

A biotechnological settlement? Making space for 'human nature' at Iceland's genomics frontier

Beth Greenhough*

ABSTRACT

Innovations within the life sciences have created a new kind of economy in so-called bodily commodities, incorporating (in both senses of the word) both biological material and clinical information (such as that contained within medical records). This paper argues that this new economy unsettles existing relationships between science, medicine and society. Drawing on the debates surrounding Iceland's Act on a Health Sector Database (1998), the paper suggests that during the course of these debates a new kind of biotechnological settlement was reached, facilitating exchanges bio-information between the public and private sectors. This accommodation, it is argued, was based on Icelanders' faith in science and government and their willingness to participate in, and donate their bio-data to, commercial genetic research. In other words, reaching a 'biotechnological settlement' required that Icelanders situate their understandings of their bio-information in particular ways – ways that allow this information to be both an altruistic donation to a public resource and an impersonal piece of data which is available for commercial exploitation. The paper concludes with a note for caution stressing that this is a temporary and fragile settlement, and that should it be disrupted there are implications for future biotechnological research.

Keywords: Science studies, situated knowledges, biotechnology, deCODE Genetics, Icelandic Health Sector Database.

ÁGRIP

Sátt um líftækni? „Mannleg náttúra“ og landnám erfðafræðanna á Íslandi

Nýjungar í lífvísindum hafa getið af sér viðskipti af nýrri tegund, þar sem höndlað er með líkama fólks, bæði í formi lífsýna og læknisfræðilegra upplýsinga (t.d. úr sjúkraskýrslum). Í þessari grein er staðhæft að þessi nýju viðskiptaform brjóti upp sambandið sem verið hefur við lýði milli vísinda, læknisfræði og samfélagsins. Því er haldið fram að í umræðunni á Íslandi í kringum frumvarp um gagnagrunn á heilbrigðisviði (1998) hafi náðst ný sátt um líftækni, sem gekk út á að greiða fyrir skiptum með lífupplýsingar milli opinbera geirans og einkaaðila. Þetta samkomulag var að mati höfundar byggt á trú Íslendinga á vísindi og stjórnvöld og hversu reiðubúnir landsmenn voru til að taka þátt í erfðafræðirannsóknnum á vegum einkafyrirtækja og láta upplýsingar um sjálfa sig í té til þeirra. Með öðrum orðum krafðist „sáttin“ þess að Íslendingar litu á lífupplýsingar sínar á tiltekinn hátt, þannig að þessar upplýsingar mætti hvort tveggja líta á sem framlag gefið af óserplægni til almannaheilla og sem ópersónuleg gögn er hagnýta mætti í viðskiptatilgangi. Í lok greinarinnar er varað við því að sátt þessi kunní að vera skammtímafyrirbæri sem geti reynst brothætt. Ef sáttin yrði rofin mun það hafa afleiðingar fyrir líftæknirannsóknir í framtíðinni.

Lykilord: Vísindafræði, félagsmiðuð þekking, líftækni, Íslensk erfðagreining, gagnagrunnur á heilbrigðisviði.

TRADING ON THE LEGACIES OF THE ISLAND-LABORATORY

Current debates [about biotechnology] must be bracketed in reference to specific cultural and historical trajectories, but they are also rooted in very particular geographies. As science privileges the gene pool, isolated, bounded populations suddenly emerge as sites of intense interest and concern. [...] distant, isolated, and exotic locales now occupy center stage in 21st-century biopolitics (Sharp 2002, 296).

The notion that island populations offer advantages for research into human disease is not new. As geographers Cliff and Haggett (1984, 110) argue,

[e]ver since Charles Darwin studied the finches of the Galapagos Islands in 1835 it has been recognised that oceanic islands can serve as large scale laboratories for the investigation of biological processes.

Within the social and human sciences islands have served as laboratories for social experi-

* Earth Sciences and Geography, Keele University, United Kingdom; b.j.greenhough@esci.keele.ac.uk

ments ranging from anthropology (Terrel et al. 1997) to economics (Kelsey 1995). However, recent developments in human genetics, and in particular the possibility of ‘linking’ diseases to particular genetic variations, have placed new demands on island-laboratories and their populations. Genetic epidemiology – “the study of the aetiology, distribution and control of disease in groups of relatives and of the inherited causes of disease in populations” (Kaprio 2000, 1257) – has a key role to play in mapping the relationships between genes and hereditary diseases. Genetic epidemiologists use information concerning individuals’ medical histories and genealogies to construct a disease pedigree, a map of a particular family whose members suffer from a hereditary disease. Living members of that family group (providing they consent) can then be genetically fingerprinted and their genetic profiles compared in order to isolate shared genetic variations (or alleles) which may be linked to a particular disease. In other forms of genetic research (for example studies using mice or fruit flies), this information might be obtained using a specially bred population within the laboratory. Within human genetics such studies are both ethically objectionable and impractical. The solution is to seek a human population whose characteristics represent most closely those of a laboratory-bred population, ideally a population which has been reproductively isolated – reducing the number of genetic variants to be searched – and which has good medical and family records. By analysing population data, commercial firms would hope to produce evidence of links between specific genes and diseases that could then form targets for drug development. As might be expected, such populations are a scarce resource. In light of the potential profits to be made in generating genetically targeted drugs and treatments, commercial biotechnology firms along (and often in collaboration) with state and academic-led laboratories are all competing for access to information and genetic material from these ‘good popula-

tions’ (Rose 2001a, 2001b). As a result, “radically new kinds of commodities are being created in the form of genealogies, medical records and genetic characteristics of entire populations” (Pálsson 1999, unpag.).

Iceland’s small, isolated population constitutes perhaps the archetypal ‘good population’ for pharmacogenomics (modelling the relationships between patterns of inheritance, medical histories and genetics in order to identify new genetic sites for the analysis and treatment of disease). Iceland has exceptional medical and genealogical records which can be used to identify disease pedigrees (Cliff and Hagggett 1984). Furthermore, it is assumed that the particular genetic traits which are linked to diseases will stand out more clearly in a population where reproductive isolation has reduced the number of alleles (genetic variations). As Cliff et al. (2000, 9–16) suggest:

From the genetic viewpoint, [...] a lack of immigration kept mixing to a minimum and Iceland provided a classic example of (i) the founder’s effect, inbreeding from a small initial population and (ii) the bottleneck effect, where sharp reductions in population size due to imported diseases and out-migration further reinforce the narrow genetic range.

A growing demand from genetic research for suitable populations has meant that the role of Iceland as a natural laboratory for genetics has new scientific, political and financial significance. The Icelandic parliament allied itself in the late 1990s with a newly founded biotechnology company based in Iceland, deCODE Genetics (hereafter deCODE). DeCODE was founded by Icelander and Harvard-based neurologist Kári Stefánsson, and incorporated in Delaware, United States, in 1996 before establishing its research base in a commercial laboratory on the outskirts of Reykjavík. In 1997 deCODE allegedly approached the Icelandic government with the draft of a bill which would legislate the granting of a twelve-year licence for a private biotechnology company to create and manage a centralised database of national medical

records. This database would later become known as the Icelandic Health Sector Database (hereafter HSD). The HSD would store non-personally identifiable information from the medical records of Icelanders that could then be linked to deCODE's existing genetic and genealogical databases.¹ The HSD would form part of deCODE's wider plan to develop a Genetic, Genealogy and Phenotypes Resource (hereafter GGPR) which would combine medical histories with databases of family histories and genetic profiles. What deCODE proposed anticipated the potential applications of Iceland's genetic, genealogical and medical records for pharmacogenomic research. As the *New Scientist* reported in 1998:

Iceland's parliament [...] is about to cash in its people's legacy. It is on the verge of passing a bill that would authorize the creation of a single database containing genetic, genealogical and medical details about all Icelanders. The bill would also license deCODE Genetics, a private company in Reykjavík funded mainly by American investors, to manage the database (Coghlan 1998, 20).

The HSD could also potentially contribute to the national provision of healthcare by collating data on disease prevalence and treatment and enabling improved resource allocation and planning. As Hilary Rose has observed,

deCODE's proposal [...] shrewdly positioned itself to be attractive to several powerful players: venture capital; the welfare state; its marketised counterpart the so-called healthcare maintenance organizations; and the insurance industry (Rose 2001b, 125).²

The Act on a Health Sector Database (Icelandic Parliament 1998, hereafter HSD

Act) was finally passed on the 17th December 1998, although the licence had yet to be allocated, and was not granted to deCODE until January 2000.

Since its inception, the HSD Act has provoked academic and political controversy, both nationally and internationally. The initial version of the parliamentary HSD Bill was heavily criticised by medical professionals, scientists and patient rights groups (for an overview see Rose 2001a; Zoëga and Andersen 1999). When the HSD Act was passed in parliament, a group of Icelandic doctors, scientists and others concerned about the private appropriation of public health data organised opposition to the HSD Act, forming Mannvernd, the Association of Icelanders for Ethics in Science and Medicine (Mannvernd 2005). But despite professional scepticism surrounding the HSD Act, the Icelandic public seems to have been largely unconcerned by the 'selling of their family secrets' (Coghlan 1998).³ In recent years, Iceland's controversial Act on a Health Sector Database has faded from discussion. DeCODE's proposed centralised research database of national medical records has yet to materialise and in light of difficulties deCODE has faced coming to terms with health institutions over the transfer of medical record data mean it seems unlikely now the database will ever be built. Yet the initial public support for deCODE and the proposed HSD still presents an intriguing case for the social scientist.

This paper is structured around the following key question: How do scientific knowledges and understandings travel outside the laboratory and negotiate their wider social and cultural environments?

¹ DeCODE's genetic database contains genetic information from patient volunteers who participate in their genetic research. DeCODE's genealogical database, *Íslendingabók* (the Book of the Icelanders), was created in co-operation with Frísk software, a company founded by Friðrik Skúlason, an ex-member of Genealogia Íslandorum hf. (the Icelandic Genealogical Society).

² Critics have noted that early deCODE publications made references to the potential insurance market for their data on the relationships between genes and diseases (see Zoëga and Andersen 1999, 6), although this is notably absent from deCODE's more recent publicly available documentation (deCODE Genetics 2005).

³ Although Mannvernd has a record of a growing number of people choosing to opt out of the database, which suggests by 2003 nearly 7% of the population had done so (see Mannvernd 2005).

I began by outlining the significance of Iceland as a metaphorical and practical ‘laboratory space’ for the study of human genetics, and for deCODE Genetics in particular. The remainder of this paper is divided into four parts. The following section provides a theoretical background to this study, looking at the emergence of what Shapin (1998) describes as broadly geographical sensibilities in science studies and how this in turn provides a starting point for exploring geographies of science. The third section then considers how the rationale promoting Iceland as the ‘ideal genetic laboratory’ translated into popular conceptions about the role of Iceland and Icelanders as a scientific resource. The next section then suggests popular acceptance of this rationale created a kind of ‘biotechnological settlement’ where Icelanders felt largely supportive of (or at least indifferent to) deCODE’s proposed research. I conclude with some reflections on what this ‘biotechnological settlement’ implies for science-society relations, and ask whether this kind of settlement provides a good model for the negotiation of science-society relations elsewhere.

PLACING THE VIEW FROM NOWHERE

Of all forms of cultural practice the geographical – and, more generally, the spatial or local – perspective on the natural sciences seems most difficult to sustain. After all, both common and philosophical usage testify to the very nature of authentically scientific ideas as disembodied and their scope as universal. (Shapin 1998, 5).

Shapin describes how science seems as though it offers the ‘view from nowhere’, a universal knowledge which is unaffected by the local circumstances of its production (e.g. laboratory space) and the dispersed circumstances of its consumption (e.g. in hospitals, industry, education; in Iceland, the US and the UK). Michel Serres (1995) terms this cartographic manoeuvre *the contract of scientific truth*, whereby local contin-

gencies are subsumed under global norms and where the achievements and findings of scientific endeavour become naturalised as some form of universal truth. As Harari and Bell (1982, xiii) suggest:

until recently science had convinced us that in the classification of the spaces of knowledge the local was included in the global [...] Clearly this implied a homogenous space of knowledge ruled entirely by a single scientific or universal truth.

This ‘universal perspective’ or ‘god trick’ (Haraway 1997) played a key role in establishing the authority of scientific knowledge over other more localised and ephemeral ways of knowing the world (Latour 1983; 2004).

In response, a key move within science studies has been to describe how scientific practice is socially situated within particular environments (e.g. experimental laboratory) and in particular communities of practice (e.g. scientific disciplines). Science studies “offered a more realistic account of science-in-the-making, grounding it firmly in laboratory sites, experiments and groups of colleagues” (Latour 1999, 15). It is this attempt to ‘place the view from nowhere’ which Shapin (1998) suggests has opened up broadly geographical sensibilities within science studies. It has also opened up the spaces of science to historical geo-graphers, whose accounts of local contexts of scientific production provide a means of ‘Putting Science in its Place’ (Livingstone 2003). These historical accounts have served to highlight the range of spaces (outside the experimental laboratory) within which scientific knowledges are (re)produced:

[W]e are now beginning to appreciate that sciences of various kinds were practiced in venues such as the ship, the coffee house, the tent, the royal court, the public house ... on stock farms, in pigeon breeding clubs, on exhibition stages, in cathedrals... (Livingstone 2002, 13).

This selection of spaces suggests that key

to generating the 'view from nowhere' was the ability to make the localised discoveries made in laboratory extend to other places. For Latour (1983, 166; emphasis added) this also means extending

to every setting some of the conditions that make possible the favourable reproduction of laboratory practices. Since scientific facts are made inside laboratories, in order to make them circulate you need to build costly networks inside which they can maintain their fragile efficacy. *If this means transforming society into a vast laboratory, then do it.*

It is perhaps not surprising then, that Shapin concludes his article with an agenda for geographical analysis which considers how scientific knowledges and meanings travel, i.e. how they are applied and verified in spaces outside the laboratory. The extension of scientific knowledges outside the laboratory requires that those scientific ideas, objectives and practices can be instrumental in 'making space'. According to Driver (1994, 388) this means that:

A focus on the geography of science thus implies more than an acknowledgement of the location or context of science; it suggests new ways of thinking about the language and rhetoric of science [...] and the relations between knowledge and power more generally.

Through their promotion of particular ways of viewing and intervening in the world, scientific practices can be seen as inherently cartographic, offering spatial representations which serve to empower those who control them (Rose 1993). For example, Donna Haraway (1997, 135) notes how genetic maps, like other geographical representations, are "embodiments of multifaceted historical practices among humans and non-humans [...], models of worlds crafted through and for specific practices of intervening and particular ways of life". Consequently the way any particular scientific laboratory seeks to situate its work within a broader social and environmental context creates what anthropologists

might term a cultural or social 'landscape' (Hirsch 1995; Helgason and Pálsson 1997), which reflects their political, social and cultural commitments.

Geographers have recently begun to think through the kinds of landscapes and spaces being inscribed by advances in genetics and the life sciences (Whatmore 1999; Spencer and Whatmore 2001; Bridge et al. 2003). Interventions range from discussions of some of the technical, commercial and political processes mapping genes entails (Hall 2003) to the ways in which genetic research has generated new kinds of commodity and new forms of exchange (Parry 2004; Greenhough forthcoming). Cultural geographers meanwhile draw our attention to the connections between culturally and genetically informed understandings of place and nation (Nash 2004). This paper aims to contribute to this growing body of work through an analysis of how the biotechnology company deCODE Genetics sought to create specific social and cultural context for their research – how they 'made space' for Icelandic commercial genomics. It draws on secondary research and in-depth interviews with participants in the HSD debate, as well as Icelandic physicians and members of the public, collected during fieldwork undertaken between January and June 2001.

MAKING ISLAND-LABORATORY SPACE

Sciences create associations, create, for better or worse, new, formidable, interesting histories that continually stabilize the distribution of what is the order of the actually possible and that of speculation, and they do it not only in laboratories, but also, if one gives them the opportunity, outside (Stengers 1997, 142).

As Stengers notes, science offers us new ways of thinking about the world and our role within it. This section is concerned with how deCODE's proposed HSD created new ways for Icelanders to think about their medical and genetic heritage. But creating such new associations is not

a straightforward process. Like any other set of associations, turning private medical information into a commercial research database entails a “negotiation between different actors” (Strathern 1996, 517). A scientific perspective is mediated by its encounters and relationships with natural and social agencies, which range from the complexities of gene expression to the mechanics of commercial laboratories and the machinations of politics. In the case of the proposed HSD, as with many other bio-resources (Hayden 2003; Greene 2004; Parry 2004), just gaining access to bio-information can present a significant challenge. In order to carry out research using state-held medical data deCODE genetics needed to secure the support of both the state and the local population (deCODE Genetics 2000). Or to put it another way, in order to make their ideas travel, deCODE have to engineer a network of associations around the HSD which argue that being a ‘good population’ for genetics is similarly a ‘good thing’ for Icelanders.

The international publicisation of the debates over deCODE’s proposed HSD carried in its wake the popularisation of Iceland as a site for genetic science (Rose 2001a). DeCODE’s use of Iceland as an island-laboratory served to popularise ideas about population-environment relationships which the media was quick to pick up on: Within the popular imagination ‘Iceland becomes the laboratory of biotechnology’ (Schümer 2000) and Icelanders ‘natural-born guinea pigs’ (Gibbs 1998). But how does the Icelandic population feel about their role as ‘natural born guinea pigs’?

Portraying the Icelandic public as guinea pigs obviously is a very negative notion [...] However, I feel that you could also say that Iceland is in some ways has [...] that there are some aspects of this country, or of this society, that make it feasible for some kinds of research [...] you could say yes, this is an island laboratory, or you can say the Icelandic public in some ways lends itself to contribute to the improved health of Icelanders and maybe of others, and the public is willing to do so (Representative from the Icelandic Ministry of Health, February 2001).

One of the key advantages of Iceland as a site for population genetics often cited by deCODE (Gulcher et al. 2000) is the support of a local population who are (so the argument goes) well educated, socially homogeneous, and above all keen to participate in genetic studies. But just how co-operative are deCODE’s Icelandic research subjects? More importantly, why might they be co-operative? The figures from a Gallup poll taken shortly after deCODE received the HSD license suggests deCODE’s proposals remained popular, with only 8.6% of Icelanders stating they were against the database (cited in Gulcher and Stefánsson 2000, 1827). Critics suggest that the Icelandic population, not having experienced ‘Frankenstein Food’ scares, BSE and other science-society antagonisms, were naive, unaware of the risks involved in biotechnology:

I’ve been aware what’s happening in Europe and America, there’s a lot more awareness there. But I think that the media have done a good job of keeping it down here in Iceland and I’m not happy about this. [Laughs, a little...] I think there’s something not right, I think people [...] it should be more in the media (Member of the Icelandic public, May 2001).

Rose (2001) also notes the almost total absence of the ‘risk society’ discourses so prevalent in other European and American societies.

However, it is important to take into consideration that from an Icelandic perspective deCODE offered a very attractive proposition. Firstly, Iceland might be thought of as a technophilic society (Rose 2001a), placing faith in scientific innovation as the key to both medical and economic progress. DeCODE’s risky biotechnological venture appeals to a nation undergoing, by its own diagnosis, a phase of late modernisation (Sigurðsson 2000; Erlingsson 2001). As one interviewee put it:

We still have this thing for new things and exciting discoveries (University student, May 2001).

DeCODE’s venture tied into an ‘Iceland Dream’ (similar to the American one) of

financial and economic success. DeCODE was seen as a source of employment and of foreign investment, providing a new source of jobs for highly skilled labour which deCODE argued made “an important contribution to preventing a brain-drain from Iceland” (Decode Genetics 1998: 2). In a population of under 300,000 many Icelanders would be directly affected by these positive changes: “we’re such a small, so few, that this company affects very many ... two of my very best friends are coming home because of this” (Member of the Icelandic public, June 2001).

Secondly, from the start there has been a highly visible degree of government involvement in deCODE. One of the most enduring images of deCODE’s political support was the signing of an agreement (made prior to the announcement of the HSD proposals) between deCODE and Swiss pharmaceuticals company, Hoffman–La Roche, in which the two shake hands watched over by Davíð Oddsson, the Icelandic Prime Minister. State support makes an important contribution to the company’s Icelandic image and is key to sustaining a connection between the company’s success and that of the Icelandic nation. Thirdly, and related, is the way that, although the majority of its investment capital comes from American and foreign investors, the company has been keen to promote itself as a ‘homegrown approach to genomics’ (Redherring 1998). The notion that the company is Icelandic and will encourage investment in the Icelandic economy provides a strong rationale for support, particularly among younger members of the Icelandic community:

Well, it’s about money, but since that money is coming here, to Iceland, more scientists are coming here to Iceland, and a lot of people, like Icelandic people who lived overseas came to work for deCODE. [BG Yes] So, it’s a good thing, but I’d be against a major, like big foreign biotech company doing what deCODE is doing, because I would not personally be gaining anything out of it (University graduate, May 2001).

In their publicity deCODE plays on its Icelandic connections. For example, Specter’s (1999) interview with deCODE’s Chief Executive Officer (CEO) in the Sunday Times entitled ‘Cracking the Norse Code’, champions Kári Stefánsson, deCODE’s CEO, as the modern Viking whose pioneering work on the genetic frontier will provide solutions to the hereditary diseases which plague Icelanders, and perhaps the world. A stereotyped picture perhaps, but a telling one in that it plays on the image of a culture entitled to the economic success and employment and investment opportunities which deCODE offered. These kinds of stories and images serve to normalise deCODE’s research project and portray its role as one of realising a valuable natural resource to the benefit of Icelanders and the world as a whole.

Fourthly, this emphasis on using Iceland’s natural resources to their country’s benefit is one that might be particularly appealing to Icelanders. Björnsdóttir (1989) noted that an emphasis on Iceland’s unique cultural inheritance played a key role in establishing a basis for Icelandic independence when the Icelandic republic was established in 1944:

Icelandic authorities were fully aware that Iceland would always be dependent on the economic and political cooperation and good will of other more powerful and richer nations. Icelanders could justify their claim to independence only in the cultural realm, the fact that Iceland was inhabited by a culturally independent nation that possessed its own language, history and literary tradition. (Björnsdóttir 1989, 100).

Pálsson and Harðardóttir (2002, 281–282) similarly suggest that “the general support of the database is partly rooted in the concept of the Nordic body developed during the nationalist era”. The belief that deCODE’s project will present positive and successful image of Iceland to the international community acts as a kind of scientific validation of the value of Iceland’s cultural

and genetic heritage. One interviewee observed that:

This mentioning of the country's name has been important to us, and our self-consciousness and our image, that people recognize us (Mannvernd member, February 2001).

Fifthly, the belief that deCODE's work could present cures for future generations, provides a strong rhetoric for support. The risks of sharing genetic information are balanced against the possibilities that that information may benefit future descendants, creating ties between individual responsibilities and social ones, which in turn creates ties between civic duty and population genetics:

In many ways also that is why people are interested in participating in genetic studies, because they feel that it concerns their prospects. And I think that's also one reason why people that have diseases that are genetically determined, they really feel that if they can contribute, and that can help those that are to come, that's good, even if it doesn't benefit themselves. So I think it has sort of other dimensions too, people maybe feel more responsible than if it is something that you cannot do anything about. (Interview with representative from the Icelandic National Bioethics Committee, March 2001)

The work that deCODE is doing becomes envisioned as a means by which individuals can become responsible for their genetic legacies, again reflecting an almost implicit faith in deCODE's ability to revolutionise medicine.

What emerges through these explorations of popular accounts and images of deCODE and the HSD debate is a belief that Iceland is the 'ideal genetic laboratory' and its population is a valuable genetic resource. In other words, it becomes apparent that deCODE has managed to „extend to other places the hierarchy of forces“ that was once favourable inside the first laboratory” (Latour 1983, 163), tying a scientific rationale which values isolated populations to Icelanders' sense of genealogical heritage and technophilic ambitions. This then places a form of social obligation on Icelanders to

assist in the drive for medical progress:

But if I could help somebody [...] [BG It's good?] It's good for me, and it would maybe, maybe it will be good for my grandchildren, and the rest of the world (Member of the Icelandic public, May 2001).

In fact, as responsible members of society, Icelanders “have a moral obligation to do what we can to move forward. Medicine today would simply not exist if privacy was the only need, the only right that, anyone ever considered important” (Kári Stefánsson cited in Specter 1999, 53). To summarise, as Rose (2001b, 126) observes: “Stefánsson has managed entirely brilliantly to locate deCODE and the HSD inside a narrative of both scientific and national progress.”

It would seem deCODE's scientific rationale, which claims Iceland as the ideal genetic laboratory (cited in Zoëga and Andersen 1999), has been accompanied by a social rationale about the economic and cultural role that deCODE has to play in Iceland and a social obligation (on the part of Icelanders) to 'the rest of the world'. If the older members of the population were drawn to the promise of helping future generations, then the younger members, especially graduates, saw deCODE as providing vital career opportunities for either themselves or their friends. But what are the implications of this extension of scientific ideas into a broader social context? What broader ethical and philosophical commitments might underlie an implicit faith in deCODE as the engineers of scientific and medical progress and a sense of obligation to contribute to their project?

REACHING A BIOTECHNOLOGICAL SETTLEMENT?

[A]ttending to the categories of person built into facts and attending to facts in the world as facts enable us to see more clearly how medical and scientific claims, along with our own, are as much about dividing persons as describing them (Dumit 1997, 89).

If we have some idea what kinds of information and artefacts travel – e.g. rationales for using islands as laboratories – we might then begin to ask what elements of a scientific perspective they might carry with them. A key observation here is to note how scientific practices of sample collection and knowledge dissemination are organized around practices of classification (placing things in categories and locating them in relation to existing samples and understandings – see for example Latour 1999, Chapter 2), and more recently intervention (changing things in order to alter their properties and connect them to different understandings – Rose 1994, 173). Consequently, one of the elements of science which transfers strongly into popular culture are ways of classifying things in the world and ways of understanding the relationship between people and their environment. Within science studies, scientific perspectives on the world are closely linked to the so-called modernist worldview (Latour 1993), and are seen to promote dualistic thinking and implicit divisions between nature and culture and between scientists (who study the former) and social scientists (who study the latter). The assumptions that govern laboratory spaces are extended into the world by

..doing the ever-local, ever partial work of making it appear that science describes nature (and nature alone) and that politics is about social power (and social power alone). (Bowker and Star 2000, 46).

For Serres (1995), the modernist settlement can be understood as two distinct forms of ‘contract’ between science and society, the social contract and the contract of scientific truth. The latter is how Serres accounts for the ways in which scientific knowledges travel outside the laboratory, and in particular they way the voice of scientific authority encourages the uncritical acceptance of scientific discoveries as matter of ‘natural fact’. It is this ‘god-trick’ (Haraway 1997) of scientific perspective which arguably not only allows but supports

the assumption that a centralized database of Icelandic medical records:

..would not only take care of medical problems in Iceland, but in the rest of the world, and [...] the world would be thankful to our [...] little island forever (Physician, April 2002).

In the Icelandic case, the scientific contract is assisted by the tendency among many Icelanders to place a great deal of faith in the capacities of deCODE to revolutionise medicine. Alongside this contract of scientific truth is a social contract which emphasises a set of social traditions that affects us as individuals by making us immediate participants in our entire community” (Serres 1995, 107). This is reflected in the explanations I received as to why Icelanders might be so willing to participate in scientific research, in particular those which cite a strong sense of social responsibility seemingly intrinsic to small island communities:

Part of belonging to a small community, [is that] you have this sort of SOCIAL RESPONSIBILITY, and people want to participate even if it doesn't benefit themselves, because they think that they should contribute to the society. (Representative from the Icelandic Ministry of Health, March 2001, emphasis added).

Or to put it another way, there is a sense in which many Icelanders feel:

WE HAVE A SOCIAL CONTRACT WITH EACH OTHER, we both give and take, and that we are somehow a little bit obliged to do something in order to improve the health of the public (Representative from the Icelandic National Bioethics Committee, February 2001; emphasis added).

The scientific and social contracts separate out those things considered human concerns (ethics, law, morality and social responsibility) from all things considered ‘natural’, including, it is argued here, human biology and pathology. The sense of a social contract specifies a specific site or view from which the Icelandic population may intervene with deCODE’s practices, the view of the concerned member of society. It separates out this viewpoint from the way

in which Icelandic citizens would be participating in deCODE's study as biological objects, genetic samples, medical records, and genealogies, i.e. as sources of scientific facts. This social contract between deCODE and the Icelandic population creates a divide between the scientific practices which actively intervene and create biological meanings or 'natural facts' and the impact of those meanings in a social world beyond the sites of scientific practice – a kind of re-working of Latour's (1993; 2004) modernist settlement. The two contracts act to divide the spaces of scientific fact which identify and simultaneously justify scientific research from those social values concerned with the responsible conduct of research and the fair and appropriate use of that knowledge once it is produced (see also Latour 2004). The result is a kind of biotechnological settlement (Figure 1).

This biotechnological settlement divides the Icelandic population into two parts. One part is the human subject, the Icelandic public who are the social arbitrators of the knowledge deCODE is producing. The other is the bio-information that belongs to the Icelandic gene pool, a public body-

object or natural resource. This division is self-reinforcing. Through a contract of scientific truth it demands a faith in the claims of science and an acceptance of the truth that Icelandic medical knowledge is a valuable resource which needs to be tapped in order to enable scientific progress. Through a social contract it perpetuates the assumption that the Icelandic public has a social obligation to see the Icelandic gene pool is exploited in a responsible way. This divide therefore neatly circumvents the fact that the public and the gene pool are one and the same human being.

The biotechnological settlement is reflected in popular representations of the HSD, as will be shown below using two examples from the Icelandic press. In the first example a national symbol of Icelandic nature/culture, Mount Esja, is used to symbolise medical records and the values embedded within them in an allegory that appeared in the weekend reader of Morgunblaðið, an Icelandic national daily, written by an Icelandic minister, Örn Bárður Jónsson:

The idea of selling Mt. Esja began as a prank, but with time it had developed into something

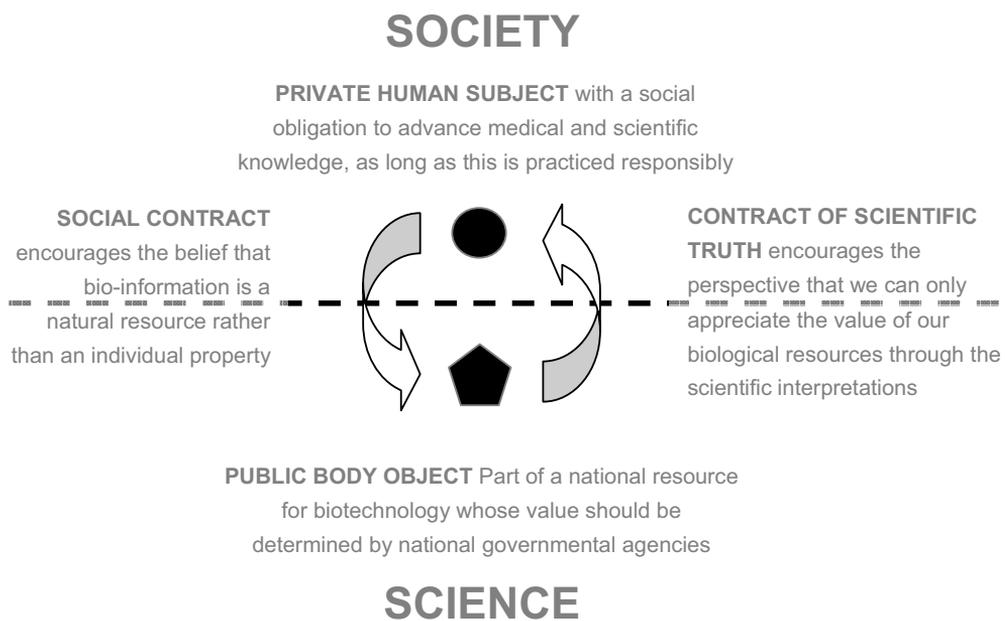


Figure 1 The biotechnological settlement?

more serious; by now it was no longer a joking matter. Peter [meant to represent Kári Stefánsson] wasted no time and founded exPORT mountains Inc. in collaboration with foreign investors. No one for example, realized that when they dug the tunnel under Whale fjord the government was doing preliminary tests, a minuscule experiment, as per Peter's consultation. The results were promising. It was considered unproblematic to tunnel under Mt. Esja, to saw it free from its base, and to sell it to mainland Europe (Jónsson 1999, transl. Mannvernd).

Mount Esja is Reykjavík's mountain and as such has a particular national significance. The story reflects the belief held by opponents of the database that deCODE is effectively exploiting a national treasure for financial gain. It also reflects how the scientific notion of Iceland as an island-laboratory, and of its population as a resource, has become so readily adopted by the national consciousness. The mountain parody capitalises on this using the mountain to represent Icelandic medical records as a valuable national and naturalised resource. Criticism aside (the story has a tragic and moral ending as the mountain sinks into the Atlantic mid-transit), it makes a salient point about the way in which the notion of the population as a resource remains largely unquestioned.

A second example can be seen in a cartoon taken from Morgunblaðið (Figure 2). The cartoon is set at the entrance to the headquarters of the Icelandic Medical Association (IMA). In the doorway is stood the chairman of the IMA, Dr Guðmundur Björnsson. He is being approached by a figure that represents one of the government officials (then Minister of Health, Ingibjörg Pálmadóttir) who is holding hands with a grand-motherly figure wrapped to excess in winter clothing and labelled *fallkonan*. The cartoon is entitled: "The government consents to the modified database bill – The hand of reconciliation is extended to critics". This is referring to the fact that the IMA was one of the organisations that

criticised the original Health Sector Database Bill.

The caption reads: "Well, so what do you say? It won't be easy for Kári to misuse her if she's dressed-up so warmly, Guðmundur my dear..."⁴ The cartoon is making a comment about the act on the HSD. It points to the proposed use of technological solutions, specified by the Icelandic Data Protection Authority (DPA), as a means of ensuring the privacy of individual contributors to the HSD. The figure of *fallkonan* (woman of the mountain) is a national symbol that emerged during the Icelandic independence movement. She encompassed the spirit of Icelandic nature and Icelandic culture (Björnsdóttir 1989) in a female 'Nordic body'. Here she embodies the classification of Icelandic bio-informatics resources as part of a national heritage, something vulnerable (feminine and elderly?) that needs to be protected (in this case by several warm and woolly layers of encryption code). The message is clear. It is not personal medical records which are being handed over here, but the national resource that is Icelandic medical records. The separation between the two is produced by the encryption procedures implemented by Iceland's Data Protection Authority. It is also, I would suggest, enabled by the belief that medical records are a national resource and the responsibility of the Icelandic government (here represented as the intervening figure negotiating access to medical records and handing over *fallkonan*) who as licensor takes responsibility for the use of 'natural' resources. The two examples reflect how the scientific and social contracts create a specific reciprocal settlement between an Icelandic public, represented by the government, and an Icelandic resource which is to be exploited by deCODE. These contracts become a means to normalise the notion that medical records are a national biotechnology resource, and restrict debate to the question of who gets to and how best to exploit and protect this resource.

⁴ All translations from the Icelandic are this the author's own and likewise any associated errors.



JÆJA hvað segirðu þá, það verður ekki hlaupið að því fyrir Kára að misnota hana svona dúðaða, Guðmundur minn . . .

Figure 2 Cartoon by Sigmundur, from Morgunblaðið, Sunday 18th Oct. 1998. Reproduced by kind permission of the artist.

IMPLICATIONS

Scientists and clinicians are powerful players [...] and seem to be able to direct attention to the social implications of genetics, often viewed as beneficial, rather than to the science and technology itself. This can serve to protect their cognitive authority by promoting the benefits of their work and marginalising more critical commentaries [...] These discourses create strategic boundaries between science and society which protect scientists' cognitive authority (Cunningham-Burley and Kerr 1999, 647).

The use of humans in genetic research is one place where the nature/society distinc-

tion is brought sharply into focus. I have argued that the notion of Iceland as a genetic laboratory creates two distinct positions for the Icelandic subject within the HSD debate: Icelanders are both the object of scientific research, the 'good population' for pharmacogenomics, but they are also the social arbitrators of deCODE's research. In effect these two roles may often become blurred, the status of Icelanders as both a natural scientific object and a social and political agent making this a useful site to begin unsettling the distinctions made by the *contact of scientific truth* and the modernist settlement (Greenhough 2003). At the same

time, however, maintaining some form of bio-technological settlement is key to supporting deCODE's cognitive authority as those best positioned to take advantage of the unique opportunities for genetic research presented by the possibility of a centralised medical records database. The modernist settlement is certainly reflected in the way the discourse of a 'good population' has become a form of *scientific contract* extending deCODE's notion of Iceland-as-laboratory into the popular imagination, perpetuated through media coverage and academic scripts alike. But what are the implications of the popularisation of the notion of Icelandic medical records as a 'natural resource'?

Firstly, what is in actuality a theory, the notion of Iceland as a genetic laboratory becomes naturalised, accepted as scientific fact and therefore closed to the questionings of social debate.⁵ Indeed, the population (like *fjallkonan*) needs to be protected from its status as a resource. This in turn reflects how, as Ettore (1999) and Cunningham-Burley and Kerr (1999) both observe, scientists legitimize their rights to particular types of resource by constructing strategic boundary lines between science and society. Secondly, as implied above, this vision of population as resource is reproduced in many of the social science accounts of the HSD debate (see also Greenhough under review). In Iceland, as elsewhere, those who study science are so concerned with working out the terms of the *social contract* and the relationships between science and society that they fail to question the assumptions made by the contract of *scientific truth*, like the view that the Icelandic population is a natural resource for genetic science. In this *Icelandic settlement*, we see the debates for and against the database orientated on the notion of protecting or changing the way in which the population as a national resource is exploited (see also Pálsson and Harðardóttir 2002), rather than questioning

whether or not medical records should be treated as a national resource.

Thirdly, the discourse of a 'good population' is equally perpetuated by a media critique and a polarised debate that does little to highlight the complex relationships between the Icelandic population and their bio-information. There is a distinct contrast between the potential value of deCODE's statistical analyses and the dream many participants have that the GGPR will somehow be 'a revolution in medicine' (see also Winickoff et al. 2000, 1734). This impression is borne out by the accounts of the 'lay' participants in this research. The belief that the population is a vital and valuable resource for genetic science and will be the source of radical advances in healthcare and disease understandings closes down the areas of ethical and public concern. The debate about the HSD is reduced to a question of being either for or against scientific progress:

We started [asking], 'If we don't go for this database, what will it mean for our society and its economy?', instead of concentrating on the important ethical issues involved (Icelandic academic, July 2001).

The debates over the HSD operated within scientifically structured limits and created a series of networks and alliances and the boundaries between them are difficult to cut. Critics were either for or against not just deCODE, but science in general.

Fourthly, the debate then serves more to promote acceptance than controversy. In approaching the government with the proposals for the HSD legislation deCODE intervened in the creation of the social context for their practices, making this an 'Icelandic' issue, a concern of the state rather than the individual. This in turn gives deCODE and the Icelandic government authority in determining the terms of the debate. As Stengers (1997, 223) argues:

When it is a question of the complex problems posed by society, the only reason why some experts may claim "authority" is

⁵ Although there have been scientific questionings of the suitability of the Icelandic population for genetic studies. See Árnason et al. 2000.

their alliance with power, that is, when power has determined in what manner the 'problem' should be posed.

Part of the social contract is to normalise participation in the HSD and distance all but the most determined from challenging deCODE's scientific authority (Greenhough under revision). For example, deCODE's publicity material and HSD Act encourage people to relate to the proposed HSD in particular ways and through particular media (e.g. opinion polls, publicised debates and opt-out forms), creating a sense of a distance between Icelandic subject and bio-informatic resource. In the words of an interviewee:

I actually don't have to take part in this, so umm, not actively. So I don't feel like I'm taking part in it, they're just using information that's already there (Icelandic graduate, June 2001).

Scientific facts about the value of exploiting Iceland's genetic heritage make for sound political policies but this alliance of state and science conceptually as well as practically limits the possibilities for people to negotiate their own terms of participation. Many of the people to whom I spoke during fieldwork seemed either to have a basic understanding of the issues involved but were not inspired by them, or alternatively and despite all the aforementioned debate, felt simply unqualified to comment. This is not to say that people are not capable of appreciating the complexities of scientific and social debates, but rather that they are not engaged by them (see also Fortun 2001; Sigurdsson 2001).

These points offer, of course, a highly simplified account. As Haraway (1992, 330) rightly notes, "it would not do to approach science as cultural or social construction, as if culture or society are transcendent categories, any more than nature or the object is." While scientific classifications and modes of ordering inhabit the world in particular ways, and while they may occupy particular spaces in geography (Bowker and Star 2000, 316) this occupation is lived and practiced rather than imposed.

More recent thinking notes how scientific theory and practice also play a key role in problematising the division of nature and society, generating 'hybrid geographies' (Whatmore 2002) through practices such as genetic modification, stem cell technologies and xeno transplantation. This has led some to suggest that the spatial imaginations and practice of the new genetics are a potent site for re-thinking traditional relations between nature and society (Whatmore 1999; Spencer and Whatmore 2001; Bridge et al. 2003). Yet at the same time, there are some occasions where it would remain strategically advantageous for scientists if wider society accepted their 'truths' on trust. Furthermore, it would be hard not to argue that particular scientific understandings of the world have become deeply embedded in popular consciousness. For example, few people would now question the existence of DNA even though scientists themselves are now raising serious doubts about the extent of its influence over human development (Fox Keller 2000). It is therefore perhaps better to think of the divisions between science and culture, nature and society, not as something definitive or universal, but instead, in some cases, as something strategically deployed (through popular representations, debates, public engagement initiatives etc.) to engineer a specific social environment for the exportation scientific ideas. It is this strategic deployment, in the form of a biotechnological settlement, which I have sought to illustrate above.

So, is this a good model for science-society relations elsewhere? In some senses the HSD debate is very specific to Iceland, and as the above discussion makes clear, there are reasons why Iceland might be particularly receptive to this kind of a biotechnological settlement. However, the case does offer both pause for thought and a note for caution. After all, what happens when this agreement is unsettled? How far people endorse this perception of their role in deCODE's gene discovery work; how far they give credence to what Serres (1995) terms the *contract of scientific truth* and

deCODE's vital role in the advancement of medical knowledge could affect the availability of a 'good population' in the future. If deCODE's hopes for the role of the HSD in the advancement of medical knowledge are proved false then the *contract of scientific truth* is broken, and Icelanders may be less willing to participate in future scientific visions (Greely 2000). In accepting deCODE's right to use of national medical records, the majority of Icelanders are, it seems, placing a heavy investment in the contract of scientific truth. As subsequent events such as the rapid fall in deCODE share prices show, such investments may not pay off: 'Decode was meant to save lives ... now it's destroying them' (Meek 2002). Science creates new associations, for better or worse, but perhaps we should learn to see such associations not as universal truths or infallible authorities, but fallible 'views from somewhere'. Rather than accepting some form of biotechnological settlement, perhaps we need to invest more in changing the terms of the relationship between science and society, and seek out, maybe even demand, debates in which both scientific facts and social values are placed in question (see also Serres 1995; Latour 2004). Perhaps we need a new contract, a new kind of settlement?

Acknowledgements

I am grateful for the support of the UK Economic and Social Research Council who funded this research, and to the Department of Geology and Geography, University of Iceland, who hosted me during the fieldwork period.

BIBLIOGRAPHY

Árnason, E., E. Benedikz and H. Sigurgíslason 2000: Genetic homogeneity of Icelanders: fact or fiction? *Nature Genetics*, 25(4): 373–374.

Björnsdóttir, I.D. 1989: Public view and private voices. In: E.P. Durrenberger and G. Pálsson (eds.), *The Anthropology of Iceland*. Iowa: University of Iowa Press. Pp. 98–120.

Bowker, G.C. and S.L. Star 2000: *Sorting Things Out: Classification and its Consequences*. London: MIT Press.

Bridge, G., P. McManus and T. Marsden 2003: The next new thing? Biotechnology and its discontents. *Geoforum*, 34: 165–174.

Cliff, A. and P. Hagggett 1984: Island epidemics. *Scientific American*, 250(5): 110–117.

Cliff, A., P. Hagggett and M.D. Smallman-Raynor 2000: *Island Epidemics*. Oxford: Oxford University Press.

Coghlan, A. 1998: Selling the family secrets. *New Scientist*, (2163): 2.

Cunningham-Burley, S. and A. Kerr 1999: Defining the 'social': towards an understanding of the scientific and medical discourses on the social aspects of the new human genetics. *Sociology of Health and Illness*, 21(5): 647–668.

deCODE Genetics 1998: Questions and Answers. *What is the point of the centralized healthcare database?* www.database.is/spurningar/nr08.html (Accessed 2/99).

deCODE Genetics 2000: *Registration Statement*. www.freeEDGAR.com (Accessed 1/6/2000).

Driver, F. 1994: Making space. *Ecumene*, 1(4): 386–390.

Dumit, J. 1997: A digital image of the category of the person: PET scanning and objective self-fashioning. In: G.L. Downey and J. Dumit, *Cyborgs and Citadels*. Santa Fe: School of American Research Press. Pp. 83–102.

Erlingsson, S.J. 2001: *How a big company can distort a small and gullible society*. www.raunvis.hi.is/~steindor/gagn.html (Accessed 2/5/01).

Ettore, E. 1999: Experts as 'storytellers' in reproductive genetics: exploring key issues. *Sociology of Health and Illness*, 21(5): 539–559.

Fortun, M. 2001: Mediated speculations in the genomics futures markets. *New Genetics and Society*, 20(2): 139–156.

- Fox Keller, E. 2000: *The Century of the Gene*. London: Harvard University Press.
- Gibbs, W. 1998: Natural-Born Guinea Pigs. A start-up discovers genes for tremor and psoriasis in the DNA of inbred Icelanders. *Scientific American* 278(2): 34
- Greely, H.T. 2000: Iceland's plan for genomics research: facts and implications. *Jurimetrics*, 40(2): 153–191.
- Greene, S. 2004: Indigenous People Incorporated? Culture as politics, culture and property in pharmaceutical bioprospecting. *Current Anthropology*, 45(2): 211–237
- Greenhough, B. 2003: *Trading the island laboratory: new cartographies of Iceland's genetic heritage* (PhD-dissertation). Milton Keynes: Open University.
- Greenhough, B. (forthcoming): Decontextualised? Dissociated? Detached? Mapping the networks of bio-informatics exchange. *Environment and Planning A*
- Greenhough, B. under review: Imagining an island-laboratory: Representing the field in Geography and Science Studies. *Transactions of the Institute of British Geographers*.
- Greenhough, B. under revision: Situating Knowledges, Informing Consent. *Geoforum*.
- Gulcher, J., A. Helgason and K. Stefánsson 2000: Genetic homogeneity of Icelanders. *Nature Genetics*, 26(4): 395.
- Gulcher, J.R. and K. Stefánsson 2000: The Icelandic Healthcare Database and informed consent. *New England Journal of Medicine*, 342(24): 1827–1830.
- Hall, E. 2003: Reading maps of the genes: interpreting the spatiality of genetic knowledge. *Health and Place*, 9(2): 151–161.
- Harari, J.V. and D.F. Bell 1982: Introduction: Journal à plusieurs voix. In: J.V. Harari and D.F. Bell (eds.), *Hermes. Literature, Science, Philosophy*. London: John Hopkins University Press. Pp. ix–xl.
- Haraway, D.J. 1992: The Promises of Monsters. In: L. Grossberg (ed.), *Cultural Studies*. London: Routledge. Pp. 295–337.
- Haraway, D.J. 1997: *Modest_Witness@Second_Millennium.FemaleMan©_Meets_OncoMouse™. Feminism and Technoscience*. London: Routledge.
- Hayden, C. 2003: From market to market. Bioprospectings idioms of exclusion. *American Ethnologist*, 30(3): 359–371.
- Helgason, A. and G. Pálsson 1997: Contested commodities: the moral landscape of modernist regimes. *Journal of the Royal Anthropological Institute*, 3(3): 451–471.
- Hirsch, E. 1995: Introduction. Landscape: between space and place. In: E. Hirsch and M. O'Hanlon, *The Anthropology of Landscape: Perspectives on Space and Place*. Oxford: Clarendon Press. Pp. 1–30.
- Icelandic Parliament 1998: *Act no. 139/1998 on a Health Sector Database*.
- Jónsson, Ö.B. 1999: *exPORT Mountains Inc.* www.mannvernd.is/english/articles/obj.short.story.html (Accessed 17/10/2005).
- Kaprio, J. 2000: Science, medicine, and the future: Genetic epidemiology. *British Medical Journal*, (320): 1257–1259.
- Kelsey, J. 1995: *The New Zealand Experiment: A World Model for Structural Adjustment?* Auckland: Auckland University Press.
- Latour, B. 1983: Give me a laboratory and I will raise the world. In: K.D. Knorr-Cetina and M. Mulkay (eds.), *Science observed. Perspectives on the social study of science*. London: Sage Publications. Pp. 141–170.
- Latour, B. 1993: *We have never been modern*. London: Harvard University Press.
- Latour, B. 1999: *Pandora's Hope*. Harvard: Harvard University Press.
- Latour, B. 2004: *Politics of Nature*. London: Harvard University Press.
- Livingstone, D.N. 2002: *Science, space and hermeneutics. Hettner Lecture 2001*. Heidelberg: Department of Geography, University of Heidelberg.
- Livingstone, D.N. 2003: *Putting Science in its Place. Geographies of Scientific Knowledge*. London: University of Chicago Press.

- Meek, J. 2002: 'Decode was meant to save lives ... now it's destroying them'. www.guardian.co.uk/g2/story/0,822816,00.html (Accessed 17/10/05).
- Nash, C. 2004: Genetic kinship. *Cultural Studies*, 18(1): 1–33.
- Pálsson, G. 1999: *Bodily Commodities: Concerns about Biotechnology and Market Exchange in Europe*. www.hi.is/pub/anthrice/bodily-commodities.html (Accessed 27/9/2004).
- Pálsson, G. and K.E. Harðardóttir 2002: For whom the cell tolls. Debates about biomedicine. *Current Anthropology*, 43(2): 271–287.
- Parry, B. 2004: *Trading the Genome*. New York: Columbia.
- Redherring 1998: *Iceland startup DeCODE takes a homegrown approach to genomics*. <http://linkage.rockefeller.edu/wli/news/deCODE.html> (Accessed 17/10/2005).
- Rose, G. 1993: *Feminism and Geography*. Cambridge: Polity.
- Rose, H. 1994: *Love, Power and Knowledge: Towards a feminist transformation of the sciences*. Cambridge: Polity.
- Rose, H. 2001a: *The Commodification of Bioinformation: The Icelandic Health Sector Database*. The Wellcome Trust.
- Rose, H. 2001b: Gendered genetics in Iceland. *New Genetics and Society*, 20(2): 119–138.
- Schümer, D. 2000: *The Lucrative Genes of the Vikings: Iceland becomes the laboratory of biotechnology*. (transl. Mannvernd) www.mannvernd.is/english/news/ds.faz.engl.html (Accessed 17/10/2005).
- Serres, M. 1995: *The Natural Contract*. Ann Arbor, MI.: University of Michigan Press.
- Shapin, S. 1998: Placing the view from nowhere: historical and sociological problems in the location of science. *Transactions of the Institute of British Geographers*, 23 5–12
- Sharp, L.A. 2002: Comments on Pálsson and Harðardóttir (2002) 'For Whom the Cell Toll. Debates about Biomedicine'. *Current Anthropology*, 43(2): 296.
- Sigurðsson, S. 2001: *Yin-yang genetics, or the HSD deCODE controversy*. *New Genetics and Society*, 20(2): 103–117.
- Sigurðsson, S. 2000: The Dome of the World: Iceland, Doomsday Technologies, and the Cold War. In: I. Sigurðsson and J. Skaptason (eds.), *Aspects of Arctic and Sub-Arctic History. Proceedings of the International Congress of the History of the Arctic and Sub-Arctic Region, Reykjavik, 18–21 June 1998*. Reykjavik: University of Iceland Press. Pp. 475–485.
- Specter, M. 1999: Cracking the Norse Code. *Sunday Times Magazine*, 21st March 1999: 46–53.
- Spencer, T. and S. Whatmore 2001: Editorial: Bio-geographies: putting life back into the discipline. *Transactions of the Institute of British Geographers*, 26(2): 139–141.
- Stengers, I. 1997: *Power and Invention. Situating Science*. Minneapolis: University of Minnesota Press.
- Strathern, M. 1996: Cutting the Network. *Journal of the Royal Anthropological Institute*, (2): 517–535.
- Terrel, J.E., T.L. Hunt and C. Gosden 1997: The dimensions of social life in the Pacific. Human diversity and the myth of the primitive isolate. *Current Anthropology*, 38(2): 155–195.
- Whatmore, S. 1999: Geography's place in the life-science era? *Transactions of the Institute of British Geographers*, 24: 259–260.
- Whatmore, S. 2002: *Hybrid Geographies: Natures Cultures Spaces*. London: Sage Publications.
- Winickoff, D., E. Arnason, J.R. Gulcher and K. Stefánsson 2000: The Icelandic Healthcare Database. *New England Journal of Medicine*, 343 (23): 1734–1735.
- Zoëga, T. and B. Andersen 1999: The Icelandic Health Sector Database: deCODE and the "new" ethics for genetic research. In: "Who Owns Our Genes?" *Proceedings of an International Conference October 1999, Tallinn, Estonia*. Copenhagen: Nordic Council of Ministers.