computer Games: Text, Narrative & Play* (Cambridge, Polity) 133-148.

Secord, James A (1985) 'Newton in the Nursery: Tom Telescope and the Philosophy of Tops and Balls, 1761-1838', *History of Science*, vol. 23: 286-315.

Secord, James A (2000) *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago & London: University of Chicago Press).

Secord, James A (2002) 'Portraits of Science: Quick and Magical Shaper of Science', *Science,* 6th September 2002, vol. 297 (5587): 1648-1649.

Secord, James A (2003a) 'Introduction to Peter Parley's Wonders of the Earth, Sea and Sky', in Aileen Fyfe (ed) *Science For Children* (Bristol: Thoemmes Press), vol. 3: v-x.

Secord, James A (2003b) 'Introduction to The Boy's Playbook of Science', in Aileen Fyfe (ed) *Science For Children* (Bristol: Thoemmes Press), vol. 6: v-ix.

Shapin, Steven (1984) 'Pump and Circumstance: Robert Boyle's Literary Technology', *Social Studies of Science,* vol. 14(1): 481-520.

Shapin, Steven & Simon Schaffer (1985) *Leviathan and the Air-Pump: Hobbes, Boyle, and The Experimental Life* (Princeton: Princeton University Press).

Shields, Rob (1990) 'The 'System of Pleasure': Liminality and the Carnivalesque at Brighton', *Theory, Culture & Society*, vol7(1): 39-72.

Shepherd-Barr, Kirsten (2006) *Science on Stage: From Doctor Faustus to Copenhagen* (Princeton, NJ: Princeton University Press).

Sheffield, Susan (2003) 'Introduction to Parables of Nature', in Aileen Fyfe (ed) *Science For Children* (Bristol: Thoemmes Press), vol. 5: v-ix.

Sherzer, Joel (1985) Puns and Jokes, in Teun Van Dijk (ed) *Handbook of Discourse Analysis,* vol 3, Discourse and Dialogue (London, Academic Press), pp213-221.

Sliverman, Hugh (ed) (2002) *Lyotard: Philosophy, Politics and the Sublime* (New York: Routledge).

Sobschack, Vivian (1991) 'Child/ Alien/ Father: Patriarchal Crisis and Generic Exchange' in Constance Penley et al (eds) *Close Encounters: Film, Feminism, and Science Fiction* (Minneapolis: University of Minnesota Press) 2-30.

Soloman, Joan (2002) 'Science Stories and Science Texts: What can they do for our students?', *Studies in Science Education,* vol. 37: 85-106.

Sontag, Susan (2002) *Illness as Metaphor, and AIDS and its Metaphors* (London: Penguin).

Snow, CP (1959) *The Two Cultures,* Canto edition, 1998 (Cambridge: Canto).

Stannard, Russell, (1999a) 'Einstein for Young People', in Eileen Scanlon et al (eds) *Communicating Science: Contexts and Channels* (London: Routledge) 134-145.

Stannard, Russell (2001) 'Communicating Physics Through Story', in *Physics Education*, vol. 36(1): 30-34

Stallybrass, Peter & Allon White (1986) *The Politics and Poetics of Transgression* (London: Methuen).

Star, Susan L & James R Griesemer (1989) 'Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39.' *Social Studies of Science* 19(3): 387-420.

Starr, Sandy (2005) 'Anti-Science Lessons', *Spiked Online*, Friday 30th September, 2005, http://www.spiked-online.com/index.php?/site/article/467/ (last accessed 6th June, 2008).

Stephens, John (1992) *Language and Ideology in Children's Fiction* (Harlow: Longman).

Stephens, John, & Robyn McCallum (1998) *Retelling Stories, Framing Culture: Traditional Story and Metanarratives in Children's Literature* (New York & London: Garland Publishing).

Stephens, John (ed) (2002) *Ways of Being Male: Representing Masculinities in Children's Literature and Film* (London & New York: Routledge).

Sutton, Clive (1992) *Words, Science and Learning* (Buckingham & Philadelphia: Open University Press).

Sutton, Geoffrey V. (1985) *Science for a Polite Society: Gender, Culture, and the Demonstration of Enlightenment* (Boulder & Oxford: Westview Press).

Sweetman, Paul (2003) 'Twenty-First Century Dis-ease? Habitual Reflexivity or the Reflexive Habitus', *Sociological Review* vol.51 (4): 528-549.

Tabbi, Joeseph (1995) *Postmodern Sublime: Technology and American Writing from Mailer to Cyberpunk* (Ithaca & London: Cornell University Press).

Tait, Sue (2006) 'Autopic vision and the necrophilic imaginary in CSI', *International Journal of Cultural Studies,* vol. 9 (1): 45-62.

Taylor, Millie (2005) 'Distance and Reflexivity: Creating the Stage World of Pantoland' *New Theatre Quarterly,* vol. 21(4): 331-339.

Taylor, Millie (2007) *British Pantomime Performance* (Bristol: Intellect Books).

Thomas, Geoffrey & John Durant (1987) Why should we promote understanding of Science?, *Scientific Literacy Papers 1.*

Thornton, Sarah (1995) 'The Social Logic of Subcultural Capital' in Ken Gelder (2005) The subcultures readers, 2nd ed (Routledge: London & New York) 184-192. Originally in Thornton, *Club Cultures: Music Media and Subcultural Capital*

(Cambridge: Polity).

Toon, Elizabeth (2004) 'Teaching children about health' in Janet Golden, Richard A Meckel, & Munro Prescott (eds)*Children and Youth in Sickness and in Health* (Westport, CT: Heather Greenwood Press.) 85-106.

Topham, Jonathan R (2007) 'Publishing "Popular Science" in Early Nineteenth-Century Britian', in Aileen Fyfe & Bernard Lightman (eds) *Science in the Marketplace: Nineteenth-Century Sites and Experiences* (Chicago & London: University of Chicago Press). 135-168.

Toumey, Christopher P (1992) 'The Moral Character of Mad Scientists: A Cultural Critique of Science' *Science, Technology & Human Values,* vol. 17(4): 411-437.

Tudor, Andrew (1989) *Monsters and Mad Scientists: A Cultural History of the Horror Movie* (Oxford: Basil Blackwell).

Tulloch, John (1976) 'Gradgrind's Heirs – the quiz and the presentation of 'knowledge' by British Television, *Screen Education*, vol. 19, 3-13. Longer version also published in Geoff Whitty & Michael Young (eds) (1976) *Explorations in the Politics of School Knowledge* (Driffield: Nafferton Books) 99-113.

Turkle, Sherry (1995) *Life on the Screen: Identity in the Age of the Internet* (New York: Simon & Schuster).

Turner, Steven (2008) 'School Science and its Controversies; or, Whatever Happened to Scientific Literacy?', *Public Understanding of Science,* vol. 17(1): 55-72.

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

Turney, Jon (2001a) 'More than story-telling – Reflecting on Popular Science', in SM Bryant et al (eds) *Science Communication in Theory and Practice* (London: Kluwer) 47-62.

Turney, Jon (2001b) 'Telling the Facts of Life: Cosmology and the Epic of Evolution', *Science as Culture,* vol. 10(2): 225-247.

Turney, Jon (2004) 'The Abstract Sublime: Life as Information Waiting to be Rewritten', *Science as Culture,* vol.13 no.1, pp.89-103.

van Dijck, José (1998) *ImagEnation: Popular Images of Genetics.* (Hampshire: MacMillian).

van Dijck, José, (2001) 'Bodies Without Borders: The endoscopic gaze', *International Journal of Cultural Studies,* vol. 4(2): 219-237.

van Dijck, José (2006) 'Picturizing Science: The science documentary as multimedia spectacle', *International Journal of Cultural Studies*, vol. 9(1): 5–24.

van Fraassen, Bas (1980) *The Scientific Image* (Oxford: Oxford University Press).

Vincent, Carol & Stephen J Ball (2007) "Making Up' the Middle Class Child: Families, Activities and Class Dispositions, *Sociology*, vol. 41(6): 1061-1078.

Voskuil, Lynn M (2004) *Acting Naturally: Victorian Theatricality and Authenticity* (Charlottesville & London: University of Virginia Press).

Waetjen, Jarrod & Timothy A Gibson (2007) 'Harry Potter and the Commodity Fetish: Activating Corporate Readings in the Journey from Text to Commercial Intertext', *Communication and Critical Cultural Studies,* vol. 4(1): 3-26.

Warner Marina (1992) 'Beauty and the Beasts'. Republished in Kim Newman (ed) (2002) *Science Fiction/ Horror: A Sight And Sound Reader* (London: BFI Publishing) 123-132.

Watson, Victor (2000) *Reading Series Fiction: From Arthur Ransome to Gene Kemp* (London and New York: Routledge).

Weaver, John (2004) 'Reading Nickelodeon: Slimed by the Contradictions and Potentials of Television', in Shirley R Steinberg & Joe L Kincheloe (eds) *Kinderculture: the Corporate Construction of Childhood,* 2nd edition (Boulder: Westview) 72-90.

Weigold, Micheal & Debbie Treise (2004) 'Attracting Teen Surfers to Science Web Sites', *Public Understanding of Science*, vol. 13(3): 219-248.

Westfahl, Gary (1996) *Cosmic Engineers: A Study of Hard Science Fiction* (Westport, CT & London: Greenwood Press).

Westfahl, Gary & George Slusser (ed) (1999) *Nursery Realms: Children in the Worlds of Science Fiction, Fantasy and Horror* (Athens & London: University of Georgia Press).

Westfahl, Gary (2000) *Science Fiction, Children's Literature and Popular Culture: Coming of Age in Fantasyland* (Westport, CT: Greenwood Press).

Whannel, Garry (1992) 'The Price is right, but the moments are sticky. Television, quiz and game shows, and popular culture' in Dominic Strinati & Stephen Wagg (eds) *Come on Down? Popular Media Culture in Post-War Britain* (London: Routledge) 179-201.

White, Hayden (1992) 'Historical Emplotment and the Problem of Truth', in Saul Friedlander (ed) *Probing the Limits of Representation: Nazism and the "final solution"* (Cambridge, MA: Harvard University Press).

White, Hayden (1981) 'The Value of Narrativity in the Representation of Reality', in W.J.T. Mitchell (ed) *On Narrative* (Chicago, IL: University of Chicago Press) 1-23.

Whitelegg, Elizabeth et al (2008) *(In)visible Witnesses: Investigating Gendered*

Representations of Scientists, Technologists Engineers and Mathematicians on UK Children's Television, (Bradford: Open University & UK Resource Centre for Women in Science, Engineering and Technology) downloadable from http://www.ukrc4setwomen.org/html/research-and-statistics/ukrc-research/ (last accessed 11th June, 2008).

Willis, Susan (1999) 'Imagining Dinosaurs', in Beverly Lyon Clark & Margaret R Higonnet (eds) *Girls, Boys, Books, Toys: Gender in Children's Literature and Culture* (Baltimore & London: John Hopkins University Press) 183-195.

Winter, Alison (1998) *Mermerized: The Powers of Mind in Victorian Britain* (Chicago & London: University of Chicago Press).

Wagg, Stephen (1992a) "One I Made Earlier': Media, popular culture and the politics of childhood' in Dominic Strinati & Stephen Wagg (eds) *Come on Down? Popular Media Culture in Post-War Britain* (London: Routledge) 150-178.

Wagg, Stephen (1992b) 'You've never had it so silly: The politics of British satirical comedy from *Beyond the Fringe* to *Spitting Image*' in Dominic Strinati & Stephen Wagg (eds) *Come on Down? Popular Media Culture in Post-War Britain* (London: Rougledge) 254-284.

Wright, David (2005) 'Commodifying Respectability: Distinctions at work in the Bookshop'. *Journal of Consumer Culture*, vol. 5(3): 295-314.

Wynne, Brian (1992) 'Misunderstood misunderstanding: Social identities and public uptake of science', *Public Understanding of Science*, vol. 1 (3): 281-304.

Wynne, Brian (2005) 'Risk as Globalising 'Democratic' Discourse? Framing Subjects and Citizen', in Melissa Leach, Ian Scoones & Brain Wynne (eds) *Science and Citizens: Globalisation and the Challenge of Engagement* (London: Zed Books) 66-82.

Young, Michael (1976) 'The Schooling of Science', in Geoff Whitty & Michael Young (eds) *Explorations in the Politics of School Knowledge* (Driffield: Nafferton Books), 47-62.

Zipes, Jack (2001) *Sticks and Stones: The Troublesome Success of Children's Literature from Slovenly Peter to Harry Potter* (New York and London: Routledge).