

Unleashing Science Popularisation

Studies on Science as Popular Culture

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Abstract

This thesis aims to broaden the concept of science popularisation. It argues that the conventional view of popularisation as the public communication of appropriately simplified versions of established facts to lay audiences fails to capture the multi-faceted nature of popularisation practices through which science and popular culture are recombined. Drawing on perspectives from Science and Technology Studies and from Cultural Studies a number of case studies are presented in order to explore anew what can be analytically treated as science popularisation and where popularisation begins and ends.

The thesis commences by critically interrogating the conventional view of popularisation as a way to enhance public understanding and appreciation of science in society. This thesis argues that science popularisation needs to be thought of as a meaning making process that is far more diverse and complex than the conventional view acknowledges. It is a field where much more than the understanding or misunderstanding of established scientific fact is at stake.

To extend the conventional view of popularisation, both science and popular culture are discussed in relation to constructivist theories and perspectives. For science, this means an emphasis on contingency in knowledge production where scientific practices are deprived of their 'specialness' and are considered more similar than different to other forms of ordinary human action. Thus, the strength and durability of particular scientific facts becomes worthy of empirical investigation dedicated to mapping the specific, local causes of credibility. Similarly, popular culture has been highlighted in Cultural Studies in opposition to conservative views offering cultural status to only a small selection of works deemed more valuable than others. Instead Cultural Studies scholars have argued for an anthropological concept of culture emphasising meaning making processes and the very distinction between fine arts and ordinary culture as objects of study. From these two traditions the thesis borrows a set of theoretical and methodological tools to examine the meaning of science in popular culture.

Four studies have been carried out promoting an expanded concept of science popularisation. In "The First Swede in Space" the character and orientation of the conventional view of popularisation is explored in relation to the attention given to Sweden's first astronaut launched into space in 2006. The article is especially concerned with discussing how the astronaut achieves his elevated position as an ideal populariser and spokesperson for science.

In "Food Fight!" the strict division between knowledge production and dissemination implicit in the conventional view of science popularisation is problematised. It is argued that while this division is designed to buttress the authority of science in society, it also leaves popularisation to 'capture' by skilled communicators. To illustrate this point the relative success of the proponents of a low-carb diet revolution in Sweden at bringing into question the authority of national recommendations on nutrition is analysed.

In "The Advanced Liberal Logic of Nicotine Replacement", the idea that science popularisation is just as likely to come before as after the establishment of scientific fact is explored further with reference to changing understandings of, and approaches to dealing with, the health consequences of smoking. The study details how a number of Swedish and British researchers launched nicotine replacement as a popular and credible way to 'treat' smoking authoritatively reimagined and re-constructed as a problem of nicotine addiction.

"Genetik i fiktion", finally, was written as a licentiate thesis and published in Swedish in 2006. It explores how genetics and gene technology are used as a narrative tool in a number of fictitious narratives. In relation to pedagogical worries about the corrupting influence of fiction on scientific understandings, genetics as a narrative theme is explored as a theme worthy of reflection in its own right. Genetics emerge from the analysis as something of a narrative utility tool suitable for discussing science as well as enhancing the credibility of the fantastical.

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Articles

Article 1

Andreas Gunnarsson (2009): 'The First Swede in Space: The Making of a Public Science Hero', *Culture Unbound*, Volume 1: 137–159.

Article 2

Andreas Gunnarsson & Mark Elam (2012): 'Food Fight! The Swedish Low-Carb/High Fat (LCHF) Movement and the Turning of Science Popularisation Against the Scientists', *Science as Culture*, DOI:10.1080/09505431.2011.632000

Article 3

Mark Elam & Andreas Gunnarsson (2012): 'The Advanced Liberal Logic of Nicotine Replacement' in Bent Larsson, Martin Letell & Håkan Thörn (eds.) *Transformations of the Swedish Welfare State: From Social Engineering to Governance?*, New York, Palgrave Macmillan.

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The fall of 2006 was an exciting time for me. As I was preparing for the defence of my Phil.Lic thesis in Norrköping, I gained a position in Göteborg to carry on with my doctoral studies. The transition was more than geographical. From writing a monograph in Swedish, I was now embarking on writing articles in English, and my interest in fictional narratives was to be complemented with a more science studies-oriented approach. That I learnt of the position in Göteborg and decided to apply was very much thanks to Marianne Winther Jørgensen who offered me great encouragement.

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Anyone who thinks that diets, astronauts and comic books are combinable topics of academic analysis in the same thesis surely needs a supporting environment to work in. In this regard I have, perhaps uncharacteristically to those who know me, no complaints to make at all.

Introduction

Science is usually and universally hailed as a pinnacle of our contemporary civilisation. Our knowledge of things as distant as the stars and as miniscule as our genes seems to be steadily growing, becoming more detailed, more secure and more accurate. At the same time, it is as commonly noted that science is becoming increasingly specialised and incomprehensible for the average reader and therefore more and more out of reach for citizens, politicians or anyone else to control except for the internal control systems of science itself. To spread the blessings of science to wider circles, to make more people party to its knowledge and its procedures have long been both an imperative and an ideal, sparked by the demands of democratic involvement, political will, citizens' curiosity, commercial opportunity and for countless other reasons. In metaphors like that of science as a closed and distant ivory tower, the general consensus that science is, could and should be a part of society at large is evident. Rarely can one hear arguments that science should be kept at a distance from everyday life. Such arguments are usually reserved for specific branches of scientific knowledge, like nuclear science and military weapons research.

On the whole, science is regarded as something good and making it public is thought to be beneficial in and of itself. This diffusion of science can be accomplished in many ways – education is perhaps the most obvious arena for making science available to large groups of citizens. But another avenue for spreading science in society is in focus here: namely the ways in which science is made present in popular culture by means of a process called '*science popularisation*', or 'popularisation' for short.

Popularisation is a multifaceted practice and has also been the object of substantial academic interest, much of which will be discussed in this introduction. I am not aiming to conclusively define science popularisation as a concept or practice, but rather to suggest that it forms a useful foundation for thinking about science in public and popular culture.

The aim of this introduction is to discuss the boundaries of what can be analytically treated by the concept of ‘science popularisation’ and the following parts will present case studies useful for such a discussion. They set out from fairly familiar terrain for students of science popularisation and then move on further into examples less obviously thought of in such terms. By presenting popularisation as something of a paradox, a discussion of the limits and the advantages of the concept will argue that it can be fruitfully applied to a wide variety of cultural phenomena. The case studies thus move from a science centred form of popularisation towards examples where science becomes increasingly subsidiary to and mixed up with popular culture. Whereas scholars of science popularisation have been primarily interested in the ‘science’ part, it is my aim to add to this thinking by paying close attention to the ‘popular’ end of the spectrum. In no way is this meant to diminish science’s influence on popular and public cultures, but rather to suggest that it is more entangled with and dependent on popular culture than is immediately obvious.

Although the cases vary in focus and purpose, they all combine insights from the study of science with insights from the study of culture to discuss the intersection between science and popular culture. Science popularisation as a concept is not the central theme in all of the collected articles: the first two are explicitly about science popularisation. ‘The First Swede in Space’ examines how Christer Fuglesang in 2006 became the nation’s first astronaut and, at the time, its most prolific spokesperson for science. The second article, ‘Food Fight!’, deals with science popularisation as a way to challenge rather than to support and promote mainstream science. The third article called ‘The Advanced Liberal Logic of Nicotine Replacement’ has a more historical interest in smoking as nicotine addiction and the attempts to handle that problem as such. It describes how markets, knowledge and new ways to scientifically know yourself

are co-emergent in the efforts to promote public health. The fourth text discussed, *Genetik i fiktion*, was published in Swedish in 2006 and is not included in this volume, although it is part of my dissertation work.¹ It deals with the use of scientific imagery in narrative fiction. Here education rather than popularisation is taken as a point of departure to discuss the implications of publically representing science.

These cases present a composite, but by no means complete, picture of science in popular culture. When read as a whole, I hope they demonstrate that the study of science in popular or public culture is a vast and interesting field. It is one where popularisation as the mediation between science and its surrounding culture does not necessarily have to be understood as a process always starting off with the expertise of scientists which is then transformed to suit other audiences. It can just as well make scientific issues relevant for wider circles in ways that might not be very palatable to the scientific actors, but that still say something about science's place in culture.

Aim and Purpose

My project concerns the presence of science, in the form of arguments, imagery, debate, statements, themes and so on in popular and/or public culture. The overall purpose is to build on the prevailing idea of science popularisation and to try to expand it by paying close attention to its cultural dimension. The aim for the thesis as a whole can thus be formulated as follows:

- To explore the concept of science popularisation by using case studies.

¹ My Licentiate thesis *Genetik i fiktion* was published in 2006. A Licentiate is a Swedish graduate degree equivalent to a M.Phil. As such, that text is part of my graduate work, but it is not included in this publication since it was written in Swedish. The thesis was publically defended in Norrköping, Sweden, on 1 November 2006. Jenny Sundén was the opponent. The text is available online from Linköping University Electronic Press at <http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-7923>

- To discuss the limits, uses and advantages of science popularisation as an analytical concept.
- To scrutinize the meaning-making processes performed through popularisation practices; what specific representations of science, public, culture, knowledge, expertise, and laymanship can be discerned in light of the chosen analytical perspective?

Accordingly, my aim is to use science popularisation as a concept that can capture science-culture mediations more broadly. This entails a perspective that treats the ‘science’ of science popularisation as content and as a theme, but not necessarily as its origin. I will discuss, stretch and test this idea of science popularisation as a mediating practice that tries to come to terms with and handle science and non-science, experts and publics, knowledge and ignorance. The case studies, in this view, are framed and analysed as instances of science popularisation. They are interpreted as practical articulations and examples of when science and the popular are configured by specific actors at specific times.

Deficient Public Understandings and the Gathering Darkness

The idea that the public are by and large misunderstanding science, usually referred to as ‘the deficit model of public understanding of science’, is central to any discussion of science popularisation. What the public knows about science and how familiar they are with it has been a worry in western cultures at least since the 19th century (Bensaude-Vincent 2001, Felt 2000, Shapin 1990). The issue is particularly conspicuous since science holds such a privileged and fundamental position in our societies. In the words of astronomer and acclaimed science populariser Carl Sagan’s last book *The Demon-Haunted World: Science as a Candle in the Dark*:

We’ve arranged a global civilization in which most crucial elements – transportation, communications and all other industries; agriculture, medicine, education, entertainment, protecting the environment; and even the key democratic institution of voting – profoundly depend on science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces. (Sagan 1995: 28).

Here public ignorance is unfortunate at best; at worst it is a threat to our entire way of life. Sagan portrays science as fundamental for our society, yet this fact goes unrecognised by most with disaster as an imminent end result. This is the enlightenment heritage of popularisation and it functions as the basis and ideological underpinning for an amalgam of governmental efforts, scientific research and critical thought carried out under the label of ‘public understanding of science’ (PUS).

Within PUS as an academic endeavour, and in the larger group of popularisers and science crusaders sometimes called ‘the Public Understanding of Science Movement’ (e.g. Gregory and Miller 1998: 1-2), the benefits of science, as well as the complicated question of what science is, has largely been taken for granted. But in 1987, Thomas and Durant published a paper called ‘Why should we promote the public understanding of science?’ detailing some of the reasons put forward by PUS proponents as to why the public should know more. Thomas and Durant, advocating a scientific literacy perspective, summarise that ‘[t]he alleged benefits [of a scientifically literate public] are to: science itself; national prosperity; national power and influence; individuals; democratic government; society as a whole; intellectual life; aesthetic appreciation; and morality’ (Thomas and Durant 1987: 2). Though they do not find the various benefits suggested equally attractive, they nonetheless conclude:

The hope we have identified is that scientifically literate people may be both more active and more effective citizens; but by the same token, of course, it may also be hoped that such people will find that the quality of their personal and working lives has been enriched. (ibid: 12)

Given these benefits, the ignorance of the public is not only unfortunate for our societies, but also for science itself. Two questions have thus dominated thinking on science-public relations in the PUS idiom: first, the issue of how much or what science the public understands, in other words the question of public knowledge; and second, the public appreciation of science and scientists (e.g. Ziman 1991). These two issues have largely been gauged by way of various kinds of survey research.

Mapping out 25 years of PUS survey research, Bauer, Allum and Miller (2007) distinguish three overlapping ‘paradigms’: (1) the ‘Science Literacy’ paradigm dominated from the 1960s with a focus on education; (2) from the mid 1980s, research and other efforts were carried out in the ‘Public Understanding’ paradigm, characterised by an emphasis on attitudes towards and the image of science rather than education; and (3) from the 1990s, the label has been ‘Science and Society’, concentrating more on public participation and deliberation in scientific matters. At the centre of all three paradigms and a common denominator for all

of them is the concept of a problematic deficit (ibid: 80). This deficit is typically ascribed to the public; either it is a deficit in knowledge or literacy, or in appreciation, understanding or trust, or all of the above.

This 'deficit model', turning differences between science and public into problems of public understanding, has gained its credence from large survey studies and influential reports, especially British and American mappings of public understanding, trust and appreciation of science and suggestions to how the deficit could and should be alleviated. Influential work of this variety include, for example, the Royal Society report *The Public Understanding of Science* (Bodmer 1985) in the UK. On a European Union level, public knowledge and attitudes have been measured in large-scale surveys like the Eurobarometer and measures have been suggested by the European Commission in reports like the *Science and Society Action Plan* (2002). Scientific literacy or knowledge usually emerges as lacking in this research, while attitudes are more complex, ranging from hostile to celebratory; sometimes correlating with literacy, sometimes not (for a more detailed discussion on survey research and its relation to the PUS movement, see Gregory and Miller 1998 and Bauer, Allum and Miller 2007). Popularisation is usually the suggested cure for these problems in science public relations. From a 'deficit model' perspective, the primary problem belongs to the public. And given that the benefits of science appear so obvious and are largely unproblematic in the PUS movement perspective, popularisation certainly fits nicely with the need to make the public more aware and attentive to science.

Returning to the Sagan quote above, it is worth noticing that his fear of a future where science is shunned echoes the logic of the 'deficit model'. For Sagan and for the PUS movement, the problem with public misunderstandings and/or lack of appreciation is one in need of a solution calling for a change on behalf of the public rather than science. Still, this is risky since only scientists are deemed sufficiently equipped to accurately portray science. The stance of Sagan can be read as a worry about who represents science in public discourse; to alleviate the ignorance, Sagan argues, scientists themselves must wrest the representational devices from the hands of the currently far too popularly

inclined writers. This line of thinking is based on a deep-rooted conviction that science is indeed a steady source, if not the only source, of rationality in modern society and that rationality is a universal and undivided good that should be the aim of all things related to science and popular culture alike. This leaves little room for other ways of describing science and scientists. Sagan goes so far as to lament the lack of scientific accuracy in fictitious television shows such as *X-Files* and *Star Trek* (1995). In Sagan's book, standing here as an example of the conventional Public Understanding of Science perspective on the issue, popularisation is thought of as science communication. Its goal is first and foremost to muster support and adherence to a scientific worldview; to rescue the ignorant from the darkness and deliver them into the light of science. The popular, in this view, can easily corrupt the science it portrays. In the words of Constance Penley: 'Entertainment, for Sagan, is the opposite of enlightenment; popular science and science cannot coexist because popular science ("irrationality") confounds the progress of science ("rationality")' (1997: 5-6). Popularisation in this discourse becomes problematic since it threatens to change science itself and this threat from the public has a long history.

As Shapin (1990) has argued, the science-public relationship from the 19th century onwards has been characterised by appeals from scientists for public financial support based on the supposedly beneficial outcomes of *free* and independent science. Scientists were to be left to decide on their research autonomously in order to foster a creativity that would lead to technical innovations further on. Yet democratic society demands that public spending must be made responsibly and on clear grounds. Thus, '[t]he demand for accountability appeared radically incompatible with the autonomy that, scientists said, was the condition for the health of science...' (ibid: 1004). In this light, the ignorance of the public becomes a functional tool for arguing that public spending on science is indeed in line with the demand for accountability, it is just that the public is too ignorant to notice the relationship between their tax money and the blessings and comforts of modern society. This is one of the functions of the 'deficit model'. It makes it possible to argue that science can remain accountable, while being autonomous, if only the public lack of understanding could be alleviated.

While I do not find the perspective on popular culture represented by Sagan, or the unproblematic view on science in much ‘deficit model’ styled PUS research to be very attractive as theoretical positions for the analysis of popular science, they are essential since they detail the *raison d’être* for so much popularisation practice. It is difficult to understand much of the overtones and reasoning in the debates about popular depictions of science, without reference to the idea of an unacceptable and threatening lack of public understanding and trust in the rationality, accuracy and value of science. An enlightening criticism of this prevalent perspective comes from a contextualist perspective sometimes called critical public understanding of science (cPUS) (cf. Wynne 1991, Irwin 1995). It takes issue with the general character of the concepts used in PUS, most notably that both science and public are too often treated as homogeneous and stable entities and as far too general concepts. Instead, cPUS proponents argue, both science and public should be thought of as local cultures that need to be understood as such. Therefore, survey research fails to grasp how the public understands science since it approaches the issue by asking quiz-like questions of science in general – rather than in relation to specific lived experience. On this account, the publics, since there are of course many local publics as well as many local sciences, will often have extensive scientific understanding relating to their social context, but will lack in generalised and detached scientific knowledge. To conclude by means of surveying ‘the public’s’ grasp of generalised and abstract science is thus simply unfair and inaccurate.

The shift from PUS to cPUS should however not be mistaken as a radical break with the deficit model as such. As Michael (2002) has argued, cPUS redistributes deficit rather than disposes of it; instead of seeing problems in science public relations as emerging from the public’s deficient understanding as traditional PUS does, cPUS reconceptualises the blame more evenly among both scientific and public cultures. Michael’s critique takes aim at that very definition of science and public as largely uncomplicated with clear categories. However, even though the categorisation of science and public as distinct categories leads to difficulties, it is foundational for understanding popularisation as a practice.

Regardless of the validity of the ‘deficit model’, of whether public ignorance is accurately measured or not and if scientific knowledge leads to appreciation or not, the importance of these questions for the whole discourse of popularisation is fundamental. PUS efforts are often made in ‘deficit model’ form and for ‘deficit model’ reasons. The ‘deficit model’ thereby lurks at the heart of the common understanding of what is and is not popularisation of science. By including less obvious examples, it is my hope to expand the concept of popularisation and free it somewhat from its normative ‘deficit model’ function - arguing that it is insufficient as a base for defining popularisation.

Besides the PUS movement discussed here, two related and partially overlapping movements deserve special mention since they are also of importance for the conventional understanding of science popularisation. In the ‘Food Fight!’ article, the Swedish LCHF dieting movement is compared to what is known as the sceptic movement. Sceptics, to whom Sagan as well as the first Swede in space could be counted, have taken it upon themselves to defend science from public ignorance as well as protect the public from unscientific charlatans. In Sweden, the main sceptic’s organisation is *Vetenskap och folkbildning*. Sceptics are typically more confrontational in their approach to popularisation, seeing science as threatened by public ignorance, they involve themselves in the public defence of established science against what they view as unscientific and ‘fringe’ phenomena like parapsychology, astrology *etcetera*. While they are usually less inclined to define scientific knowledge in much detail, they nonetheless form a group of vocal science guardians or self-appointed vigilantes, dedicated to promoting rationality in public discourse (Hess 1993, Forstorp 2005). A third context where deficient public understanding forms an influential trope we find within discourses of pedagogy and science education. Here public misunderstandings are viewed as an educational problem emerging from a deficient educational system and public deficiencies in scientific knowledge should thus be remedied by that system as well. Deficient public understanding, from an educational viewpoint, is a result of a failing school system, implying that the problem is pedagogical. For disciplines of pedagogy, this is in no way controversial or surprising; but it has led to occasional overtones in pedagogy’s relations to fiction, popular

culture and public uses of scientific concepts. This version of the deficit model is elaborated upon in *Genetik i fiktion* where science educators worried about the damaging influence of fictitious and entertaining discourses form the starting point for discussing fictitious science more on its own terms and not as a corrupted form of science communication. As with the deficit model in general, my aim is not primarily to discredit these takes on public ignorance, even though that is at times called for, but rather to argue that a more descriptive and analytical stance vis-à-vis science popularisation is called for, one including other forms of public science beyond the troubleshooting approach of mitigating (public) ignorance.

The Paradox of Popularisation

Conventional PUS and the deficit model thus present both science and the public as two relatively stable and set fields and envisions them as out of sync and in need of adjustment, usually on behalf of the public's ability to understand and appreciate science. Popularisation in the deficit model therefore easily becomes a highly normative affair of educating and promoting proper science in public discourse. My aim is to keep some distance from this view on science popularisation and instead aim for an approach less oriented toward solving the problem of a supposedly deficient public understanding.

The merger of science and the popular into 'science popularisation' can be a confusing affair and a reader expecting a formal and clear definition of the term will not find it here. In my judgement, such a definition would not be very helpful. Instead, I suggest that science popularisation should be viewed as a diverse set of practices where science – be it in the form of content knowledge, methodological issues, institutional form and so on – is brought to audiences not regarded as insiders to it.² The

² Throughout these texts I have chosen to talk mainly about 'popularisation' by which I mean the popularisation of science, as this is the focus of all the studies presented here. There are a few more or less synonymous concepts to chose from, including 'science communication' and 'science information'. I have, however, opted to use popularisation and instead have tried to broaden the concept to include a wider variety of forms, since I find this more palatable than to invent further neologisms. By the same token, I have largely chosen to talk of popularisation instead of popular science, although the latter sometimes features in the texts. When it does, it is meant to denote the genre of popular science, which I would argue covers a much smaller and more coherent genre than the media texts resulting from practices of popularisation. Popularisation, I feel, also makes it easier to talk of various degrees or expanding the circles of communication of scientific ideas. This is an advan-

problem with popularisation is discernible already in this broad and provisional description: Science is supposed to be spread and diffused to larger audiences – but this diffusion implies dilution as it can no longer be as scientific as before. At the heart of popularisation as a practice lies a paradoxical idea of simultaneous communication and exclusion. To talk of a paradox in this context might seem exaggerated, but I do it to stress the problem of mediation that popularisation presents – the whole point of popularisation is typically thought of as that of bringing highly specialised expertise to a vast and lay audience. Popularisation is the external communication of science aimed at a wider audience and that is something quite different from the internal discussions that take place in laboratories, journals and at conferences. As science meets the popular, it seems to be transformed by adapting to a non-discriminating public. The price of widely

tage since an oft-heard critique of popularisation research is that it takes for granted or exaggerates the division between expert and lay and thereby misses crucial instances of intra-scientific popularisation for example. That popularisation is also an intra-scientific process as a result of the high degree of specialisation in the sciences. Shinn and Whitley have pointed out that this means that popularised science, in the meaning of diluted science aimed at non-expert audiences, is so common in that it might be better to talk of what we now call popularisation in terms of expository science. This, they argue, would more clearly emphasise that the various methods and techniques employed in communicating science are not exclusively related to extra-scientific communication but are just as present within science (Shinn and Whitley 1985: viii-x). In a similar way, Bucchi notes that popularisation implies a linearity where public communication is the last step in the diffusion of a piece of knowledge, but that this linearity is not always followed in practice. Instead, scientists sometimes skip intra-scientific agreement and launch various popularisation efforts before, for example, peer-review or publication. Bucchi wants to call this process deviation, in order to emphasise that this is not in line with the ‘canonical account’ of popularisation. (Bucchi 1998: 1-15). Both of these are examples of how the term popularisation is felt to be too restricted and therefore should be complemented in one way or another. I want to argue that while they are correct in identifying that popularisation is a much wider process than the ‘dominant view’ or ‘canonical account’ suggests, this problem is not resolved by inventing any number of auxiliary concepts or neologisms. Instead, I think it is better to keep popularisation as the concept, but add meaning to it and try to stretch it out to include other forms.

aimed communication is thought to be the devaluation or even corruption of science. This is why I choose to talk of it as a paradox: science in popular discourse seems unable to remain scientific. As Greg Myers has pointed out, this is a peculiar situation, since popular science becomes a discourse that rules out intra-scientific discussions:

There is no field that names all discussions of crime and punishment except those published in law journals, or all discussions of God except those given the imprimatur of an established church, or all discussions of politics except those in government documents. Popularization includes only texts about science that are not addressed to other specialist scientists, with the assumption that the texts that are addressed to other specialists are something else, something much better: scientific discourse. (Myers 2003: 265).

Hence a separate discourse emerges, one that lies somewhere in between ‘science proper’ and ‘popular culture’. This patchwork field is what is under scrutiny in this text. I want to explore how the popularisation of science is carried out and presented: how it confirms, challenges, defines and tears down ideas about both science and the popular in various attempts to mediate between the two. That this mediating practice is placed in a discourse, neither wholly scientific nor wholly popular, affords some interesting possibilities for those involved in popularisation work. For example, it makes it easier for scientists to distance themselves from popular representations of their work by reference to the difference between science proper and popular science. But it also means that popularisation is a discourse not exclusively in the hands of scientists and can be hijacked by others. Skilled communicators or science fiction writers can craft popular images of science and have them turn back against the discourse of science proper. The separation of popular and proper science grants access of scientific representation to actors who would otherwise be excluded by the institutional gate keeping practices of science. As will be argued in the article about low-carb dieting, popularisation can be used not only to spread the knowledge of science to the lay public, but to also attack established expertise through popular representation. It is the separation of science proper and popular science that evokes the need for this line of attack (by shutting alternative dieting experiences out of established science). It is also the very same separation that makes this mode of attack possible (shut out of science proper,

the alternative can still thrive in paradoxical popularisation discourse).

Myers' point that popularisation has become a discourse, separate from science, is important, because it draws attention to the possibilities created by the sealing off of science from popularisation: sometimes scientists can have a great influence over public representations of their work; sometimes they can be left to suffer the representational powers in the hands of others. Much energy has gone into detailing the transfer of scientific knowledge to popular discourse, tuning the communicational means to increase public knowledge in various ways, not least from PUS oriented scholars and activists. Much has also been said about how science proper has managed to seal off popularisation from its own discourse, while at the same time largely retaining the right of last word on the quality of the products of that discourse. Both of these traditions form important backdrops for the studies presented here.

The separation of a discourse for science proper and a discourse for popular representations, combined with a linear diffusion model of communication, form a powerful cultural trope analysed by Hilgartner as 'The Dominant View of Popularisation' (1990) and by Cooter and Pumfrey as 'Separate Spheres' (1994). For Hilgartner, popularisation is a blunt oversimplification that grants scientists significant political power, by describing popularisation as a two-stage process in which 'scientists develop genuine scientific knowledge', which is then popularised in simplified form. This simplification can then be judged by scientists, from their position as possessing the genuine and original knowledge, as "distortion" or "degradation" of the original truths' (Hilgartner 1990: 519).

The most the popularisers can hope for in Hilgartner's interpretation is that their efforts be described as "appropriate simplification" – a necessary (albeit low status) educational activity of simplifying science for non-specialists.' (ibid.). The dominant view thus constructs a metaphorical river where pure knowledge springs from the scientific up-stream and is then diluted as it travels towards the popular down-stream for public consumption. The popularisation discourse becomes a product of scientific discourse and as such, it is accountable to a proper science that it can never fully reach. Hilgartner's critique of the domi-

nant view on science popularisation is therefore also a powerful critique of the deficit model and its way of granting right of interpretation to established science. The up-stream and down-stream thinking of the 'dominant view' is a way to grasp how science popularisation is carried out in deficit model mode and to what ends.

The resulting ability of science to distinguish true from false in a discourse held out of reach from the public, has been conceptualised as 'cognitive' or 'epistemic authority' (cf. Gieryn 1999). To have epistemic authority means that those who can claim scientific status for themselves, or their statements, gain a privilege of interpretation difficult to untangle for those regarded as lay or non-experts. The practise of popularisation is dependent upon the idea of an epistemic divide between expert and lay, but it is also and more importantly, the arena in which the configuration of this divide is negotiated. The cases included here have negotiations as their main object and my hope is that some of them will reveal that the authority to dictate what goes on in the discourse of popularisation is not unambiguously in the hands of established science. Scientific status itself becomes easier to both assert and contest in popularisation discourse, opening up for a wider array of actors. For now, however, it will be sufficient to note that popularisation, even though it is thought of as a discourse separate from science proper, is by no means independent from it. In fact, popularisation is frequently portrayed as more or less subservient to science proper. By employing a less science-centred take on popularisation, the dominance of science can be lessened and other examples shown, but the centrality of science still remains.

The problem with analysing science popularisation is to handle these seemingly contradictory ideals. In popularisation, established science takes centre stage as the final voice of truth and as the arbiter on appropriate and flawed representations of science. Yet established science's ability to make such distinctions is not rooted in the popular discourse in which it is wielded. Popularisation is perhaps best understood as an uneasy compromise or mixture of two elements: in Hilgartner's (1990) account called the upstream science and the downstream public, whereas Cooter and Pumfrey (1994) and Fleck (1935/1979) talk of the difference between the esoteric and the exoteric and

Brown and Michael (2001) describe popularisation as a practice characterised by a constant switching back and forth between repertoires of authority and authenticity, between science and culture. This conceptualisation of popularisation as a clash between seemingly contradictory entities will reappear throughout this text and it is a strong feature of much of the thinking and writing on the subject. In this introductory text, the two influential, yet usually vague, cultural ideas of *science* on the one hand and *popular culture* on the other will return again and again as I try to outline some of the features of my thinking on popularisation. Both concepts are highly contingent and while science is usually thought of as an elevated form of knowing and a path towards truth about nature, popular culture is conventionally seen as more debased and tainted. This conventional take on the two terms and the relation between them, is influential and shapes much of the practice of popularisation, the thinking about it and how we typically view science. But rather than thinking in terms of science and popular culture as colliding forces in popularisation, I want to argue that popularisation is a *mediating* practice, typically trying to reconcile the two in various ways. As will be seen in the case studies, this is not necessarily an even and equal process, where one of the two wins out and the other loses, neither is it a process requiring a complete levelling out between the two.

The centrality of communication in the practice of popularisation has long been recognised. Already in the 1930s, Ludwik Fleck commented on how scientific knowledge spreads through society and changes while doing so. In his theory, science is one of several *thought styles* belonging to a *thought collective* which guides cognition (1935/1979). These styles of thought function as limitations for what can be thought and they guide the internal coherence of a body of knowledge. On Fleck's account, there are numerous styles and related collectives, within as well as outside of science. His theory is not limited to scientific thinking, instead it claims to describe knowledge production and diffusion more broadly by means of 'comparative epistemology'. By comparing earlier thinking and knowing on a given subject with that of his contemporaries, Fleck provides an account of how social mechanisms create facts that then become creative limitations on further thinking: 'In the field of cogni-

tion, *the signal of resistance* opposing free, arbitrary thinking is called a *fact*' (ibid: 101 italics in original). Of central importance for the understanding of popularisation is Fleck's account of how the thought collectives relate to their surroundings. At the centre of a thought collective is a small group of experts that make up an *esoteric* circle. For Fleck, there are esoteric circles to be found in all camps of human thinking, from religion to science. There are many such esoteric centres in science, at least one for each stable collective and the wider *exoteric* circles surround them (ibid: 104-105). These circles are never finally settled and stable; individuals travel constantly between them and can belong to several different thought collectives simultaneously in either esoteric or exoteric circles.

A thought collective consists of many such intersecting circles. Any individual may belong to several exoteric circles, but probably only to a few, if any, esoteric circles. There is a graduated hierarchy of initiates and many threads connecting the various grades, as well as the various circles (ibid: 105).

For Fleck, the path from the exoteric to the esoteric is one of education and initiation, but what interests me the most here is what he says about the other route, that from the esoteric and outward. 'Popular science in the strict sense is science for non-experts...' it is characterised by 'the omission both of detail and especially of controversial opinions; this produces an artificial simplification.' 'Simplified, lucid and apodictic science – these are the most important characteristics of exoteric knowledge.' (ibid: 112). This pessimistic image of popular science should not be overstated however. I want to argue that, pessimism aside, Fleck has quite accurately described the results of communication more generally in that it forces the esoteric towards the exoteric: '*Every communication and, indeed, all nomenclature tends to make any item of knowledge more exoteric and popular*' (ibid: 114 italics in original).

Fleck is an early example of a theory of science that does not view it as fundamentally different from other forms of knowledge. His depreciating comments on popular science above are, I believe, best understood as a frustration that popular science fails to account for some of the most central and interesting parts of scientific knowledge – like its amazing detail, its controversial views on various subjects and the way science as a practice

manages to include so diverse and contradictory understandings. With Fleck, the concept of science popularisation begins to open up somewhat. Science is to him linked to its site of production and use, but its confidence and the ideal of certainty are not primarily products of the esoteric. Instead, the esoteric is dependent on the exoteric for support and confidence.

Science and the Social

Fleck's view of science was not widely taken up by his contemporaries, but it would be rediscovered in the wake of a new perspective on science that shares his interest in the social and cultural elements of knowledge. This new approach was perhaps most clearly expressed in the Strong Programme, developed by Barry Barnes and David Bloor in the 1970s, which soon became a platform for an emerging sociology of scientific knowledge. The Strong Programme insisted that the study of science could and should pay close attention to the social as a fundamental factor at the very heart of scientific knowledge and content. Therefore the sociology of scientific knowledge needed to apply its causal explanations 'symmetrically'; that is, they insisted that the social could not be used exclusively to explain failure in science. If the social should have any explanatory power at all, it ought to be able to explain success as well. Proponents of symmetrical thinking argue that the commonsensical tendency to oppose the rational and the social is a mistake; that something is rational does not mean it is not social (cf. Barnes, Bloor and Henry 1996: 28-33). The principle of symmetry thus calls on the sociologist of scientific knowledge to treat conflicting scientific knowledge or theories as equally valid descriptions from the onset and then account for their success or failure socially – that is, not by reference to any inherent ability to accurately reflect nature. The Strong Programme was heavily indebted to a selective and careful reading of, among others, Kuhn's historical study of how scientific revolutions come about (Golinski 1998).

Central to this reading was Kuhn's analysis of how scientific knowledge depended on the paradigms within which it emerged. He described the paradigms of science as the result of successful problem solving that subsequently became templates, or exemplars, for further solutions. A paradigm, on this account, is thus to be understood as a typical way of thinking and perceiving,

emerging from the successful solution to a central problem and then applied to others. Within the paradigm, this works just fine for the problems considered relevant, whereas phenomena not explainable within it are thought of as anomalies, usually not given much attention or regarded to be of only minor significance. As time passes, the number of anomalies increases and a shift in the paradigm can come about when the anomalies begin to be considered a pressing problem. Then, a new solution to one of the anomalies can form the basis for a new paradigm, but the scientists working in the old one will have great difficulties in making the switch (Kuhn 1962). Scientific change, according to this account, is intimately tied to the practices and ideas (usually 'tacit' rather than formal) of the scientists involved. By that, Kuhn had, perhaps unwillingly, opened the door for a view on science that took the social and cultural specifics of the scientists involved very seriously.

The insistence on symmetry opened up a new area for sociological analysis and rejected the notion that science achieves its success by being intimately and directly linked to nature. By not taking for granted that scientific facts are socially and culturally untainted readings of nature, the construction of truth became, at least in part, an available object of study for anthropological, sociological and other types of social and cultural studies. Exactly to what extent the principle of symmetry could be applied became a contested issue within science studies from the late 1980s onwards (cf. Pickering 1992), but that some version of symmetrical thinking has been an essential part of most versions of science studies in the last decades seems an uncontroversial claim. In accounting for their principle of symmetry and the methodological relativism that comes with it, Barnes and Bloor explain that:

... all beliefs without exception call for empirical investigation and must be accounted for by finding the specific, local causes of this credibility. This means that regardless of whether the sociologist evaluates a belief as true or rational, or as false and irrational, he must search for the causes of its credibility (Barnes and Bloor 1982:23).

This is a call for localised and contextual rationality rather than granting scientific knowledge a privileged position as more rational than other forms. Barnes and Bloor are careful not to

equate this kind of relativism with nihilism and argue that it does not imply that all beliefs and all knowledge are equally valid. Instead the relativism turns the extraordinary credibility of scientific knowledge into an empirical question that can be studied. The rationality of science is not denied, but it cannot be explained by inherent and transcendent rationality since ‘... there are no context-free or super-cultural norms of rationality...’(ibid: 27). Instead, a focus on science as a cultural and social activity more like any other is more appropriate. In the wake of this new view, science could be thought of more in terms of a human activity performed by groups sharing central values and the laboratories were opened up for anthropological study and critical reflection. Scientific claims of a more accurate truth could now be analysed by the same rhetoric methods used to study the statements of politicians and others. This did not necessarily involve a denial of scientific accuracy; instead the issue was bracketed and disqualified as an argument for the social and cultural study of science. Even though there has been much debate about whether this way to think of science is too irreverent or perhaps even dangerously anti-scientific, it is important to notice that what the constructivist argument claims is not that science is irrational, but that it is *contingent* (for a discussion of contingency in science studies see Hacking 1999: 68-80). This approach to the study of science soon proved a productive one and sparked a plethora of studies and controversies concerning science and the place of science in society.

That scientific rationality cannot be taken for granted but must be contextualised and accounted for by reference to social and cultural contexts can, all the differences in approach aside, be said to form the starting point for most, if not all, science studies in the vein presented and practised in this thesis (cf. Golinski 1998: 13-27). How to apply the symmetry principle in practice remains open to discussion. To talk of it as a ‘principle’ leads, I would argue, to an unfortunate tendency to turn it into a fundamental theoretical description of science and other forms of knowledge in general, since treating contradictory or discrepant claims symmetrically tends to equate them. It seems to me that symmetry is better understood as a methodological tool and its application is therefore to be made strategically, rather than presented as a general ‘principle’. An example of this way to

strategically apply a symmetrical reading can be found in ‘Food Fight!’ If that study had been written with a general principle of symmetry, we would probably have had to pay far closer attention to the government institutions that the low-carb dieters attack. It would have been more of a controversial study, postponing the question of who is right in favour of detailing their strategies and rhetorical means and striving to pay them equal and fair attention. Instead, the symmetrical element in that particular study consists of attempting to be symmetrical about who can or cannot be a science populariser (and about whether either diet actually works at all). Thus it pays far more attention to the candidate that is supposedly less likely according to conventional popularisation theory.

The authority of science thus has to be explained by other means than an inherent ability to unveil truth about nature – popularisation is one of those other means. The importance of popular culture for the authority of science was recognised by Fleck when he remarked that: ‘*Certainty, simplicity, vividness originate in popular knowledge*. That is where the expert obtains his faith in this triad as the ideal of knowledge. Therein lies the general epistemological significance of popular science’ (Fleck 1935/1979: 115 italics in original). According to this statement, the popular is where certainty starts, implying that such certainty is not to be found in science prior to popularisation. The point is that certainty is a product of science and that it is enhanced as it spreads, but that the *ideal* of certainty as such is not primarily a product of the esoteric but, even for the expert, emerges from the exoteric.

Collins has famously noted that when it comes to science ‘distance lends enchantment’; that which is unclear and complicated in what he refers to as the core-set, his name for the esoteric centre, is both presented and perceived as increasingly more stable as it travels to others (Collins 1985: 144-145). This increase in certainty then ebbs out and uncertainty again rises as the audiences are so far removed from the context of the knowledge production that it becomes increasingly meaningless. The function of ‘dominant view’-popularisation can be thought of as an attempt to expand the reach of this zone of high certainty. As illustrated in the article on Sweden’s first astronaut, his popularisation work is geared for increasing the general Swedish pub-

lic's appreciation for science and space exploration. This is not primarily done by diffusing complex knowledge on space matters, but by telling tales of adventure, risk, reward and everyday excitement in connection with science and technology. Fuglesang's popularisation work is effectively trying to reconfigure on a national scale how people view science – the aim seemingly being to reduce the group so removed from science as to be ignorant and thus lacking in trust and certainty.

Popularisations like those of the first Swede in space take science, as a general and uncomplicated category, to be an undivided and self-evident good. It is therefore by default working in a way that reproduces the epistemic authority of science. That science is seen as something good, naturally makes it desirable, it is always better to be scientific than not. From this point of view, science is something that needs to be spread like a gospel; it can save those who have not heard it. With popularisation defined as the diffusion of science to those deemed less scientific, this missionary tendency is built in to the definition itself and the practices it denotes.

Interestingly, popularisation, by its own description, does not seem to work very well. Bensaude-Vincent (2001) has conceptualised one of the most influential ideas diffused through 'dominant view'-popularisation as that of an ever-widening gap between science and public. She notes that the idea of a deplorable inability of the public to keep up with science and to understand even the most basic of scientific knowledge has been a part of the story at least since the 19th century and the birth of consumer culture (ibid: 102-104). Science became more and more divided into a professional and a popular part and as we shall see when we turn to popular culture in the next section, a popular science set aside for the masses gained a predictable role as the low-status version.

Science became the home of knowledge, the popular was associated instead with opinion and a gap between the two was established, both in the sense of a problematic chasm in need of bridging (preferably by some sort of mediator, like a science journalist, or other populariser), but also as a resource for scientific authority. The latter role was secured by popularisation as it continuously described scientific knowledge as both superior and more important than public opinion, but through this medi-

ating practice, the audience of popularisation was in effect kept away from science proper and instead handed only diluted versions of it. The gap produced for mediators a professional niche to be filled in translating science for the public, and scientists were in turn furnished with a platform from which to teach the importance and certainty of their work, without risk of losing the exclusivity of it. This tendency is strengthened further since the gap as it is conceptualised is not only a constant but also a growing problem in the science-public relation (Bensaude-Vincent 2001).

This growing gap can also be seen as a form of large-scale boundary-work. Following Gieryn (1983), this concept of boundary-work denotes the process by which professional authority over certain parts of the world is created and upheld by setting the boundaries for where various forms of knowing are applicable. As such, he argues, the issue of what constitutes scientific knowledge is not a philosophical but a practical problem: one of identifying, drawing and defending boundaries against other contenders to the same authority. What is science is thus largely decided by rhetorical and ideological struggles with others deemed to stand outside its boundaries. Gieryn exemplifies his idea by describing science as a number of negative definitions, designed to keep other forms of knowledge out of science. For example, the struggles over phrenology in the 18th century were full of attempts, ultimately successful, to ‘discredit the scientific legitimacy of phrenology by exposing its political and especially religious ambitions’ (ibid: 788).

What the concept of a growing gap and the practice of boundary-work teach us is that popularisation is an arena on which science is simultaneously diffused and defined. The very idea of popularisation as the communication of science to the non-scientific is in itself a form of boundary-work since it takes for granted that such communication is both possible and necessary. This is a problem that emerges with the lay character of the audience of popularisation. Since this is taken for granted, popularisation is especially prone to and useful for, mediations that become didactic and ‘gap-widening’. The dominance of the dominant view, it should be remembered, is partly due the structural characteristics of how popularisation practice imagines the relationship between popular cultures and science.

The Field of Popular Culture

To be interested in popularisation is to be interested in science's relation to popular culture. In the widest definition, I suggest that science popularisation denotes the practices in which science is made part of such a culture – regardless of whether these practices are successful or not. From this broad definition it follows that the popular culture to which science is presented is not only the coveted prize of successful popularisation, but also the field in which the attempts to popularise it are made.

So what characterises the popular as a field? The academic thinking about popular culture has been characterised by a turn not unlike that detailed above in which sociologists began to treat science more like any other human activity. In the case of popular culture, it was the break with conservative images of a sharp distinction between high and low, or art and folk culture, that sparked a renewed interest for popular culture as a field of analysis, rather than a problem of ignorant and pacifying entertainment for manipulation of the masses. This new approach to popular culture was largely intended to break with more conservative views on culture that had set up, or rather created, popular culture as a debased and problematic contrast to the cultural preferences of privileged classes.

First and arguably the most influential, among the proponents of a new perspective on popular culture was Raymond Williams who sparked an increased interest in popular culture by arguing for an anthropological definition of culture as a 'description of a particular way of life' (Williams 1961: 56). This definition of culture was made in opposition to what Williams called 'ideal' definitions of culture that took it to describe 'a state or process of human perfection, in terms of certain absolute or universal values.' (ibid.)

Williams thus wanted to rid the term 'culture' of its qualitative stamp and talk of culture not as an ideal but as a more uni-

versal and social process by which meaning is ascribed and allocated by particular groups at particular times. He proceeded by distinguishing three ways to think of culture: first, 'the lived culture of a particular time and place'; second, 'the recorded culture, of every kind, from art to the most everyday facts'; and third, 'the culture of the selective tradition' (ibid: 62). The first one is a lived form of culture, in principle impossible to fully grasp or describe even by those who live it. The second one is the recorded traces produced by that culture. Whereas the third one, the selective tradition, is even further removed from lived culture, consisting of the recorded traces taken up by culture in the first sense, 'a continual selection and re-selection of ancestors' (ibid: 64). The case studies presented later in this text concern themselves mainly with recorded culture, the traces of our contemporary pondering on science and its role in our society.

This way of thinking about culture opens up for a wider field of study as compared to the ideal notion of culture. The task of the analysis can no longer be to identify, explain and clarify a limited number of cultural artefacts reckoned to constitute 'human perfection'. Instead, recorded culture and the selective tradition, including but not exclusively 'high culture', become gateways to understand forms of life. Among the new forms of culture taken up for analysis in the wake of Williams' call for a wider definition was the plethora of cultural practices lumped together under the highly problematic umbrella term 'popular'.

Some of the confusion around what it means to popularise science stems from the inherent problems concerning what it means for something to be popular. As Stuart Hall has pointed out, some things can be popular 'because masses of people listen to them, buy them, read them, consume them and seem to enjoy them to the full.' Hall calls this the commercial definition of the popular to underline its connection to the market and 'the manipulation and debasement of the culture of the people' (Hall 1981: 231). This sense of popular usually leads down two roads, both unfortunate: either it takes the consumers of popular culture to be 'cultural dopes' who passively and uncritically swallow whatever popular culture they are fed; or it focuses on counter-cultures and argues that there are wholly independent and authentic forms of culture resisting the pressures of the cultural industries. 'The study of popular culture keeps shifting between

these two, quite unacceptable, poles: pure “autonomy” or total encapsulation’ (ibid.). Hall suggests that the problem arises since ‘we tend to think of cultural forms as whole and coherent’ when they are instead to be viewed as ‘deeply contradictory; they play on contradictions, especially when they function in the domain of the “popular”’ (ibid: 232).

As John Storey (2005) has noted, it is the quantitative dimension associated with the popular which accounts for many of the contradictions and problems inherent in the concept. The Latin *popularis* means to belong to the people, a commonality and quantitative character often put in opposition to quality. The large following of something ‘popular’ is taken to contradict any possibility of being refined or profound. Popular press is thought of as the opposite of quality press, popular culture is traditionally inferior to high culture or art. This quantitative dimension suggests that the popular as such lacks judgement: ‘Its audience is a mass of non-discriminating consumers.’ (ibid p.264). This idea can be found in popular science as well, as it is usually thought of as something other than and inferior to, science. Popular, then, is clearly related to ‘the people’ in some way, but it is not so simple that the two are interchangeable concepts. According to Hall, the popular is not just a way to try and form this concept of ‘the people’ whoever they might be, it is also the site of the struggle (Hall 1981: 235).

Following Williams, Hall and Storey we can thus think of popular culture as a field of meaning-making struggles related to larger groups conceptualised as ‘people’, ‘citizens’ or ‘Swedes’ for example. In this field, cultural forms engage in attempts to define, describe, distribute and market various ideas, ideals, artefacts and goods, one of which is science. Three themes have been of special importance in the analysis of these cultural forms thought of as popular. First is the issue of where popular culture comes from? Is popular culture something that rises up from ‘the people’ or something that is imposed on them from above? Second, the question of quality as opposed to commercial value, where scholars of popular culture have been concerned with the effects of the commodity form and whether or not it corrupts quality? And, third, the difficulty in trying to assess if popular culture is a form of indoctrination of the public,

or if it can be seen as an opposing force in its own right (Strinati 2004).

These questions cannot be settled in any general fashion, but they are, I suggest, useful for studying cultural forms. Are the popularisation efforts of the first Swede in space an attempt to compel a Swedish public into a more enthusiastic view of science and its ability to set the agenda for the future? Is the proliferation of new forms of addiction and new cures for them chiefly a scientific accomplishment announced to the public for their benefit, or a commercial exercise to profit from the good name of science, or is it both? The answers to questions like these will rarely be unequivocal but the study of examples can say something about science as well as the popular and the combination of the two.

Science in Popular Discourse

Public Understanding of Science scholars, government programs for the advancement of science, initiatives to recruit children to a scientific education as well as popularisers like Carl Sagan or Christer Fuglesang, all worry about the public as audiences of popularisation. Such a worry, I would argue, is very much in line with a conservative view of the popular as a problematic and tainting influence on an otherwise fine noble science. In order not to be dragged into discussions of to what extent publics do or do not ‘understand’ science, I have opted for a different approach to popularisation. The studies presented here at first sight might seem to have little to say about audiences or publics at all and that I have not bothered to measure public attitudes or understandings. But the audiences of popularisation always lurk in any analysis of it; they represent the great unknown, their (sometimes imagined) beliefs, attitudes and reading matter. They are the target of popularisation and are so usually labelled as the more or less ignorant, non-expert recipients of science communication. They are on the other side of the ever-present gap and popularisation purports to bring science to them. In the ‘deficit model’ account, they are in dire need of enlightenment. For Fleck, they supply epistemological confidence and for Gieryn, they form the basis for epistemic authority by being outside of the boundaries of science.

All these theories take for granted a sharp and clear-cut difference between scientific knowledge and popular culture. That science and public or science and popular culture are not the same thing is of course a banal observation, but the problem of where to draw the line in practice is nevertheless an awkward one. At what point does internal scientific communication tip over into popularisation, where can it be said to enter popular culture and discourse? Here one confronts the notoriously difficult question of the audiences of popularisation. Who the actual

readers and consumers of popularisation are cannot be said with any certainty, fellow experts read their colleague's popularisations (cf. Bucchi 1998), the so-called lay public often seem to pay it no attention at all, or the scientific information simply does not apply in any rational way to their situation or interest (cf. Irwin 1995: 90-91) and so on. Following Paul Ricoeur, we can note that the universal address of a specific work is in practice only potential. A work reaches its audience through socially permeated practices and mediums that delimit the potential audience. As such, the address of the work matters greatly, but the resultant readers remain beyond control. In Ricoeur's words the address 'is both universal and contingent' (1976:31). To define popularisation by its audience (actual or intended) is therefore very difficult. Instead of relying on the actual audience of popularisation, the act of popularising itself needs to be elaborated in relation to the audience it addresses and seeks.

Whitley argues that popularisation is a matter of degree and suggests two axis according to which it can be categorised, one being the amount of technical and formalised language, the other with what certainty claims are made (Whitley 1985). Hence, a text with a less technical and more certain tone is easier to identify as popularisation. Such a definition can be analytically applied to texts as such, regardless of who actually reads them. Less technical jargon means that the intended audience is non-expert in relation to the field discussed. One can therefore argue that the text is a popular one, even if it is in practice only read by other experts, or not read at all. Therefore the readers of popular science are thought of as unfamiliar with the issue at hand and popularisation tends to cast the reader in this role, discursively positioning him or her as less knowledgeable. As such popularisation can be contrasted with scientific discourse in that the former is meant to be inclusive where the latter is exclusive. The issue is open to analytical judgement based on the account itself: can this account be interpreted as aimed at a popular (as opposed to scientific) audience? If so, I would argue, it can be regarded as a popularised account regardless of how successfully it reaches this audience. It is the reconfiguration of scientific knowledge into other forms deemed more publicly available that distinguishes popularisation, not the success of that process. In Whitley's words: 'The transmission of intel-

lectual products from the context of their production to other contexts, then, seems to me to be the key feature of popularisation' (ibid: 12).

Texts, it is assumed here, are always written to be read. They contain a certain kind of address and hence a preferred reader. In narratology, this reader is referred to as the *implied reader*, as opposed to the *historical* or *actual* reader. With the distinction between the implied and historical reader, it is possible to argue that texts can be analysed as popularisations, even though their success as such can be difficult to determine. Jacob Lothe (2000), basing his argument on the works of Wolfgang Iser, pointed out that the implied reader functions in two ways in narratological theory, both of them important for the analysis of popularisation. First, the implied reader can simply be taken to signify the spoken-to reader, the preferred or intended reader to whom the text is addressed. In the case of popularisation, this would be someone outside the discussed field of expertise, someone belonging to the exoteric circles. Second, the implied reader also denotes the positioning of the reader through the narrative discourse itself. It is thus a position constructed by the text that shapes, but does not ultimately decide, how the work can be interpreted. 'The implied reader's activity is very much a structuring process' - one where the 'meaning of a text arises in *productive tension* between the role or model reader the text presents and the historical reader's dispositions and interests' (ibid: 19 italics in original).

An elegant use and development of the concept of implied readers can be found in Martin Barker's work on comics (1989). Barker suggests that the relation between a text and its readers can be thought of in terms of a contract that can be accepted, rejected or renegotiated in the process of reading itself. He presents his contractual concept as a way out of the overly simplistic theorising about the ideology and influence of media texts that shapes much of our cultural discussions. In a manner reminiscent of Hall and Williams' thinking on popular culture discussed above, Barker rejects both the idea that comics (and by extension also other media texts) are harmful influences, simply by portraying and glorifying violence or stereotyped femininity, as well as the counter argument that they are nothing more than innocent pastimes without any influence at all. Instead, he

claims that media texts are better understood in terms of suggestions to preferred readings. The power of the media then becomes wholly contingent on its ability to relate to the implied reader. Barker presents his hypotheses in three parts:

(1) that the media are only capable of exerting power over audiences to the extent that there is a 'contract' between texts and audiences, which relates to some specifiable aspect(s) of the audience's social lives; and (2) the breadth and direction of the influence is a function of those socially constituted features of the audience's lives and comes out of the fulfilment of the contract; (3) the power of 'ideology' therefore is not of some single kind, but varies entirely – from rational to emotional, from private to public, from 'harmless' to 'harmful' – according to the nature of the contract. (Barker 1989: 261 – italics in original).

In popularisation terms this contract can be thought of as suggesting, regulating and prescribing not just a reading but a social relation between expert and lay, science and public or esoteric and exoteric. In Gieryn's account (1983), this contract usually works by allowing the reader access to some parts of the expertise, while keeping others beyond his or her grasp.

Although it is one of the sources of popularisation, institutionalised and established science does not have complete monopoly on describing its own practices and knowledge (the LCHF and the writers of sci-fi can exemplify this). That popularisation to some degree and in many cases relies on scientific authority to gain credibility is not a good enough reason to define the practice of popularisation by its historical roots in science itself. For example, popularisation is not generally considered a prestigious activity among scientists who often willingly delegate the work of communication to various 'mediators' like information departments or journalists (cf. Nelkin 1987). The actual author of an unsigned press release on a piece of science news is usually not made clear. To what degree the claims made in such texts, or in news reports, have been made by the scientists themselves, the information department at their university or by the journalists reporting, is a typical source of confusion when opposing voices are raised in its wake. Further, the descriptions of science aimed at lay publics are often made in the form of oppositions, refusals or denials of scientific actors, developments or institutions. When, to give an example

taken from David J. Hess' study of sceptics (1993: 43-46), New Age writer Marilyn Ferguson accuses science in general of representing an atomistic understanding of nature which needs to be replaced by a more holistic approach, she is clearly representing science. However, her argument that the present day science should and will be replaced by a more holistic alternative emerging out of a 'Pacific Culture' with its centre in California has yet to be embraced by any significant part of the scientific establishment. Her writings could well be taken as a form of popularisation as she is depicting the science of today as well as making predictions on where it will be going in the future, complete with visions of new knowledge and technology. To rely on the origins of the science popularised leads further down the road that seems to have troubled Hilgartner in 1990, since it means that scientists (usually thought of as a homogeneous group) remain in a privileged position to judge what is appropriate popularisation.

Therefore popularisation, while being thought of as a bridge between science and popular culture, shapes and defines the two just as much as it mediates between them. John Storey notes regarding cultural texts that they 'do not simply reflect history, they make history and are part of its processes and practices and should, therefore, be studied for the (ideological) work they do, rather than the (ideological) work (always happening elsewhere) that they reflect' (1996: 3). The same is true for popularisation in relation to science as for other cultural texts in relation to history – popularisation helps shape the science it purports to portray as well as the public addressed. With science being such an influential force in our societies, it is perhaps to be expected that popularisation will predominantly be involved in its reproduction and reinforcement.

In his meticulously detailed ethnographic account of the production of a BBC science documentary in the 1980s, Roger Silverstone explicates this struggle between ideals of science and of popular culture in practice. Of special relevance is his description of how the popularisers are caught up in both a 'naïve empiricism' about their own ability to stay impartial that spills over into an equally naïve belief in the scientific method and a 'mercurial demand' to be fascinating and entertaining (Silverstone 1985: 11, 17-19, 103). Ultimately, however, the

demands of television and by implication popular culture, trumps scientific accuracy in Silverstone's account:

... the presentation of science on television to a presumed non-specialist and non-student audience involves major transformations and translations from one discourse, that of science, to another, that of television. ... it is television discourse which holds all the aces. (ibid: 163)

So in the end, Silverstone opts to give the right of interpretation to popular culture rather than science, but it is not an unqualified conclusion. For the popularisers to have any authority and perhaps even more importantly not to be shut out of the fields they mean to portray, they are 'entirely dependent on the goodwill of the scientific community.' (ibid: 166). While the scientists are crucial for their connection to knowledge, truth and expertise (and as Hilgartner pointed out can judge the popular accounts on that basis), the popularisers, by virtue of their ability to relate the science to an audience and make decisions based on their tastes and behaviours (accurate or not), ultimately decide on what is and is not good enough for the audience to see.

The point of this is, of course, that while the 'dominant view' holds that popular science is diluted science and that it emerges from within science, the representational tools are rarely exclusively in the hands of scientists. The influence of the experts over the popular portrayal of their expertise is usually negotiated in the process of popularisation; sometimes to the point where popular accounts can no longer be said to emerge *from* science at all, but are more accurately described as replies, rebuttals or alternatives to that expertise – as will be exemplified in the study of Swedish low-carb dieters.

Methodological Consequences of Contingency

From the perspective sketched out here, combining insights from Cultural Studies and Science and Technology Studies, a number of methodological concerns can be deduced. Some have already been mentioned, like the strategic use of the principle of symmetry, the view of texts as mediations between authorial intentions and lived cultural experience and the need to examine science popularisations as attempts to define and delimit science from other forms of knowledge. A few of the pitfalls to be avoided have been pointed out, like the unfortunate tendency to ascribe deficient scientific understanding to 'the public', the problems connected with working with singular and universal concepts of science and public and the risks of viewing science popularisation as always stemming from within the established sciences. In the kind of analyses of cultural texts performed here, theoretical perspective and methodological practice are intimately linked. Thus this section aims to make clear how the theoretical and empirical merge in analysis to account for science popularisations as cultural phenomena.

In the wider sense, my project aims to combine Science and Technology Studies with Cultural Studies to configure an analytical perspective that can account for and describe the co-dependency, contingency and the articulation of science and popular culture in specific cases. Among STS-scholars, popularisation has often been taken as a form of scientific activity which, while being viewed by many as external and of low status, remains crucial for the overall ideological work of maintaining scientific legitimacy. But as I have argued here, popularisation is more than just an ideological moonlight business for established science. In arguing for a step away from accounting

for the legitimacy of science, Joseph Rouse, to name just one example, has argued that STS has much to learn from Cultural Studies (1996). His point is that both STS-scholars, who are typically (social) constructivists and philosophers of science, who Rouse characterises as more realist, have become too tangled up in arguments about the referentiality of science and preoccupied with accounting for its privileged standing in contemporary society, either by reference to its social power or its ability to unveil nature. While this issue is a relevant and important one, Rouse suggests that it leads to a preoccupation with issues of representation, the accuracy of scientific content and questions of science's legitimacy.

What can be learned from Cultural Studies in this regard is the value of a closer examination of scientific meaning. Instead of approaching science from the outside and try and account for its legitimacy, such a project would, Rouse argues, be less prone to granting science 'epistemic sovereignty' from the onset. Instead a study of science based on the study of culture would ask for the meaning and significance of science. Meaning and significance are of course issues since long central to Cultural Studies and although I find Rouse's description of STS research as lacking in this respect somewhat exaggerated, I sympathise with the general idea of approaching science as just another, admittedly central, form of cultural expression. Rouse also argues that the idea of science as *one* is just as inappropriate as talk of *one* western or national culture. Such characterisations are made continuously and are sometimes warranted. But as argued by cPUS proponents like Wynne and Irwin science, as well as culture, is multifaceted and local, while scientific discourse often strives to establish itself as global. The cultural study of science thus has to be careful of how it talks of science as a global or universal concept.

In the studies presented here, science as a cultural idea with global characteristics is an important component. "The First Swede in Space" argues for science as an undivided and single good, the Food Fighters argue for a similarly universal idea of science that has been corrupted by a dietetic establishment and so on. Much of the point of these studies is to show that pure science as a general concept is nowhere to be found; it has to be made and given meaning in relation to other cultural concepts

and aspirations, like a nation supposedly losing scientific interest for example. It matters greatly if a study like that of the first Swede in space takes scientific legitimacy as its starting point or if it asks for the meaning of the popularised science first, thus approaching the question of legitimacy from a cultural perspective. The point is therefore not that legitimacy is a moot question, but that it is an unfortunate starting point for analysis.

Donna Haraway has outlined a similar project. In her book *Primate Visions* (1989) and much of her subsequent work, an interest in the meanings of science in contemporary cultures has been central. Constantly curious about the shifting meanings of science in various discourses and contexts, Haraway practices a style of analysis that draws on many and diverse empirical, political and theoretical sources, juxtaposing them to make them contrast and complement each other in surprising and illuminating ways. In *Primate Studies*, monkeys, apes and humans make up a family of species saturating scientific, technological, popular and political discourses. Her analyses circle around the primates as a thematic centre and she is able to discuss them as useful metaphors with a much more significant and contestable cultural importance than as 'merely' natural objects for specific branches of anthropology or biology. My point is not to dwell on the primates however, but to discuss the possibilities of thematic studies of science and culture.

Where scientific realism and universal perspective leads to troubling questions of representational accuracy, a cultural focus and constructivist methodology instead asks different questions, but it also leads to other problems. With such a strong insistence on contingency, interpretation and contextual dependency, the most prominent methodological problem for constructivist studies of the ilk practiced here is that of unchecked relativism and the allegation that no knowledge of anything would be possible should the constructivism be taken literally. When subjecting the work of others to constructivist criticism, it might seem difficult to argue the relevance of the critique itself. One way to answer this problem is to brush it aside by noting that all methodological stances have their difficulties – for a realist methodology, the corresponding problem is that of the inability to ever guarantee the accuracy of representation – and then simply go along with business as usual. However, this seems too casual a stance to

take. The problem is that constructivism taken seriously seems to become nihilist and thus realism has a tendency to enter into constructivism unnoticed as constructivist epistemologies are only applied to others and never to oneself (Woolgar 1983).

This problem (Woolgar goes so far as to refer to it as ‘the Problem’) is easier to describe than to solve. Indeed, I find it might even be more constructive as a problem than any solution would be. It is related to the obsession with representational accuracy outlined above. According to Woolgar, there are three main ways to think about the relation between the world and accounts of the world. The first one is ‘reflective’ (that is realist) and holds that representation is indeed a more or less accurate description of something actual. The second one is ‘meditative’ and holds that all accounts are ‘*underdetermined* by the facts of the natural world.’ For this view no description can ever be accurate enough and several descriptions are always possible since there is no such thing as unmediated and ‘untainted’ representation. This category is where most constructivist thinking can be found. The third category is less common but nonetheless argued from time to time. It presupposes that the world is instead constituted by accounts. In Woolgar’s words: ‘In this view there is no a priori distinction between accounts and reality, ... the accounts *are* the reality; there is no reality beyond the constructs...’ (ibid. 242-246, italics in original).

While it would be possible to argue that the third position is the most stringently constructivist, Woolgar’s main discussion concerns the second position: if we are truly constructivist, how can we then argue that one description is more accurate than its alternative, are they not all equally valid or invalid? This tends to lead, again according to Woolgar, to ironic writings which work by juxtaposing one account of reality with another, a move that is difficult to justify with a constructivist epistemology.

A similar description of how constructivist studies tend to be epistemologically contradictory can be found in Hacking’s aptly titled *The Social Construction of What?* (1999). According to Hacking, most constructivist studies are not properly constructivist in any philosophically stringent way. Instead, they typically take issue with selected issues commonly thought of as more or less natural or stable and strategically apply a constructivist methodology to them in order to show how they could and

usually should be different from how we view them today. Hacking has much to say about the use of such a strategy, but I find such strategic uses of constructivism to be a productive way to handle 'the Problem'. They may lack clear-cut answers to epistemological problems and they may invite a kind of everyday realism in through the backdoor, but they have one advantage: they can do so openly and thus be held accountable.

Returning again to Haraway (1988), she has argued that the study of science needs a far more contextual, or rather situational epistemology, in order to maintain the advantages of constructivism. To move on from the fruitless discussions about universal scientific accuracy vs. equally universal deconstructions of any and all knowledge claims (i.e. unchecked relativism), Haraway argues that science studies should be intensely particular. Again, this is not an argument against objectivity as such, but a reversal of where knowledge production can and should start.

Instead of relying on universal scientific objectivity to explain particular examples, both science and culture could be better understood as emerging from the particular and then achieving what might look like universal truth, masking much of its particular and located history along the way. It is in this denial of its particular origins that universal science fails. 'Objectivity' becomes problematic since it is presented as without origin, history or context. This kind of objectivity and denial of any form of reliance on situation, practice or circumstance for properly scientific science is what makes critical deconstruction of knowledge both interesting and possible; to find the specific, social, cultural or personal behind scientific facts is a worthwhile enterprise because official discourse takes for granted that scientific objectivity means precisely that no such thing should affect knowledge.

But to Haraway, whose feminist project is reliant on being able to argue that some accounts of the world are actually better than others, the alternative to universal objectivity cannot be all out relativism. Instead, she argues that situated objectivity, tied to a particular perspective, makes for more accurate knowledge since it is accountable and thus responsible in a way that universal objectivity is not. This situational epistemology, where scientific accuracy is a result of negotiating the particular into

something of wider relevance, can, of course, be linked to thoughts like Kuhn's notion of paradigms and Fleck's view on facts already discussed.

Situated knowledge seeks validity by aiming to be relational and particular rather than universal. It means that science must be understood as local and that the analysis of science must pay attention to its cultural context. Furthermore, when it comes to learning from the pioneering STS 'laboratory studies', few would have missed that great emphasis is placed on and ample illustration supplied of how knowledge emanates from localised and highly situated practice. The laboratory in this respect can be viewed as a place for locating objects, theories and techniques in such a way that accounts of them can be made (cf. Latour and Woolgar 1979/1986, Traweek 1988). Specifics and local conditions thus matter greatly for natural as well as social and cultural sciences and how one approaches problems can never be innocent. Instead, the argument must be as clear as possible about why and how science constructs its cases and draws its conclusions.

This local character and situational dependency of knowledge and claims to accuracy matter greatly as a methodological stand for the studies presented here. Not only have I tried to be clear about the theoretical perspectives from which interpretations are drawn and why questions have been raised, but also how location matters greatly as an analytical theme in itself. This is evident, for example, in the focus on practices of witnessing in the case studies. Witnessing is a practice that brings the location (both physical and social) and the situation of the witness to attention (Peters 2001). Thus 'The First Swede in Space' does not primarily ask about the accuracy of Fuglesang's statements about science, but how he has managed to obtain a position from where those statements can be made and heard. Similarly, the articles about the low-carb movement and the nicotine replacement advocates are both interested in how they position and manoeuvre in order to locate themselves as credible spokespersons for their cause in their respective contexts.

This translates into a perspective on science popularisation that is explicitly interested in it as a cultural practice of wider significance than, but not excluding, that of establishing and defending scientific legitimacy. Popularisation is performed, as I

have repeatedly argued, in a discourse fluctuating between esoteric and exoteric demands. As Mulkay, Potter and Yearley (1983) have argued, to examine particular discursive practices and patterns and suspend the grander issues like whether or not they are scientifically accurate and epistemologically solid enough, is a methodological strategy that while being less bombastic in its claims, might be more enlightening in its detailed study of practice. To examine the image of science in popular culture, I have therefore chosen cases that range from more a conventional style of popularisation, to examples that sit more uncomfortably with a commonsensical understanding of the term. They have been chosen to explore science popularisation as a broader concept than usually proposed and they have been chosen in no small part to represent contemporary and (locally) well known discussions on science.

Therefore, by carefully situating both the studies as they are made and the objects of those studies, epistemological problems are perhaps not resolved (at least not in any general way), but they are nonetheless acknowledged and discussed. For this reason, case study design becomes crucial for the kind of work I have undertaken here. The studies that follow carry with them an assumption of saying something about science and popular culture through detailed accounts of examples. They are also analyses of various forms of texts: books, newspaper materials, websites and various broadcast materials to name the most prominent sources. The studies are based on the claim that cultural products relate to the society in which they are produced and tell us something about it.

For qualitative research, the case study is important since it gives the researcher a chance to set up bounds within which larger cultural and societal currents can be studied in their particularities. A classic example that is enlightening in this context is Brian Wynne's study of Cumbrian sheep farmers (1996a, 1996b). Wynne's study follows the events in Cumbria after the radioactive fall-out from Chernobyl hit the area in 1986. Of particular interest to Wynne is the relationship between scientists and sheep farmers that became increasingly tense as various restrictions were placed on farming in order to limit the damage done by the fall-out. The restrictions seemed, to the locals, to be arbitrary and lacking in understanding for the practicalities of

sheep farming. Overly confident statements from scientists that they subsequently had to change only increased the lack of trust. By contrasting his case study of how various forms of knowledge collide and confront with the public understanding of science perspective promoted by the Royal Society, Wynne is able to use his example to show how the 'deficit model' fails to understand how science is locally and culturally negotiated and how scientific expertise is often ill prepared for such confrontations with local knowledge and expertise.

By detailed analysis and discussion of the particulars of this one case, Wynne can not only add to some of the questions asked by public understanding of science proponents like the Royal Society, he is also able to go beyond those questions and discuss the relevance of such a perspective, the foundational assumptions supporting it and its ideological functions.

In similar ways, other scholars have used case studies to question how we understand laboratory work (e.g. Latour and Woolgar 1986, Traweek 1988), medical research (e.g. Epstein 1996) and technical development (e.g. Bijker 1995), to mention just a few examples of influential case studies in the STS field. Case studies are important since they can provide both detail and depth, something of utmost importance to anyone subscribing to a view of both culture and science as specific and contextual human thought and activity. Case studies, therefore, are best suited to show and illustrate the general by careful attention to the particular; although rarely definitive in their answers or conclusive in their descriptions of overall patterns, they can be very enlightening through their ability to show how cultural, social or scientific ideals, thoughts and knowledge play out differently in different contexts (cf. Flyvbjerg 2006).

The epistemological loyalties of case studies are usually twofold. Firstly, they need to be sensitive to the internal cultural dynamics of the case itself. This requires an interest in the self-understanding of the actors involved and their way of thinking and arguing. The first step in any case study is therefore to familiarise oneself with the case itself. But the wider relevance of case studies springs from their ability to contextualise the case in one way or another. A case study draws its wider significance by relating the case to more general phenomena, by aligning or contrasting it to theory, previous research or

literature for example (cf. Stake 1995). As I hope has become clear by now, I have attempted to read my cases in light of, and in relation to, science popularisation – understood as a mediating practice attempting to handle the paradoxical relation between discourses of science and discourses of popular culture. In order to handle the methodological difficulties of doing case studies, I have thus attempted to firstly be attentive to the cases in their own right, meaning that I have tried to understand them in some depth and by their own rules. For example, by paying close attention to the writings, discussions and understandings, characteristic of the LCHF movement in their own discourse and meaning makings. But it is in the second step of creating tensions between the case and other contexts that the cases gain wider significance. In relating the discourse and rhetoric of the LCHF movement to scholarly work on science popularisation, the case, hopefully, becomes something more than just an in-depth description of a dieting and public health movement. This step is where both theoretical significance and methodological problems of interpretation emerge more conspicuously and it is difficult to resolve this tension by reference to any general rule or theory. Instead, it could perhaps best be understood in terms of a trade-off between insight and interpretation; if the compromise is a fair one must ultimately be decided by the reader in each case. I do not say that in order to escape responsibility for the conclusions and suggestions made here, but merely to say that while I stand by them and argue that they are indeed relevant, I still recognise that the ultimate right of interpretation lies with the reader (see also Ricouer 1976 and Barker 1989 on the co-dependence of author and reader).

Besides being case studies, my studies are also textual studies in a wider sense of the term. They take as their empirical base mediated material of various kinds – from newspaper articles, novels and films, to web forum discussions and dieting books. As such they are interested in what Williams called recorded culture (1961: 62), that is, the traces made by cultural processes as they take place, rather than the lived culture itself, which would require another set of methodologies. Most of the methodological issues related to the study of recorded culture and textual analysis have been dealt with above in my discussion on audiences and popularisers. To reiterate, the kind of textual ana-

lyses performed here take texts to be open to interpretation, yet interpretation is never arbitrary. I have suggested that concepts like ‘implied reader’ and ‘reader contracts’ are ways to understand the complicated process of textual analysis as it is performed in relation to the text itself and its contexts. Methodologically, this assumption means that my readings of texts and my drawing together of texts into ‘cases’, are choices that must be argued for on a case-by-case basis – since other readings and connections are always possible. Thus my argument that all the studies here are readings of texts as examples of popularisation hinges not on their being naturally so – indeed many of the texts analysed can and usually will be read as something else – but on whether the reader can agree with my assessment that treating the cases as popularisations is a fruitful strategy. That is the methodological rationale behind the studies that make up this book, not to argue that these cases are in and of themselves natural cases of popularisation, but that it is a valid and interesting approach to analyse them *as* such.

A good case study is thus theoretically located and supplies an empirical anchor to interpret, contest, illustrate, expand or discuss that theoretical framework. It is thus never final or complete in its analysis, but rather works as a way to discuss theoretical and empirical issues in tandem. The case studies in my work are chosen to perform theoretical work and the theoretical is by the same token meant to (re-)frame the cases in illuminating ways. In selecting cases, I have attempted to find contemporary examples, for which the idea of extending the popularisation concept has been my guide.

Conclusion – Configuring Paradoxical Science Popularisation

Before dealing with the case studies one by one in light of the thoughts presented in this introduction, some general conclusions can be drawn. My ambition in this introduction has been to expand our understanding of what can be regarded and understood in terms of 'science popularisation'. I started off by summarising the 'deficit model' and 'the public understanding of science'-project as an unsatisfactory way to think of science in popular culture. While I was careful not to jettison the knowledge gained from that perspective, I nonetheless allied myself with a number of critics arguing that PUS thinking tends to misrepresent both science and public by its focus on rectifying various deficits. Instead, my perspective argues that science popularisation can be better understood as a process of mediation trying to resolve and handle a fundamental incongruity, that between the narrow appeal to properly scientific discourse and the broad appeal of popular culture. I have presented various ways to view the mediation between science and popular culture and in doing so, I have argued that popularisation is a concept that can be fruitfully applied to a wide variety of practices and cultural phenomena. The tension created by the urges to reconcile science and popular culture is a creative one. I view both science and popular culture as contingent phenomena, thereby making science popularisation a much more contextually dependent practice than a traditional PUS perspective admits. The cases analysed here can be viewed as attempts to handle in practice the perceived paradox of scientific knowledge and popular culture. Throughout this introduction, I have presented a number

of ways in which this balancing act has been approached theoretically, from the allocation of deficit understandings to various actors and groups, usually in the public realm (cf. Michael 2002), to subsuming science to the logics of media production (as in Silverstone 1985).

Most of these configurations of science and public can be fruitfully understood as attempts to resolve or handle (however temporarily) the paradoxical discourse of an unscientific, or less scientific, science for public consumption. All these have political implications, usually granting right of interpretation to actors and groups who can successfully claim to be scientific. Epistemic authority, then, seems to be a result of successfully configuring this popularisation discourse so that science ends up on your side of the equation. In the end, few popularisations seem to challenge science as the source of knowledge in general, but can indeed challenge particular practices or actors as less scientific than they claim. It is in this light that the case studies should be read – they are examples of particular configurations of the paradoxical relation between discourses of science and popular culture. From the attempts of the first Swede in space to re-establish science as the guiding force for a prosperous future, to the utilisation of scientific imagery of fictitious narratives to construct semi-credibility, science are both means and end in these cases that I have chosen to view as science popularisations.

My aim has not been to argue that work on the 'dominant view' or 'deficit model' variety are invalid or flawed, but that by placing science and the scientific institutions and actors themselves as the source not only of scientific content and knowledge, but also of popular accounts and representations of science, these perspectives become somewhat self-referential. The dominance of science over popularisation as described by Hilgartner is accurate for certain, but by assuming that popularisation emanates from science, it misses out on the examples that help to make the picture more blurred and less 'dominant'.

The same is true, in my view, of the 'deficit model' as a model of how well publics measure up to intra-scientific demands on what constitutes scientific knowledge. It may well be, as far as I can judge, an accurate description. But when it comes to understanding the relation between lay publics of various

kinds and equally equivocal sciences, it fails to conceptualise that scientific knowledge is not something that can just simply be diffused to and subsequently held by such audiences. Instead, I have argued for an examination of popularisation as a process in which science is represented and negotiated, in and through popular culture. A process that needs to be investigated from a vantage point that takes both popular culture and science to be contingent phenomena given meaning through popularisation, rather than inherently beneficial scientific knowledge being corrupted by acts of simplified communication. To make sense of this process, I have argued that science popularisation could be better understood as attempts to configure the incongruent relationship between science and popular culture in various ways. And further, that these configurations can be analytically located as at a varying distance to the esoteric demands of the represented science; thus my presentation of the cases as located in expanding exoteric circles, ranging from those closely allied, to the esoteric to those more concerned with exoteric appeal. Whether I have been successful is not for me to judge, but I hope that the case studies demonstrate that 'dominant view' popularisation is surely alive and well (as in 'The First Swede in Space'), but that such popularisations lives side by side with other forms of representation of science in popular culture (like the fictitious uses in *Genetik i fiktion* and the 'anti-establishment' popularisations of the LCHF dieters).

The Case Studies

The case studies are firstly meant to be read as individual studies that can stand for themselves. But given this introduction, they can also be taken as attempts to widen the circles of science popularisation in various directions.

The studies taken together represent science as presented in various ‘exoteric circles’. I have chosen to present them here as starting fairly close to some kind of esoteric centre and then moving further and further away from the ‘dominant view’ or ‘deficit mode’ popularisation towards increasingly popular or exoteric circles. The four texts thus tug at the theoretical perspectives sketched out in this introduction in various ways: (1) ‘The First Swede in Space’ attempts to illustrate and discuss the merits of ‘dominant view’ popularisation and link it to other culturally strong ideas about both science and public. Among these ideas, three especially interesting ones are given analytical priority, that of (a) the problems of a technological dependency that the astronaut attempts to resolve by exemplifying the benefits of willing submission, (b) dreams of transcendence, both physical and mental, which are both a condition for the point of space travel and universal science alike and (c) themes of unreflective and banal nationalism, serving to both make the achievement of Fuglesang noteworthy by virtue of his nationality, while simultaneously connecting him back to an imagined commonality with his audience. All these themes are then read as attempts to establish him as an especially suitable spokesperson for science and the benefits of a scientific society. (2) The second article, ‘Food Fight!’, by contrast, tries to show that the ‘dominant view’ mode of popularisation is not unequivocally working on behalf of established and consensual science. Instead, we argue that ‘dominant view’ popularisation by its categorical statements of scientific accuracy opens up possibilities for dedicated actors to publically challenge scientific con-

sensus for not living up to its own standards. This does not necessarily require a settled and complete alternative, but can be accomplished by working in the ‘downstream’ waters of conventional popularisation. (3) ‘The Advanced Liberal Logic of Nicotine Replacement’ carries on with the theme of challenging established scientific consensus. This study is more historical (or more accurately genealogical) than the others and details the public repercussions of the successful attempt to establish smoking as a problem of nicotine addiction. The public and popular results of this redefinition of the problem include commercial opportunities for the pharmaceutical and the tobacco industries, redefinitions of what it means to be an addict and new tools for self-diagnosis. As such, the redefinition of health has been far more successful for those arguing that smoking is a problem of nicotine addiction than it has been for the low-carb proponents and they have also handled their attempts at rearticulating public health problems differently. (4) *Genetik i fiktion*, finally, splits with the realistic ambitions of the other popularisers I have studied to examine how science (in this case genetics and gene technology) supply meaning making material for cultural production seemingly far from any sanctioned or intra-scientific discourse.

Case 1: ‘The First Swede in Space’ – Exploring the Dominant View

The first of the following texts deals with the popularisation work of a Swedish celebrity. The status of Christer Fuglesang changed dramatically when he became the first Swede in space in December 2006. The many postponements of his flight that occurred after he was announced as Sweden’s first astronaut in 1992 had earned him a national reputation as the astronaut who never went into space. He had been ridiculed on television and still a few days before take-off news journalists wondered whether he was actually going to lift off this time or not. But with the launch, Fuglesang was embraced by media, government officials and scientists of various backgrounds and quickly became the public face of Swedish science – a role to which he seemed to have no objections.

The case of the first Swede in space is the most obvious example of a ‘dominant view’ styled popularisation of those presented here. It shows how the role of scientific hero is achieved by adapting to scientific ideals, which are then further diffused through the popularisation work of the astronaut himself. Among the insights relevant for a discussion on popularisation in general, I would like to emphasise that the mediation between the exceptionality of scientific knowledge, technological achievement and the personal qualities of the astronaut on the one hand and the imagined ordinary frame of reference of the implied readers. To make the popularisation successful, it seems, the astronaut needs to be depicted as both exceptional and mundane, he needs to be a bridge over the science-lay gap in order to make science and technology seem at once extraordinarily good, achievable and relevant for all.

In Fuglesang’s popularisations, the gap between being in space and remaining grounded double for the gap between the scientific topic and the implied readers. Fuglesang’s travel into space becomes a theme symbolic of how his experience differs from those of the readers; the theme of the popularisation is aligned with its narrative form. The exceptionality of Fuglesang’s experience of space flight and of seeing the earth from the outside becomes central since it sets aside a privileged position achievable solely by scientific and technological means. This exceptionality gives the astronaut not only a privileged position and experience; it also qualifies him as the maker of authoritative statements detailing this experience to the public – i.e. an ideal constructor of ‘dominant view’ popularisation.

Still, this exceptionality runs counter to the inherent goal of ‘dominant view’ popularisation, to not only portray science as epistemically and technologically successful, but also publicly relevant and even enjoyable. For ‘dominant view’ popularisation, this contradiction is chronic, the representation of science as an epistemic authority for a large and ‘non-discriminating’ public means that the goals of being superior and folksy coexist. It seems difficult to resolve this contradiction, it is inherent to the ‘dominant view’, but it requires mediation. In this case, it is made by emphasising the mundanity of Fuglesang in the non-scientific parts of his life. The depiction of Fuglesang frames him as a national figure of importance by using banal, everyday

markers of national belonging (Billing 1995). Still, this image probably says more about how his implied audience is imagined than about how he (or they) lives his everyday life. It clarifies how science is supposed to be a part of everyday identity, as Sweden reclaims an allegedly lost (or at least threatened) position as a scientifically leading nation. Just like Fuglesang, his readers are encouraged to continue their everyday lives full of elk meat and ABBA tunes, trusting that science and technology can and will solve present-day problems and create exciting paths for the future.

Thus, the reader contract (Barker 1989) suggested by Fuglesang's popularisation work calls on the reader to recognise a shared background and cultural belonging with the astronaut through the use of various banal and everyday markers, but also to marvel at his transcendence and the role played by science and technology in creating the wonders of space flight. This mediating between the banal every day, supposed to relate to the implied reader and the privileged position of science, carves out a 'dominant view' ideal of science as something to be admired at a distance. As such the study of the first Swede in space reinforces the image of popularisation as a means for strengthening the epistemic authority of science by creating a gap between science, always happening elsewhere and suitably popular depictions of it for an ignorant public. The implied reader position of Fuglesang's writings is very much in line with the 'dominant view', his writings have very little to say about scientific content, fact or practice, but significantly more about science's social importance, achievements and the individual benefits available to those willing to dedicate themselves to science.

Case 2: 'Food Fight!' – Counter-Popularisations of High Fat Dieters

A first step away from 'dominant view' popularisation is made in the second article on the counter-popularisations of a Swedish group of High Fat Low Carb (LCHF) dieters. This article was written together with Mark Elam, with myself as lead author. Where Fuglesang was popularising from a position firmly estab-

lished and sanctioned by scientific institutions in Sweden, no such blessing has been given to the LCHF movement. As a movement, the LCHF is interesting because they are related to a fairly well known and familiar international phenomenon of low-carb diets, the most notable being the Atkins diet. But the Swedish variant has made the opposition against established dietary expertise and general recommendations a much higher priority than most other similar movements. The LCHF article illustrates how scientific authority and influence is not necessarily a prerequisite for popularisation. The LCHF movement instead use popularisation as a means to compensate for their lack of 'upstream' influence.

Interestingly, this is not coupled with a critique of established scientific imagery, instead the scientific ideals of the LCHF movement and those of the popularisations of the first Swede in space are remarkably similar. The strategy is one of reinforcing established and almost trite ideas of what science is and should be. Then the low-carb popularisers can compare this idealised notion of scientific certainty to the dietary recommendations given to the public, to the scientific base of those recommendations and to the conduct and history of the individual experts supporting them. This comparison, unsurprisingly, does not come out in favour of established dietary science and recommendation. So by utilising the simplifications so typical of popularisation and by turning them around, the LCHF movement manages, at least to some degree, to undo the epistemic authority of contemporary dietary science by framing it as an unfortunate exception from and corruption of sound science.

Instead of relying on the authority of the esoteric circle, LCHF suggests that dietary science has been corrupted. The contract with the reader that they present is one of two parts; first, it invites the reader to doubt the quality of current recommendations and expertise, by suggesting various forms of foul play and unscientific practice by the establishment. Then the reader is more humbly invited to try the LCHF alternative, launched not primarily from an esoteric ivory tower, but presented instead as a practical solution, which, while lacking scientific underpinnings, works in 'real life'. The contract of LCHF thus trades esoteric authority for exoteric, by inviting the reader

to contrast theoretical and aloof science with actual and everyday experience.

It is clear in the case of LCHF that popularisation, in the sense of a representation of science aimed at a general and non-expert audience, does not have to emerge out of established science. It can just as well be used to criticise ‘upstream’ science and open up for alternatives. In addition, the LCHF also utilise popularisation to build alternative forms of authority.

Case 3: ‘The Advanced Liberal Logic of Nicotine Replacement’ – Restoring Reason

The third article started as a spin off from my work on low-carb dieting and Mark Elam’s scholarly interest in the Swedish tobacco product *snus*. They both detail attempts to authorise alternative knowledge on health as a viable and credible science. One has been more successful than the other; one has worked mainly in established science, the other against it. Both have also worked with a direct form of witnessing and corporeal self-knowledge, since nicotine replacement and low-carb dieting have both become interesting fields for their proponents, firstly by practising them individually as experiments.

Like ‘Food Fight!’, the third article included here is also one that was co-authored with Mark Elam, this time with him as lead author. The primary theme of this article is not popularisation, but rather the various attempts to handle the problem of smoking related illness in an advanced liberal society. Since such a society places strong emphasis on the freedom of its citizens to exercise free choice, it becomes highly problematical when these choices harm them. While there is no shortage of restrictions on smoking in Sweden, the country’s main contribution to dealing with the smoking problem is arguably the invention of medicinal nicotine replacement. Emerging from *ad hoc* experimentation practices not unlike those of the LCHF dieters, a group of Swedish, British and American researchers managed to link smoking as a habit to the addictive properties of nicotine. Thus the stage was set for the idea that while smokers smoke to get their nicotine, the health risks are associated with the other com-

ponents of cigarette smoke; if smokers could get their nicotine in a clean and effective way, without exposure to smoke, their health would improve dramatically.

From a popularisation perspective, nicotine replacement is especially interesting, as an attempt to make esoteric science publically available. Not only commercially and through health promotion, but also, significantly, as a way to make the irrational more rational. Where the LCHF movement argue that the National Food Administration is undermining the public's ability to make rational choices by promoting corrupt science, clean nicotine deals with the problem of rational choice by trying to cure a misguided public led astray by a deadly appetite for cigarettes. Both the LCHF movement and the proponents of nicotine replacement attempt to restore rationality by reinstating their version of science as the guiding force for civilising the irrational. In this context, self-diagnostic tests like the Fagerström Test for Nicotine Dependence, and products promising clean nicotine delivery, function as mediating tools for diffusing the science of nicotine replacement to the irrational smokers, promising to bring them back to rationality.

While the article primarily details the more esoteric moves and debates of this development, it is also made clear how this is related to exoteric developments promoting a new kind of self-understanding to people who can now identify themselves as addicts in a new way. The article addresses how the esoteric construction of smoking as a nicotine addiction is made exoterically attractive by inviting new understandings of behaviour and responsibility as well as ways of handling addiction as a problem that everyone can potentially confront in many aspects of everyday life. By offering consumers the choice to handle their addiction rationally, nicotine replacement products function as popularisation tools diffusing a particular form of scientific-based consumption in society. Self-diagnostic tests and nicotine replacement products thus provide tools to handle your addiction in a rational way based on scientific knowledge. They are truly civilising technologies promising to bring uncivilised, irrational smokers back to reason and a healthy mind and body (Vrecko 2010).

The various nicotine replacement products and the associated marketing and diagnostic techniques serve as an interesting

counter example to the LCHF case: where nicotine replacement and low carb dieting have similar origins in the idiosyncratic practices of individual doctors struggling to make their observations scientifically valid, proponents of nicotine replacement have taken the long and arduous road of esoterically settling and stabilising their claims while ‘going public’. The two cases thus start off in similar practices, but the actors have chosen different means to build public credibility.

Case 4: ‘Genetics in Fiction’ – Popular Uses of Science

Even though the articles included here all deal with representations of science made with claims of accurately depicting actual science, the cultural study of popularisation does not necessarily require the analysis to end there. I have previously worked with analysing fictional uses of genetics. This study could also be reframed according to the paradox of popularisation and included as another example of how science is portrayed in publicly directed descriptions. The point of such a manoeuvre is that popularisation as a concept is useful when it can say something about the cultural significance of scientific representations in societal contexts larger than the scientific institutions themselves. That significance does not stop at a line in the sand where fact ends and fiction begins; Sarah Shieff has noted that ‘fiction and nonfiction can be mutually enlightening in approaching these insidious and pervasive problems: looking across the genres, it is possible to see their connections through a relatively consistent range of preoccupations’ (Shieff 2001: 216).

The work on fictitious narratives was published in Swedish in 2006 under the title *Genetik i fiktion* (*Genetics in Fiction*). It addresses four narratives, two movies and two novels, as examples of how the new biology of genetics and its accompanying field of gene technology have been used as narrative devices and depicted in various ways in order to assist in the construction of fictitious credibility. As a point of departure, the seeming contradiction between science and fiction is used to argue for an

understanding of science as a cultural phenomenon larger than a simple provider of knowledge in need of appreciation. Instead, I argue that the study of science as a fictitious theme or function is useful, because it shifts attention away from public misunderstandings toward science as a resource for the construction of meaning.

The four narratives chosen for the study are: Margaret Atwood's novel *Oryx and Crake* (2003); Swedish writer P.C. Jerild's novel *Geniernas återkomst* (*Return of the Geniuses* 1987); Andrew Niccol's film *Gattaca* (1997); and the movie *Hulk* (2003), written by James Schamus and directed by Ang Lee. Chosen for the various uses of genetic imagery and thematics, the narratives are not analysed in their entirety as they would have been if subjected to film or literature studies. Instead, it is the fictitious utilisation of genetics that is the focus. A number of narrative functions were identified based on the inherent cultural dissonance between scientific knowledge and narrative fiction. The narratives take advantage of the double image of science and technology as on one hand realistic and hence related to factual and certain knowledge and purposeful manipulation of nature, while on the other hand, marvellous and fantastic in their ability to make the unbelievable believable and the unlikely real.

Genetics turn out to be a useful theme for the production of meaning in fictitious narratives. Its status as a 'science of life', decoding and manipulating the very conditions of life itself, is a powerful cultural theme in itself. The contemporary feel of genetics and gene technology further enhance the sense in that they open up new and wondrous possibilities and risks for the future. In one of the narratives analysed, the movie *Hulk* from 2003, this is made evident when compared to the first original story of the Hulk in 1962. In 1962, the Hulk came into being when Dr. Banner was exposed to vast amounts of radiation from a nuclear blast. This transformation process is given an alternative genetic explanation in 2003 as this more contemporary science provides a more 'believable' narrative explanation for the presence of a green giant. Arguably, the radiation science of the 1960s now lacks the exiting potential that genetics have in the early years of the 21st century. It is a form of narrative credibility reliant not on actual realism – no one is supposed to actu-

ally believe that a Hulk can be created in the way portrayed in the film – but on narrative believability based on uncertainty. Radiation today signals certain risks rather than uncertain rewards. Therefore, within the narrative universe of the film, genetics has a potential that has not yet been corrupted and disenchanted, a combination of its ‘code of life’ image and its contemporary feel.

Viewed as a form of popularisation, the fictitious narratives can be said to exemplify a different use of scientific imagery when compared to the other cases. The purpose of the fictitious narratives is not primarily (or at least not only) to make statements about science and its place in society. They are rather using science and scientific imagery as a means towards other ends, like entertainment, reflection or storytelling. They are however not neutral or disinterested, the scientific imagery is often passionately described and used, but in a less enthusiastic way than ‘dominant view’ popularisations; which is why it might be difficult to agree with my interpretation that these narratives can be read as a form of popularisation. They are, however, in line with the definition outlined above, since they are implicitly addressed to a lay audience and make statements concerning science. As such they make up useful counterexamples that might move us beyond the dominance of the ‘dominant view’ when it comes to the circulation and diffusion of images of science in popular culture.

The images of science in the fictitious narratives analysed in *Genetik i fiktion* have some things in common with those of the other studies and some that are very different. One of the commonalities is the just discussed connection between science and development. Just as Fuglesang’s popularisations identify science and technology as the force responsible for setting the stage for the future, *Hulk* utilises this association between science and development to update the original story to feel less nostalgic. Similarly, most narratives analysed in *Genetik i fiktion* take place in an undefined future, extrapolated from current circumstances. That today’s science is tomorrow’s society seems to be the message of both *Gattaca* and the first Swede in space, admittedly in very different ways.

Another common theme is that of science as leading to the manipulation of nature, be it the catastrophic loss of control of

the Hulk or the successful weight loss of LCHF dieters – both seem to require some sort of scientific explanation. That a diet works or a body changes is not enough, contemporary culture seems to crave a scientific explanation. For the LCHF, it is important not to settle with what they view as a working method for weight loss; it needs to be in line with and acknowledged by scientific authority. So much so that they have launched an extensive campaign against established scientific expertise linking their failure to recognise the harmfulness of carbohydrates to the corruption of science as such. Similarly, of all the explanations that could be used for the appearance of a green giant, not to mention the fact that most Hulk narratives do not at all explain how he came into being, only a scientifically updated version of the original story seemed to be adequate for a film adaptation of the comic. The plethora of superhero origin stories filmed in the early years of the 21st century strengthens this tendency – most of them include scientifically updated versions of the old transformation narratives, usually based on genetic manipulation. In the *Hulk* case, this is probably not because the filmmakers feel the need to associate themselves with scientific establishment, but because both cases share a tendency to relate science with strengthened credibility – thereby basing their popularisations on the association of science with the believable.

When it comes to the differences that follow with the crossing of the fiction line, these are mainly related to what truth claims are made. The very idea of something being fictitious rests on the understanding that no direct and factual referential claims to the world outside of the narrative can be taken as given.³ This means that the fictitious narratives remain unde-

³ I do not mean that fiction has no referential relation to anything outside itself. Only that unlike science, fiction is based on the understanding that this is not a direct relation but a created one. Science on the other hand, traditionally implies that its reference is direct, even though with the constructivism idiom of this text, the difference is not all that clear.

cided on just the points where the other popularisations are struggling to establish scientific authority. When the neurobiological popularisations state that addiction is a case of brain disease that can be handled in various ways, this is a directly factual claim. Whereas when Atwood writes of the birth of a new humanity in a laboratory, this is a claim made within the parameters of fiction and as such it is more of a suggestion or a hint. It is not meant to be taken literally, like that of neurobiology, but neither is it a claim not meant to be taken seriously.

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Sammanfattning på svenska

Att popularisera (natur-)vetenskap så att den kan spridas och förstås av en bredare allmänhet är en omhuldad strävan för den samtid som gärna beskriver sig själv som ett kunskapssamhälle. I ett sådant samhälle härskar upplysningens ideal om en kunskapsförstärkning och nyfiken allmänhet som drar nytta och nöje ur den kunskapsproduktion som bedrivs av forskare och andra experter. Men ur samma strävan stiger också frustration; allmänheten verkar helt enkelt inte särskilt intresserad. Den verkar missförstå det mesta och värdesätter inte alltid de framsteg som vetenskapen skänker dem. Den konventionella bilden av popularisering, som också omfattar mycket av den forskning som bedrivs inom området, består av två komponenter. Först, tänker man sig, arbetar vetenskapliga aktörer i sina laboratorier med att metodiskt och noggrant avtäcka naturens mysterier. Därefter publicerar de sina resultat internt för att granskas av andra experter i det globala forskningssamfundet innan de sedan anpassas för en läsekrets utanför akademien och presenteras för dessa. Det är detta sista steg som vanligtvis avses när man talar om vetenskapspopularisering.

Ett problem med denna konventionella syn på popularisering är emellertid att den bygger på en strikt uppdelning mellan vetenskap och allmänhet och tillskriver den förra ett alltför starkt tolkningsföreträde. Den vetenskap som populariserats är så att säga aldrig tillräckligt bra, varför populariseringsprocessen ur det här perspektivet alltid kommer att urvattna det som från början var viktig kunskap till en andra klassens vetenskap. Allmänheten blir härigenom utestängd från just den kunskap populariseringen är tänkt att delge dem. Dessutom går den demokratiska nyttan med en upplyst allmänhet förlorad då den aldrig kan uppnå tillräcklig så kallad epistemisk auktoritet; inte, till skillnad från de vetenskapliga aktörerna, avgöra vad som är relevant kunskap.

Trots att mycket av den forskning som bedrivits analyserar popularisering som en form av politiskt gränsarbete som upprätthåller experters tolkningsföreträde så är den vanligaste reaktionen på detta problem en helt annan. Istället för att ta itu med det problematiska i den konventionella uppfattningen om popularisering brukar problemet tillskrivas allmänhetens oförmåga att förstå och uppskatta vetenskaplig kunskap. Denna uppfattning brukar kallas bristmodellen. I dess kölvatten återfinns en mängd projekt som söker förbättra allmänhetens bristande vetenskapliga kunskap och uppskattning. Oftast undersöks allmänhetens förståelse i stora enkät- eller telefonundersökningar där människor uppmanas svara på ett antal frågesportsliknande frågor om naturvetenskap och teknik. Vanligtvis framstår här allmänhetens kunskap som djupt otillräcklig.

Den här avhandlingen försöker bredda synen på vad popularisering kan vara genom att testa gränserna för begreppet genom en serie fallstudier. Istället för att försöka lösa problemen i den dominerande synen på popularisering. Den ibland paradoxala synen på popularisering som en process som samtidigt som den sprider vetenskap berövar den dess vetenskaplighet, tas till utgångspunkt för analysen. För att komma bort från den konventionella synen med dess fokus på allmänhetens bristande förståelse mobiliseras två närbesläktade konstruktivistiska traditioner, kulturstudier och teknik- och vetenskapsstudier (STS). Den senare har växt fram ur en kritik av hur vetenskapshistoria och stora delar av vetenskapsfilosofin har sett på naturvetenskaplig kunskap som en exceptionell mänsklig aktivitet med en närmast mytisk förmåga att formulera sanningar om naturen. Särskilt viktigt har synen på sociala faktorerers inverkan på kunskapsproduktionen varit. Där tidigare sätt att se på vetenskaplig kunskap har tagit sociala faktorer i beaktande uteslutande för att förklara misslyckanden och felaktigheter i den vetenskapliga forskningen, har STS-forskare istället envist hävdade att om sociala faktorer kan påverka kunskapen negativt borde de också kunna ha positiva effekter. Sanningen och det sociala kan alltså inte ses som ömsesidigt uteslutande fenomen. Istället bör förklaringar kunna användas symmetriskt, dvs. de bör kunna förklara såväl framgång som misslyckande. Det innebär att naturvetenskaplig kunskap inte är väsensskild från andra mänskliga aktiviteter utan

precis som annan kunskap påverkas av tidigare kunskap, kulturella faktorer, förmågan att argumentera och övertyga, osv.

På motsvarande sätt problematiseras också populärkulturen. Där den konservativa kultursyn som dominerat framhöll vissa kulturella artefakter för deras inneboende värden, kom kulturstudierna under 60- och 70-talen att skifta fokus. Istället för att framhäva vissa kulturformer och fördöma andra började man istället se kultur som en bredare allmänmänsklig form av meningsskapande. Den kvalitativa skillnaden mellan fin- och populärkultur tonades ner, men framförallt blev den en analytisk fråga. Den viktiga frågan blev hur populärkulturen kommit att bli både brett omfamnad och samtidigt förkastad. Sådana frågor ledde till en kultursyn som kan kallas för antropologisk, där kultur ses som ett levnadsmönster och ett betydelsesystem som lämnar efter sig spår vilka bör analyseras i relation till sociala strukturer, föreställningar, traditioner och ideologier.

Ett konstruktivistiskt perspektiv på vetenskap och en antropologisk kultursyn öppnar således populariseringsbegreppet för en bredare analys av hur mening skapas, såväl vad gäller den naturvetenskapliga kunskapens plats i samhället som hur föreställningar om det populära skapas och sprids. Detta vidgade populariseringsbegrepp förmår fånga ett bredare spektrum av praktiker genom vilka vetenskap gestaltas i populärkulturen. Det blir lättare att analysera även representationer av vetenskap som inte har sitt ursprung i institutionaliserad och vedertagen forskning. På så sätt kan fallstudier som inte följer den dominerande modellen inkluderas. Härigenom kan de vetenskapliga aktörernas epistemiska auktoritet göras till en analytisk fråga, och popularisering bli till en praktik som kan användas både för att underbygga och för att utmana denna auktoritet.

Ur det här perspektivet blir det viktigt att förhålla sig till populariseringar som något annat än neutrala beskrivningar av verkligheten. Istället appellerar de till sin publik genom att erbjuda beskrivningar av vetenskap i relation till föreställningar om publikens sociala och kulturella erfarenhet. Publiken, eller i en narratologisk begreppsapparat läsarna, är här en okänd storhet. Hur de egentligen tolkar och förstår de populariseringar de tar del av är ett av de problem som enkätundersökningarna om allmänhetens förståelse av vetenskap ständigt måste leva med. Här har jag valt att istället se på publiken som en produkt av

texten. Med hjälp av begreppen *implicit läsare* och *läsarkontrakt* ser jag populariseringarna som försök att placera läsarna i förhållande till den vetenskap som presenteras genom att medvetet relatera till dem och föreslå vissa läsningar före andra. Denna process styr läsarens förståelse för texten men kan aldrig slutgiltigt bestämma den, det finns alltid utrymme för läsaren att förkasta eller modifiera den tolkning som texten försöker uppmuntra. Läsarproblematiken flyttas från de faktiska läsarna till de implicita läsare som populariseringarna försöker skapa.

För att hantera alla dessa faktorer – en socialt grundad vetenskap, en antropologisk kultursyn, en okänd och textuellt konfigurerad publik, ett populariseringsbegrepp baserat på motsägelse – används i avhandlingen en konstruktivistisk metodologi. Fördelarna med denna ligger främst i att analysen blir ansvarig inför såväl det analyserade som den som läser den på ett tydligt sätt. Genom ett antal fallstudier som relateras till ett bredare populariseringsbegrepp försöker avhandlingen generera nya tolkningar och förklaringar av såväl fallen som teorin. Ambitionen är alltså inte att slå fast slutgiltiga förklaringar utan att skapa nya och kontrasterande sådana. Om de förklaringar som avhandlingen erbjuder är bättre än andra vilar slutligen på läsarens tolkning, men ambitionen är att de genom att vara situerade och tydliga med sitt perspektiv är ansvariga på ett sätt som exempelvis realistiska vetenskapliga produkter sällan är. Snarare än att hasta igenom tolkningsarbetet för att fokusera på slutsatserna försöker denna avhandling alltså vara öppen med sina teoretiska ställningstaganden för att tydliggöra hur resultaten nåtts.

Sammantaget argumenterar avhandlingen alltså för ett populariseringsbegrepp som lägger stor vikt vid det kulturella meningsskapandet i och kring vetenskaplig kunskap. De fall som analyseras behandlas som försök att konfigurera den paradox mellan vetenskapliga och populärkulturella ideal som beskrivs i introduktionskapitlet. Det finns i de beskrivna fallen få exempel på försök att på en bredare front ifrågasätta idéer om vetenskaplighet i generell mening. Istället ses fallen som försök att beskriva sin egen eller andras vetenskaplighet på olika sätt. Oftast i syfte att placera sig själv inom gränserna för en idealiserad vetenskap och sina meningsmotståndare utanför.

Artikel 1

”The First Swede in Space” publicerades 2009 i tidskriften *Culture Unbound*. Den analyserar Christer Fuglesangs populärvetenskapliga produktion och bilden av honom som en förebild i samband med att han blev Sveriges förste astronaut 2006. Fallet är nära knutet till den konventionella synen på popularisering. Det är således en uttalad och medveten populärvetenskaplig bild som Fuglesang och andra presenterar i offentligheten. Det intressanta här är att förstå hur denna bild görs möjlig i och med själva rymdfärden. Även om Fuglesang länge varit en offentlig person var det först i samband med att han faktiskt lämnade atmosfären som han på allvar kunde anta rollen som förebild och nationell hjälte. I en om än försenad nationell rymdhysteri kunde han skaka av sig bilden av den misslyckade astronauten och istället bli en nationell talesman för värdet och vikten av vetenskaplig och teknisk forskning, utbildning och nyfikenhet.

Tre huvudsakliga förutsättningar för denna transformation analyseras i relation till konventionella föreställningar om popularisering. (1) Först handlar det om hur astronauten genom att underkasta sig teknologin anpassar sig till de krav som gäller för att kvalificera sig för en rymdfärd, samtidigt som han demonstrerar hur vi bör förhålla oss till teknik och risk på ett rationellt sätt. Genom att vara medveten om men inte skrämmas av riskerna sitter astronauten i rymdfärjan som ett exempel på hur teknik, dess risker till trots, öppnar nya fantastiska möjligheter.

(2) En andra förutsättning för att bli en vetenskaplig hjälte är att astronauten faktiskt lyckas frigöra sig från jorden. Det är givetvis ett oavvisligt krav på en astronaut att ha varit i rymden, steget ut ur atmosfären kan ses som en övergångsrit som etablerar astronauten som just astronaut. Men det är mer än så; genom att överskrida det jordbundna förkroppsligar astronauten också en gammal dröm om absolut vetenskaplig objektivitet i form av möjligheten att kunna iaktta vår värld utifrån. Astronautens erövrar en privilegierad position som vittne byggd på ett både bildligt som bokstavligt överskridande av det vardagliga, det situerade, och det subjektiva.

(3) Det tredje villkoret handlar om förståelsen av Fuglesang som en *svensk* astronaut. Det är som svensk som han representerar något nytt, det uppdrag han deltog i är inte ett sådant som

numera normalt skulle motivera särskilt mycket intresse från allmänhet och medier. Som astronaut är han unik främst genom sin nationalitet, något som också betonades genom hela rymdfärden, symboliserat av alltifrån ABBA-låtar till älgkött och svenska flaggor. Det är genom en sorts banal nationalism som Fuglesang återknyter till sin publik.

Dessa tre villkor utgör grunden för att lansera Christer Fuglesang som en vetenskaplig hjälte med rätt att offentligt representera naturvetenskap och teknik som nationella angelägenheter och framtida drivkrafter.

Artikel 2

Den andra artikeln, ”Food Fight!”, publicerad i *Science as Culture* 2012, är samförfattad med Mark Elam. Fallet beskriver den svenska rörelse av lågkolhydratsförespråkare som kallar sig Low Carb, High Fat (LCHF) och som blivit en alltmer inflytelserik röst i offentligheten de senaste åren. Den har själv lanserat LCHF som något mer än en bantningsmetod; de har beskrivit den som en livsstil och dessutom drivit en stundtals intensiv kampanj för att reformera svensk kostrådgivning. Till skillnad från rekommendationer som ser fett som den makronutrient vilken orsakar övervikt och ohälsa, ser LCHF fett som ofarligt och hälsosamt. Istället anser dess förespråkare att det är kolhydraterna som ligger bakom viktökning och viktrelaterade följsjukdomar.

Artikeln tar fasta på hur LCHF’s syn på hur kost och hälsa är sammankopplade står i bjär kontrast till uppfattningen hos en överväldigande majoritet av svensk och internationell expertis. Utgår man från den konventionella uppdelningen av vetenskap i en inomvetenskaplig och en populär del, framstår LCHF som en ytterst marginell rörelse inom den etablerade vetenskapen. Huruvida dess diet är en bättre diet eller inte är inte en fråga som artikeln intresserar sig för, istället undersöks hur LCHF som rörelse kompenserar sin brist på vetenskapligt inflytande.

Den vetenskapssyn som LCHF ger uttryck för kan beskrivas som konventionell och idealiserad. Trots att den vetenskapliga expertis man söker debatt med på intet sätt delar dess syn på kostens inverkan på hälsan, bekänner sig LCHF till och åberopar

stöd för sin hållning hos en objektiv och obefläckad vetenskap kapabel att generera sann kunskap. Rörelsen betraktar den idag förhärskande expertisen som ett korrumpert undantag, ett avsteg från vetenskaplighet. Det korrupta hos dem som egentligen borde stå för kunskapen om kost och hälsa förs fram som förklaringen till varför det finns så jämförelsevis få studier som stödjer LCHF:s sak.

Som ett komplement till etablerad vetenskap mobiliserar LCHF-rörelsen också en omfattande populariseringskampanj via böcker, bloggar, föreläsningar och konferenser. De ställer i denna kampanj vetenskaplig auktoritet mot individuell upplevelse och erfarenhet; i detta fall en i deras ögon korrumpert vetenskaps rekommendationer mot ett antal bantares autentiska vittnesmål om en metod som fungerar men tystats av "etablissemangen". Fallet innefattar Ur ett populariseringsperspektiv är det här intressant eftersom LCHF mobiliserar populära bilder av vetenskap i opposition mot etablerad vetenskap, ett perspektiv som är lätt att missa med en konventionell förståelse av förhållandet mellan vetenskap och det populära. Istället för att, som brukligt är, se popularisering som en process som följer och understödjer etablerad vetenskap, visar exemplet med LCHF-rörelsen på hur frikopplingen mellan den etablerade vetenskapen och dess populära del också möjliggör för aktörer utanför "etablissemangen" att ta över representationsverktygen.

Artikel 3

Den tredje artikeln är också samförfattad med Mark Elam. "The Advanced Liberal Logic of Nicotine Replacement" publicerades som ett bidrag i Larsson, Letell och Thörn (red.) *Transformations of the Swedish Welfare State* (2012). Den beskriver hur rökning kom att transformeras från en ovana till ett beroende, närmare bestämt nikotinberoende, samt ett antal svenska och brittiska aktörers roll i att etablera denna transformation tillsammans med dess praktiska utformning som ett läkemedel för nikotinersättning.

I studien återkommer flera av de teman som diskuterats i "Food Fight!", om än i ny skepnad. Båda rörelserna har försökt utmana och förändra konventionella uppfattningar om hälsa och

ohälsa, och i båda har läkare spelat centrala roller. ”The Advanced Liberal Logic of Nicotine Replacement” handlar inte lika explicit om popularisering som de andra artiklarna. Istället fokuserar den på att ur ett Foucault-inspirerat perspektiv beskriva hur cigarettökning delades upp i två huvudsakliga delar – en farlig komponent bestående av de ohälsosamma ämnena i själva röken, och en beroendeframkallande del i form av nikotinet. Genom denna separation blev det möjligt att argumentera för en framväxande marknad av produkter som kan tillfredställa beroendet, men utan den skadliga röken. Inspirerade av, eller ibland i direkt konkurrens med snus, har ett antal svenska pionjärer lyckats etablera en trovärdig framtid för nikotin som en substans marknadsförd som ett mer rationellt alternativ till cigaretten.

Det var i och med lanseringen av nikotinersättning som en rationell produkt som den blev intressant ur ett populariseringsperspektiv. Med nikotinersättningsprodukterna följde ett helt batteri idéer om hälsa, vilja och rationalitet. För att nikotinersättning skulle kunna bli ett trovärdigt alternativ måste dessa kringliggande uppfattningar spridas och etableras. Förutom själva produkterna krävdes även en omstrukturering av själva marknaden. Dels krävde lanseringen av nikotinersättning nya tekniker för att mäta nikotinnivåer i blodet, utan dem kunde rökning inte lanseras som nikotinberoende. Dels krävdes att de rökare som skulle utgöra den nya marknaden kunde känna igen sig själva som nikotinberoende. Genom diagnostiska självtester för hur beroende man är, och genom marknadsföringen av nikotinersättningsprodukterna, understryks att rökare nu fått chansen att förstå sin vana i termer av nikotinberoende på ett nytt sätt. Det har blivit möjligt att identifiera sig som nikotinst. Därigenom blir de nya produkterna ett sätt att hantera ett beroende, snarare än att bryta det. Ersättningsprodukterna och de logiker som ledsagar dem omformulerar själva rökningen, från att ha varit en inbiten vana till att ses som ett irrationellt skadligt beroende; ett beroende dessa produkter nu sägs kunna hantera, och på så sätt återcivilisera de irrationella rökarna.

Licentiatavhandling

Den sista studien, *Genetik i fiktion*, försvarades och publicerades 2006 som en licentiatavhandling vid Linköpings universitet. Den undersöker och diskuterar fiktiva bruk av genetik i fyra fiktiva narrativ, med särskilt fokus på hur genetik och genteknik porträtteras och fyller olika narrativa funktioner. Urvalet består av två romaner, Margaret Atwoods *Oryx och Crake* och P.C. Jersilds *Geniernas återkomst*, samt två filmer, *Gattaca* av Andrew Niccol och *Hulk* i regi av Ang Lee med manus av James Schamus.

Avhandlingen tar sin utgångspunkt i en pedagogisk och didaktisk oro över att fiktionen riskerar sprida missuppfattningar och antivetenskapliga föreställningar. Sådan oro är möjligen begriplig om man arbetar med att lära ut naturvetenskap och teknik, men som en utgångspunkt för att förstå vårt förhållande till dessa breda fenomen är det mindre lyckat. Istället argumenterar *Genetik i fiktion* för ett kulturorienterat perspektiv som fokuserar på vetenskapens roll i fiktionen snarare än på om den är tillförlitlig och korrekt. Utifrån detta antagande skisseras sedan dels en definition av genetik och genteknik som fiktiva begrepp, dels en narratologisk begreppsapparat för att beskriva och analysera genetik och genteknik i de fyra narrativen.

Genetik och genteknik framträder i studien som något av ett multiverktyg för samtida fiktionsproduktion. Narrativen använder sig av detta på lite olika sätt. Sex huvudsakliga narrativa funktioner lyfts fram i analysen:

(1) Den första narrativa funktionen handlar om genetikens samtida känsla. Som narrativt verktyg är genetiken användbar eftersom den signalerar något nytt. Detta bottenar i en vida spridd uppfattning om att dagens forskning är morgondagens verklighet, vilket gör att genetik kan användas för att ge ökad narrativ trovärdighet åt spekulativa framställningar.

(2) Vidare signalerar genetiken som fiktivt tema en drastisk kraft, genom att den kopplar samman natur och teknik och förstås som en manipulation av livets minsta byggstenar. Detta gör den användbar för att framställa drastiskt annorlunda världar och varelser, från en biologisk postapokalyps i *Oryx och Crake* till ett grönt monster i *Hulk*.

(3) Genetiken kan också narrativt fungera som en effektiv brygga mellan det otroliga och det trovärdiga. Då gränserna för vad som går att åstadkomma med genteknik är svåra att bedöma

kan den höja läsarens känsla av realism även i mycket spekulativa framställningar.

(4) Det fjärde temat handlar om kontroll. Genetik och genteknik, och i förlängningen vetenskap och teknik, gestaltas i narrativen som en ständigt närvarande men fåfång strävan att manipulera naturen; en inledningsvis förtroendeingivande möjlighet att styra över det som senare visar sig omöjligt att kontrollera.

(5) Nästa återkommande funktion handlar om att genetiken kan knyta samman mikro och makro. Då den gärna beskrivs som en biologisk programmering med omfattande konsekvenser för organismer, samhällen och ekosystem lånar den sig för att koppla samman det inre med det yttre, de små orsakerna med de stora konsekvenserna.

(6) Slutligen framstår genetiken och gentekniken som narrativt användbara därför att de beskrivs och uppfattas som både natur och teknik. Genom att gestaltas som en vetenskap som överbryggar och kombinerar dessa två skänker den en plasticitet åt fenomen som annars inte skulle äga någon sådan, ofta med häpnadsväckande resultat i berättelserna. Genteknik framstår i de analyserade narrativen som en teknisk erövring av naturen på dess allra mest grundläggande nivå, en teknifiering av själva livet.

Alla dessa narrativa bruk av genetik och genteknik spelar på ett eller annat sätt på bilden av vetenskap som något trovärdigt och på fiktionen som något otroligt. Genom iscensättningen av olika kombinationer av dessa två ytterligheter används vetenskapen för att ge tyngd och en känsla av narrativ relevans åt fiktionen.