

Sex, Science and Symbiosis

Feminism and Queer Theory in a More-than-human World

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Thesis Summary

This thesis interrogates various accounts of the relationship between the biological and social. Often the biological is conceptualised as built upon, or originating from, the foundation of the social (or vice versa). I suggest an alternative approach, using various resources and approaches from the sciences and from social theories, to reconceptualise the biological and social as always already entangled.

I develop an account of the entanglement of the biological and social that also entangles the ontological and epistemological, matter and meaning. I begin by exploring feminism and sociobiology in the 1970s and 1980s, particularly feminist standpoint and postmodernist epistemologies. Building on this, and developing my approach (particularly in terms of conceptualising material and more-than-human agency), I explore queer and deconstructive approaches to sexuality alongside the Human Genome Project and genetic determinism in the 1990s, and more recent theories of kinship from gender and sexuality studies alongside insights from animal studies and critical posthumanisms. Finally, I interrupt this trajectory, suggesting that the so far uninterrogated opposition of living/non-living that structures biological science is threatened by the liminal status of viruses. More importantly, people living with viruses can become liminal in relation to this and other binary oppositions, with consequences for their health and ability to live well.

I propose an approach to living well that is both ecological and queer; connections, symbioses and entanglements are crucial throughout. I argue that attention to the entanglement of the biological and social offers a way of interrogating narratives of biological determinism and for countering the effects of patriarchy and heteronormativity in the theory and practice of science. Furthermore, this approach can offer ways of rethinking the production of scientific knowledge and the effects this has on the possibility of living well as biopolitical citizens in the more-than-human world.

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‘There are two aspects to emphasize when discussing biology. The first is: *We live intimately “as” and “in” a biological world.*

This may seem obvious but I emphasize it to reiterate the ordinariness or quotidian nature of what we are talking about when we talk about biology. And the second aspect, which represents a major gestalt switch from the previous point, is: *Biology is a discourse and not the world itself.*’

Donna Haraway, *How Like a Leaf: An Interview with Thyrza Goodeve* (New York: Routledge, 2000), p. 25

Introduction

Strange Bodies, Strange Pleasures

‘Biology need not be a purveyor of essentialism, of rigid universals.

Biology need not limit our potential.’

Joan Roughgarden, *Evolution’s Rainbow*¹

On the 18th January 2010, *The Times* published an article by Patrick Muirhead entitled ‘The Day I Decided to Stop Being Gay’. In the article, the former BBC newsreader describes how, twenty years after coming out, he witnesses a father and son in a barber’s shop and this leads to his decision to ‘stop being gay’. Specifically, in this moment, he decides that he not only wants a child, but also a wife and to reject what he describes as the ‘lifestyle’ of homosexuality.² The article is problematic for many reasons, including Muirhead’s reduction of all homosexuality to his twenty years of personal experience of ‘cavorting’ with men, as he describes it: from ‘pubescent fumbling’ to ‘numerous hours of internet dating; a dizzying number of casual couplings and a few trips to genitourinary medicine clinics’.³ Muirhead associates homosexuality with promiscuity and disease, while associating heterosexuality with procreation, family and love (although interestingly not

¹ Joan Roughgarden, *Evolution’s Rainbow: Diversity, Gender, and Sexuality in Nature and People* (California: University of California Press, 2004), p. 180.

² Patrick Muirhead, ‘The Day I Decided to Stop Being Gay’, *The Times Online*, 18 January 2010 <http://www.timesonline.co.uk/tol/life_and_style/men/article6990013.ece> [accessed 10 July 2010] (para. 12 of 38). The article was simultaneously published in the T2 supplement of *The Times* print edition under the title: ‘I want a wife to love and a child to protect: Twenty years after he came out, Patrick Muirhead, 41, explains why he is suddenly feeling the appeal of the opposite sex’, 18 January 2010, p. 2–3. I am primarily referring to the online version, as the online comments are particularly interesting and illuminating in relation to my thesis.

³ Muirhead, ‘The Day I Decided to Stop Being Gay’ (para. 19 of 38).

monogamy – he states ‘Would I keep faithful? Well, I would try. The same siren voices to stray call to all men, all the time. I would be no different’).⁴

While the article itself is interesting and problematic, a comment that was made on the online version of the article is particularly arresting and is illustrative of a number of the issues that I raise in this thesis. After congratulating Muirhead on his decision, the commentator states, ‘I think [...] you will enjoy yourself a whole lot more putting it where it was designed to go.’⁵ There are two key assumptions at work in this statement. First, that it – the penis – was designed to go in the vagina for the purposes of procreation. This assumption has echoes of the Judeo-Christian creation myth where the creation of complementary male and female bodies was followed immediately by the imperative: ‘Be fruitful and multiply’.⁶ This is not necessarily solely a religious imperative, however, and the idea of self-evidently complementary male and female bodies and seemingly inevitable heterosexuality is not confined to religious rhetoric. Compulsory heterosexuality and the supposed complementarity of male and female bodies, for example, are also central to many evolutionary origin stories.⁷ As Roger N. Lancaster states:

Heterosexuality, like nature, is ‘there from the first day’. Or rather, heterosexuality *is* the first day – the very principle of origin, creation, and generation. By extension, heterosex – that is, reproductive sex: penis-in-vagina-to-the-point-of-ejaculation-sex – is ‘real’ sex, manifestly revealed in the design of the genitalia. (That’s what sex is *for*, isn’t it?)⁸

⁴ Muirhead, ‘The Day I Decided to Stop Being Gay’ (para. 32 of 38). See also the following response to Muirhead’s article: David L. Rattigan, “‘Ex-gays’ side with prejudice”, *The Guardian*, 20 January 2010 <<http://www.guardian.co.uk/commentisfree/2010/jan/20/ex-gay-prejudice-attack>> [accessed 20 November 2012].

⁵ Muirhead, ‘The Day I Decided to Stop Being Gay’. Online comments accessed 10 July 2010, but no longer available online.

⁶ Genesis 1. 28.

⁷ I take the term ‘compulsory heterosexuality’ from Adrienne Rich, ‘Compulsory Heterosexuality and Lesbian Existence’, *Signs*, 5:4 (1980) 631-660, in which she employs the term to think about heterosexuality as an all-pervading western political institution in which homosexuality and other non-normative acts and identities will always be marginal or deviant.

⁸ Roger N. Lancaster, *The Trouble with Nature: Sex and Science in Popular Culture* (Berkeley, CA: University of California Press, 2003), p.38.

Second, the statement assumes that by putting *it* where *it* was designed to go, Muirhead should enjoy himself a lot more; that is, 'correct' sexual use of the body should produce more and better pleasure than the non-normative or incorrect uses alluded to in Muirhead's article. The link between the body, sexual acts and pleasure is seemingly natural and unproblematic; bodies are self-evidently designed for procreation, and the complementarity and congruence of correct orientation between the male and female body (should) lead to greater enjoyment than any other wrong, or queer, alignment.

This example demonstrates a particular normative attitude to the body. It also begins to demonstrate the complex interdependent relationship between social attitudes towards the body and biological 'facts' about the body. In this thesis I will explore this relationship, arguing that the biological and the social are not independent but are, in fact, inseparable. I will argue that attention to the inseparability of the biological and the social is important for a number of reasons. Chief among these is the fact that living well depends on both biological and social factors. In terms of health, the biological body is always already part of a multispecies world and health is often dependent upon the negotiation of the human's relationship to nonhuman others such as bacteria and viruses. Illnesses and health practices (as well as the conceptualisation of multispecies relationships) are, although always embodied and biological, always emphatically social issues. I will argue this in detail in the final chapter in relation to social attitudes towards bodies infected with HIV/AIDS. Living well is a negotiation of the entangled relationship of the biological and the social. My focus in this thesis is on how gendered and sexual bodies are understood in terms of this biological-social entanglement, and what the consequences are for living well in a world of multispecies relationships. I will ask a number of questions in the thesis, but there are two questions that underlie the thesis as a whole. First, are there ways in which the theories and practices of the biological sciences can offer opportunities rather than constraints for gender and sexuality studies, for living well, and for bringing about more equitable futures? Instead of supporting conservative and normative narratives (such as those implicit in the statement that you should enjoy yourself

more when you put it where it was meant to go), could biology offer radical, alternative and more equitable narratives, bodies of knowledge, and ways of living? Second (and conversely), can theories and practices from gender and sexuality studies, as well as closely related work from animal studies and ecological thinking, offer opportunities to those working in science and biomedicine?

This is a feminist project, and as such Chapter One outlines the development of feminist approaches to the sciences, as well as exploring a particular example of a feminist attempt to rewrite a narrative from the biological sciences. Chapter One seeks to demonstrate that while patriarchy can be seen to structure the theory and practice of evolutionary science, this is not inevitable and there are other ways of producing evolutionary narratives for different political and social purposes. My project is also a queer project, and as such Chapter Two explores the development of queer theory and its relation to the feminist approaches outlined in the first chapter. The focus of the chapter is a clear example of the entanglement of the biological and social: the search for gay genes. This is also a particularly pertinent example of why the entanglement of the biological and social matters, as a genetic basis for homosexuality (or a lack of one) is important for queer politics. As in Chapter One, I suggest in this chapter that biological determinism is not the only option, and that the biological sciences offer opportunities for alternatives. I offer an alternative account of 'gay genes' that I argue is more attentive to the biological complexity of genes and to the social complexities of sexuality. The main question of my project is how to live well, and as I have stated, this is always a worldly multispecies negotiation.

Chapters Three and Four build upon the theoretical foundations of the first two chapters to suggest a novel approach to the biological-social entanglement of the human with bacteria, viruses and other infectious microorganisms. Once again, my questions of how the biological and the social can offer opportunities for each other through their interrelationship are important here. And once again, my argument is that biological determinism is not the only option when considering this relationship. Chapter Three develops my approach to the relationship with the microbiological, and

begins to think through some of the biosocial consequences of this relationship. Focusing more specifically on viruses, and the biosocial and biopolitical consequences of being entangled with the microbiological, Chapter Four explores living with HIV/AIDS. Drawing together the insights of the previous chapters I offer an account of living with the virus that can provide resources for gender and sexuality studies, as well as biological and biomedical sciences. The work done in the earlier chapters is essential to develop an approach that is faithful to the real and material nature of the virus and of infected bodies, while recognising the ways in which infected viruses and bodies are configured, constructed and then treated with scientific and biomedical knowledge. My project is feminist, queer and ecological, and asks what opportunities can be produced when these areas are put into conversation with the biological sciences. The thesis argues that through this conversation, resources can be developed for both the sciences and for gender and sexuality studies, resources that are directed towards bringing about more equitable futures where people (healthy or otherwise) can live well in this entangled multispecies world.

Bodies and Pleasures

In her article ‘Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective’, Donna Haraway states:

I think my problem and ‘our’ problem is how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects [...] *and* a no-nonsense commitment to faithful accounts of a ‘real’ world.⁹

This ‘problem’ – the need to account for the material specificity and ‘realness’ of bodies, and of the world, while simultaneously emphasising the historically and socially contingent nature of all knowledge claims about this real world – is one that informs my entire project. As I have stated, I

⁹ Donna Haraway, ‘Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective’, *Simians, Cyborgs, and Women: The Reinvention of Nature* (London: Free Association Books, 1991), pp. 183–201 (p. 187).

approach the biological and social as not independent, but as always already interrelated and inseparable. This has a number of consequences, a number of which I have just outlined. In the thesis I will argue that attention to the inseparability of the realness of the world and the contingency of accounts of the world, in terms of the entanglement of the biological and social, can offer alternatives to biological determinist and normative accounts of bodies, pleasures, health and communities.

A lot of work has been done in gender and sexuality studies to resist normative accounts of bodies and pleasures – what Michel Foucault calls, in the final section of the first volume of *The History of Sexuality*, ‘that austere monarchy of sex’.¹⁰ For Foucault, bodies and their associated pleasures can be resistant, and can counter the normative narrative of complementary male and female bodies, and compulsory reproductive heterosexuality. Elsewhere Foucault focuses on non-normative practices such as S&M to elaborate on this point, insisting that ‘we can produce pleasure with very odd things, very strange parts of our bodies, in very unusual situations’.¹¹ Heteronormative logic and rhetoric – often informed by and informing evolutionary narratives – specifies and depends upon a right and wrong use of the body. Odd things, strange body parts and unusual situations, in this narrative, can be interpreted as wrong things, body parts and situations. Yet these ‘wrong’ configurations of objects, bodies and situations can in fact produce pleasure, and this pleasure, for Foucault, can be resistant. Speaking of the same passage in Foucault, David Halperin argues that the emergence of sexual and subcultural phenomena such as S&M and fist-fucking ‘has the potential to contribute to redefining both the meaning and the practice of sex’.¹² In this Foucauldian approach, bodies and pleasures seem to offer productive sites of resistance to compulsory heterosexuality and normative reproductive sex.

¹⁰ Michel Foucault, *The Will to Knowledge*, trans. by Robert Hurley, *The History of Sexuality*, Vol I, 3 Vols (Hammondsworth: Penguin, 1990), p. 159.

¹¹ Foucault, ‘Sex, Power and the Politics of Identity’, in *Ethics: Subjectivity and Truth*, ed. by Paul Rabinow, trans. by Robert Hurley and others (London: Allen Lane, 1997) pp. 163–174 (p.165).

¹² David M. Halperin, *Saint Foucault: Towards a Gay Hagiography* (Oxford: Oxford University Press, 1995), p. 91.

Popular evolutionary narratives are often based upon the assumption that evolution has developed or designed male and female bodies so that they complement each other. This assumption often surfaces in terms of an over-emphasis on adaptationism, which I will discuss in detail in Chapter One. In this account, all physiology and behaviour must have an evolutionary function, and must be adaptations that somehow improve the likelihood of passing on genes. Bodies and pleasures, then, from an adaptationist perspective, must have evolved as an adaptation, and exist only to promote procreation and the continuation of the species. In these terms, homosexuality is difficult to explain, as are all non-normative and non-procreative sexual uses of the body, and this is true for both humans and nonhumans.¹³ In this approach, homosexuality and other non-normative configurations of bodies become either deviations or throwbacks; alternatively, they must be explained by some circuitous logic wherein homosexuality actually promotes or supports heterosexuality (importantly heterosexual reproduction, not necessarily heterosexual pleasure). In these terms, putting *it* where *it* was designed to go really should lead to more and better pleasure. Sexual pleasure, after all, must be for the continuation of the species, and male and female bodies must have evolved to complement each other, just as sexual pleasure must have evolved to promote procreation. In contrast, non-normative uses of the body (and the strange pleasures that can result) question and challenge the logic of adaptationism, and can disrupt and threaten the heteronormativity in this approach.

The use of the body in non-normative ways and the non-normative pleasures that arise can offer new ways to think of the body, the individual and the community. A Foucauldian analysis of a practice such as S&M undermines the self-evidence of bodily design, sex and sexuality illustrated in the online comment on Muirhead's article. The obviousness of the reference – 'it' clearly refers to the penis, while 'where it was designed to go' clearly refers to the vagina – illustrates this supposed self-evidence of the complementarity of male and female bodies in heterosexual reproduction.

¹³ For accounts of non-normative sexual behaviour in nonhumans, see Bruce Bagemihl, *Biological Exuberance: Animal Homosexuality and Natural Diversity* (London: Profile, 1999); and Roughgarden, *Evolution's Rainbow*.

Foucauldian readings of non-normative bodies and pleasures undermine this, and the related assumption that more and better pleasure is produced by normative configurations of bodies than any other. Foucault's insistence on the resistance of bodies and pleasures, however, is not without its problems. Judith Butler argues that celebrating bodies and pleasures over sex-desire is problematic for a number of reasons. She argues that to replace sex-desire with bodies and pleasures simply inverts the binary opposition and in turn actually reifies the distinction: '*Not sex-desire, but bodies and pleasures*; a strange binarism at the end of a book that puts into question binary opposition at every turn.'¹⁴ Butler argues that an insistence on bodies and pleasures at the expense of sexuality can be seen in contemporary queer studies, and suggests that the exuberance with which queer theory attempts to abandon sexuality for bodies and pleasures is related to the attempt to abandon the past, and with it the categories of gender and sex-desire.¹⁵ The inverting of a binary opposition which, in fact, leaves the structure of opposition intact is problematic for queer theory. In Chapter Two I argue for a queer theory that is formulated as a deconstructive approach to sexuality. Following the work of Jacques Derrida and feminists engaging with deconstructive approaches to gender, I argue that 'queering' must not just invert hierarchical binary oppositions, but deconstruct these oppositions and the structures in and with which they are articulated.

A subtlety of this deconstructive queer approach to sexuality and to the body is that the body is necessarily active and agential, and always already deconstructing and queering itself. Derrida argues that deconstruction is not a process performed by a knowing subject, but rather is always already happening, and to itself. As he states, 'Deconstruction takes place, it is an event that does not await the deliberation, consciousness, or organization of a subject, or even of modernity. *It*

¹⁴ Judith Butler, 'Revisiting Bodies and Pleasures', *Theory Culture Society*, 16:2 (1999), 11–20 (p. 16–17).

¹⁵ For further discussion of the relationship between gender and sexuality in the context of queer theory, feminism, and lesbian and gay studies, see Butler, 'Against Proper Objects', in *Feminism Meets Queer Theory*, ed. by Elizabeth Weed and Naomi Schor (Bloomington, IN: Indiana University Press, 1997), pp. 1–30; and Biddy Martin, 'Extraordinary Homosexuals and the Fear of Being Ordinary', in *Feminism Meets Queer Theory*, pp. 109–135; and Martin, 'Sexualities without Genders and other Queer Utopias', *Diacritics*, 24:2/3 (1994), 104–121. The birth of queer theory and its relation both to feminism and to gender and sexuality studies is discussed at length in Chapter Two.

deconstructs itself. It can be deconstructed [Ça se deconstruit].'¹⁶ A deconstructive queer approach to the body and to sexuality suggests that the body is queer and is always already queering itself without the need for a subject who is 'doing' the queering. This queerness of the body itself is often not recognised or interrogated in accounts of queer uses of the body, and of non-normative acts and pleasures. In Foucauldian terms, we may be able to produce pleasure with 'strange parts of our bodies', but I argue that the body is always itself strange, and this strangeness of our bodies can be read as resistant. It is, in fact, a central argument of my thesis that the body is itself queer, both biologically and socially.

The strangeness of bodies

Work has been done in feminist and queer theories to recognise the complex and active character of the body, while attending to the ways in which bodies are constructed in particular historical and cultural moments. Judith Butler's work in particular has drawn attention to the ways that bodies come to matter (in all senses of the word). Through the critical lens of performativity, Butler suggests that bodies are active sites of negotiation between matter and meaning. Although her work emphasises the ways in which bodies are constructed in, and understood through, discourse, her work does not make a purely constructivist claim. Rather, Butler's work seeks to explore the fact that bodies are real *and* constructed, material *and* semiotic. Indeed, in an interview, she states of her approach as outlined in her 1990 and 1993 works *Gender Trouble* and *Bodies that Matter*, that:

It would be equally right – or possible – to say that it seeks to understand why the essentialism/constructivism debate founders on a paradox that is not easily or, indeed, not ever overcome. Just as no prior materiality is accessible without the means of discourse, so no discourse can ever capture that prior materiality; to claim that the body is an elusive

¹⁶ Jacques Derrida, 'Letter to a Japanese Friend', *Psyche: Inventions of the Other, Volume II*, ed. by Peggy Kamuf and Elizabeth Rottenberg (Stanford, CA: Stanford University Press, 2008), pp. 16–19.

referent is not the same as claiming that it is only and always constructed. In some ways, it is precisely to claim that there is a limit to constructedness, a place, as it were, where construction necessarily meets its limit.¹⁷

Butler's denaturalisation of the body and of biological matter is foundational for queer theory and important in my approach to the biology of bodies. Not only this, but Butler's insistence on not resolving the tension and paradox between essentialist and constructivist accounts of matter and meaning is important, and is explored in more depth in Chapter Two.

There is an important way in which the body can be read as strange or queer that is often not accounted for in gender and sexuality studies, and which this thesis attempts to articulate in a number of different ways. Crucially, for my project, the human body is always already queer to itself because of its nonhuman origin and composition (evolved from prehuman apes, and full of microbiological agencies), and also because of the problems involved in isolating the human body or defining its limits. This is both an ontological and epistemological claim, as it concerns the body as a 'real' material entity and the discourses and bodies of knowledge that produce this entity. In fact, the entanglement of ontology and epistemology (as a corollary to the entanglements of matter and meaning and of the biological and social) is central to my thesis. My approach builds on a number of theoretical engagements with this entanglement, especially Haraway's work on the inseparability of the material and the semiotic and the natural and cultural, and Karen Barad's insistence on the entanglement of matter and meaning, as well as the ontological, epistemological and ethical.¹⁸ Entanglement is an important phenomenon, concept and figure for my project. Barad explores entanglement and diffraction as quantum physical phenomena that can also be employed in critical theories of bodies and knowledge, matter and meaning. Entanglement, specifically, refers to the

¹⁷ Irene Costera Meijer and Baukje Prins, 'How Bodies Come to Matter: An Interview with Judith Butler', *Signs*, 23:2 (1998), 275–286 (p. 278). See Butler's *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990) and *Bodies That Matter: On the Discursive Limits of "Sex"* (New York: Routledge, 1993).

¹⁸ Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (London: Duke University Press, 2007).

necessary and performatively co-constitutive relationships that precede the facts and objects of matter and meaning. Bodies and discourse, matter and meaning, and the biological and the social are, for Barad, performatively co-constituted: neither one precedes the other, nor pre-exists their entangled and entangling relationship. I explore this in more depth in Chapter Two, in reference to discourses of genetic determinism surrounding the Human Genome Project, and the material specificity of genes. I argue that the biological specificity of genes and the social meanings that are associated with genes and genetic discourse produce (or performatively co-constitute) one another; the biological and the social are always already entangled. This perspective leads to an account of the biological-social body that is (right down to its genes) complex, active, agential and queer.

This queerness of the biological-social body is, I argue, dormant in all evolutionary narratives, even when these support or are supported by conservative heteronormativity. The nonhuman ancestry of human bodies problematises attempts at attributing fixity and stability to the category of human. This challenging and problematic character of Darwinian evolutionary theory can be threatening to normative and conservative notions and narratives that rely on human exceptionalism, and reveal a non-normative potential in Darwinism. Charles Darwin's theory of evolution by natural selection was originally considered so challenging to accepted notions of human sovereignty at the time that in 1860, Bishop Samuel Wilberforce described Darwin's theory as 'utterly irreconcilable' with man's self-evident 'supremacy over the earth'.¹⁹ This threatening element of Darwinism is often effaced or ignored, and Darwinism and neo-Darwinism have served a variety of conservative agendas or purposes since the publication of Darwin's *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* in 1859.²⁰ Sociobiology, for example, which I discuss in Chapter One, was interpreted by many critics as not only following faulty scientific logic, but serving conservative ideological ends, and upholding

¹⁹ Samuel Wilberforce quoted in Robert Young, *Darwin's Metaphor* (Cambridge: Cambridge University Press, 1985), p. 8.

²⁰ Charles Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1859).

the patriarchal status quo. However, it is my argument that the threatening and subversive elements of Darwinian evolutionary theory are dormant even in these conservative accounts, and in all evolutionary accounts of the biological and social human body. This is demonstrated by Elaine Morgan's feminist retelling of the narrative of descent from the perspective of the female prehuman ape, discussed in Chapter One. Biology and evolutionary theory are not necessarily conservative and can offer the opportunity for the production of subversive narratives and (re)interpretations.

More-than-human Entanglement

Not only has the human body evolved from pre-human others, but the current composition of the body demonstrates nonhuman (or 'more-than-human') reliance or entanglement. Bacterial cells outnumber human cells in the body ten to one, and the human body is, in a very real way, a bacterial community.²¹ The bacteria that live in the human gut for example, the human gut microbiota, are essential for digestion. Gut microbiota and humans have co-evolved over thousands of years and are involved in a long-term relationship of mutual dependence and co-constitution. Digestion (which I will discuss along with the concept of *indigestion* in Chapter Three) is always, then, a multispecies process. Similarly, all plant and animal cells, including those of humans, contain organelles that have evolved from free-living bacteria. These organelles – chloroplasts in plants and mitochondria in animals – produce energy for the cell which is essential for life. This interdependence and entanglement of the human and the bacterial demonstrates both the more-than-human origin and composition of the human body as well as the complications and problems involved with defining the human. Human-bacterial entanglement, then, raises biological-social questions to humanism and to the doctrine of human exceptionalism. Human exceptionalism – the view that humans are the pinnacle of evolution and that this grants them mastery over all

²¹ Jennifer Ackerman, 'How Bacteria in Our Bodies Protect Our Health', *Scientific American*, 15 May 2007 <<http://www.scientificamerican.com/article.cfm?id=ultimate-social-network-bacteria-protects-health>> [accessed 17 February 2013].

nonhuman species – is threatened by human-bacterial entanglement, as it questions the human's position at the highest point of evolution as well as suggesting the impossibility of isolating and defining the human. This project focuses on more-than-human interdependence and entanglement and attempts in a number of different ways to account for more-than-human agency. More-than-human agency is, in fact, essential to the project's challenge to humanism and the doctrine of human exceptionalism.²²

The question of how to account for more-than-human agency is important to my thesis and in my approach I use resources from a number of different areas. I explore scientific accounts of bodies, organisms, behaviours and practices, and while always remaining aware that scientific theory and practice is produced and maintained within socially and historically specific paradigms, the attempt to account for the material specificity of bodies and organisms in scientific publications is essential to my approach. I explore feminist and queer approaches that emphasise the active and agential character of the body. These include approaches from new materialism as well as approaches from feminist technoscience studies.²³ These approaches are useful, as they call attention to the ways in which bodies are constructed, produced and controlled in specific historical and social circumstances, and the ways in which bodies and technologies are always already entangled. I also use approaches and resources from animal studies that attempt to break down the hierarchical divide between the human and the animal. Work has been done in animal studies to challenge this divide, as it strengthens and supports human exceptionalism by disallowing agency (as

²² Posthumanism, and the kinds of critical posthumanisms that inform this project, will be discussed in more detail in Chapter Three. For more general introductions to the field, see *Posthumanism*, ed. by Neil Badmington (Houndmills: Palgrave, 2000); Neil Badmington, 'Theorizing Posthumanism' *Cultural Critique*, 53 (2003), 10–27; and N. Katherine Hayles, *How we became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

²³ New materialism is most often associated with writers such as Karen Barad, Rosi Braidotti, and Elizabeth Grosz. For an introduction to the field of new materialism, see *New Materialisms: Ontology, Agency, and Politics*, ed. by Diana Coole and Samantha Frost (Durham, NC: Duke University Press, 2010). Feminist technoscience studies is a varied and interdisciplinary field. For useful genealogies of feminist technoscience studies see Maureen McNeil, *Feminist Cultural Studies of Science and Technology* (London: Routledge, 2007); and Nina Lykke, 'Feminist Cultural Studies of Technoscience: Portrait of an Implosion', in *Bits of Life: Feminism at the Intersections of Media, Bioscience and Technology*, ed. by Anneke Smelik and Nina Lykke (Seattle: University of Washington Press, 2008), pp. 3–15.

well as, among other things, language and culture) to animals, and this is useful to the attempt to account for *all* more-than-human agency, not just that of animals.²⁴ My project is also indebted to work done in and around Actor Network Theory, specifically that of Bruno Latour.²⁵ My insistence on the entanglement of the biological and the social (as well as the ontological and epistemological and of matter and meaning) is indebted to Actor Network Theory's insistence on the links between the material and the semiotic. This project maps some networks of more-than-human agency, thinking of these more-than-human connections and networks as ecological entanglements.

Ecological thought and criticism is important to this thesis, and I explore some specific connections and entanglements between the human and the more-than-human world. These connections and entanglements include those with pre-hominid apes, genes, bacteria and viruses. In the third and fourth chapters I develop a queer ecological approach. In particular I develop claims by Timothy Morton that ecological thinking is always already queer, while exploring work done at the intersection of ecofeminism, ecological theory and gender and sexuality studies, tentatively titled 'queer ecologies'.²⁶ Morton explicitly sets his queer ecological thinking apart from much ecofeminist work; however, the work of feminists in ecological and environmental studies is foundational to the development of an approach that is both ecological and queer.²⁷ As well as being indebted to these ecological and environmental projects, I also align my queer ecological approach developed in the later chapters with the feminist postmodernist and deconstructive epistemologies discussed in

²⁴ See, for example: Erica Fudge, *Animal* (London: Reaktion, 2002).

²⁵ See Bruno Latour's *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open University Press, 1987); 'On Actor Network Theory. A Few Clarifications plus more than a Few Complications', *Soziale Welt*, 47 (1996), 369–381; and *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005).

²⁶ Timothy Morton, 'Queer Ecology', *PMLA*, 125:2 (2010), 273–282. For further elaboration of Morton's approach to ecology, see his *Ecology without Nature: Rethinking Environmental Aesthetics* (Boston, MA: Harvard University Press, 2007); and *The Ecological Thought* (Cambridge, MA: Harvard University Press, 2010). See also *Queer Ecologies: Sex, Nature, Politics, Desire*, ed. by Catriona Mortimer-Sandilands and Bruce Erickson (Indiana: Indiana University Press, 2010).

²⁷ Although feminist ecocriticism and environmental studies are wide-ranging fields, the following can be considered key texts or introductions: Val Plumwood, *Feminism and the Mastery of Nature* (New York: Routledge, 1993); *Environmental Culture: the Ecological Crisis of Reason* (New York: Routledge, 2002); *Ecofeminism: Women, Animals, Nature*, ed. by Greta Gaard (Philadelphia: Temple University Press, 1993); and Maria Mies and Vandana Shiva, *Ecofeminism* (Halifax, NS: Fernwood Publications, 1993).

Chapters One and Two. These feminist postmodernist and deconstructive epistemologies emphasise the political nature of networks and connections, and this is important for thinking through the importance of responsibility in the entangled web of ecological relationships with the more-than-human world.

As I stated earlier, the work of Haraway is important throughout my project. Her article, 'Situated Knowledges' is an important resource for my first chapter, as it provides a way to think through some of the tensions in feminist epistemologies and feminist engagements with science and objectivity. Haraway's 1997 work,

Modest_Witness@Second_Millennium.FemaleMan@_Meets_OncoMouseTM: Feminism and Technoscience, is a key resource for my second chapter, as I focus on the Human Genome Project and the phenomenon and critical practice of diffraction. Once again, in this work, Haraway is dedicated to maintaining the tension of needing faithful accounts of a 'real' world and recognising the always historically and culturally situated nature of all knowledge claims about the world. Chapters Three and Four explore and elaborate Haraway's companion species framework and approach that she outlines in *The Companion Species Manifesto: Dogs, People, and Significant Otherness* and *When Species Meet*.²⁸ Haraway's companion species framework is important as it suggests that more-than-human entanglement is always performative and co-constitutive. She emphasises that the human and the more-than-human become with each other through these performative relationships, and this notion of multispecies becoming-with is central to my

²⁸ Donna Haraway, *The Companion Species Manifesto: Dogs, People, and Significant Otherness* (Chicago: Prickly Paradigm Press, 2003); and *When Species Meet* (Minneapolis: University of Minnesota Press, 2008).

conceptualisation of entanglement as both performative and constitutive, for the human and the more-than-human.²⁹

Apes, Genes, Bacteria, Viruses

In Chapter One, 'Connections: Sociobiology, Feminist Apes, and Cyborgs', I discuss feminist engagements with the natural sciences in the late 1970s and 1980s. In particular I consider different feminist approaches to patriarchy in the theory and practice of evolutionary biology. Taking the publication of Edward O. Wilson's *Sociobiology: The New Synthesis* in 1975 as an important moment in post-Darwinian evolutionary theory, I analyse certain claims put forward by Wilson as well as looking at feminist criticisms of *Sociobiology* that were published in the late 1970s and 1980s. As well as discussing Wilson's text, I also focus on a particular example of a feminist attempt to write an evolutionary (and sociobiological) narrative from the perspective of the female ape. Elaine Morgan's work on the Aquatic Ape Hypothesis is just such a project, and illustrates certain tensions in feminist engagements with evolutionary science at this time. Morgan's work employs a sociobiological approach to create a narrative of female descent, from pre-hominid apes to contemporary female bodies and experience. I contextualise Morgan's work with the feminist criticism of Wilson's *Sociobiology* published in the late 1970s and early 1980s, and from this perspective Morgan's work can appear problematic; it appears to replicate the sorts of biological determinism that are at work in Wilson's text, which often do nothing more than confirm a rather conservative social status quo. However, by further exploring work done by feminists engaging with science in the 1980s – specifically feminist standpoint epistemologies and feminist postmodernism – I argue that Morgan's

²⁹ It is worth stating that this notion of multispecies becoming-with is taken from Haraway, and not associated with the Deleuzian notion of becoming-animal. Haraway explicitly disassociates her multispecies becoming-with from the becoming-animal that is outlined in Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. by Brian Massumi (Minneapolis: University of Minnesota Press, 1987) in *When Species Meet*, pp. 27–30. As she states elsewhere: 'I think part of my own allergy to (too much of) Deleuze comes from years of being named as a Deleuzian, when my conversations are overwhelmingly with other folks (many of whom are or were graduate students), especially biologists, feminist theorists, geographers, anthropologists, and ordinary animal people (many of whom crowd the pages and endnotes of WSM).' (Donna Haraway, 'When Species Meet: Staying with the Trouble', *Environment and Planning D: Society and Space*, 28 [2010], 53–55 [p. 53, n. 2]).

work can be read in a more productive way. Crucially, this approach suggests that Morgan's narrative can be read as usefully interrogating and challenging certain hierarchical binary oppositions at work in Wilson's and other sociobiological narratives. Central among these are the oppositions of male/female, subject/object, active/passive, and agent/resource, as well as human/nonhuman, in terms of the relationship of contemporary human embodiment and society to those of prehumanid apes. This chapter explores the historical development of feminist engagements with the science as well as demonstrating, through Morgan's work, the possibility of alternative narratives and knowledges within science. The idea of connection is important in this first chapter; connections across binary divides and between the contemporary human and the prehumanid ape make possible certain situated engagements with, and responses to, the patriarchal and the conservative in the theory and practice of evolutionary science.

In Chapter Two, 'Entanglements: Diffraction, The Human Genome Project and Queer(ing) Genes', I will follow the trajectory of my thesis into the 1990s to discuss the meeting of feminism with queer theory and deconstruction. I discuss this alongside the proliferation of narratives of genetic determinism that surrounded the Human Genome Project. A central concern of this chapter is the debate about the origins of sexuality that is often crudely expressed in the terms 'born' or 'made'. To contextualise, in the early 1990s feminists were engaging with deconstruction and the work of Jacques Derrida, and developing insights from earlier feminist epistemologies. Contemporary with these developments in feminist theory in the 1990s, the word 'queer' was increasingly being reclaimed from its derogatory definition, and paired with the word 'theory' in sexuality studies. Feminist engagements with deconstruction and queer theory in the 1990s focused on indeterminacy and the lack of singular stable identities upon which to ground politics. Linking developments in queer theory with these insights, I suggest that 'queer' can be conceptualised as a deconstructive approach to identity, sexuality and normativity. It is interesting to note that at the same time that this deconstructive approach to sexuality was gaining prominence, narratives of genetic determinism proliferated, and key pieces of scientific research were published that claimed a

biological or genetic basis for homosexuality. To explore this apparent incongruity, I will discuss the genesis of the Human Genome Project. A certain amount of hubris surrounded the Human Genome Project in the early years, and it was in this climate that this research was published. I interrogate these pieces of research in the light of feminist and queer approaches to sexuality, agency and the theory and practice of science. My approach attempts to go beyond overturning or interrogating binary oppositions such as born/made and biological/social, and provides a starting point for thinking about the possibility of queering genes, and for queering conservative narratives of genetic determinism. In this chapter, I argue that the search for 'gay genes' not only misrepresents sexuality but also the material specificity of genes. I take this argument further, suggesting a diffractive approach (building on work by Barad and Haraway) which recognises and promotes the active and agential character of genes.

In Chapter Three, 'Symbiosociality: Bacteria, Humans and More-than-Human Kinship', I expand this diffractive approach beyond the boundaries of the human to develop a symbiosocial approach to human kinship with the more-than-human world. Specifically, I suggest symbiosociality as a merger of symbiosis and biosociality. My discussion of symbiosis in this chapter is indebted to Lynn Margulis's work on bacteria, speciation and symbiogenesis. Margulis claims in her work that symbiosis is the driving force of evolutionary novelty, and that this can be observed in bacterial symbioses. With this in mind, I discuss the bacterial ancestry of organelles in human cells, as well as the role of human gut microbiota in digestion. Biosociality is itself a merger, suggested by Paul Rabinow as a way of thinking through the interrelatedness of biological sciences and community formation, particularly in relation to communities arranged around rare genetic disorders. Integral to the merger of symbiosis and biosociality into symbiosociality is the question of kinship. In this chapter I place insights from gender and sexuality studies on human kinship into dialogue with Donna Haraway's companion species framework for conceptualising human/more-than-human kinship as well as insights from previous chapters on connections, entanglements, performativity and more-than-human agency. This continues the focus on the relationship between the biological

and social and begins to conceptualise human/more-than-human kinship and the consequences for human and more-than-human health and flourishing. In particular I discuss human-bacterial kinship as a symbiosocial kinship – an entangled and entangling biological-social relationship of endless multispecies becoming-with. This is important for my thesis, as I try to offer resources for alternative narratives, bodies of knowledge and ways of living as biopolitical citizens in a multispecies world.

In the fourth and final chapter, 'Interruptions: Viral Biopolitics, Queer Ecologies and Monstrous Futures', I interrupt the trajectory of the thesis so far and interrogate an important binary opposition at work (yet so far uninterrogated) in the discussion of the entanglement of the biological and social: the distinction between the living and the non-living. In this final chapter I discuss how this distinction and opposition structures the theory and practice of the biological sciences. I explore the material agency of viruses in order to problematise the opposition between living and non-living. I suggest that viruses are liminal agents that interrupt in a number of ways, and this includes interrupting understandings of life and death as well as linear and progressive narratives of evolution. Interruption is an important central theme in the final chapter, and I will suggest that interruption is a necessary critical practice that is essential to the approach I have developed in the earlier chapters. The fourth chapter emphasises what is at stake in my project: that living and becoming in more-than-human worlds is not a matter of peaceful coexistence and harmony; rather, this is always a mortal becoming, and must be thought alongside the threat of failure and unbecoming. To illustrate this point I discuss people living with HIV/AIDS and the ways in which the virus entangles individuals in knots that connect to issues of – and this is far from an exhaustive list – nation, economics, sexuality, health practices, biomedicine, conservation and ecologies. Viruses are liminal but more importantly, people living with the virus can also become liminal themselves, losing full biopolitical citizenship: relegated to the status of not quite fully living but not yet dead. This liminal status, although bringing with it a loss of biopolitical citizenship does, however, allow for coalitions and patient advocacy. These coalitions and the insistence on infected bodies being reconceptualised as active participants in, rather than the passive resources for

biomedical science, has changed the way that biomedical knowledge about living with HIV/AIDS gets produced and how health practices are implemented. I suggest that this approach can be productively linked with critical theories of temporality in the necessary attempt to imagine and bring about more equitable possible futures.

Living and dying in the more-than-human world

This thesis attempts to take the active and agential character of the body (both human and more-than-human bodies) seriously. In doing so, it demands an interrogation of material agency, and of how to conceptualise agency outside of the realm of the human, where it is traditionally conceived. In doing so, it also demands a questioning of what is meant by 'human' in the first place. As I have stated, this is aligned with posthumanism, even while Chapter Three recognises and explores some of the difficulties and the problems associated with this term. Throughout the project, I try to emphasise agency outside of the human and draw attention to the constitutive performative relationships that exist between the human and the more-than-human. One way in which this is done is through the choice of terms, such as 'becoming-with', 'more-than-human' and 'entanglement'. These terms all seek to avoid human exceptionalism, and demonstrate that the human is embedded in a more-than-human ecology as well as being a more-than-human ecology itself: an ecosystem for trillions of bacteria and other microorganisms. These terms have been chosen specifically to attempt to go beyond ecological embeddedness and to emphasise the entanglement of the human and the biological-social body in co-constitutive, performative, biological-social relationships. Throughout the project I insist not only upon the active and agential 'nature' of the body, but of 'nature' itself and the queer and performative ways that more-than-human networks of relationships pre-exist the biological-social bodies and meanings that emerge through their relating.

This project is important for a number of different reasons. The thesis analyses how the body is conceptualised, both in terms of its biological make-up and in social terms, which includes

issues of sex, gender and sexuality. This has relevance for normative and non-normative bodies, practices and communities. In reference to the biological body, I explore how the matter and materiality of the body are thought of in scientific theory and practice, and follow some of the consequences of this. For example, I investigate the links between bodies in neo-Darwinian sociobiology and feminist epistemology and between the findings of the Human Genome Project and the ways that genes get appropriated and used in narratives of genetic determinism about sexuality. This is not just of social and political relevance, but also has consequences for the theory and practice of science. I illustrate in this thesis that there are different ways of 'doing' science – different ways of producing scientific knowledge and of putting science and biomedicine into practice. Another issue that this project raises is how to define the human, again in biological and social terms. To explore this I interrogate the notion of the human from a number of different angles: as a descendent of pre-hominid apes; as a carrier of vertically inherited genes; as an ecosystem and habitat for trillions of bacteria; and as a porous and penetrable entity that is open to infection and the mortal dangers of failure and unbecoming. The problems associated with the definition of the body and of the human also raise questions about the relation of the human to more-than-human others (both animal and non-animal, right down to the scale of bacteria and viruses) and the more-than-human world (in terms of environment and ecology). Living well as a human is always a question of multispecies becoming-with (and the constant threat and danger of unbecoming) and living well in a more-than-human world.

One of the most important issues raised by this project is the relationship between life forms and forms of life. That is to say, there is an entangled relationship between biology (in terms of biological matter and the way that it is conceptualised through the theory and practice of biology as a science) and the social possibilities and opportunities that are open and available to individuals and communities. This is particularly well illustrated by the unbecoming of the body when infected by viruses. This can be read as an unbecoming in a number of ways: the biological unbecoming of the body into illness and disease, and the social unbecoming of individuals in terms of citizenship. In

Chapter Four I discuss the US immigration ban on people living with HIV/AIDS, in place from 1988 to 2010. This example clearly illustrates that not only did individuals suffer the mortal unbecoming of living and dying with the virus, but also a biopolitical unbecoming in which they were denied full citizenship. Individuals in this example are reconfigured as unhealthy and dangerous to the majority. Furthermore, non-normative communities and practices necessarily suffered: they too were reconceptualised as dangerous and unhealthy, necessitating eradication for the sake of the health of the nation. The entanglement of human and virus involves a threatening liminality – threatening to both life forms and to forms of life. It is clear that at stake here are both ways of living and practices of dying in the more-than-human world.

Putting it where it was Supposed to Go

The project begins roughly chronologically, covering feminist epistemologies and sociobiological narratives developed in the 1970s and 1980s; feminist engagements with deconstruction, queer theory and the genetic determinism of the 1990s; and symbiogenesis and kinship studies and companion species approaches from the late 1990s and early 2000s. The final chapter then interrupts this trajectory and, in fact, suggests the importance or necessity of interruptions. The thesis itself is an interruption of sorts, hoping to interrupt conservative narratives and ideologies that are formative of and formed by biological determinism. This interruption of the thesis is important, as it works to challenge narratives of progression or development as well as teleology in both scientific and social theories. I also want to associate interruption as a critical practice with what Haraway calls ‘staying with the trouble’. She states: ‘I am committed to the finicky disruptive details of good stories that don’t know how to finish’.³⁰ Haraway describes staying with the trouble as an interruption and a disruption. Staying with the trouble is a practice of

³⁰ Donna Haraway, ‘Cosmopolitical Critters: Companion Species, SF and Staying with the Trouble’, unpublished paper presented at *Cosmopolitan Animals*, John Coffin Memorial Lecture, Institute of English Studies, 26 October 2012. A recording is available online at *Youtube*, 19 November 2012 <<http://www.youtube.com/watch?v=fMIm0SeRRY4>> [accessed 17 February 2013]. See also Haraway, ‘*When Species Meet: Staying with the Trouble*’.

interrupting storytelling to draw attention to the historically and socially situated practices that make storytelling possible; staying with the trouble also makes it possible to expand upon details, complexities, problems and questions, without letting the story end or come to any resolution. The thesis itself, and the final chapter within the thesis, attempts to stay with the troubles I have outlined in this introduction: troubles of biology, evolution, science as theory and practice, gender, sexuality, slippery and unstable definitions of humans, of animals, of bacteria and viruses – troubles, in short, of living and dying together in multispecies entanglements.

To return to the quotation at the start of this introduction: ‘I think [...] you will enjoy yourself a whole lot more putting it where it was designed to go’. This statement can be interrogated to illustrate some of the ways relevant to my project that the queer, multispecies and more-than-human relationship commonly thought of as the human body is conceptualised in biological and social terms. What is *it*? How can *it* be defined? *It* is part of the body, but the concept of the biological-social body is problematised, interrupted, and put into question throughout this thesis. *It*, then, can be thought of in a number of different ways: as the penis of an evolved primate body descended from pre-hominid apes; as a means to the end of a genetic legacy through vertical inheritance and heterosexual biological reproduction; part of a larger ecosystem that trillions of bacteria call home; a means of producing pleasure and opening oneself up to relationships of hospitality and becoming; as well as a demonstration of the dangers of infection, failure and unbecoming. This thesis proposes an approach to the strange, queer, multispecies becoming-with of the body and of living (and dying) well. This approach depends upon the entanglement of the biological and social, attention to which I argue offers a way of interrogating narratives of biological determinism and for countering the effects of patriarchy and heteronormativity in the theory and practice of science. Also, and perhaps more importantly, this approach attempts to make a contribution to the ways that the production of scientific knowledge and biomedical practices are conceptualised, and the effects that these have on the possibility of living well as biopolitical citizens in the more-than-human world.

Chapter One

Connections: Sociobiology, Feminist Apes, and Cyborgs

‘Addressed to each other, western and feminist scientific discourses warp each other's story fields and redraw possible positions for claiming to know something about the world, including gendered social space and sexed bodies’

Donna Haraway, *Primate Visions*¹

In this chapter I will analyse feminist engagements with evolutionary science in the 1970s and 1980s. I will focus on two examples of engagements with evolutionary narratives of descent and their social and political implications: the feminist response to Edward O. Wilson's *Sociobiology* and Elaine Morgan's attempt to create a feminist narrative of evolution in *The Descent of Woman*. I will use these examples to discuss the feminist use and interrogation of empiricism and biological determinism, and the development of feminist standpoint epistemologies in the late 1970s and early 1980s. I will suggest that the emergence of postmodernist feminism in the late 1980s illustrated tensions in these and other feminist engagements with the natural sciences. Feminist engagements with patriarchy in the theory and practice of science are foundational to my project. For this reason it is important to explore in detail the development of the particular approaches that I will be employing throughout the later chapters of my thesis.

¹ Donna Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (London: Routledge, 1989), p. 324.

Early feminist engagements with science are important for emphasising the ways that patriarchy uses (or abuses) scientific knowledge, while later work began to question the more fundamental theories and practices of science itself, not just the use of scientific findings. Both approaches are important to my thesis, and are explored here in depth to emphasise both that science is not produced in a socially innocent vacuum and that it is necessary to be vigilant for the uses and abuses of this socially-produced scientific knowledge. As well as establishing this historical context to feminist engagements with science which will form part of my approach in later chapters, this chapter explores an example of an attempt to rewrite a particular evolutionary narrative from a feminist perspective. While I analyse some of the difficulties associated with this, the important point is that biological determinism, conservatism and patriarchy are not inevitable. My reading of Morgan's evolutionary narrative, through Donna Haraway's concept of situated knowledges (an approach to science and knowledge-production that I place in its historical context), offers a novel interpretation of Morgan's narrative, and more importantly the role of alternative narratives in science. I propose that this example illustrates the opportunities provided by science for these alternative narratives. Crucial to my reading of Morgan is the agency of prehuman apes. This interpretation of Morgan's work forms an essential foundation to later work in the project on nonhuman agency, as well as later discussion of other opportunities for radical or alternative interpretations and narratives within science. This chapter works to lay the foundation for my later queer approach to scientific theory and practice, as well as demonstrating that science and social theories such as feminism are not necessarily oppositional. The biological and the social can, when put into conversation, offer possibilities for new and radical positions, narratives and knowledges.

Feminist Engagements with Patriarchy in Science

Feminists in the late 1970s began to recognise and interrogate patriarchal assumptions that structured the content and methodology of the natural sciences.² Three key feminist texts were published in the late 1970s that engaged with scientific theory and practice. These three texts approach areas of science in similar ways and an analysis of convergences between these texts reveals certain important feminist concerns with scientific theory and practice in the late 1970s, which have relevance for my project. First, a special issue of *Signs: Journal of Women and Society* focusing on feminism and science was published in 1978, entitled *Women, Science, and Society*. This issue set out to contribute to discussions between feminism and science, recognising the imperative to do so to counter patriarchal uses of biological determinism. Catharine Stimpson and Joan Burstyn, the editors of the issue, argue that an investment in supposedly biologically determined division of labour, especially in child-rearing, has far-reaching political implications and consequences:

The advocacy of such beliefs has, as its equivalent, the current political and social struggle about women, the women's movement, and modern motherhood, bitterly formalized in the issues of abortion, gay rights, and the Equal Rights Amendment.³

The essays included in the special issue range from those focusing on patriarchy surrounding science (such as the barriers that stop women entering into the sciences in the same numbers as men) to articles concerned with patriarchal assumptions that structure the practice of science itself, with

² I am using patriarchy throughout this research project to refer to an understanding of society as structured and defined around a binary of male-female wherein the male dominates the female. I take this definition from Kate Millett's classic feminist text, *Sexual Politics* (New York: Doubleday, 1970). In particular I am employing her expansive use of the term from what she describes as her 'notes towards a theory of patriarchy' that sketches the support for patriarchy through the ideological; the biological; the sociological; class arrangements; the educational and economic; force and violence; the anthropological such as myth and religion; and the psychological (pp. 24–58).

³ Catharine R. Stimpson and Joan N. Burstyn, 'Editorial', in *Women, Science, and Society*, ed. by Catharine R. Stimpson and Joan N. Burstyn (= *Signs: Journal of Women in Culture and Society*, 4:1 [1978]), 1–3 (p. 2).

reference to evolution, primate studies, sociobiology and sex difference research.⁴ The editors suggest that feminist work in these areas can imagine, and presumably bring about, 'a change in the composition of scientific laborers and in the work and idioms of their enterprise'.⁵ According to the editors of the special issue, feminist engagements with science have two aims: a change in the number of women in scientific professions, and a change in the type of scientific theory and practice that is carried out.

Second, in 1979, Ruth Hubbard, Mary Sue Henifin and Barbara Fried published *Women Look at Biology Looking at Women: A Collection of Feminist Critiques*.⁶ The book is arranged in two sections, entitled 'What is a Woman?' and 'Gaining Control'. As the title of the book suggests, the focus of the collection is the fact that women have been figured as the object of scientific inquiry, distanced from male scientists. The book attempts to remedy this by suggesting that an interrogation of science – whereby women look at biology – can question the ways in which women are defined by science and the patriarchal power this bestows on androcentric scientific practice. The essays in the first section, 'What is a Woman?', investigate the ways in which women are defined by science: in evolutionary theory, accepted scientific language, and in research on brain asymmetry. This is followed by the second section, 'Gaining Control', which investigates how definitions of women can lead to an imbalance in power and control in scientific practice, particularly in medicine and reproductive science. *Women Look at Biology Looking at Women* states its political aim as one of combating patriarchal assumptions in the questions asked, the language used in questioning, and the answers discovered in science, encouraging more women to enter into

⁴ Adrienne L. Zihlman considers feminism and evolution in 'Women in Evolution, Part II: Subsistence and Social Organization among Early Hominids', *Women, Science, and Society* (pp. 4–20); Donna Haraway's 'Animal Sociology and a Natural Economy of the Body Politic, Part I: A Political Physiology of Dominance' (pp. 21–36) and 'Animal Sociology and a Natural Economy of the Body Politic, Part II: The Past Is the Contested Zone: Human Nature and Theories of Production and Reproduction in Primate Behavior Studies' (pp. 37–60) engage with evolutionary theory, primate studies and sociobiology; Marion Lowe also considers sociobiology and sex difference research in 'Sociobiology and Sex Differences' (pp. 118–125).

⁵ Stimpson and Burstyn, 'Editorial', *Women, Science, and Society*, p. 3.

⁶ *Women Look at Biology Looking at Women: A Collection of Feminist Critiques*, ed. by Ruth Hubbard, Mary Sue Henifin and Barbara Fried (Cambridge, MA: Schenkman Publishing Co., 1979).

scientific professions and overcoming the imbalance of power in science that has negative medical consequences for women.

Third, in 1980, The Brighton Women and Society Group published *Alice through the Microscope: The Power of Science over Women's Lives*.⁷ The group had formed in 1976 and included biologists, community workers, sociologists, zoologists, social anthropologists and policy workers. *Alice through the Microscope* was a response to what the editors describe as a 'serious gap in the literature on science'.⁸ The title of the book suggests that, like *Women Look at Biology Looking at Women*, the concern is with the patriarchal convention that women are restricted to the role of objects in scientific investigations, and are underrepresented as scientists. The articles included look at the patriarchal structure of science that discourages participation by women; areas of scientific research such as sociobiology, anatomy and medicine; and the growth of technology and its effects on the ways in which science considers women's bodies.⁹ The editors state that across these areas of engagement they are primarily concerned with the ways in which theories are produced about women, in the name of scientific knowledge:

We believe them to be, more often than not, based on sexist prejudices and ideology; we also believe such theories to have a specific role in providing scientific legitimization of the existing hierarchical organisation of society.¹⁰

⁷ *Alice through the Microscope: The Power of Science over Women's Lives*, ed. by The Brighton Women and Society Group (London: Virago, 1980).

⁸ *Alice through the Microscope*, Front Insert.

⁹ Libby Curan considers the role of education in the imbalance of women in scientific professions in 'Science Education: Did She Drop out or Was She Pushed?', *Alice through the Microscope* (pp. 22–41). Sociobiology, anatomy and medicine are discussed in Deirdre Janson-Smith, 'Sociobiology: So What' (pp. 62–86); Lynda Burke and Sandy Best, 'The Tyrannical Womb: Menstruation and Menopause' (pp. 89–107); and Hilary Standing, '"Sickness is a Woman's Business?": Reflections on the Attribution of Illness' (pp. 124–138). Technological control over women's bodies is considered in the following articles: The Brighton Women and Science Group, 'Technology in the Lying-in Room' (pp. 165–181); Vivien Walsh, 'Contraception: The Growth of a Technology' (pp. 182–207); and Jalna Hanmer and Pat Allen, 'Reproductive Engineering: The Final Solution?' (pp. 208–227).

¹⁰ *Alice through the Microscope*, p. 3.

The contributions to *Alice through the Microscope* recognise an intimate relationship between patriarchy and scientific practice. They acknowledge that patriarchy structures the practice of science, producing scientific knowledge that is based on sexist prejudices and ideology. Following this acknowledgement they argue that this scientific knowledge is employed to justify the existence of patriarchy in society.

To interrogate this argument I will focus on an area of feminist engagement with science that is common to the three publications, and which I therefore understand as a key feminist concern of the time. This example demonstrates one of the ways that social structures affect the production of scientific knowledge, which is a theme throughout my thesis. All three early feminist collections of engagements with science include an analysis of sociobiology, in particular the work of Edward O. Wilson. Wilson published *Sociobiology: The New Synthesis* in 1975, a book in which he attempted to instantiate the new science of sociobiology – evolutionary biology and theory applied to social organisation.¹¹ Marion Lowe approaches Wilson's claims from a scientific and political perspective in 'Sociobiology and Sex Differences' published in the special issue of *Signs*. She analyses the scientific basis of many of Wilson's claims, and concludes that: 'We do not need to treat sociobiology seriously as a scientific theory of human behavior. Unfortunately, we do have to take it seriously as a political theory.'¹² Ruth Hubbard expands upon this in her article, 'Have Only Men Evolved?' published in *Women Look at Biology Looking at Women*. She illustrates the ways in which Victorian stereotypes influenced Charles Darwin's theory of sexual selection, and the ways in which these stereotypes of female passivity and male agency and activity are replicated in sociobiological theory and practical research.¹³ Hubbard questions the political and social conventions that structure the particular type of evolutionary science that is practised, and the methods by which it proceeds. She also traces the ways that this science is employed to justify a conservative social

¹¹ Edward O. Wilson, *Sociobiology: The New Synthesis* (Cambridge, Mass: Harvard University Press, 1975).

¹² Marion Lowe, 'Sociobiology and Sex Differences', *Women, Science, and Society*, 118–125 (p. 123).

¹³ Ruth Hubbard, 'Have Only Men Evolved?', *Women Look at Biology Looking at Women*, pp. 7–36.

status quo, and suggests avenues for future feminist engagements with evolutionary science.

Meanwhile, Deirdre Janson-Smith considers *On Human Nature*, Wilson's work that followed *Sociobiology*, in her article 'Sociobiology: So What?', published in *Alice through the Microscope*.¹⁴

Janson-Smith interrogates Wilson's response to the reception of *Sociobiology*, as well as his development of certain themes in this later publication including the sexual division of labour.

Janson-Smith, like Lowe and Hubbard, recognises the ways in which political commitments influence the way science is practised, and the political implications of sociobiological claims.

Edward O. Wilson's Metaphor of Extension

Wilson described the science of sociobiology as 'the extension of population biology and evolutionary theory to social organisation'.¹⁵ Wilson had previously published texts on population biology and invertebrate zoology and *Sociobiology* was an attempt to expand his work into new areas of research.¹⁶ The 'synthesis' that *Sociobiology* attempted to create was a combination of Wilson's earlier work on population biology, observations of animal (especially invertebrate) sociality, and neo-Darwinism. The idea of a 'new synthesis' as stated in the book's subtitle suggests a new method of using or interpreting Darwinism following from what scientists refer to as the Modern Evolutionary Synthesis. The latter takes its name from Julian Huxley's *Evolution: The Modern Synthesis* published in 1942, in which Mendelian genetics was shown to be compatible with natural selection.¹⁷ The Modern Evolutionary Synthesis combined seemingly contradictory observations from palaeontology, botany, microbiology, and population genetics into a synthesis that could still be legitimately called Darwinian, because the common factor was the work of natural selection in

¹⁴ Edward O. Wilson, *On Human Nature* (Cambridge, Mass: Belknap Press of Harvard University Press, 1978); Deirdre Janson-Smith, 'Sociobiology: So What?', *Alice through the Microscope*, pp. 62–86.

¹⁵ Edward O. Wilson, *On Human Nature*, p. x.

¹⁶ Edward O. Wilson and William H. Bossert, *A Primer of Population Biology* (Sunderland, Mass: Sinauer, 1971); Edward O. Wilson, *The Insect Societies* (Cambridge, Mass: Belknap Press of Harvard University Press, 1971).

¹⁷ Julian Huxley, *Evolution: The Modern Synthesis* (New York: Harper & Brothers, 1942).

gradual evolution.¹⁸ Wilson's subtitle, 'The New Synthesis', attempts to position sociobiology as the next step in the Darwinian synthesis based on natural selection. Wilson states, 'It may not be too much to say that sociology and the other social sciences, as well as the humanities, are the last branches of biology waiting to be included in the Modern Synthesis.'¹⁹ This is a particularly pertinent comment for my thesis; although I am arguing for the inseparability of the biological-social and for the blurring of disciplinary boundaries throughout, Wilson's approach is very much the antithesis of my approach. Wilson's approach is to reduce all disciplines to biology, rather than open up the possibility for new positions, narratives and knowledges through interdisciplinary conversation. *Sociobiology* endeavours to reformulate the social sciences and humanities as functions of natural selection, and thus as elements of a new evolutionary synthesis.

Wilson's claim that sociobiology is an 'extension' of evolutionary science to theories of society and social organisation is illuminating, because his use of the metaphor of extension is illustrative of certain assumptions and tensions in the study of science. I will analyse three perspectives on scientific practice that involve or interrogate the metaphor of extension. First, the metaphor of extension suggests continuity with a traditional scientific method that values objectivity gained through distance between the scientist and the object of scientific inquiry. Second, it can suggest that there is a value-neutral science that can be extended to comment on society. This leads to the conclusion that debates and disputes about science should be directed to the use or abuse of science, not the structure of science itself. Finally and closely related to the second perspective, the metaphor of extension creates an artificial distinction between the practice of science and politics. This distinction can protect scientific practice as well as the structure of science itself, as the practice of science is constructed as inhabiting a different domain from culture or politics. Analysing this one claim of Wilson's illustrates how traditional models of scientific practice and objectivity function.

¹⁸ For a history of the concept of evolution and the context of the Modern Evolutionary Synthesis see Peter J. Bowler, *Evolution: The History of an Idea* (Berkeley, CA: University of California Press, 2003), especially pp. 333–339.

¹⁹ Wilson, *Sociobiology*, p. 4.

This is foundational for my project, as the question of different ways of producing knowledges of scientific objects is one that recurs throughout. Furthermore it illustrates how Wilson's sociobiological claims are positioned, and some of the ways in which these claims can be countered by feminists.

The metaphor of extension implies a particular method of practising science. The activity of extending suggests expansion, invasion, dominance and even penetration. For the scientist to be able to extend knowledge into a certain field, a pre-existing distance must be assumed between the scientist and the objects or domain of scientific inquiry. Evelyn Fox Keller suggests that this distance is a patriarchal construct, relying on a Baconian notion of nature as female, and knowledge or rationality as male.²⁰ Genevieve Lloyd argues that Francis Bacon's gendered metaphors structure his philosophical and logical system and have the effect of building the masculine scientific manipulation of feminine nature 'into the very articulation of the nature of science'.²¹ Lloyd traces the gendering of rational knowledge through Bacon to Greek theories of rationality and logic, to argue that:

Rational knowledge has been construed as a transcending, transformation or control of natural forces; and the feminine has been associated with what rational knowledge transcends, dominates or simply leaves behind.²²

The metaphor of rationality as masculine and nature as feminine resource to be used, controlled, dominated by and for rational knowledge is powerful and insidious. As Lloyd argues, 'The metaphors do not merely express conceptual points about the relations between knowledge and its objects. They give a male content to what it is to be a good knower.'²³ So, the metaphor of extension relies

²⁰ Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven: Yale University Press, 1985), especially pp. 33–42.

²¹ Genevieve Lloyd, *The Man of Reason: 'Male' and 'Female' in Western Philosophy* (London: Methuen, 1984), p. 16.

²² Lloyd, *The Man of Reason*, p. 2.

²³ Lloyd, *The Man of Reason*, p. 17.

upon a tradition and history of patriarchal metaphors that structure the theory and practice of science. To be able to extend one area of knowledge into another domain suggests a distance between rational male subject and feminine object or resource, and the reliance on the metaphor suggests a 'good knower', namely a rational male theorist or scientist, proceeding along traditional models of scientific inquiry.

The metaphor of extension can suggest that there is a value-neutral and empiricist science that is extended, either successfully or unsuccessfully to comment on society. This perspective implies that there is a proper domain of science, and that debates and disputes only arise when it is exported to other, cultural, domains; that is, biases and contradictions arise from unsuccessful or improper extension of the value-neutral facts of science. This is a form of scientific realism or empiricism, and is reflected in some feminist claims that patriarchy surrounding science affects the ways in which scientific facts are used or abused, interpreted and implemented. In this chapter I will discuss empiricism and some of its problems, returning to a more in-depth discussion of realism in the following chapter. The use-abuse model is often invoked by scientists (and others) as a defence against charges of negative personal or political bias in scientific practice, and some feminist scholars have argued that the use-abuse model has a patriarchal function. For example, the editors of *Alice through the Microscope* suggest that it serves two purposes:

First, it absolves scientists themselves from responsibility, and from the need to question the ethics of what they are doing. More important, it bolsters the image of 'pure' science, somehow divorced from the social world in which it takes place, and thus diverts attention from more fundamental questions of the politics of science.²⁴

To suggest that the practice of sociobiology is the extension of population biology and evolutionary theory to comment on social organisation thus absolves Wilson and other sociobiologists from the

²⁴ *Alice through the Microscope*, p. 17.

need to question the ethics of such an 'extension', as well as bolstering the image of science as pure, in this case suggesting that population biology and evolutionary theory are themselves value-neutral and separate from the social world in which they have been formulated.

The metaphor of extension therefore creates a fictitious distinction between science and society. This distinction is paradoxical as the proclaimed aim of sociobiology is to reduce the distance between the domains of science and society, through a common grounding in neo-Darwinist principles. Yet, as I have shown, the metaphor of extension also protects sociobiological theories from cultural analysis. A pertinent example is when sociobiologist David Barash states, in reference to sociobiological claims about sex differences, that 'ironically, mother nature appears to be a sexist'.²⁵ This claim is typical of sociobiology as it suggests that seemingly political and cultural biases are not a product of the scientific method or theory, but rather a feature of the nature that sociobiology supposedly reflects. Sociobiology attempts to explain all social behaviour as a consequence of evolution by natural selection, thus breaking down the distinction between biology and social organisation. Fundamentally, however, this distinction is preserved; as a response to the charge of patriarchal and conservative political biases, sociobiology can rely upon the distinction between an empirical science and cultural politics to make the claim that it is nature which is sexist, not the science that simply interprets empirical facts. This deserves further attention as it emphasises particularly clearly the effects of the use-abuse model of scientific knowledge. Sociobiologists' claim that they are attempting to reduce the distance between culture and science is, in fact, supported by a distinction between 'pure' science and the uses made of scientific facts. The reduction of fictional distance between subject and object, as between science and societal organisation, is figured in only one direction. Sociobiologists can extend evolutionary science to comment on the biological basis of culture, yet charges of cultural bias in the theory and practice of science are claimed to be based on a lack of scientific knowledge. Sociobiologists do not consider the

²⁵ David Barash, *Sociobiology and Behavior* (New York: Elsevier, 1977), p. 283.

humanities eligible to comment on science, and any charge of sexism in the theory and practice of sociobiology can be interpreted by sociobiologists as misrecognition of a biologically universal sexism they consider themselves better qualified to interpret. The distinction between subject and object – and between science and culture – is reinforced through the claim that the scientific theory and practice is pure and not influenced by politics, history or culture.

Wilson's *Sociobiology*

Wilson's text itself is organised into twenty-seven chapters, of which only the first and last are entirely devoted to human social relations. The other twenty-five chapters of illustrated double-column biological and zoological observation are intended to bridge the gap between the attempt at instantiating a new science in the first chapter and the suggestions about human behaviour made in the final chapter. In effect, the middle twenty-five chapters that cover more than five hundred pages must function as scientific proof, in the form of observation, of Wilson's claim in the first chapter that all social behaviour has a biological basis.²⁶ Furthermore, they are intended to provide a scientific basis for hypotheses made in the final chapter about – among other things – altruism, sex, the division of labour, aesthetics, ethics and territoriality in human social relations. For example, Wilson states in the final chapter that 'nearly all human societies' are organised by the sexual division of labour: 'During the day the women and children remain in the residential area while the men forage for game or its symbolic equivalent in the form of barter and money.'²⁷ This statement and its implications are given more significance and plausibility due to its position in the structure of the overall work. It appears as a scientific hypothesis rather than a political or socially biased statement, because it supposedly follows from Wilson's claim that all behaviour has a biological basis and the wealth of biological and zoological observations that structurally support the first and final chapters.

²⁶ Wilson, *Sociobiology*, p. 4.

²⁷ Wilson, *Sociobiology*, p. 553.

In the chapter on aggression, Wilson suggests that aggression has a genetic basis and is adaptive. He defines the following eight forms of aggression: territorial, dominance, sexual, parental disciplinary, weaning, moralistic, predatory, and antipredatory.²⁸ A wide range of behaviour can be considered aggressive under this system, from territorial displays to maternal termination of unwanted suckling, and defensive manoeuvres directed towards predators by potential prey. The expansive and relatively imprecise definition of aggression does not concern Wilson; in fact he states 'we should not worry too much about terminology'.²⁹ Despite its expansive and imprecise definition, Wilson proceeds to make claims about aggression and competition, and about the adaptive and genetic basis of aggression in all animals, including humans. Wilson defines aggressive competition as any sexual or resource competition, commenting that sexual competition between males is 'competition for a very special kind of resource'.³⁰ In this example, Wilson starts with the assumption of competitive aggression – defining it vaguely and expansively – and consequently observes it in a variety of animal behaviour. Competitive aggression is then defined as a behavioural universal and suggested as an evolved biological adaptation. Importantly, the biological suggestion is replete with assumptions including that of a hierarchical relation between male and female in which the male is active and an agent of evolutionary change and the female is figured as passive and as a resource for the male.

Wilson uses the terms 'competition' and 'aggression' expansively to bolster his argument, without interrogating the cultural and political assumptions that structure these concepts. Michael Gross and Mary Beth Averill argue that sociobiology and other areas of evolutionary science are fundamentally structured by such uninterrogated concepts. In particular, they suggest that the concepts of scarcity and competition in evolution are patriarchal constructs, rather than empirical givens. Gross and Averill argue that Darwin developed the theory of natural selection in the light of

²⁸ Wilson, *Sociobiology*, pp. 242–243.

²⁹ Wilson, *Sociobiology*, p. 242.

³⁰ Wilson, *Sociobiology*, p. 243.

Thomas Malthus's *An Essay of the Principle of Population*.³¹ Darwin himself stated that this text had a direct influence on his evolutionary theory:

In October 1838, that is, fifteen months after I had begun my systematic enquiry, I happened to read for amusement 'Malthus on Population', and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here then I had at last got a theory by which to work.³²

Malthus argued that population would increase geometrically, doubling each generation, while food supply could only increase incrementally due to natural limitations. These two principles provided Darwin with a mechanism by which species would be transformed over time. As Gross and Averill state, 'Malthus showed Darwin that if one assumed scarcity of resources, especially food, a competition would ensue which affected the composition of successive generations.'³³ In other words, in an environment of scarce resources organisms would have to compete for food; organisms best suited to their environment would out-compete those less well suited, and they would produce relatively more offspring.

Gross and Averill argue that Malthus's principles are contradictory when applied to the natural world. They maintain that it is overly simplistic to suggest that populations increase geometrically while resources increase incrementally as 'one kind of organism's "overproduction"

³¹ Thomas Malthus, *An Essay on the Principle of Population* (London: Dent, 1973 [1798])

³² *The Life and Letters of Charles Darwin, Including an Autobiographical Chapter*, ed. by Francis Darwin, 3 vols (London: John Murray, 1887) I, p. 83.

³³ Michael Gross and Mary Beth Averill, 'Evolution and Patriarchal Myths of Scarcity and Competition', in *Discovering Reality: Feminist Perspectives on Epistemology, Metaphysics, Methodology, and Philosophy of Science* (London: D. Reidel Publishing Company, 1983), pp. 71–95 (p. 74). Other useful studies of the links between Malthusian principles of population and Darwinian evolution are: Peter Vorzimmer, 'Darwin, Malthus, and the Theory of Natural Selection', *Journal of the History of Ideas*, 30:4 (1969), 527–542; and Peter J. Bowler, 'Malthus, Darwin, and the Concept of Struggle', *Journal of the History of Ideas*, 37:4 (1976), 631–650.

may be another kind of organism's food supply'.³⁴ This is a more ecological approach than sociobiology and neo-Darwinism traditionally allows. I will explore this further in Chapters Three and Four. Furthermore, the concepts of scarcity and competition are not value-neutral but developed as a consequence of Malthus's social and political concerns. They argue that Malthus employed his population principles so as to oppose nineteenth-century poor laws in England, believing that aid would encourage the poor to reproduce, thus having a detrimental effect on society as a whole. Gross and Averill identify in Malthusianism a number of patriarchal themes: 'male control of reproductive choices for the sake of abstract political-economic goals'; 'capitalistic defense of middle class accumulation, expansion, and domination'; and 'objectification of rather than identification with the "other"'.³⁵ Gross and Averill illustrate very clearly the ways in which patriarchal political concerns are inscribed into metaphors that structure scientific theory and practice. In particular, they draw attention to the fact that social and political values structure the theory and practice of evolutionary science by way of the metaphor of struggle. Although Darwin stated he used struggle in a 'large and metaphorical sense', it becomes the underlying and unquestioned essential principle of nature.³⁶ Gross and Averill call attention to the fact that the patriarchal metaphor not only structures theoretical concepts such as natural selection but also the practical content and methodology of scientific research, because research proceeds without questioning certain key concepts such as scarcity and competition.³⁷ Gross and Averill's analysis is important to my analysis in this chapter (and to the development of my approach to science in the thesis as a whole) as it illustrates the

³⁴ Gross and Averill, p. 74. For other issues related to the Malthusian basis of natural selection, see Elliott Sober, *The Nature of Selection: Evolution Theory in Philosophical Focus* (Cambridge, Mass: MIT Press, 1984), especially pp. 15–17 and pp. 194–195. Sober suggests that considering Malthusianism as a central axiom of natural selection is a distortion of current understandings of evolution. I agree that natural selection as it is understood in contemporary evolutionary science cannot simply be reduced to Malthusianism; yet it is important to recognise the historical context of scientific concepts, so as to be in a better position to interrogate their political uses.

³⁵ Gross and Averill, p. 75.

³⁶ Charles Darwin, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1859), p. 62.

³⁷ Gross and Averill, p. 76.

extent to which social values and assumptions can function as unquestioned principles structuring both scientific theory and practice.

The Feminist Response to *Sociobiology*

In the year that *Sociobiology* was published, a group of scientists, feminists and social theorists wrote a letter to the *New York Review of Books* in which they questioned the objective nature of sociobiology.³⁸ I will briefly outline their argument, before examining a specific feminist analysis of a sociobiological claim to illustrate my position that not only can patriarchal assumptions and values structure scientific theory and practice but also, when biological or evolutionary science is called upon (or ‘extended’ to use Wilson’s metaphor) to comment on social organisation, these patriarchal assumptions can resurface in the form of unquestioned biological fact. Such biological facts are then used as justification for the social status quo. The authors of the letter, entitled ‘Against “Sociobiology”’, emphasise the cyclical nature of Wilson’s sociobiological arguments, and question the scientific evidence that supposedly proves that all behaviour and social structures are genetically determined, stating that for Wilson, ‘what exists is adaptive, what is adaptive is good, therefore what exists is good’.³⁹ It is Wilson’s preference for genetic explanations that the authors claim is responsible for his ‘leap of faith from what might be to “what is”’.⁴⁰ The authors claim that this leap is one that could be made with the use of cultural or other explanations yet, for no

³⁸ Elizabeth Allen et al., ‘Against “Sociobiology”’, *New York Review of Books*, 13 November 1975, pp. 182, 184–186. This letter to the Editors was signed by Elizabeth Allen, Barbra Beckwith, Jon Beckwith, Steven Chorover, David Culver, Margaret Duncan, Steven [sic] [Jay] Gould, Ruth Hubbard, Hiroshi Inouye, Anthony Leeds, Richard Lewontin, Chuck Madansky, Larry Miller, Reed Pyeritz, Peter Bent, Miriam Rosenthal, and Herb Schreier. The letter is reprinted in *The Sociobiology Debate: Readings on Ethical and Scientific Issues*, ed. by Arthur L. Caplan (New York: Harper and Row, 1978), pp. 259–264, and further references will be to this reprinted version. Caplan’s collection of critical responses to Sociobiology also contains Wilson’s response to the letter written by Allen et al. ‘For Sociobiology’, *New York Review of Books*, 11 December, 1975 (repr. in *The Sociobiology Debate*, pp. 265–268.)

³⁹ ‘Against “Sociobiology”’, p. 261. The disadvantages of the type of adaptationist argument employed by Wilson are outlined by Stephen Jay Gould and Richard Lewontin in an article in which they state: ‘Often, evolutionists use *consistency* with natural selection as the sole criterion and consider their work done when they concoct a plausible story.’ (‘The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme’, *Proceedings of the Royal Society of London, Series B*, 205:1161 [1979], pp. 581–598).

⁴⁰ ‘Against “Sociobiology”’, p. 262.

scientific reason, Wilson prefers genetic explanations. They also state that Wilson uses *ad hoc* arguments from economics and speculative anthropology and that he uses 'metaphor and presumed analogy [...] to mask the absence of evidence'.⁴¹ For Wilson's critics, the biological determinism found in *Sociobiology* rests upon assumptions, social conservatism and cyclical logic, rather than upon the discovery of biological or social facts.

One sociobiological claim that received attention from contemporary feminists was the argument that certain gendered social structures and roles were, in part, a consequence of the difference between the supposed energy investment demanded of males and females for successful sexual reproduction. Ruth Hubbard, in her essay 'Have Only Men Evolved?', analyses the sociobiological claim that it is the relative size of gametes, sperm and egg cells, which structures gendered social structures.⁴² Wilson states that:

One gamete, the egg, is relatively very large and sessile; the other, the sperm, is small and motile [...] Because it represents a considerable energetic investment on the part of the mother the embryo is often sequestered and protected, and sometimes its care is extended into the postnatal period. *This is the reason why parental care is normally provided by the female.*⁴³

⁴¹ 'Against "Sociobiology"', p. 263.

⁴² Hubbard traces the history of feminist engagements with the egg and sperm differences to Ruth Hershberger, *Adam's Rib: A Defense of Modern Woman* (New York: Harper and Row, 1970 [1948]). Key later engagements include Emily Martin, 'The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles', *Signs*, 16:3 (1991), pp. 485–501. Haraway also considers sociobiological assumptions regarding the size of gametes, and links this to the definition of the female as a scarce resource for the males in evolutionary narratives, in *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York: Routledge, 1989). See in particular the chapter 'Sarah Blaffer Hrdy: Investment Strategies for the Evolving Portfolio of Primate Females', pp. 349–367.

⁴³ Wilson, *Sociobiology*, pp. 316–317. Quoted in Hubbard, 'Have Only Men Evolved?', p. 24. Italics added by Hubbard.

For sociobiologists, the difference in the size of gametes and the interpretation of this corresponds to a hypothetical difference in levels of energetic investment.⁴⁴ The female's large eggs are interpreted by sociobiologists as passive, receptive and immobile, whereas the male's smaller sperm are interpreted as active and agile. Furthermore, the female gametes supposedly demand a higher level of energy investment. Hubbard asks, 'Does it really take more "energy" to generate the one or relatively few eggs than the large excess of sperms required to achieve fertilization?'⁴⁵ She argues that not only is the supposed energetic investment unknown, it is of little or no significance other than to justify existing social structures. Patriarchal assumptions about the passivity of women and activity of men structure the methodology and content of sociobiological theory about the relative size of gametes, and function only to provide political justifications for patriarchy.

The justification of the patriarchal status quo is supported in sociobiological theory by a rhetorical move that Anne Fausto-Sterling describes as a '*linguistic hat trick*'. Discussing sociobiological theories of forced copulation in animals and their relation to the human phenomenon of rape, she states:

In using the word *rape*, [sociobiologists] have transformed its meaning. First, to describe certain animal behaviors they use a word originally applied to a human interaction, one that includes within its definition the notion of conscious will. Then they employ the animal behavior (named after the human behavior) in theories about rape in human society. In the process they confuse the meaning of two different behaviors and offer a natural justification

⁴⁴ For an analysis of the concept of 'investment' in sociobiology, see Marshall Sahlins, *The Use and Abuse of Biology: An Anthropological Critique of Sociobiology* (London: Tavistock Publications, 1977). Sahlins argues that the use of investments and competition in sociobiology reveal it as a system based on capitalist economics, rather than reflecting biological truths. Hubbard argues, however, that his argument is flawed as he 'fails to notice [sociobiology's] obvious androcentrism' ('Have Only Men Evolved?', p. 25).

⁴⁵ Hubbard, 'Have Only Men Evolved?', p. 25.

for a human behavior that Webster's calls criminal. *This linguistic hat trick characterizes virtually all of human sociobiology.*⁴⁶

This logical move is evident not just at the level of comparative animal behaviour. The example of the relative size of gametes clearly demonstrates that sociobiologists also employ this logic at the level of the microbiological. Wilson describes the difference in sex cells in terms of level of activity, care and investment. Then these descriptions, based on fundamental assumptions about the difference between male and female nature, are employed in theories of male and female behaviour and social roles. Importantly, this confuses two very different phenomena and offers a justification for the original assumptions about male and female nature. The claims of sociobiology are so expansive and ill-defined that they can apply to the level of the microorganism, organism or even social group. This is important as it demonstrates one of the ways that social structures and the biological sciences are related, as well as emphasising that this brand of conservative logic can function at the level of social groups, individuals and the microbiological. This has relevance to Chapters Three and Four, where I will discuss microorganisms such as bacteria and viruses. Wilson's text makes claims based on a similar logic that naturalises male aggression, female passivity and the sexual division of labour, alongside other political claims that touch on human social phenomena such as slavery, war and genocide.⁴⁷ These claims confuse biological and social meanings and are inherently conservative, concerned with providing natural justifications for the social status quo.

As I have argued, sociobiology and biological determinism were a concern for feminism in the 1970s. Feminist engagements with sociobiology illustrate a number of questions that feminists were raising regarding the theory and practice of science in the 1970s. Feminists in the 1970s began to recognise that patriarchy was not simply external to science, affecting the ways scientific

⁴⁶ Anne Fausto-Sterling, *Myths of Gender: Biological Theories about Women and Men*, 2nd edn (New York: BasicBooks, 1992 [1985]), p. 161.

⁴⁷ For a comparison of human slavery to drone workers in insect societies, see Wilson, *Sociobiology*, pp. 368–371. War and genocide are discussed on pp. 572–574.

communities excluded women and used scientific research to support patriarchy, but that patriarchal constructs could structure the theory and practice of science itself. One of the ways in which this was interrogated was to analyse concepts such as scarcity and competition to reveal the political and social history of the terms that patriarchal science ignores. Similarly, feminists interrogated the traditional methodology of science and its political history. There was growing recognition in the 1970s that getting more women into scientific professions was important, but was inadequate to counter patriarchy in scientific practice; feminist scholarship was increasingly recognising the subtle and insidious ways that patriarchy structured science.

Feminist Standpoints

Feminist engagements with science in the late 1970s and 1980s were indebted to a history of cultural studies of science, in particular the work of Thomas Kuhn. Kuhn's book, *The Structure of Scientific Revolutions*, was originally published in 1962 and questioned the notion of scientific objectivity and introduced the term 'paradigms' into the history and philosophy of science. Kuhn criticised the conventional view of science as proceeding in a linear fashion, gradually adding more facts and refining hypotheses. For Kuhn, scientists work within paradigms. These paradigms are 'coherent traditions of scientific research', that incorporate 'law, theory, application, and instrumentation together'.⁴⁸ Paradigms are inherently conservative and concerned with the status quo; as Kuhn states, 'Normal science does not aim at novelties of fact or theory and, when successful, finds none.'⁴⁹ Scientists working within a paradigm approach scientific research with theories, laws, methodologies and instruments that have been constructed within the paradigm. Kuhn describes the Copernican revolution as an important example of paradigms and paradigm shift. Kuhn states that Ptolemaic astronomy – the astronomical paradigm that Copernican astronomy succeeded – was 'admirably successful in predicting the changing positions of both stars and

⁴⁸ Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), p. 10.

⁴⁹ Kuhn, p. 52.

planets'.⁵⁰ Not only this, but 'for the planets, Ptolemy's predictions were as good as Copernicus'.⁵¹

Kuhn suggests, however, that as the science of astronomy increased in complexity, discrepancies with the Ptolemaic paradigm became impossible to ignore. This accumulation of discrepancies or anomalies led to Copernicus' rejection of the Ptolemaic system and his search for a new paradigm.⁵²

Normal science, for Kuhn, always reflects the contemporary paradigm and does not work to question or dispute elements of this. However, anomalies are always discovered, and it is the increase of anomalies which cannot be assimilated into the current paradigm which ultimately leads to scientific revolution, or paradigm shift. Kuhn's theory of scientific paradigms disrupts a more conventional view, wherein science proceeds in a linear fashion, gradually uncovering more truths. Science, for Kuhn, is a social enterprise; social structures, conventions and assumptions are all part of paradigms and are thus integral to the theory and practice of science. Kuhn and the feminist expansion of his insights are important to my approach to scientific knowledge production. Science *does* reflect truths about the 'real' world, but science is always done within specific historical and cultural paradigms.

For feminists working in the late 1970s and early 1980s, Thomas Kuhn's paradigm approach to science offered a set of useful analytic tools to the growing recognition that science both supported and was structured by patriarchal social structures. Kuhn's argument undermined the conventional linear structure of the history of science, as a progression of great men that added gradually and cumulatively to scientific knowledge. Although he does not mention the masculinist bias within this paradigmatic history of science, the possibility for alternative histories of science with more prominent historical females is dormant in his project. The concept of the paradigm also offered feminists a productive language with which to speak about the metaphors that scientists used in the pursuit of normal science. Donna Haraway, for example, discusses the metaphors used in

⁵⁰ Kuhn, p. 68.

⁵¹ Kuhn, p. 68.

⁵² Kuhn, p.68–69. Kuhn explores the Copernican revolution in detail in, *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought* (Cambridge, MA: Harvard University Press, 1957).

embryology in *Crystals, Fabrics, and Fields: Metaphors of Organicism in Twentieth-Century Developmental Biology*. Although not an explicitly feminist text, it illustrates the use of metaphor in science and the importance of this process for the formation of scientific communities.⁵³ Hubbard too follows a Kuhnian concept of paradigm communities when she states, 'Science is made by people who live at a specific time in a specific place and whose thought patterns reflect the truths that are accepted by the wider society.'⁵⁴ I argue that Kuhn offered feminist engagements with science the framework within which to subvert the masculinist linear history of science, to draw attention to patriarchal metaphors in science, and to question the supposed objective and gender-neutral claims made by predominantly male scientific communities.

The Kuhnian approach to the production of scientific knowledge was integral to the development of a significant feminist response to science in the 1970s and 1980s known as the feminist standpoint. Many early feminists responding to science had approached the question of patriarchy and science with a research programme that did not question the objectivity of science, but rather questioned the barriers and inequalities that meant more men than women entered the sciences. A concurrent and related programme studied the use and abuse of biology, arguing that the issue for feminism is the patriarchal use of science, rather than questioning the science itself. Sandra Harding has described a series of feminist epistemologies developing from these research programmes that foreground the question of objectivity in different ways. For Harding, these feminist epistemologies attempted to respond to an apparent paradox in feminist engagements with science:

Feminism is a political movement for social change. But many claims, clearly motivated by feminist concerns, made by researchers and theorists in the social sciences, in biology, and

⁵³ Donna Haraway, *Crystals, Fabrics, and Fields: Metaphors of Organicism in Twentieth-Century Developmental Biology* (London: Yale University Press, 1976). Reprinted as *Crystals, Fabrics, and Fields: Metaphors that Shape Embryos* (Berkeley, CA: North Atlantic, 2004).

⁵⁴ Hubbard, 'Have Only Men Evolved?', p. 7.

in the social studies of the natural sciences appear more plausible – more likely to be confirmed by evidence – than the beliefs they would replace. How can such politicized research be increasing the objectivity of inquiry? On what grounds should these feminist claims be grounded?⁵⁵

Harding explores the relation of politics and objectivity in the sciences, defining three major feminist responses to this paradoxical relation: '*feminist empiricism*, the *feminist standpoint*, and *feminist postmodernism*'.⁵⁶ I will briefly outline the objectives and problems associated with feminist empiricism, before analysing in detail an early attempt to formulate a feminist standpoint within evolutionary theory. I will follow this by looking at the emergence of a feminist postmodernist approach to science studies in the late 1980s.

Feminist empiricist epistemologies suggest that social biases leading to the misuse or abuse of science could, and should, be corrected through stricter adherence to existing scientific methodologies. For feminist empiricists, it is biases such as patriarchy and androcentrism that distort the objective nature of science. Feminism, working to encourage more women to enter into scientific careers and to remove the social barriers obstructing this, encourages gender equity in the sciences and thus reduces male bias in the interpretation of scientific results. Harding quotes Marcia Millman and Rosabeth Moss Kanter's description of this empiricist logic. They claim that social liberation movements 'make it possible for people to see the world in an enlarged perspective because they remove the covers and blinders that obscure knowledge and observation'.⁵⁷ Unquestioned is the objectivity of knowledge and observation; scientific facts are gender neutral and available for objective observation. Alison Wylie associates this with a distinction she makes between feminist engagements with science that attempt to correct 'bad science', and engagements

⁵⁵ Sandra Harding, *The Science Question in Feminism* (New York: Cornell University Press, 1986), p. 24.

⁵⁶ Harding, *The Science Question in Feminism*, p. 25.

⁵⁷ *Another Voice: Feminist Perspectives on Social Life and Social Science*, ed. by Marcia Millman and Rosabeth Moss Kanter (New York: Anchor Books, 1975), p. vii. Quoted in Harding, *The Science Question in Feminism*, pp. 24–25.

that question 'science as usual'.⁵⁸ Feminist empiricism works to correct a bias in the interpretation of observed facts. Harding identifies a paradox within this logic that suggests that even within the project of feminist empiricism, the claims of an empiricist science do not hold.

The social identity of the inquirer is supposed to be irrelevant to the 'goodness' of the results of research. Scientific method is supposed to be capable of eliminating any biases [...] But feminist empiricism argues that women (or feminists, whether men or women) *as a group* are more likely to produce unbiased and objective results than are men (or nonfeminists) as a group.⁵⁹

The logic of feminist empiricism actually subverts the empiricist assumption that science is value-neutral; if a community of female or feminist scientists produced a different set of scientific values, then this questions the empirical nature of the science itself. Feminist empiricism claims a distinction between bad science and science as usual yet, in effect, makes this distinction untenable.

The idea that the gender of the scientist would have an effect on the science was taken further by advocates of a feminist standpoint epistemology. The feminist standpoint combined Kuhn's insight that scientists work within socially constructed paradigms with the feminist insight that science had historically been performed by men and suggested that scientific knowledge, when grounded in women's experience, would produce 'a morally and scientifically preferable grounding for our interpretations and explanations of nature and social life'.⁶⁰ Nancy Hartsock develops the project of feminist standpoint epistemology, defining a standpoint as 'not simply an interested position (interpreted as bias) but [...] interested in the sense of being engaged'.⁶¹ A feminist standpoint would counter the male bias in the sciences, and a resultant female bias should be

⁵⁸ Alison Wylie, 'Good Science, Bad Science, or Science as Usual? Feminist Critiques of Science', in *Women in Human Evolution*, ed. by Lori D. Hager (London: Routledge, 1997), pp. 29–55.

⁵⁹ Harding, *The Science Question in Feminism*, p. 25.

⁶⁰ Harding, *The Science Question in Feminism*, p. 26.

⁶¹ Nancy Hartsock, 'The Feminist Standpoint: Developing the Ground for a Specifically Feminist Historical Materialism', *Discovering Reality*, pp. 283–310, p. 285.

interpreted not as a negative consequence but a positive political engagement on the part of women. Furthermore, Hartsock's feminist standpoint is developed from the Marxist proposal that knowledge produced by those in a dominant social position can only ever be partial knowledge systems, whereas the subjugated position of women would necessarily produce more complete knowledge. This leads Hartsock to the argument that feminist epistemology should begin with women's 'life activity', how women experience the world and their relations to others.⁶² A science grounded in women's experience would engage with patriarchal bias, while producing a more complete system of knowledge. The feminist standpoint attempts to answer the paradox of feminist epistemology by suggesting that a bias should be interpreted as political interest, and arguing that an interested engagement with the sciences actually produces more complete systems of knowledge.

Elaine Morgan and the Aquatic Ape Hypothesis

To explore this argument more fully, I will introduce a particular example of an early feminist standpoint epistemology in evolutionary science. This example illustrates the social nature of scientific knowledge-production, the possibility of producing alternative narratives within science, as well as some of the constraints on this. It also begins to demonstrate the importance of nonhuman agency, which I will discuss in more detail in later chapters. In 1972, Elaine Morgan published *The Descent of Woman*, in which she argued that contemporary Darwinian anthropology was androcentric and that a reinterpretation of the Darwinian 'descent' of the human from the perspective of the female would provide an alternative narrative. Morgan argues from a Kuhnian perspective that androcentrism in evolutionary theorising is a paradigm, and that a female

⁶² Hartsock, 'The Feminist Standpoint', p. 305. A feminist standpoint is also developed by Jane Flax from a psychoanalytic point of view. Flax suggests that feminism would benefit from an expanded psychoanalysis with more emphasis on female experience and methods of identifying and relating to others as children and adults. Here 'women's experiences' is expanded to include non-Oedipal experiences of girls in childhood development ('Political Philosophy and the Patriarchal Unconscious: A Psychoanalytic Perspective on Epistemology and Metaphysics', *Discovering Reality*, pp. 245–281.)

reinterpretation or revision represents a call for a paradigm shift.⁶³ Morgan's argument is that from the androcentric paradigm, all characteristics of human beings are interpreted within a particular framework, that of the 'Mighty Hunter':

Almost everything about us is held to have derived from this. If we walk erect, it was because the Mighty Hunter had to stand tall to scan the distance for his prey. If we lived in caves it was because hunters need a base to come home to. If we learned to speak it was because hunters need to plan the next safari and boast about the last. Desmond Morris, pondering on the shape of a woman's breasts, instantly deduced that they evolved because her mate became a mighty hunter.⁶⁴

Morgan considers the narrative of human evolution from the perspective of the female of the species and, through a development of a new female-centred narrative of evolutionary descent, argues for the acceptance of the Aquatic Ape Hypothesis.

The Aquatic Ape Hypothesis was first suggested by Alister Hardy in 1960, in an article in the *New Scientist*.⁶⁵ He argues that certain physiological characteristics of *Homo sapiens*, such as hairlessness, can be best explained by positing that prehumanid apes spent a significant length of time towards the end of the Miocene period (23 million to five million years ago) living in a semi-aquatic environment. Hardy had wondered about an aquatic period in the evolution of humans since reading about the layer of subcutaneous fat present in humans but no other primates, in 1930. Being a marine biologist, Hardy was reminded of a similar layer of fat existent, and often coexistent with

⁶³ Elaine Morgan, *The Descent of Woman* (Gateshead: Northumberland Press, 1972). Although she does not mention Thomas Kuhn, her work is clearly Kuhnian. She states: 'The trouble with specialists is that they tend to think in grooves. From time to time something happens to shake them out of that groove.' (p.10) Her commitment to a Kuhnian interpretation of science is made more explicit in later works. In *The Naked Darwinist*, for example, she refers to the Savannah Hypothesis as a paradigm and questions the resistance of scientists to the Aquatic Ape Hypothesis which she believes could have provoked a paradigm shift (*The Naked Darwinist: Questions about Human Evolution* [Leeds: Eildon Press, 2008]).

⁶⁴ Morgan, *The Descent of Woman*, p. 11.

⁶⁵ Alister Hardy, 'Was Man More Aquatic in the Past?', *New Scientist*, 17 March 1960, pp. 642–645.

hairlessness, in aquatic animals such as dolphins and seals.⁶⁶ Hardy did not present his ideas on the aquatic history of humans until 1960 when he mentioned his thoughts to a lay audience at a sub-aqua club in Brighton. At this point in his career he was a professor and a Fellow of the Royal Society and, although working within a scientific paradigm, his standing was such that he could attempt to ignore Kuhn's paradigm imperative discussed earlier: 'Normal science does not aim at novelties of fact or theory and, when successful, finds none.' In the face of a negative academic reaction to his comments, however, Hardy only published the single article in the *New Scientist*. This context is illustrative as it provides support for the Kuhnian analysis of the paradigm nature of science, and for Morgan's view that evolutionary theory works within a particular paradigm, that of Man the Mighty Hunter, and that an alternative narrative or standpoint could – or perhaps rather should – provoke a paradigm shift.

The Aquatic Ape Hypothesis has received some support, with Morgan being its most prominent proponent, publishing *The Descent of Woman* in 1972 and a further five books on the subject: *The Aquatic Ape: A Theory of Evolution*; *The Scars of Evolution*; *The Descent of the Child: Human Evolution from a New Perspective*; *The Aquatic Ape Hypothesis*; and *The Naked Darwinist: Questions about Human Evolution*.⁶⁷ Morgan comments in *The Naked Darwinist* that she expected, after publishing *The Descent of Woman*, for the Aquatic Ape Hypothesis set out in that book to be discussed, interrogated, and possibly refuted. However, she states, 'The response I had not foreseen was total silence.'⁶⁸ Morgan claims that the scientific community generally found it more effective to protect the prevailing paradigm by ignoring the Aquatic Ape Hypothesis, rather than attacking or

⁶⁶ For an opposing account of the role of fat in evolution and the existence of a layer of fat in some primates, see Caroline Pond, *The Fats of Life* (Cambridge: Cambridge University Press, 1998), especially pp. 236–238.

⁶⁷ Morgan, *The Aquatic Ape: A Theory of Evolution* (London: Souvenir, 1982); *The Scars of Evolution* (London: Souvenir, 1990); *The Descent of the Child: Human Evolution from a New Perspective* (London: Souvenir, 1994); *The Aquatic Ape Hypothesis* (London: Souvenir, 1997); *The Naked Darwinist: Questions about Human Evolution* (Leeds: Eildon Press, 2008).

⁶⁸ Morgan, *The Naked Darwinist*, p. 18.

questioning it.⁶⁹ Daniel Dennett, in his book *Darwin's Dangerous Idea*, commented on the refusal of scientists to engage with the Aquatic Ape Hypothesis:

During the last few years, when I have found myself in the company of distinguished biologists, evolutionary theorists, paleoanthropologists and other experts, I have often asked them just to tell me, please, exactly why Elaine Morgan must be wrong about the aquatic theory. I haven't yet had a reply worth mentioning, aside from those who admit, with a twinkle in their eyes, that they have also wondered the same thing.⁷⁰

The reaction of the scientific community to *The Descent of Woman* is illustrative of the way paradigm communities within science operate, and the ways that paradigms define who can ask questions, about what, and the answers that can be expected to those questions.

A lucid example of Morgan's reformulation of the evolutionary narrative can be seen in her description of the development of the human vagina and penis. Morgan claims that living in an aquatic environment could have encouraged the retraction of the vagina in the female of the species: '[The vagina] not only moved forward – it also withdrew farther within the body cavity, possibly for additional protection against salt water and abrasive sand. This is normal marine modification.'⁷¹ (In *The Descent of Woman* Morgan also claims that the hymen developed for reasons of protection, but states in later work that this claim is untenable due to the discovery of the existence of a hymen in other non-aquatic animals, including horses.⁷²) It is Morgan's claim that the vagina retracted as a response to environmental change, and that the development of a larger penis in humans compared to other apes such as chimpanzees was a response to this. Importantly, in Morgan's narrative, male development follows initial developments in the female. The length of the human penis and the development of ventro-ventral (face to face) sexual intercourse are interpreted

⁶⁹ Morgan, *The Naked Darwinist*, p. 20.

⁷⁰ Daniel Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon and Schuster, 1995), p. 244.

⁷¹ Morgan, *The Descent of Woman*, p. 59.

⁷² Morgan, *The Naked Darwinist*, p. 30.

as a consequence of female development.⁷³ This subverts the androcentric view that female physiology and sexual behaviour developed as a consequence of the developments of Man the Mighty Hunter, and undercuts the assumption seen in sociobiological narratives, that man is the agent of evolutionary change. I believe Morgan's work to be important, whatever the factual status of the Aquatic Ape Hypothesis, especially in conjunction with my analysis of sociobiology, because it clearly illustrates the ways in which gendered assumptions can produce an androcentric narrative of evolutionary change, with man as the active evolutionary agent and the female as a passive sexual resource. It also emphasises the possibility for alternative narratives and knowledges, which will be important in the following chapter where I propose a queer alternative to narratives of genetic determinism. This is also important for my project as a whole, which seeks to put science and social theory into conversation to produce alternative and more equitable narratives, knowledges, and ways of living.

Morgan, through the adoption of a feminist standpoint, effects a shift in the traditionally gendered evolutionary narrative; the female of the species may have developed in a certain way in an aquatic environment with contemporary female and male physiology and behaviour following as an evolutionary consequence. I think that this narrative is very important for feminist engagements with evolutionary science, although it is also problematic for reasons I will outline below. Morgan's narrative and its history and reception illustrates the extent to which androcentric paradigms define the ways in which scientific facts are interpreted, and the kinds of science that are encouraged or discouraged within paradigms. Morgan's epistemology is avowedly feminist, and I believe *The Descent of Woman* to be typical of early feminist standpoint science, as the focus is the use and abuse of biologically deterministic narratives of evolutionary descent, rather than questioning the fundamental problems with such an approach. *The Descent of Woman* is an early example of an attempt to formulate a scientific narrative from a female perspective so as to counter gendered

⁷³ Morgan, *The Descent of Woman*, pp. 57–67.

assumptions and biases in narratives of biological determinism, such as sociobiological narratives of descent. Morgan's narrative is important as it shows one method of opposing patriarchy in science. Also, it illustrates a number of problems with this approach; in particular it prompts the question of whether relying on biological determinism and a linear narrative of descent is a successful method of producing a feminist epistemology.

Problems with Feminist Standpoints

Based on this interpretation of her work, Morgan's argument depends upon biological determinism, albeit from a subversive feminist standpoint. Among the drawbacks of this approach is the lack of analysis of patriarchal values that structure theory and method, as well as interpretation. As a consequence, her approach does not adequately confront the paradox of feminist empiricism, that a politically motivated empiricism can question the very truth claims of empirical science. For Morgan, the politically motivated narrative of *The Descent of Woman* reveals anomalies in the content of work produced within the androcentric evolutionary paradigm. Unfortunately, her work does not proceed to further question the validity of the adaptationist method, or the patriarchal assumptions that function in biological determinism and linear narratives of descent. Morgan's narrative relies upon biological determinism, suggesting that contemporary behavioural and physiological characteristics of humans and human societies can be best explained through the construction of plausible narratives of descent. As a consequence, Morgan's work draws attention to patriarchy in the traditional narratives of descent, yet replicates patriarchal methods and theoretical techniques such as the assumption of scarcity and competition without questioning the historical and political contexts within which these concepts were developed.

Hubbard addresses the feminist standpoint in evolutionary science in her article, 'Have Only Men Evolved?' Hubbard's perspective is interesting, as it illustrates a tension between empiricism and standpoint epistemology while pointing to some issues that led, in the 1980s, to the emergence of postmodernism in the feminist engagement with science. Hubbard argues that feminist

standpoint theories like Morgan's are inadequate, because they overestimate biological determinism, and underestimate the role of social and cultural change:

Except as a way of parodying the male myths, I find it unsatisfactory because it locks the authors into many of the same unwarranted suppositions that underlie those very myths. For example, both accept the view that our behavior is biologically determined, that what we do is a result of what we were or did millions of years ago. This assumption is unwarranted given the enormous range of human adaptability and the rapid rate of human social and cultural evolution.⁷⁴

As an alternative to feminist myth-making, Hubbard suggests 'exposing and analyzing the male myths that hide our overwhelming ignorance', arguing that 'women who recognize an androcentric myth when they see one and who are able to think beyond it, must do the necessary work [...] and come up with ways of seeing the facts and of interpreting them'.⁷⁵ She also draws attention to a difficulty with this project:

None of this is easy, because women scientists tend to hail from the same socially privileged families and be educated in the same elite universities as our male colleagues. But since we are marginal to the mainstream, we may find it easier than they to watch ourselves push the bus in which we are riding.⁷⁶

Hubbard recognises the problems of a feminist standpoint or the creation of female myths: that unquestioned assumptions in male-centred theories can be replicated in female-centred theories. Her suggestion for an alternative is that feminist scientists 'think beyond' androcentric myths, rather

⁷⁴ Hubbard, 'Have Only Men Evolved?', p. 31. For a useful discussion of 'cultural evolution' and the available positions between biological and cultural determinism see Steven Rose, R. C. Lewontin and Leon J. Kamin, *Not in Our Genes: Biology, Ideology and Human Nature* (London: Penguin, 1990).

⁷⁵ Hubbard, 'Have Only Men Evolved?', p. 32.

⁷⁶ Hubbard, 'Have Only Men Evolved?', p. 32. Hubbard uses the analogy of the bus to describe the difficulty of becoming aware of 'implicit, unstated and often unconscious beliefs about the nature of reality' ('Have Only Men Evolved?', p. 10–11). This analogy is expanded from Peter Berger and Thomas Luckmann, *The Social Construction of Reality*, 2nd ed (Garden City: Doubleday and Co., 1966), p. 12.

than creating feminist myths. This suggestion, however, depends upon empiricism. For Hubbard, the facts exist to be interpreted and 'women who recognize an androcentric myth when they see one' could, and should, 'do the necessary work' to uncover the empirical facts and interpret them without bias. As I argued earlier, the notion that science can become more empirical when practised by a particular group of people is problematic and actually subverts the notion of empiricism itself.

Hubbard emphasises the problem with biological determinism in standpoint epistemologies such as Morgan's, yet her suggested empirical response is problematic. The feminist empiricist paradox is not resolved by the suggestion that women can produce a more value-neutral science. Furthermore, it is not apparent that all female or feminist scientists would respond to androcentric myths in the same ways. This problem is recognised by Hubbard, and she makes reference to the fact that female scientists tend to be from similar class and educational backgrounds as male scientists. For Hubbard, female scientists may, in fact, be committed to the same androcentric myths as male scientists, due to a collective similar background or educational bias. Implicit in this recognition is the question of what constitutes a collective solidarity or commitment to scientific myths. Her argument points to a tension in feminist science studies in the late 1970s and 1980s which questioned whether a female or feminist identity could be collectively assumed to produce standpoints or politically useful scientific knowledge. If class or educational background could produce a bias that would destabilise a standpoint, then this would suggest that other identities or loyalties could also threaten such solidarity grounded in female identity; and, indeed, Hubbard's comments foreshadow the question of whether there could even be a single female identity upon which to ground a single stable feminist standpoint.

As I have shown, the feminist standpoint was an attempt to counter patriarchy in scientific narratives such as sociobiology. Feminist standpoint epistemology attempted to create systems of knowledge that originated in women's experience, and accounted for women's lives. This developed as a consequence of early feminist recognition of the imbalance of women and men in scientific

careers, and the ways in which science was often used as a patriarchal tool of control over women's bodies and lives. Elaine Morgan's *The Descent of Woman* represents an early attempt to formulate a feminist standpoint, and also draws attention to some of the problems of this approach – in particular the use of patriarchal concepts and theoretical approaches to fashion a narrative that appears valid as scientific theory. Not only does Morgan's Aquatic Ape Hypothesis reproduce the biological determinism of sociobiological narratives, but the suggestion of a feminist standpoint that grounds epistemology in women's experience also raises the question of whether a singular stable feminist identity exists from which to take a standpoint and, in fact, what counts as women's experience. I will build on this argument in the following section, looking at some theoretical developments in the 1980s, before rereading the Aquatic Ape Hypothesis and suggesting a novel and alternative interpretation in the light of some of the findings of feminist postmodernism.

Feminist Postmodernism

The growing recognition of the difficulty in taking up a single standpoint from which to practise science illustrates a tension in feminist engagements with science in the 1970s and early 1980s that led to the development of postmodernist perspectives within science studies. Harding outlines this development, echoing Hubbard's recognition of social privileges and bias and expanding upon the implications. Harding asks, 'what are the intellectual and political relationships between feminist scientific and epistemological projects and the similar projects of the other groups?':

Furthermore, are women, or even feminists, a 'group' in the sense required by the standpoint epistemologies? Do not *other* self-conscious political projects create in many women and feminists self-identities and political loyalties that are in tension with the metaphysics and politics of the standpoint epistemologies?⁷⁷

⁷⁷ Harding, *The Science Question in Feminism*, p. 163.

Harding argues that the standpoint assumption that common female experiences produce a stable identity from which to produce a feminist epistemology and politics is undercut by ‘fracturing identities’ related to race, class and sexuality.⁷⁸ In 1979, Hubbard had drawn attention in ‘Have Only Men Evolved’ to the fact that class and education problematise the project of taking a stable standpoint based on singular female identity. Feminists in the 1980s began to recognise that there are multiple ways in which an identity can be fractured and that there are many and varied complex political commitments and projects related to identity that could undermine the attempt to create a stable feminist standpoint.

Feminist postmodernism also interrogates the process of producing knowledges, and questions the possibility of value-neutral empiricism.⁷⁹ A singular stable position or standpoint is illusory, as is a singular stable realm of scientific facts that can be observed, described or interpreted. As Harding says,

Contrary to the assumption of ‘a’ world out there composed of essential dichotomies, which it is science’s job to reconnect through explanation, there are as many interrelated and smoothly connected realities as there are kinds of oppositional consciousness. By giving up

⁷⁸ Harding, *The Science Question in Feminism*, p. 163.

⁷⁹ One of the key texts for the development of postmodernist epistemologies is Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. by Geoff Bennington and Brian Massumi (Manchester: Manchester University Press, 1984 [1979]). In this text, Lyotard makes a number of claims about science and the validation of knowledge. Chief among these is the claim that postmodernism should be understood as ‘incredulity towards metanarratives’, p. xxiv. Lyotard also argues that science should be understood in terms of language games and speech acts and that scientific knowledge must, in fact, be legitimated by narrative knowledge (Lyotard acknowledged that this particular claim emphasised narrative knowledge to too great an extent in later texts – see in particular *The Postmodern Explained to Children: Correspondence 1982–1985*, ed. by Julian Pefanis and Morgan Thomas, trans. by Don Barry and others [London: Turnaround, 1992], especially pp. 29–32). *The Postmodern Condition* illustrates the questioning of science and the legitimation of knowledge that was occurring in the late 1970s and early 1980s. I am employing the term postmodern to signal a suspicion towards the political uses of metanarratives (in particular patriarchal narratives of evolutionary descent) but not engaging directly with Lyotard’s text as I believe Donna Haraway’s formulation of a postmodernist epistemology, which I will discuss later, to be a more successful negotiation between relativism and realism, and thus to be more useful for political engagements with scientific narratives and knowledge claims.

the goal of telling 'one true story', we embrace instead the permanent partiality of feminist inquiry.⁸⁰

Feminist postmodernism is concerned with the fracturing of identities, as well as the problems of objectivity and empiricism. It recognises the partiality of all inquiries, scientific and feminist, and suggests ways in which this partiality can be embraced for transformative political projects.

Postmodernist epistemologies directly interrogate the traditional model of scientific practice, that a stable singular individual scientist can approach an object of scientific inquiry, itself singular and knowable, and produce empirical bodies of knowledge. Postmodernist epistemologies thus offered feminists a method of interrogating the Baconian gendered model of patriarchal scientific practice and the split between object and subject in scientific inquiry.

Donna Haraway sees political potential in the fracturing of identities and it is her perspective, as outlined in 'A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s', that I will be employing as a particular form of 1980s feminist postmodernism, although it is worth noting that she has since distanced herself from the term.⁸¹ Haraway argues for '*pleasure* in the confusion of boundaries and for *responsibility* in their construction'.⁸² Haraway's work is important throughout my thesis, as she sees possibility and radical potential in science. Haraway regards the development of science and technology as bringing about confusion in the three fundamental distinctions that are the basis of humanism:

Biology and evolutionary theory over the last two centuries have simultaneously produced modern organisms as objects and reduced the line between humans and animals to a faint trace re-etched in ideological struggle or professional disputes between life and social

⁸⁰ Harding, *The Science Question in Feminism*, p. 194.

⁸¹ See Donna Haraway, 'The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others', in *Cultural Studies*, ed. by Lawrence Grossberg, Cary Nelson, Paula A. Treichler (New York; Routledge, 1992), pp. 295–337, especially pp. 297–298.

⁸² Donna Haraway, 'A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s', *Signs*, 4 (1987), 1–42 (p. 3).

sciences [...] The second leaky distinction is between animal-human (organism) and machine [...] The third distinction is a subset of the second: the boundary between physical and non-physical is very imprecise for us.⁸³

I will focus on the first 'leaky distinction' and its effects in narratives of evolutionary descent and in the operations of biological determinism.⁸⁴ Wilson and other sociobiologists misinterpret cultural phenomena as biological fact and this is in part achieved through a negotiation of the boundary between human and animal. As I argued earlier, with reference to Fausto-Sterling's '*linguistic hat trick*', constructs from human culture are attributed to animal populations; they then function as supposed natural phenomena; these phenomena are then applied to human culture. This confuses different sets of phenomena and supports the status quo. It is important to note here that this sociobiological logic depends both upon the 'leakiness' of the animal-human distinction, and the ability of the sociobiologist to define the distinction as is necessary for the theory.

In this approach, the boundaries between human and animal are questioned, as are the ways in which this boundary is defined and negotiated. Feminist standpoint epistemologies suggest that feminist science should start from women's experience, and Morgan's narrative of evolutionary descent of the female of the species does exactly that, anachronistically considering evolutionary adaptation from the point of view of contemporary women's experience of, among other things,

⁸³ Haraway, 'A Manifesto for Cyborgs', pp. 4–6.

⁸⁴ The second and third distinctions and their permeability can also be observed in evolutionary theory, for example in the debates over human development and tool use. The distinction between the animate and non-animate is brought into question in discussions of the importance of inanimate objects in human evolution. Many anthropologists suggest that tool use was a watershed moment in human evolution, taking hunting tools as the first or most important tool; feminist anthropologists have responded to this with the suggestion that the proto-tool might have been the female gatherer's basket, not the male hunter's spear (For example Sally Slocum, 'Woman the Hunter: Male Bias in Anthropology', in *Towards an Anthropology of Women*, ed. by Rayna R. Reiter [New York: Monthly Review Press, 1975], pp. 36–50.). Adrienne Zihlman traces the historical representation of the gendered division of labour in anthropological and evolutionary narratives. She argues that both Man the Hunter and Woman the Gatherer narratives reproduce a gendered division of labour that reflects contemporary society rather than the prehistoric past ('The Paleolithic Glass Ceiling: Women in Human Evolution', *Women in Human Evolution*, pp. 91–114). Morgan argues that the female would have developed tool use so as to break into crustaceans at the shore, a development unnecessary for the male with generally larger sharper teeth, again subverting the conventional idea of man as the agent of evolutionary change and offering a narrative that does not depend upon the gendered division of hunting and gathering (Morgan, *The Descent of Woman*, p. 27).

their bodies, reproduction, and childbearing. The question, however, of what comes to constitute women's experience in the face of the fractured identities and loyalties recognised in different women becomes an important question for postmodernist feminist science studies in the 1980s. Feminists began to recognise that there is not one set of experiences that fully represents women's experience. Furthermore, Haraway emphasises the impossibility of a stable cultural or biological identity base from which to formulate a feminist standpoint: 'There is nothing about being "female" that naturally binds women. There is not even such a state as "being" female, itself a highly complex category constructed in contested sexual scientific discourses and other social practices'.⁸⁵ Haraway does, however, recognise the need to produce bodies of knowledge that speak for a feminist political purpose and does not suggest that feminist science is impossible. Rather, I think it is useful to restate her call for pleasure in the confusion of boundaries, and for responsibility in their reconstruction. Feminist postmodernist science studies – as well as the queer approach that I will build upon these epistemologies in the next chapter – faces a paradoxical imperative: it must support the pleasure in the confusion of traditional boundaries that support the patriarchal status quo, while also recognising the necessity of the reconstruction of boundaries for knowledge-making and political purposes.

Haraway's Postmodernism and Objectivity

Haraway's argument suggests an epistemology based on pleasure in the confusion of the central boundaries of Western humanism, such as fusions between human, animal and machine. The cyborg is an ironic symbol of hybridity in the face of the leaky boundary distinctions. She argues that, 'From the point of view of pleasure in these potent and taboo fusions, made inevitable by the social relations of science and technology, there might indeed be a feminist science.'⁸⁶ Harding concludes from Haraway's cyborg myth that,

⁸⁵ Haraway, 'A Manifesto for Cyborgs', p. 8.

⁸⁶ Haraway, 'A Manifesto for Cyborgs', p. 28.

From this perspective, if there can be 'a' feminist standpoint, it can only be whatever emerges from the political struggles of 'oppositional consciousnesses' – oppositional precisely to the longing for 'one true story' that has been the psychic motor for Western science.⁸⁷

Harding suggests that feminist postmodern epistemology must always be figured in opposition to the dominant scientific drive for universal narratives. It is, however, important to read Haraway's epistemology as not simply suggesting a politics based on an oppositional identity, as this would replicate the very problems that feminist postmodernism identified in standpoint epistemologies. Haraway's postmodernist epistemology attempts to create political solidarity without recourse to universal narratives or identity. This epistemology seems to contrast to Morgan's attempt to produce a narrative of female evolutionary descent. As useful and potentially subversive as her narrative is, it is an attempt to produce a singular factual universal narrative from a singular female perspective, and it fails to recognise the structural problems with this attempt, either from the patriarchal or feminist perspective.

Haraway sets her outlined feminist postmodernism apart from relativism, or radical social constructionism. Her project is one of mediation between a position of Kuhnian social constructionism in science and the political need for a feminist standpoint. As she states in 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective':

I think my problem and 'our' problem is how to have *simultaneously* an account of radical historical contingency for all knowledge claims and knowing subjects [...] *and* a no-nonsense commitment to faithful accounts of a 'real' world.⁸⁸

⁸⁷ Harding, *The Science Question in Feminism*, p. 193.

⁸⁸ Donna Haraway, 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Simians, Cyborgs, and Women: The Reinvention of Nature* (London: Free Association Books, 1991), pp. 183–201 (p. 187).

Haraway's postmodernist feminist epistemological approach must therefore account for both the contingent constructed nature of scientific claims, and the necessity of a certain type of scientific realism for political projects. This mediation between two seemingly opposite approaches to scientific knowledge is accomplished, in part, through a reinterpretation of the concept of objectivity and the consequences of the development and insistence upon this new mode of feminist postmodernist objectivity. Crucially, this illustrates that there are different ways of producing knowledge about objects of scientific enquiry; in short, there are always alternative ways of 'doing' science.

Haraway suggests that feminist standpoint epistemologies point the way to a politically useful reinterpretation of objectivity. Feminist standpoints lay claim to greater objectivity as they originate in a position of subjugation, and are thus less biased by dominant norms and conventions. Haraway states that these subjugated standpoints seem to promise 'more adequate, sustained, objective, transforming accounts of the world'.⁸⁹ For Haraway, however, it is not a matter of simply replacing male scientists with female scientists, or recognising and challenging androcentrism when it is apparent. Haraway's feminist postmodernist objectivity demands taking up a partial position, so as to 'see from below', while problematising the very possibility of taking up 'a' position in the first place.⁹⁰ This positioning must negotiate the impossibility of a stable ground or standpoint without becoming a form of relativism, since as Haraway states, 'Relativism is a way of being nowhere while claiming to be everywhere equally.'⁹¹ This statement is important as the alternative to taking up a singular stable standpoint is not necessarily positionless relativism. Haraway argues, in fact, for an alternative to relativism, not in the development of universal truths or singular stable narratives and identities, but in partiality, contingency and critical reflection: 'The alternative to relativism is partial, locatable, critical knowledges sustaining the possibility of webs of connection called solidarity in

⁸⁹ Haraway, 'Situated Knowledges', p. 191.

⁹⁰ Haraway, 'Situated Knowledges', p. 191.

⁹¹ Haraway, 'Situated Knowledges', p. 191.

politics and shared conversations in epistemology.⁹² It is important to note here that Haraway usefully rejects the fictional necessity to choose one of two dichotomous positions in epistemologies of science: Baconian objectivity based on a split between object and (male) scientific subject, or relativism and the rejection of any sense of realism. Haraway redefines the Baconian position as identity, as it protects the subject from connection with the object, and suggests that the alternative is in fact a reformulation of objectivity, achieved through partial perspectives, connections and conversations.

It is solidarity without the ground of identity that is fundamental to Haraway's reformulation of objectivity. Complete and discrete identity reinforces the fictional distance between subject and object, between scientist and the object of scientific inquiry. Haraway argues that a complete and discrete self is incapable of objectivity, because true objectivity demands a collapse of distance between subject and object:

The knowing self is partial in all its guises, never finished, whole, simply there and original; it is always constructed and stitched together imperfectly, and *therefore* able to join with another, to see together without claiming to be another. Here is the promise of objectivity: a scientific knower seeks the subject position not of identity, but of objectivity; that is, partial connection.⁹³

Traditional models of scientific practice have valorised the distance between scientist as subject and the object of scientific inquiry as the most efficient way of producing rational knowledge. Haraway's postmodernist feminist reformulation of objectivity suggests that contingency, positioning, location and partiality are the conditions of producing rational knowledge claims.⁹⁴ Haraway thus encourages the reduction of distance between subject and object. This reformulation of objectivity is useful to feminist epistemologies, as it problematises the traditional gendered models of rationality that

⁹² Haraway, 'Situated Knowledges', p. 191.

⁹³ Haraway, 'Situated Knowledges', p. 193.

⁹⁴ Haraway, 'Situated Knowledges', p. 195.

structure the practice of science. It does, however, threaten the possibility of a singular female identity or standpoint, as much as it does male identity or patriarchal perspectives. It is also crucial to my project, and foundational for the deconstructive approach to gender and sexuality I will discuss in Chapter Two. Again, Haraway's call for responsibility in the reconstruction of boundaries is useful, as it illustrates the need for certain contingent responsive and responsible standpoints for feminist politics.

Haraway and the Agency of the Object

One of the ways that Haraway suggests the object-subject distinction can be broken down to encourage more contingent partial connections, and thus more objectivity, is by emphasising the agency of the object. Haraway's conception of objects as actors offers a more complex way of interpreting Morgan's feminist narrative of evolutionary descent, rather than simply as an alternative narrative of biological determinism. Haraway argues that the objects of scientific inquiry have traditionally been seen as passive and inert, and that:

Accounts of such objects can seem to be either appropriations of a fixed and determined world reduced to resource for the instrumentalist projects of destructive Western societies, or they can be seen as masks for interests, usually dominating interests.⁹⁵

Haraway uses the example of biological sex to elucidate this point; when sex becomes an object of biological knowledge, this encourages biological determinism, and threatens the work of social constructionism and the critical theory of political projects such as feminism. A more pertinent example for my own argument is that of the female in evolutionary theory. Androcentric accounts of females in evolution reduce the female to a resource for the male in sexual competition, and Morgan's narrative of female evolutionary descent emphasises the extent to which the traditional agents of evolutionary change are male. The apparent plausibility of the adaptationist narratives

⁹⁵ Haraway, 'Situated Knowledges', p. 197.

regarding gendered development in evolution masks the dominant interest in maintaining the status quo in relation to gendered social structures.

Haraway names this traditional way of conceiving of the subject's relation to the object as an appropriationist or productionist logic.⁹⁶ Haraway argues that there is a logic of domination built into traditional Western binaries such as object-subject, whereby one component side of the binary is always figured as passive and as a resource for the production or appropriation by the corresponding active component. Nature is considered as the raw material or resource for cultural production; sex is the resource for the acts of gender; the female is the resource for the male. The object of inquiry, or resource, must be denied the status of an agent in the production of knowledge. Haraway suggests that feminist postmodernist epistemologies emphasise the agency of the object:

Situated knowledges require that the object of knowledge be pictured as an actor and agent, not a screen or a ground or a resource, never finally as slave to the master that closes off the dialectic in his unique agency and authorship of 'objective' knowledge.⁹⁷

Haraway argues that conceiving of objects as actors is not a naive form of scientific realism, which depends upon a logic of discovery, but an engagement that depends upon a 'power-charged social relation of "conversation"'.⁹⁸ The material and productive nature of active objects reduces the distinction between subject and object, threatening productionist or appropriationist narratives, and providing space for the work of social constructionism without slipping into mere relativism.

This theory of objects as actors is reminiscent of Bruno Latour's use of the term 'actant'. Latour uses the concept of actants to emphasise material agency within scientific practice and, like Haraway, to negotiate a middle-ground between radical social constructionism and naive scientific realism. An actant in Latour's conception is an object, considered as material and active, and

⁹⁶ Haraway, 'Situated Knowledges', p. 198.

⁹⁷ Haraway, 'Situated Knowledges', p. 198.

⁹⁸ Haraway, 'Situated Knowledges', p. 198.

contributing to the scientific process. Objects of scientific inquiry are actants with multiple effects, not all of which can be known by the scientist. The scientific process turns 'actants' into 'actors', defining the ways in which the object relates to other objects, including how it is affected by these relations.⁹⁹ The concepts of nature and culture are by-products of this process, rather than simple dichotomous opposites. As Haraway states, 'The world neither speaks itself nor disappears in favour of a master decoder [...] The world is not raw material for humanization'.¹⁰⁰ The 'activation' of the categories previously held to be passive and inert, such as biological sex, nature, and the female, provides a way of challenging the productionist and appropriationist logic without resorting to radical social constructionism or naive scientific realism. As Haraway argues, 'The activation permanently problematizes binary distinctions like sex and gender, without however eliminating their strategic utility'.¹⁰¹ Latour's concept of the actant is useful when following Haraway's system of critical objectivity achieved through a collapse of the distance between subject and object, and offers a way of considering Morgan's narrative of female evolutionary descent that goes beyond a criticism of its reliance upon biological determinism.¹⁰² I will be using the term 'actor' or 'agent' throughout this thesis; as useful as the actor/actant distinction is, there is a danger of it giving overdue emphasis to scientific and laboratory work, rather than the agency of the actors in question, which is something I am trying to avoid throughout.

Morgan's Apes as Agents of Evolution

Morgan's narrative in *The Descent of Woman* reformulates the subject-object division along the traditional lines of male-female within evolutionary theory. In sociobiological theory, for

⁹⁹ For a detailed explanation of actants, see Latour's *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open University Press, 1987).

¹⁰⁰ Haraway, 'Situated Knowledges', p. 198.

¹⁰¹ Haraway, 'Situated Knowledges', p. 199.

¹⁰² It is important to note that Haraway has certain problems with Latour's theory. In particular she questions whether his celebration of scientific practice (in *Science in Action* in particular) leads his work to present scientists as heroes, and thus to reinforce the object-subject distinction (Donna Haraway, *Modest_Witness@Second_Millennium.FemaleMan@_Meets_OncoMouseTM: Feminism and Technoscience* (New York: Routledge, 1997), especially pp. 33–35.

example, the female is considered a 'special kind of resource', and the clear distinction is made between male and female along the hierarchical binary oppositions of active/passive and agent/resource.¹⁰³ The male is the agent of evolutionary change, and the female is solely object or resource. Morgan's narrative of descent of the female inverts this binary, suggesting that the body or actions of the female ape brought about evolutionary change. A pertinent example is that of the sexual relationship between male and female prehumanid apes and its connection with social bonds, as discussed in the chapter entitled 'Love'. Morgan draws attention to the 'stultifying tendency to assume that the male has always been the initiator of sexual activity, and the female only a passive instrument or receptacle of his desire'.¹⁰⁴ She proceeds to discuss estrous cycles in primates, a female sexual cycle that she argues actually stimulates and produces male sexuality as a developmental response.¹⁰⁵ Morgan argues that the lack of estrus in *Homo sapiens* has not detracted from the female ape's agency, but rather that this can be considered as one of the origins of more complex contemporary sexual and social relationships.¹⁰⁶ In effect, in this example and throughout *The Descent of Woman*, Morgan performs an activation of the object, giving the female of the species evolutionary agency. Morgan considers the female of the species as an actor and agent, rather than just a passive resource.

¹⁰³ Wilson, *Sociobiology*, p. 243.

¹⁰⁴ Morgan, *The Descent of Woman*, p. 115.

¹⁰⁵ Morgan, *The Descent of Woman*, pp. 116–118.

¹⁰⁶ The lack of estrus in humans is not agreed upon by all scientific researchers. Some suggest that the estrous cycle has been lost or hidden in human females, for example Beverly I. Strassmann, 'Sexual Selection, Paternal Care, and Concealed Ovulation in Humans', *Ethology and Sociobiology*, 2 (1981), pp. 31–40; and Paul W. Turke, 'Effects of Ovulatory Concealment and Synchrony on Prothominid Mating Systems and Parental Roles', *Ethology and Sociobiology*, 5 (1984), pp. 33–44. It is interesting to note that both Strassmann and Turke suggest that estrous cycles may have become hidden as a response to lack of parental care and excessive polygyny on the part of the male, and thus reinforce the traditional model of female evolutionary development as effect, rather than cause. Other researchers have suggested that human female estrous cycles may not be obvious but are important in contemporary social and sexual relations nevertheless. A wealth of rather dubious research has been done to investigate the effect of estrous cycles on contemporary sexuality in relation to, amongst other things, female clothes choice, body odour and even economic success while lap dancing. See in particular, Martie G. Haselton and others, 'Ovulatory Shifts in Human Female Ornamentation: Near Ovulation, Women Dress to Impress' *Hormones and Behavior*, 51(2007), pp. 41–45; Jan Havlíček and others, 'Non-Advertized does not Mean Concealed: Body Odour Changes across the Human Menstrual Cycle', *Ethology*, 112:1 (2006), pp. 81–90; and Geoffrey Miller, Joshua M. Tybur, Brent D. Jordan, 'Ovulatory Cycle Effects on Tip Earnings by Lap Dancers: Economic Evidence for Human Estrus?', *Evolution and Human Behavior*, 28 (2007), pp. 375–381.

Morgan's narrative does, however, somewhat fail to mediate successfully between social constructionism and scientific realism, and ultimately falls back upon biological determinism without adequately recognising the problems with this approach. In the previous example, contemporary social and sexual relations are argued to be determined by the loss of estrous cycles in early *Homo sapiens*. Not only can this account therefore be read as performing the same logical trick that I identified earlier in sociobiological accounts of differences between egg and sperm, it also reduces contemporary female and male sexuality to solely a process of biological reproduction. It is my contention, nonetheless, that the way in which she 'activates' the category of woman in evolution can in fact be used as a powerful tool to counter conservative biological determinism. The female body for Morgan is a productive site, not a passive resource as considered by sociobiologists. Morgan's female apes are active agents from whose body and actions follow evolutionary changes. It is for this reason that I believe that the Aquatic Ape Hypothesis can be re-evaluated as a useful epistemology for feminists engaging with evolutionary science. In representing the active and agential nature of the female body, rather than figuring it as a passive resource, I believe Morgan's aquatic apes can be interpreted as representations of active female embodiment, and as resistant to the patriarchal conventions of active male domination of a passive female resource.

Haraway states in 'A Manifesto for Cyborgs' that, 'Biological-determinist ideology is only one position opened up in scientific culture for arguing the meanings of human animality. There is much room for radical political people to contest for the meanings of the breached boundary.'¹⁰⁷ Sociobiology negotiates the boundary of the human and the animal in a way that reinforces the distinction and reinforces conventional social norms in the process. Haraway suggests that this leaky distinction, the transgression of the boundary of human and animal, can offer – and it is important to note her choice of words – other 'positions' to interrogate the production of meanings in scientific culture. Haraway thus recognises the necessity of political positions and the responsible negotiation

¹⁰⁷ Haraway, 'A Manifesto for Cyborgs', p. 4.

and construction of boundaries, however partial and contingent. Feminists engaging with sociobiological claims in the 1970s had to take a position from which to interrogate the political claims of sociobiologists such as Edward O. Wilson. This need for a position from which to interrogate patriarchy is elaborated further in Morgan's alternative female narrative of descent and the development of feminist epistemologies in the late 1970s and early 1980s. Haraway, although opposed to a singular feminist standpoint, offers the cyborg as a myth of transgressed boundaries, where positions can be created in the impossibility of identity. Importantly, Haraway's postmodernism and cyborg myth offer a way to reinterpret feminist engagements such as Morgan's *The Descent of Woman* without simply reducing her work to biological determinism. Morgan's Aquatic Ape Hypothesis, when seen through Haraway's postmodern framework, is not about a single identity shared between contemporary women and prehomimid apes, but rather a sense of solidarity without a ground of identity and a conversation and partial connection between feminist politics and the active evolving bodies of prehomimid female apes.

While Haraway develops her argument in opposition to feminist standpoint epistemologies, she incorporates elements of the standpoint strategy. Harding argues that the oppositional and political nature of Haraway's postmodernism makes the cyborg myth not incompatible with standpoint epistemology. Feminist postmodernist epistemology begins from 'nonessential, nonnaturalizable, fragmented identities and the refusal of the delusion of a return to an "original unity"'.¹⁰⁸ This, for Harding, offers tools with which to explore the naturalisation of patriarchal assumptions and values in science. However, she maintains that feminist standpoint epistemologies of science cannot be abandoned; 'they are central to transferring the power to change social relations from the "haves" to the "have-nots"'.¹⁰⁹ Harding thus illustrates a tension in feminist engagements with science in the 1980s. The development of feminist postmodernism identified internal contradictions in the feminist standpoint project and suggested that the attempt to ground

¹⁰⁸ Harding, *The Science Question in Feminism*, p. 193.

¹⁰⁹ Harding, *The Science Question in Feminism*, p. 195.

a feminist epistemology in a particular standpoint or identity was a totalising gesture.

Simultaneously, feminist postmodernism pointed to oppositional political action, which feminist standpoint epistemologies were committed to producing, in the form of a feminist standpoint which was oppositional to the masculinist, androcentric discourses of the sciences.

Conclusion

A rigid distinction between feminist standpoint epistemologies and feminist postmodernism is unhelpful, as it reduces feminist standpoint theories to naive scientific realism or universalising and totalising identity claims, while caricaturing feminist postmodernist theories as relativist or a radical form of social constructionism. Feminist standpoint epistemologies offer science studies an approach that recognises the social nature of science and the ways in which social conventions and political ideologies structure the theory and practice of science. Feminist postmodernism offers the recognition that no position is value-neutral and that powerful political responses can be made from opposition to dominant use of science; however, following from Haraway's work on situated knowledges, these positions of opposition must always be partial and contingent, rather than grounded in universal and totalising notions of identity. It is the conversation between feminist standpoint epistemologies and feminist postmodernism that I take as my resource here, and which I will build on in the next chapter, when elaborating a queer approach to narratives of genetic determinism about gender and sexuality.

Haraway's situated knowledges approach to science questions the possibility of empirical truths and the traditional model of scientific practice, where the male scientist reveals empirical truths about the object of inquiry while maintaining a distance in this subject-object relation. Haraway suggests that objectivity should be reinterpreted as a solidarity achieved through partial connections and conversations with the object, rather than the maintenance of distance. In the light of this reinterpretation of the concept of objectivity, Wilson's metaphor of extension of population biology and evolutionary theory to social organisation reveals sociobiology to be not about

objectivity and connection between subject and object, but about the identity of the scientist, and the science itself. Wilson's discovery of sociobiological 'facts' through extension is in opposition to Haraway's suggested model of conversation and partial connections. Thus, working from Haraway's model, sociobiology cannot be defined as objective but rather as a system of knowledge that protects and reinforces traditional patriarchal theories, identities and practices.

Feminist postmodernist epistemologies also question the possibility of constructing a singular standpoint from which to create alternative narratives and bodies of knowledge. Questioning what counts as women's experience and the notion of a singular female position, feminist postmodernism is seemingly hostile to early attempts at female retellings of scientific narratives. Haraway's approach is useful, however, because it recognises the need to constantly negotiate between the constructed nature of all knowledge and the political need for accounts of (and to account for) a 'real' world; and between the impossibility of stable positions and the political necessity of positions, however contingent, for feminist epistemologies. Feminist postmodernist approaches offer ways of rethinking the projects of early feminist engagements with evolutionary science. From this perspective, the biological determinism in Morgan's Aquatic Ape Hypothesis can be re-evaluated as an activation of the female ape, a contingent connection across time and species. Morgan's narrative of female evolutionary descent is thus reappraised as an activation of the female and of female embodiment in evolutionary science, and an attempt to break down the traditional subject-object divide, in turn creating a space for partial connection and solidarity. From this perspective, Morgan's narrative offers the possibility of conversations between subject and object, and thus objectivity in Haraway's sense. There is a temptation to read Morgan's work as simply biological determinism, but as Haraway emphasises this is not the only position available when traditional patriarchal boundaries are breached.

My analysis of Morgan's narrative of evolutionary descent through Haraway's situated knowledges reveals a number of salient issues for my project. First, my analysis demonstrates the

historical development of feminist engagements with science. This is important as the queer approach I will develop in subsequent chapters builds upon these insights. Second, my reading of Morgan's narrative begins to gesture towards the importance of nonhuman agency, which is a major theme throughout this project. Finally, Morgan's narrative, however problematic, illustrates the possibility and potential for alternative positions, narratives and bodies of knowledge in science. This point will be particularly important in the final chapters when I will discuss health and biomedical knowledge. In the next chapter I will build upon the possibility for alternatives to biological determinism and radical re-readings of scientific narratives in relation to genetic determinism and the search for gay genes.

Chapter Two

Entanglements: Diffraction, The Human Genome Project and Queer(ing) Genes

‘The “gene” is nothing but a very applicable little word’

Wilhelm Johannsen, ‘The Genotype Conception of Heredity’¹

In the previous chapter I discussed feminist engagements with evolutionary science in the 1970s and 1980s. I argued that the meeting of feminism and postmodernism in the 1980s and the development of feminist postmodernism offered ways of interrogating patriarchy in the theory and practice of science. In the 1990s, feminist approaches to identity met deconstruction, and the developing field of lesbian and gay studies met the new field of queer theory. Meanwhile, narratives of genetic determinism proliferated, attempting to relate complex behavioural and social phenomena to hypothetical genes or genetic factors. The multi-national Human Genome Project seemed to promise a genetic basis for all physical and behavioural traits, and this provided the background for specific scientific research in the 1990s that attempted to define the biological or genetic basis for homosexuality.

In this chapter I will analyse theoretical developments in the 1990s that increasingly focused on indeterminacy and non-essential theories of identity, including feminist and queer theories and their relation to deconstruction. I will situate these theoretical developments alongside deterministic

¹ Wilhelm Johannsen, ‘The Genotype Conception of Heredity’, *American Naturalist*, 45 (1911), 129–159 (p. 132).

narratives of the Human Genome Project, and of specific research into the genetic basis for homosexuality, in order to question the legitimacy of the research and claims. To interrogate these genetic narratives, I will argue that a theoretical approach that focuses on the deconstruction of binary oppositions and the assumptions that hold such oppositions in place is necessary but ultimately limited. I will instead propose a diffractive approach, promoting the performative and agential nature of genes. The metaphor and physical phenomenon of diffraction offers a productive starting point for queering genes, and attempts to produce narratives of genetic determinism related to sexual identity.

This chapter builds on a number of insights developed in Chapter One. My queer approach to genetic science is indebted to a history of feminist engagements with science. More specifically, in this chapter I build upon the idea that a conversation between science and social theory can produce the possibility for alternative narratives, positions and bodies of knowledge. I also develop on the discussion of agency in the previous chapter. In this chapter I will argue that thinking about the agency of the objects of scientific study does not necessarily lead to biological determinism (in terms of genetic determinism and sexuality this would be expressed as an active gene *causing* sexual identity and behaviour). I will argue instead that thinking of the objects of scientific study as agential and queer can open up the possibility of an alternative queer genetic approach that is more attentive to both the biological and social complexities at work. This chapter also explains my particular deployment of the term queer, which is important as in later chapters I will argue for a queer ecological approach to living well in multispecies entanglements. The complex intersections of sexuality, politics and scientific knowledge will be particularly important in the final chapter where I discuss health, viruses and biomedical knowledge.

What is Diffraction?

Throughout this chapter I will be referring to diffraction as a metaphor and as a theoretical approach, relating this to deconstructive and queer approaches. Initially, however, it is important to

have a sense of diffraction as a physical phenomenon. Diffraction demonstrates the complexity of the 'real' world and the role of situated knowledges in scientific theory and practice, which will be important in later chapters. In a classical physical interpretation, diffraction is a phenomenon that occurs when waves combine or overlap, and when waves encounter an obstacle. To fully understand this, it is important to emphasise that waves are different phenomena from particles (although the phenomenon of diffraction is intimately linked to the problematic distinction between waves and particles – something to which I will return shortly). In classical physics, a particle is a material entity that can only occupy a single position in time and space. Waves, in contrast, are not entities but rather disturbances in a medium that cannot be localised to a single point in time or space. All waves, whether propagating in air or water, can exhibit diffraction under the right conditions. Straight waves in water will curve when they pass through a small opening in a barrier, just as light waves appear to bend around the edge of objects or through slits. In the right conditions, diffraction patterns can be produced whereby waves overlap and combine – a physical process known as superposition. Superposition is the phenomenon whereby waves combine, either cancelling one another out when they are out of phase, or adding to one another's strength when they are in phase. Superposition is essential to diffraction and is responsible for diffraction patterns, the sometimes unexpected dark and light areas that are produced when light waves are diffracted. Familiar examples of diffraction are found in the patterns that can be seen when light shines off a compact disc, or in the iridescence of some birds' feathers. In both cases, light waves of different frequencies are being diffracted through slits – what is called a diffraction grating – and the interference and superposition of the different frequencies of light produce colourful diffraction

patterns.²

Importantly, diffraction is not explainable by geometric optics. Geometric optics approximates light as a ray so as to indicate its direction and does not take account of the physical wave-nature of light. Reflection of light can be adequately explained by geometric optics. The angle and direction of light, approximated to a ray, can successfully explain the reflection of light off an object such as a mirror. The Newtonian law of reflection, that the angle of incidence (approach to the mirror) equals the angle of reflection (reflected light from the mirror), is achieved through the approximation of light to a ray. Diffraction, on the other hand, demands a physical optics that takes account of the wave-nature of light. As diffraction is dependent upon the superposition of waves, approximation of light to a directional ray cannot account for diffraction patterns. It is for similar reasons that diffraction has been instrumental in the wave-particle debates about light in physics. Isaac Newton claimed that light was made up of particles which he called ‘corpuscles’. Newton’s corpuscular theory of light easily explained the phenomenon of reflection, much in the same way as the approximation of light to a ray.³ In the early nineteenth century, double-slit experiments that produced diffraction patterns through superposition seemed to suggest that light acted like a wave, and thus the wave theory of light became the predominant paradigm in physics.⁴

² For a detailed description of the physical phenomenon of diffraction, see Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham, NC: Duke University Press, 2007), especially Chapter Two, ‘Diffractions: Difference, Contingencies and Entanglements that Matter’, pp. 71–94. Interference and diffraction are, in fact, the same physical phenomenon. Both are produced by the combination of amplitudes in wave superposition. As physicist Richard Feynman states, ‘No one has ever been able to define the difference between interference and diffraction satisfactorily. It is just a question of usage, and there is no specific, important physical difference between them.’ (‘Diffraction’, Volume 1, *The Feynman Lectures on Physics*, 3 Vols [Reading, Mass: Addison-Wesley, 1965]), Chapter 30, p. 1. It is for this reason that I use the terms interchangeably throughout this chapter.

³ Certain phenomena of reflection problematise this, such as partial reflection off a glass surface. If light is made up of particles, but is only partially reflected, how do the particles of light ‘decide’ whether they will be reflected or not? For a detailed discussion of this phenomenon and how the theory of quantum electrodynamics approaches it, see Richard Feynman, *QED: The Strange Theory of Light and Matter* (London: Penguin, 1990 [1985]).

⁴ For a discussion of the paradigm shift from a particle theory to a wave theory of light see, Jed Z. Buchwald, *The Rise of the Wave Theory of Light: Optical Theory and Experiment in the Early Nineteenth Century* (Chicago: University of Chicago Press, 1989).

This was not, however, the end of the story. In the early twentieth century, Albert Einstein's Nobel Prize-winning research on the photoelectric effect (the emission of electrons from matter when light is absorbed) reintroduced the notion of particles of light into physics, now described as photons, or quanta of light. Double-slit experiments and the phenomenon of diffraction still suggested, however, that light behaved like a wave, even as scientific equipment was developed that could detect single photons of light. Quantum physics, in fact, suggests that light behaves as both a wave and a particle, and light is commonly referred to as having a wave-particle duality.⁵

Interestingly, in 1924, Louis de Broglie proposed that material particles have a wave-like behaviour, and thus also have a wave-particle duality.⁶ Experimental confirmation followed, demonstrating that electrons exhibit diffraction, even when a single electron is fired at a time through an experimental set-up such as the double-slit experiment.⁷ Because diffraction patterns are caused by interference, this means that a single electron must interfere *with itself* to produce the diffraction pattern on a screen set up on the other side of the slits from the electron source.⁸ This counterintuitive theory of matter, its particle-wave duality – also known as the quantum theory of matter – can be utilised to produce scientific equipment of very high accuracy. In electron microscopy, a beam of electrons is first diffracted by the object and then re-focused into a diffraction pattern that can be viewed on a detector screen. This process allows for much greater magnification and resolution than traditional optical microscopes.⁹ This brief explanation of wave-particle duality and its role in diffraction is

⁵ For a clear introduction to these and many other concepts in physics, see Richard Feynman, *The Feynman Lectures on Physics*, especially Volume 3, Chapter 1, 'Quantum Behavior'.

⁶ Louis de Broglie, 'Recherches sur la Théorie des Quanta' (Thesis, Paris, 1924).

⁷ C. Davisson and L. H. Germer, 'Diffraction of Electrons by a Crystal of Nickel', *Physics Review*, 30:6 (1927), 705–740; and G. P. Thomson and A. Reid, 'Diffraction of Cathode Rays by a Thin Film', *Nature*, 119 (1927), 890.

⁸ O. Donati, G. P. Missiroli, and G. Pozzi, 'An Experiment on Electron Interference', *American Journal of Physics*, 41:5 (1973), 639–644.

⁹ Arthur L. Robinson, 'Electron Microscope Inventors Share Nobel Physics Prize', *Science*, 14 November 1986, 821–822. Ian Hacking discusses the role of microscopes as interventions in science, and the role of diffraction in optical microscopes (although he does not discuss electron microscopy) in *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science* (Cambridge: Cambridge University Press, 1983), pp. 186–209. Barad builds upon Hacking's argument in relation to electron microscopy and scanning tunnelling microscopy to question the relation of subject to object. Barad questions whether the practice of microscopy can be adequately described as 'seeing' the object, or whether a rather more complex description of the ongoing embodied practice of microscopy is needed (Barad, *Meeting the Universe Halfway*, pp. 50–59).

important to this chapter and to my thesis as a whole as it illustrates the complexity of the material world. Matter, in a quantum mechanical account (and in my queer diffractive approach that I will propose) is always complex, agential and producing biological-social interference in attempts to construct narratives and bodies of knowledge.

As a metaphor, Donna Haraway suggests that diffraction may be preferable to that of reflection, and the related practice of reflexivity: 'Reflexivity is a bad trope for escaping the false choice between realism and relativism in thinking about strong objectivity and situated knowledges in technoscientific knowledges.'¹⁰ I will return to this 'false choice' later in the chapter. Haraway suggests that, 'Diffraction, the production of difference patterns, might be a more useful metaphor for the needed work than reflexivity.'¹¹ Haraway suggests that reflexivity is inseparable from the geometric optics of reflection, and is therefore caught up in the mirroring of the same elsewhere. Diffraction, however, is attuned to differences, and how these differences matter. As I have shown, diffraction also allows for the active (and often counterintuitive) nature of matter. It is therefore a useful metaphor for theories that want to promote the active and agential nature of matter and of the world. As Karen Barad notes, diffraction is not only a metaphor, and thinking about the physical phenomenon of diffraction can offer a productive theoretical approach to social and scientific theories. In particular she suggests diffraction as a theoretical approach to interdisciplinary studies of theory and science. She argues that diffraction, as an interdisciplinary methodology, places understandings from putatively separate fields into a conversation of dynamic relationality with each other, so as to question the boundaries between areas of knowledge. She states:

The diffractive methodology that I propose enables a critical re-thinking of science and the social in their relationality. What often appears as separate entities (and separate sets of concerns) with sharp edges does not actually entail a relation of absolute exteriority at all.

¹⁰ Donna Haraway, *Modest_Witness@Second_Millennium.FemaleMan@_Meets_OncoMouse™: Feminism and Technoscience* (New York: Routledge, 1997), p. 16.

¹¹ Haraway, *Modest_Witness*, p. 34.

Like the diffraction patterns illuminating the indefinite nature of boundaries – displaying shadows in ‘light’ regions and bright spots in ‘dark’ regions – the relation of the social and the scientific is a relation of ‘exteriority within’.¹²

This differs from Edward O. Wilson’s approach outlined in the previous chapter, where the humanities are to be subsumed within biology, as it puts disciplines into conversation rather than assuming that one discipline will ultimately be expanded to include all others. Diffraction offers a possible approach to the relationship between social theories (particularly for my project, feminist and queer theories) and scientific theories (such as narratives of genetic determinism that surround the Human Genome Project and the search for the gay gene).

Feminism and Deconstruction

Feminists in the 1990s began to see productive convergences between their projects and approaches and the work of deconstruction. Feminists in the 1970s and 1980s had recognised the need to contest patriarchy at the level of social practices such as those preventing women entering the sciences, as well as at the level of language, conventions and paradigms. As discussed in the previous chapter, feminists in the 1980s recognised the problems associated with countering patriarchy from the position of a stable singular identity, and began to question the category of woman. For Diane Elam, this is the starting-point for a productive association of feminism and deconstruction. In her book, *Feminism and Deconstruction: Ms. en Abyme*, Elam suggests that feminism and deconstruction both bring about a ‘deferral of consensus but *not* at the cost of political solidarity or ethical judgement’.¹³ This is the abyss of Elam’s subtitle – ‘the infinite displacement brought about by feminism and deconstruction: the displacement of the subject, of

¹² Barad, *Meeting the Universe Halfway*, p. 92–93. Barad is here drawing on Haraway’s notion of difference as not a matter of essence but as a ‘critical difference within’ that she elaborates in ‘The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others’, in *Cultural Studies*, ed. by Lawrence Grossberg, Cary Nelson, Paula A. Treichler (New York; Routledge, 1992), pp. 295–337 (p. 299).

¹³ Diane Elam, *Feminism and Deconstruction: Ms. en Abyme* (New York: Routledge, 1994), p. 25.

identity politics, of the subject of feminism and deconstruction'.¹⁴ It is important to emphasise Elam's argument that this displacement and deferral is not brought about at the expense of political solidarity. She refers to Jacques Derrida's statement that 'there is a duty in deconstruction' which he characterises as a call that 'comes from nowhere'.¹⁵ Feminism represents a similar obligation – the duty to respond to the call of feminist politics, while being aware that this call does not come from a stable singular ground of identity. As Elam states: 'I understand the subject as neither sovereign nor autonomous but as always caught up in a network of responsibilities to others.'¹⁶ 'The obligation of feminism,' she argues, 'is an obligation that, in effect, comes from nowhere.'¹⁷ Feminist politics are not made impossible by the recognition that there is not one single stable identity of woman, or even of feminism. On the contrary, this recognition allows for potential connections, and the fulfilment of the obligation of political solidarity.

Feminism and deconstruction both work to problematise binary oppositions. For Derrida, oppositions are always arranged hierarchically, with one privileged term dominating the other. He states in an interview that, 'in a classical philosophical opposition we are not dealing with the peaceful coexistence of a *vis-à-vis*, but rather with a violent hierarchy. One of the two terms governs the other [...] or has the upper hand'.¹⁸ For a feminist engagement with deconstruction, the domination built into the 'violent hierarchy' of binary oppositions is particularly relevant in relation to the oppositions (or paired terms) of male/female, sex/gender, and heterosexual/homosexual. Similarly, for feminist engagements with science, the domination built into binary oppositions that function in evolutionary science – such as active/passive, mind/body, and subject/object – are especially pertinent. Attendance to the deconstruction at work in hierarchical oppositions of

¹⁴ Elam, *Feminism and Deconstruction*, p. 25.

¹⁵ Jacques Derrida, "'Eating Well," or the Calculation of the Subject: An Interview with Jacques Derrida', *Who Comes After the Subject?*, trans. by Peter Connor and Avital Ronnell, ed. by Eduardo Cadava, Peter Connor, and Jean-Luc Nancy (New York: Routledge, 1991), pp. 96–119 (p. 108).

¹⁶ Elam, *Feminism and Deconstruction*, p. 105.

¹⁷ Elam, *Feminism and Deconstruction*, p. 26.

¹⁸ Jacques Derrida, 'Positions: Interview with Jean-Louis Houdebine and Guy Scarpetta', in *Positions*, trans. by Alan Bass (London: Athlone, 1987), pp. 37–96 (p. 41).

domination is, for Derrida, the way to approach a relationship to sexual difference that is 'sexual otherwise', that is sexual difference 'beyond opposition and beyond binary structure'.¹⁹ Crucially, then, deconstruction does not simply invert the binary oppositions, as this would reinscribe the binary system. Derrida argues that, 'Deconstruction does not consist in passing from one concept to another, but in overturning and displacing a conceptual order, as well as the nonconceptual order with which the conceptual order is articulated.'²⁰

Derrida's statement that deconstruction consists in the overturning and displacing of non-conceptual as well as conceptual orders warrants further discussion, particularly in relation to feminist engagements with binary oppositions in evolutionary science. Derrida suggests that concepts are only meaningful when understood in hierarchical relation to other concepts. A deconstructive approach problematises this set of hierarchical relations – the conceptual order – by interrogating the hierarchical relations and oppositions involved in systems of meaning. A nonconceptual order is best thought of as that which makes the articulation and coherence of a conceptual system possible. A nonconceptual order provides the conditions for articulation of – and is only knowable by its effects within – a coherent and meaningful conceptual order. For example, the narratives of sociobiology discussed in the previous chapter rely upon a hierarchical binary arrangement of male and female, a binary that implicates other hierarchical oppositions, such as active/passive, agent/resource, and aggressive/coy. A feminist deconstructive approach might begin at the male/female opposition, and attempt to overturn it.

In the previous chapter I discussed Elaine Morgan's development of a narrative of descent from the perspective of the female ape, thus displacing the male from the position of active agent of

¹⁹ Jacques Derrida, 'Choreographies', trans. by Christie V. McDonald, in *Points...: Interviews, 1974–1994*, ed. by Elisabeth Weber (Stanford, Calif: Stanford University Press, 1995), pp. 89–108 (p. 108); 'On Colleges and Philosophy', *Postmodernism: ICA Documents*, ed. by Lisa Appignanesi (London: Free Association, 1989), pp. 209–228 (p. 227). For further articulation of Derrida's approach to sexual difference, see 'Voice II', in *Points...*, pp. 156–170; and Derrida and others, 'Women in the Beehive', *Differences*, 16:3 (2005), 139–157.

²⁰ Jacques Derrida, 'Signature, Event, Context', in *Margins of Philosophy*, trans. by Alan Bass (Brighton: Harvester, 1982), pp. 307–330 (p. 329).

evolution with the passive female resource as the dominated other. Placing the female as the active agent of evolution could be interpreted as reinscribing rather than subverting the binary alignment of maleness and activity in opposition to femaleness and passivity, thus overturning a restricted conceptual order but not troubling the nonconceptual order with which it is articulated. With this in mind, a feminist approach might further draw attention to the fact that concepts such as active/passive, agent/resource, and aggressive/coy are made possible by a larger nonconceptual order – for instance emphasising that the structuring of scientific concepts around hierarchical binaries of sexual difference is made possible by the existence of patriarchy. Patriarchy, functioning as the possibility and condition of the articulation of certain conceptual orders, is (prior to its conceptualisation) a nonconceptual order with which the conceptual order is articulated. Accordingly, the female ape becomes both active agent of evolution *and* the resource, through Morgan's commitment to begin her project from a feminist standpoint of contemporary female bodily experience. In this way, patriarchy, which was previously a nonconceptual order, making the conceptual order possible, is now conceptualised. This has its benefits, as patriarchy can now be interrogated itself, rather than known only through its effects in the conceptual order. Yet the conceptual order of patriarchy can be articulated only within a nonconceptual order. This is the abyss of deconstruction, as there is no solid ground, no final concept or end point that exists without a nonconceptual order that can itself be overturned and displaced.

Diffraction can offer a way of developing a deconstructive approach, through its use as an alternative optical metaphor to reflection. As I have noted, the geometric optics of reflection suggests the displacement (or mirroring) of the same elsewhere. This is also the weakness in reading deconstruction as a reflexive practice. Reflexivity is too easily reduced to reflection, and the mirroring of the same, rather than the production of, and attention to, difference. The overturning and displacing that occurs within binary oppositions is not something that needs to be performed by a reflexive subject, someone 'doing' the deconstruction. As Derrida says, 'Deconstruction takes place, it is an event that does not await the deliberation, consciousness, or organization of a subject,

or even of modernity. *It deconstructs itself. It can be deconstructed* [Ça se deconstruit].'²¹ A diffractive approach supports Derrida's claim that deconstruction does not just overturn or displace conceptual orders, but also the nonconceptual order with which they are articulated. That is, deconstruction is more than the overturning of an opposition, which would simply lead to the displacement of meaning, and an endless mirroring of binary oppositions. This would produce the same elsewhere, while leaving the conceptual and nonconceptual orders intact. This is insufficient for deconstructive approaches that seek to overturn and displace conceptual and nonconceptual orders. Diffraction emphasises not the mirroring of the same, but the production of differences between or within. Diffraction interrogates binaries by suggesting that the relation between supposed separate entities is not one of absolute exteriority; boundaries are never fixed and determinate. Diffraction is therefore a more productive metaphor than reflexivity, producing 'interference patterns' or patterns of difference (rather than the replication of the same) and also emphasising the effects of these differences. Diffraction, then, supports a deconstructive approach to the production of meaning, and is important to my project as it suggests possible ways to approach the differences between and within queer and feminist theories, and the production of scientific knowledge.

The Emergence of Queer Theory

In the early 1990s, work was being done in gay and lesbian studies that intersected with feminist politics and deconstructive theories. David M. Halperin traces the beginnings of queer theory to a conference organised by Teresa de Lauretis, held in February 1990 at the University of California, Santa Cruz. Halperin states that:

She had heard the word 'queer' being tossed about in a gay-affirmative sense by activists, street kids, and members of the art world in New York during the late 1980s. She had the

²¹ Jacques Derrida, 'Letter to a Japanese Friend', *Psyche: Inventions of the Other, Volume II*, ed. by Peggy Kamuf and Elizabeth Rottenberg (Stanford, Calif: Stanford University Press, 2008), pp. 16–19.

courage, and the conviction, to pair that scurrilous term with the academic holy word, 'theory'. Her usage was scandalously offensive.²²

Following the conference, a number of essays generated in the context of this conference were collected in the journal, *Differences*. In the introduction to this special issue, entitled *Queer Theory: Lesbian and Gay Sexualities*, de Lauretis claims that the term 'queer' marks a certain critical distance from 'lesbian and gay', which she describes as an 'established and often convenient formula'.²³ De Lauretis suggests that the development of queer theory depends upon,

the speculative premise that homosexuality is no longer to be seen simply as marginal with regard to a dominant, stable form of sexuality (heterosexuality) against which it would be defined either by opposition or by homology. In other words, it is no longer to be seen either as merely transgressive or deviant vis-à-vis a proper, natural sexuality [...] or as just another, optional 'life-style' [...] Instead, male and female homosexualities [...] may be reconceptualized as social and cultural forms in their own right.²⁴

De Lauretis sees queer as the promise of thinking about sexuality not in the terms of binary oppositions, wherein homosexuality is always oppositional to heterosexuality, and lesbian and gay sexualities are problematically both linked and opposed through the 'and' of lesbian *and* gay studies. In Derridean terms, queer is an attempt to think sexuality otherwise – sexuality beyond these and other oppositions and binary structures.

It is my argument that queer theory offers a deconstructive approach to identity. Queer suggests configurations other than those in which homosexuality is opposed to, or marginal to,

²² David M. Halperin, 'The Normalization of Queer Theory', co-published in *Journal of Homosexuality*, 45:2–4 (2003), pp. 339–343; and in *Queer Theory and Communication: From Disciplining Queers to Queering the Discipline(s)*, ed. by Gust A. Yep, Karen E. Lovaas, and John P. Elia (Binghamton, NY: Harrington Park, 2003), pp. 339–343.

²³ Teresa de Lauretis, 'Queer Theory: Lesbian and Gay Sexualities, An Introduction', in *Queer Theory: Lesbian and Gay Sexualities*, ed. by Teresa de Lauretis (also published in *Differences: A Journal of Feminist Cultural Studies*, 3:2[1991]), iii–xviii (p. iv).

²⁴ De Lauretis, 'Queer Theory', p. iii.

heterosexual identity, and offers a non-essential theory of identity. In *Saint Foucault*, published in 1995, David M. Halperin proposes a formulation of queer that, although it relies upon a framework of opposition, employs a deconstructive approach to identity. He states that:

queer identity need not be grounded in any positive truth or in any stable reality. As the very word implies, 'queer' does not name some natural kind or refer to some determinate object; it acquires its meaning from its oppositional relation to the norm. Queer is by definition *whatever* is at odds with the normal, the legitimate, the dominant. *There is nothing in particular to which it necessarily refers*. It is an identity without an essence.²⁵

Queer is, for Halperin, an oppositional identity. It is important, however, to draw attention to his emphasis in the sentence: 'Queer is by definition *whatever* is at odds with the normal, the legitimate, the dominant.'²⁶ Queer is not simply homosexuality, in an oppositional position to stable heterosexuality. Rather, queer is *whatever* is oppositional to the norm in any context at any given time. Queer, in Halperin's formulation, is a contingent identity – one that is always shifting and aligning itself along different axes of opposition and non-normativity.²⁷ Halperin's description of a queer identity without an essence follows the logic of a deconstruction of stable, essential, oppositional sexual identities. As noted, Halperin does still employ 'queer' within a framework of opposition and identity – he does not use it to suggest a Derridean sexuality otherwise, a sexuality beyond opposition and binary structure. Rather, Halperin's formulation of queer is an oppositional deployment of sexuality along contingent axes of social normativity.

²⁵ David M. Halperin, *Saint Foucault: Towards a Gay Hagiography* (Oxford: Oxford University Press, 1995), p. 62.

²⁶ Halperin, *Saint Foucault*, p. 62.

²⁷ Many feminist critics have criticised this element of queer theory, suggesting that the reliance of queer upon shifting flexible alliances promotes gay male sexuality at the expense of lesbianism and feminism, as only gay male sexuality is seen as sufficiently flexible to negotiate the shifting axes of normativity. See Shelia Jeffreys, 'The Queer Disappearance of Lesbians: Sexuality in the Academy', *Women's Studies International Forum*, 17:5 (1994), 459-472.

Halperin's insistence that queer can be 'whatever' and need not be limited is useful. The emphasis on opposition, however, is potentially problematic. If queering is an oppositional process, then it follows that queer always comes after, or is instantiated by, whatever is the norm. This would be a reduction of the reach or agency of queer and queering. Queer is often strategically positioned as oppositional to oppressive and seemingly ubiquitous norms of heterosexuality. My reading of queer is that, rather than always oppositional, queer is about relationality; queering draws attention to discourses, narratives, bodies, communities and practices and how they intersect and relate, and how these relationalities can structure and be structured by norms of gender and sexuality. I develop this approach to the queer alongside diffraction as these relationalities are not ones of opposition and absolute exteriority, but of connections, conversations and the blurring of boundaries. My use of queer is also strategic and political. I am not attempting to replace sociobiology as a normative paradigm with symbiogenesis (to be discussed in the following chapter) as a queer alternative in opposition. This approach would risk replacing one normative paradigm with another. Instead, queering can draw attention to the political uses of scientific narratives and the fact that narratives and knowledges are formed in a dynamic relationality with each other and, among other things, issues of gender and sexuality, as well as social and political forces of normativity and resistance. Queer is thus, in my project, a collection of methodologies, negotiations, positions and resistances, which can challenge and threaten binaries and conventional categories – particularly those binaries and categories that structure and are structured by conservative patriarchy and heteronormativity. My use of queer is more specifically biopolitical, and in the next chapter I will discuss biopolitics in terms of queer and multispecies kinship. This will be important for my final chapter in which I argue that the theory and practice of science as well as the material realities of more-than-human kinship have real material effects on individuals and groups. My queer account is a strategic political attempt to imagine and bring about more equitable futures for non-normative bodies, practices and communities.

The idea of queer as a non-normative social process is emphasised by Michael Warner in the introduction to *Fear of a Queer Planet: Queer Politics and Social Theory*, published in 1993. Warner suggests that queer identity is always performing a social reflection and resistance to normativity.

The passage deserves quoting in full:

Every person who comes to a queer self-understanding knows in one way or another that her stigmatization is connected with gender, the family, notions of individual freedom, the state, public speech, consumption and desire, nature and culture, maturation, reproductive politics, racial and national fantasy, class identity, truth and trust, censorship, intimate life and social display, terror and violence, health care, and deep cultural norms and the bearing of the body. Being queer means fighting about these issues all the time, locally and piecemeal but always with consequences. It means being able, more or less articulately, to challenge the common understanding of what gender difference means, or what the state is for, or what 'health' entails, or what would define fairness, or what a good relation to the planet's environment would be. Queers do a kind of practical social reflection just in finding ways of being queer.²⁸

For Warner, being queer is a social process in itself.²⁹ Furthermore, queer here may be understood to converge with the non-programmatic and self-enacting nature of deconstruction. Warner's queer self-understanding is always already deployed against normativities, rather than awaiting the conscious actions of a queer subject. To rephrase Derrida's statement about deconstruction: queer takes place; it is an event that does not await the deliberation, consciousness, or organisation of a subject. *It queers itself. It can be queered.* Following De Lauretis, Halperin, Warner, and the logic of

²⁸ Michael Warner, 'Introduction', in *Fear of a Queer Planet: Queer Politics and Social Theory* (Minneapolis: University of Minnesota Press, 1993), pp. vii–xxxi (p. xiii).

²⁹ Warner uses the term 'queer self-understanding' rather than 'queer identity', but queer is undoubtedly an identity for Warner. It is, however, a non-essential identity, based on the sharing of historically contingent queer publics. In an article co-written with Lauren Berlant, 'What Can Queer Theory Tell Us About X?', Warner argues that 'Queer publics make available different understandings of membership at different times, and membership in them is more a matter of aspiration than it is the expression of an identity or a history', *PMLA*, 110 (1995), 343–349, p. 344.

deconstruction, queer is a contingent, non-essential identity that positions itself as whatever is oppositional to social normativity and, importantly, is self-forming in the act of positioning.

Queer Problems, Queer Approaches

Queer is not an unproblematic term; many of the theorists who helped to develop queer theory in the early 1990s have since raised concerns over its use, or even abandoned the term altogether. Teresa de Lauretis, in an article published in 1994, emphasises that her choice of the term 'lesbian' rather than queer in her book, *The Practice of Love: Lesbian Sexuality and Perverse Desire*, constitutes a deliberate repudiation:

As for 'queer theory', my insistent specification *lesbian* may well be taken as a taking of distance from what, since I proposed it as a working hypothesis for lesbian gay studies [...] has very quickly become a conceptually vacuous creature of the publishing industry.³⁰

De Lauretis distances herself from queer theory, suggesting that the political and critical potential it once had has been effaced or destroyed. David M. Halperin echoes this sentiment, suggesting that queer theory has been normalised by its acceptance in the academy. He describes this normalisation in three steps. First, 'queer' becomes a qualifier of 'theory':

if it's theory, progressive academics seem to have reasoned, then it's merely an extension of what important people have already been doing all along. It can be folded back into the standard practice of literary and cultural studies, without impeding academic business as usual.³¹

Second, queer theory despecifies the sexual identities that were integral to queer theory's development. This, claims Halperin, has the effect of

³⁰ Teresa de Lauretis, 'Habit Changes', *Differences*, 6:2–3 (1994), 296–313 (p. 297). See also Teresa de Lauretis, *The Practice of Love: Lesbian Sexuality and Perverse Desire* (Bloomington: Indiana University Press, 1994).

³¹ Halperin, 'The Normalization of Queer Theory', pp. 341.

abstracting 'queer' and turning it into a generic badge of subversiveness, a more trendy version of 'liberal': if it's queer, it's politically oppositional, so everyone who claims to be progressive has a vested interest in owning a share of it.³²

Finally, queer theory, through its status as a theory, can be incorporated into established disciplines and applied to topics in already established fields. Halperin's criticisms clearly illustrate the concerns raised by some theorists about the possible neutralising of the radical potential of queer theory.

Another criticism of queer theory, and one closely related to the second step of Halperin's normalisation of queer theory, is that it distances itself too readily from lesbian and gay studies. When de Lauretis stated in 1990 that queer marks a 'certain critical distance' from lesbian and gay studies, the choice of terms was unfortunate and somewhat misleading. The special issue of *Differences* was entitled *Queer Theory: Lesbian and Gay Sexualities*, and I think that this demonstrates the intimate links between queer, lesbian and gay, as well as those between theory and multiple sexualities. Queer theory was suggested as a way of taking a critical distance from gay and lesbian studies that would paradoxically produce closer and more representative meanings and knowledges about lesbian and gay sexualities. As de Lauretis states, 'our "differences", such as they may be, are less represented by the discursive coupling of those two terms in the politically correct phrase "lesbian and gay", than they are elided by most of the contexts in which the phrase is used'.³³ De Lauretis sees queer as offering a critical distance from this elision, and as actually offering a more intimate recognition and representation of sexualities in the plural, including lesbian and gay sexualities, and the differences in and between these sexualities. De Lauretis's formulation of a queer theory in intimate relation with lesbian and gay sexualities is vastly different from the queer theory that Halperin critiques in 'The Normalization of Queer Theory'. This is a queer theory that distances itself from lesbian and gay studies by presenting itself as the new and radical successor.

³² Halperin, 'The Normalization of Queer Theory', pp. 341–2.

³³ De Lauretis, 'Queer Theory', p. v.

Lesbian and gay studies becomes queer theory's other, and critics such as Halperin have noted that this legitimises queer theory at the expense of the historically, socially and theoretically important work of lesbian and gay studies.³⁴

Some critics have claimed that queer theory is apolitical, and ahistorical – of little use to communities based around non-normative sexual identities or gender-identifications. Similar claims were levelled at the feminist postmodernism that was being developed in the 1980s. Feminist postmodernist epistemologies problematise the stable category of woman, and further question the efficacy of grounding politics in identity and stabilising identity categories by recourse to essentialism. Queer theory follows these findings of feminist postmodernism and questions the categories of lesbian and gay, and the efficacy of grounding sexual politics in identity, along with the stabilisation of identity through essentialism. This, however, is not an abandonment of politics. Judith Butler states: 'The deconstruction of identity is not the deconstruction of politics; rather it establishes as political the very terms through which identity is articulated.'³⁵ I maintain that queer is a politically useful term, not as a 'new' or 'radical' identity, but as a deconstructive approach to identity. I believe that in this form, it links productively to Haraway's feminist postmodernism – as a negotiation rather than a stable position. Queer is useful for avoiding and negotiating between two supposed opposite poles of theorising sexuality, and therefore is not simply oppositional, but about negotiating relationalities often structured by patriarchy or heteronormativity. The first pole is an 'anything goes' approach to sexuality, which, like Haraway's description of relativism is 'a way of being nowhere while claiming to be everywhere equally'.³⁶ This is the approach to sexuality critiqued by Grosz in her article 'Experimental Desire: Rethinking Queer Subjectivity'. In this article, published

³⁴ See *The Lesbian and Gay Studies Reader*, ed. by Henry Abelove, Michèle Aina Barale, and David M. Halperin (New York: Routledge, 1993), especially the introduction, pp. xv–xviii.

³⁵ Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990), p. 148. Diane Elam disagrees slightly with Butler on this point, suggesting that 'the deconstruction of identity is also the deconstruction of politics – which does not mean the end of politics' (*Feminism and Deconstruction*, p. 139, n. 18).

³⁶ Haraway, 'Situated Knowledges', p. 191.

in 1994, Grosz warns of the dangers of allowing queer to accommodate any non-normative sexuality, which she claims will 'provide a political rationale and coverage [for] many of the blatant and extreme forms of heterosexual and patriarchal power games', including '[h]eterosexual sadists, pederasts, fetishists, pornographers, pimps [and] voyeurs'.³⁷ The second pole is a realist approach to sexuality, whereby sexual politics is related to notions of the real that deny the shifting and contingent nature of meaning.³⁸ This approach grounds politics in the 'real' of bodies and identities, and stabilises the contingencies through the essentialist notion that sexuality is a property of individuals and bodies, and a property that exists prior to intervention through definition or classification.

Queer, in its negotiation between the supposed poles of relativism and realism, also draws attention to the need to account for the reality of sexual difference, while simultaneously recognising the always historically contingent nature of such differences. This is a very important point to emphasise in my project. Overly simplistic realist approaches, such as biological determinist accounts of sexual difference, suggest that individuals have natural biological characteristics or properties that can be observed, measured and then used to classify those individuals. This approach suggests that, whether at the level of bodies, organs, genes, hormones, or chromosomes, differences between individuals are best accounted for as being determined by biology. In this account, representations of sexual difference are reflections of natural pre-social and pre-intervention (such as measurement or classification) properties of individuals. Social constructivist

³⁷ Elizabeth Grosz, 'Experimental Desire: Rethinking Queer Subjectivity', in *Supposing the Subject*, ed. by Joan Copjec (London: Verso, 1994), pp. 133–157. Reprinted in Grosz, *Space Time and Perversion* (New York: Routledge, 1995), pp. 207–228. Grosz's argument is reminiscent of the anti-pornography stance taken by writers and activists such as Andrea Dworkin and Catharine MacKinnon in what are commonly referred to as the 'sex wars' of the 1980s. The sex wars deeply divided feminism in the 1980s between anti-pornography and sex-positive feminists (such as Pat Califia), through debates over sexuality, gender, violence, pornography, and non-normative sexual practices such as S&M. For a detailed discussion of the sex wars and their ongoing significance, see *Sex Wars: Sexual Dissent and Popular Culture*, ed. by Lisa Duggan and Nan D. Hunter, 10th Anniversary Edition (New York: Routledge, 2006).

³⁸ Sharon Marcus criticises this approach in relation to feminist engagements with the difficulties surrounding poststructuralism and the 'real' of sexual violence against women ('Fighting Bodies, Fighting Words: A Theory and Politics of Rape Prevention', *Feminists Theorize the Political*, ed. by Judith Butler and Joan W. Scott [New York: Routledge, 1992], pp. 385–403).

accounts, on the other hand, suggest that representations of sexual difference are not reflections of any 'true' nature, but cultural constructions. In a weak constructivist account, there may well be pre-social biological differences between individuals; yet these differences are only knowable through historically contingent cultural constructions and representations. In a strong constructivist account, not only are the representations cultural constructions, but there is no 'real' core of pre-social biological difference underneath the representations, only further cultural constructions. It is my argument that all these approaches are unsatisfactory, as they rely upon and reinforce the separation of the real and the culturally constructed. They also have more in common than is first apparent, as they rely upon representationalism: the underlying belief that representations mediate between knowers (subjects) and what can be known (objects). Both scientific realists and social constructivists rely upon the assumption that representations mediate access to the 'truth' of sexual difference. For realists, representations faithfully reflect the truth of the material and biological nature of sexual difference; for constructivists, although representations can never reflect the 'real' material and biological nature of sexual difference, they can seemingly unproblematically reflect certain social and historical 'truths'.

In the following section I will further analyse the realist and constructivist strands of scientific representationalism with reference to the Human Genome Project, before elaborating an alternative, performative approach to scientific practice and the production of scientific knowledge. I will also use this example to expand upon the possibility of using diffractive and queer approaches to scientific practice, before analysing specific research carried out in the 1990s that claimed to discover a genetic basis for homosexuality. Although mindful of the problems associated with the term 'queer', I will be using it throughout my thesis as I believe it can be a useful and productive term when linking multiple and disparate areas of theory and social practice with ways of thinking about sexualities and normativities. I wish to preserve the strangeness at the heart of queerness, and to employ it to suggest a link to Elam's 'groundless solidarity'. Due to the strangeness of queerness and the importance of Elam's groundless solidarity, I will not be using queer as a noun to

refer to a stable queer identity, but rather employing it more as an adjective and verb – as an adjective to preserve the links between disparate forms of strangeness through a description of a shared queerness; as a verb to preserve the deconstructive notion that queer is a process that takes place, and that queers itself. To queer, in my approach, is to make strange, to make apparent any strangeness that is already at work, and to question the positioning of strangeness in opposition to normativity. Again, I would liken this approach to a Derridean logic of deconstruction: queering brings out a queerness that is always already taking place before the intervention of a subject. Diffraction is once again a useful metaphor for queer approaches. Queering is not a process of projecting queerness onto an object, nor is it a process of revealing the essential queerness of the object. Instead, queering attends to the patterns of interference and difference (and the effects of these differences) created by the interaction of subject and object within a field or network usually defined or structured by heteronormativity. In this respect, this deconstructive and diffractive queer approach is also useful in the context of evolutionary science to preserve the queerness of the scientific object, and hence as a way of accounting for the active and agential nature of the ‘real’ world. Simultaneously, I am using queer to signal (deconstructively) the constructed nature of all knowledge, the ways that knowledge is developed and expressed within paradigms of hierarchy and domination. Throughout this thesis I am arguing that science is inseparable from the social and always produced in paradigms with all the biases that this entails. This does not mean, however, that relativism is inevitable. I am developing an account of scientific knowledge production that is committed to ideas of the ‘real’ (for example I am committed to the fact that ‘real’ science makes a ‘real’ difference in ‘real’ lives – something that is more apparent in my discussion of biomedical knowledge and health practices in the final chapter) as well as being attentive to the historically and socially situated ways in which knowledge claims about the real are constructed.

Representing the Human Genome

The Human Genome Project began in the late 1980s, supported by the United States Department of Energy. Historian of Science Daniel J. Kevles suggests that much of the early impetus of the project originated from initiatives undertaken in the 1980s by molecular biologist Robert Sinsheimer and physicist and mathematical biologist, Charles DeLisi.³⁹ They organised workshops on the prospects for such a project, most notably in Santa Cruz in 1985 and Los Alamos in 1986. It was during these workshops that the scale and some of the technical approaches to a human genome project were outlined. They also set the tone for the language used about the project. It was at the Los Alamos meeting in March 1986 that Walter Gilbert, molecular biologist and Nobel Laureate, described the human genome as the Holy Grail of biological research.⁴⁰ Gilbert persuaded a number of key scientists of the merit of the venture, including Nobel laureate James D. Watson, co-discoverer of the helical structure of DNA. In the late 1980s the US National Institutes of Health (NIH) endorsed the Department of Energy-backed Human Genome Project, and Watson agreed to head the NIH office of the Human Genome Project in 1988. The project was officially inaugurated as a federal programme in 1991 and became a multi-billion dollar, multi-national project, worked on in both private and public laboratories across Europe and North America.

There are a number of ways of interpreting the theory and practice of the Human Genome Project. I am focussing on realist and constructivist interpretations to argue that both are examples of representationalism and to propose an alternative, performative approach to the Human Genome Project. Performativity plays an important role in my thesis, as my articulation of it will attempt to bring together its usage in both science studies and gender and sexuality studies. This will be of

³⁹ Daniel J. Kevles, 'Out of Eugenics: The Historical Politics of the Human Genome', *The Code of Codes: Scientific and Social Issues in the Human Genome Project*, ed. by Daniel J. Kevles and Leroy Hood (Cambridge, Mass: Harvard University Press, 1992), pp. 3–36 (p. 18).

⁴⁰ See also Walter Gilbert, 'A Vision of the Grail', *The Code of Codes*, pp. 83–97. For a discussion of the metaphor of the Holy Grail in the Human Genome Project, see Richard Lewontin, 'The Dream of the Human Genome', in *It Ain't Necessarily So: The Dream of the Human Genome and Other Illusions* (London: Granta, 2000), pp. 133–196.

relevance when exploring kinship beyond the human in the third and fourth chapters. In the early stages of the Human Genome Project, the language used to describe the undertaking was one of optimism and exuberance, especially by figures such as Gilbert and Watson. The project was often described in terms of mapping the human genome, or reading the book of life.⁴¹ In 'A Personal View of the Project', Watson describes the aim as 'a complete genetic blueprint of man', as well as suggesting setting up a databank of overlapping genetic markers which he imagines as a 'library for the entire human genome' and 'a map of overlapping fragments'.⁴² While in places Watson refers to the genome sequence as a 'blueprint', 'description', and 'map', elsewhere he refers to the project as able to explain 'how life works', and he predicts the possibility of not just *describing* the human genetic sequence but of *knowing* the human genome'.⁴³ Watson's account is illustrative of naïve scientific realism, as he claims that the descriptions and maps produced by the human genetic sequence faithfully and unproblematically represent the biological real. For Watson, the draft of the human genome allows access to the truth of human biology and life. This realism, however, is a form of representationalism; the blueprint, description or map is necessary to mediate between the human knower – that is the subject or scientist – and the real that can be known – the object of scientific knowledge. This mediation maintains and reifies the distance and distinction between the real and its representations, as well as reinforcing the divide between subject and object.

There are several problems with the realist claim that the Human Genome Project mediates access to the real of the human genome, or the more exuberant claim that it explains 'how life works'. One practical problem with this claim is the composite nature of the human genome that is

⁴¹ Mary Rosner and T. R. Johnson, 'Telling Stories: Metaphors of the Human Genome Project', *Hypatia*, 10:4 (1995), 104–129. Roser and Johnson explore the patriarchy involved in the metaphors of books and libraries; maps and explorers; and also machines and mechanics. The metaphor of mapping did not lose its appeal as the project continued. When the Human Genome Project published its 'first draft' in 2000, announced simultaneously by US President Bill Clinton and UK Prime Minister Tony Blair on June 26th, Clinton described the draft as 'without a doubt [...] the most important, most wondrous map ever produced by humankind' (Mark Kukis, 'Clinton, Blair and Scientists Announce Full Genome Sequencing', *United Press International*, 26 June 2000).

⁴² James Watson, 'A Personal View of the Project', *The Code of Codes*, pp. 164–173 (p. 164 and p. 169).

⁴³ Watson, 'A Personal View of the Project', p. 164–167, and p. 173, my emphasis.

sequenced. As all humans except identical twins have different DNA, the human genome sequenced by the HGP is necessarily a composite human. This raises the question of who selects which sections of DNA code are included and which excluded from the supposedly universal human genome. As Mary Rosner and T.R. Johnson point out, the metaphors of books and libraries in this context suggests that the Human Genome Project is 'master librarian':

By the choices it makes – the choice of what books to include in the library and in what condition – the Project will determine what is 'correct', what is 'real'. It will necessarily set standards, defining and cataloguing what it means to be human, limiting what range of diversity is acceptable.⁴⁴

For Rosner and Johnson, the metaphor of books and libraries is telling; it reveals the powerful ability of the scientists involved in the project to define standards and limit diversity. This example also problematises the realist claim that the Human Genome Project mediates knowledge of, and access to, the real of human life. The genome that is sequenced is a composite human, suggesting that the Human Genome Project does not offer access to the truth of any 'real' human genome. Instead, the object of knowledge in the project is a construction, whose composite parts have been chosen in a specific cultural and historical moment for a variety of cultural and historical reasons.⁴⁵

This leads to a possible constructivist account of the Human Genome Project. From this perspective, the Human Genome Project is a cultural construction, representing the specific cultural and historical moment in which it takes place, as well as revealing particular socioeconomic and cultural truths. The metaphor of mapping is revealing in this context, invoking the power of the

⁴⁴ Rosner and Johnson, 'Telling Stories', p. 107.

⁴⁵ The issues of race and nation are particularly relevant in this regard. To deal with some of the ethical implications surrounding this, and born out of an interest in global population genetics, the Human Genome Diversity Project was set up in the early 1990s to run alongside the Human Genome Project. For a history of the Human Genome Diversity Project and some of its controversies, see L. Luca Cavalli-Sforza, 'The Human Genome Diversity Project: Past, Present and Future', *Nature Reviews: Genetics*, 6 (2005), 333–340. See Haraway, *Modest_Witness*, pp. 247–253.

scientist to delineate the territory of nature, which is linked to related disputes over ownership.⁴⁶ Disputes over ownership have plagued the Human Genome Project, in particular in debates over gene-patenting. As large-scale gene sequencing proceeded, patent applications were submitted by some scientists involved in the project. This ignited a debate about the status of genes, questioning whether they could be patented, and if so, who should own the patent rights. From a legal perspective, the difficulty derived from the fact that the genetic material was both natural and unnatural; genes are, as Rebecca S. Eisenberg states, 'both material molecules and information systems'.⁴⁷ Genes are problematic entities, both natural and unnatural, and this difficulty is emphasised by the continuing debates over what genetic material it is acceptable to patent.⁴⁸ I will return to the mapping metaphor in greater detail as part of my elaboration of a performative account of the Human Genome Project. Importantly, in a constructivist account, the metaphors of the Human Genome Project are representations of cultural truths: revealing, for example, how science is being modelled on patriarchal exploration, ownership, limitation and domination of nature.

A constructivist account of the Human Genome Project, like the realist account, depends upon representationalism. In a constructivist account such as Rosner and Johnson's, the narratives of the Human Genome Project are representations of a specific social and historical context, revealing truths about patriarchal culture. As in the realist account, the separation of subject and object, as well as between representations and that which they represent, is maintained by the mediation of representation between human knowers and what can be known. In the realist account the representation is the blueprint, and the object of representation is the biological truth of human genetics revealed through scientific practice. In the constructivist account, the representations are the narratives of the project, and the objects of representation are the various

⁴⁶ Rosner and Johnson, 'Telling Stories', pp. 115–122.

⁴⁷ Rebecca S. Eisenberg, 'How Can You Patent Genes?', *American Journal of Bioethics*, 2:3 (2002), 3–11 (p. 3).

⁴⁸ See also Gary Stix, 'Owning the Stuff of Life', *Scientific American*, 294:2 (2006), 76–83.

truths about the specific social and historical context that are revealed through critical practice. I find both accounts to be insufficient. The previous chapter introduced the possibility of alternative narratives and knowledges that arise in the breakdown of the subject-object distinction. It is for this reason that I will articulate a performative account of the Human Genome Project.

Performing the Human Genome

An alternative to representationalist accounts of science is offered by Andrew Pickering in *The Mangle of Practice*. Pickering differentiates between what he calls ‘the representational and performative idioms for thinking about science’. Pickering argues that: ‘The representational idiom casts science as, above all, an activity that seeks to represent nature, to produce knowledge that maps, mirrors, or corresponds to how the world really is.’⁴⁹ I would expand this definition of the representational idiom in relation to my argument that both realist and constructivist accounts of science are, in fact, representationalist. Whether scientific theory and practice represents nature, or certain truths about culture and society, the relationship between human knower and the object of knowledge is still one of distance, mediated by representations. This distance depends upon the assumption of agency being a property of human knowers, and denied to the objects of scientific knowledge. Pickering’s performative idiom, on the other hand, suggests an alternative approach to science:

One can start from the idea that the world is filled not, in the first instance, with facts and observations, but with *agency*. The world [...] is continually *doing things*, things that bear upon us not as observation statements upon disembodied intellects but as forces upon material beings.⁵⁰

⁴⁹ Andrew Pickering, *The Mangle of Practice: Time, Agency and Science* (Chicago: University of Chicago Press, 1995), p. 5.

⁵⁰ Pickering, *The Mangle of Practice*, p. 6.

This is very important, and foundational for my approach to agency, and I will return to it in later chapters. Pickering's performative idiom suggests that science should be thought of as an ongoing process of 'coping with material agency'.⁵¹ Significantly, the shift from a representationalist to a performative account of science is a shift from thinking about science-as-knowledge (wherein human agents produce representations of a non-contingent really real) to a performative account of science-as-doing (where knowledges are produced within complex ever-changing fields of human and nonhuman agency).

The term performativity is used in different ways in science studies and social theory. Social theories of performativity, most significantly in gender studies, suggest formulations of gender-as-doing as an expansion of a linguistic theory based on citation and iterability.⁵² Gender performativity is most often associated with Judith Butler who, in *Gender Trouble*, suggested that gender is not a natural property of individuals. Rather, Butler argues that, 'Gender is the repeated stylisation of the body, a set of repeated acts within a highly rigid regulatory frame that congeal over time to produce the appearance of substance, of a natural sort of being.'⁵³ For Butler, gender is an ongoing process that operates through the repetition and recognition of norms. In short, 'Gender is always a doing'.⁵⁴ Eve Kosofsky Sedgwick develops Butler's theory of gender performativity into a queer formulation,

⁵¹ Pickering, *The Mangle of Practice*, p. 6. Ian Hacking also considers material agency as a challenge to representationalism. His formulation that 'if you can spray them they are real' – in reference to spraying a niobium ball with positrons or electrons so as to increase or increase electrical charge in quark-search experiments – is useful for understanding his move from representing to intervening. I prefer Pickering's representational and performative idioms to Hacking's representing and intervening, however, because of Hacking's reliance upon human agency. Pickering's account would suggest that positrons and electrons are material agents and therefore 'real' even before a human sprays them. Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science*, pp. 22–24.

⁵² See J. L. Austin, *How to do Things with Words: The William James Lectures delivered at Harvard University in 1955* (Oxford: Oxford University Press, 1962).

⁵³ Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 2008 [1990]), p. 45.

⁵⁴ Butler, *Gender Trouble*, p. 34. Butler develops her account of performativity throughout her work. See in particular *Bodies that Matter: On the Discursive Limits of Sex* (New York: Routledge, 1993); *Excitable Speech: A Politics of the Performative* (New York: Routledge, 1997); *Undoing Gender* (New York: Routledge, 2004); *Giving an Account of Oneself* (New York: Fordham University Press, 2005).

arguing in fact that “‘Performativity’ is already quite a queer category’.⁵⁵ Sedgwick takes advantage of the centrality of the performative utterance ‘I do’ used in marriage ceremonies, and draws on its repetition and failure throughout linguistic accounts of performativity to suggest a queer performativity based on the failure of heterosexuality, connected to the affect of shame. Sedgwick’s account is important as it emphasises the political – and possibly always queer – nature of performativity.

Pickering’s account of performativity is significantly different from that of Butler or Sedgwick. Although Pickering’s performativity attempts to account for nonhuman agency, which is something missing from Butler’s version, it does assume that this agency is a property of individuals or objects that precedes the performance. Butler’s performativity suggests that gender is a doing by a human individual although the individual does not precede the performance, stating that: ‘gender is always a doing, though not a doing by a subject who might be said to pre-exist the deed’.⁵⁶ Barad suggests a posthumanist performativity that builds upon Pickering’s performativity of nonhuman agency and Butler’s insights, including the significant point that performativity is constitutive. Posthumanist performativity, for Barad, is an ‘approach to understanding technoscientific and other naturalcultural practices that specifically acknowledges and takes account of matter’s dynamism’.⁵⁷ Barad’s performativity, like Pickering’s, is an attempt to move away from representationalism to ‘matters of practices, doings, and actions’.⁵⁸ Barad suggests that representationalism is ‘caught up in the geometrical optics of reflection where, much like the infinite play of images between two facing mirrors, the epistemological gets bounced back and forth, but nothing more is seen’.⁵⁹ As an alternative to the geometric optics of reflection and the question of whether a representation faithfully mirrors the real, Barad suggests a diffractive posthumanist performative account whereby

⁵⁵ Eve Kosofsky Sedgwick, ‘Queer Performativity: Henry James’s *The Art of the Novel*’, *GLQ*, 1:1 (1993), 1–16 (p. 2).

⁵⁶ Judith Butler, *Gender Trouble*, p. 34.

⁵⁷ Karen Barad, *Meeting the Universe Halfway*, p. 135.

⁵⁸ Barad, *Meeting the Universe Halfway*, p. 135.

⁵⁹ Barad, *Meeting the Universe Halfway*, p. 135.

the real and its representations are performatively co-constituted through a network of human and nonhuman agency. Barad follows Pickering in emphasising the active nature of matter, yet considers agency not as a property of individual entities but as performatively constituted. I agree with Barad that it is useful to attempt to sharpen the theoretical tool of performativity.⁶⁰ In particular I find Barad's elaboration of a posthumanist performativity useful as it 'allows matter its due as an active participant in the world's becoming, in its ongoing intra-activity'.⁶¹ I will predominantly be referring to 'performativity' rather than 'posthumanist performativity' as I want to emphasise that this is a sharpening of an existent theoretical tool; I will return to the issue of posthumanism in Chapter Three.

Barad's posthumanist performativity offers a productive way to think about the Human Genome Project. Eschewing a representationalist account, either from a realist or constructivist perspective, I want to propose a reading of the Human Genome Project that recognises the social and historically contingent nature of the project, while allowing biology – specifically human genetics – its due as an active participant in the Human Genome Project. Once again, the metaphor of the map is informative. In a performative account, the map of the genome is not a representation or reflection of the biologically real, but rather genomes and their maps are co-constituted through the performativity of the scientific practice of gene-sequencing. In my performative account of the Human Genome Project, I am building upon Haraway's statement that 'map-making is world-making'.⁶² Haraway argues against what she calls the fetishism of the map – that is, a 'reification that transmutes material, contingent, human and nonhuman liveliness into maps of life itself and then mistakes the map and its reified entities for the bumptious, nonliteral world'.⁶³ Instead, she

⁶⁰ This is a demand placed by Sedgwick, to sharpen the theoretical tool of performativity, and to avoid the 'sadly premature domestication of a conceptual tool whose powers we really have barely yet begun to explore' ('Queer Performativity', p. 15).

⁶¹ Barad, *Meeting the Universe Halfway*, p. 136. Barad uses the term 'intra-activity' rather than interactivity to suggest that instead of thinking of the world as full of separate and discrete entities inter-acting, it is more productive to think of the world as full of relations and agency, and intra-action within and between parts of the world.

⁶² Haraway, *Modest_Witness*, p. 133.

⁶³ Haraway, *Modest_Witness*, p. 135.

proposes maps as ‘models of worlds crafted through and for specific practices of intervening and particular ways of life’.⁶⁴ Haraway here echoes Hacking’s distinction between representing and intervening; I would elaborate on Haraway’s argument to suggest that maps are not necessarily just interventions or representations but rather constitutive performative enactments. The draft of the Human Genome, published in 2000, is a map that enacts the human genome and its biological and social meanings. I am arguing that biological genes are not passive in this ongoing enactment of the genome; they are active participants that are co-constituted along with the practices of genetic science, such as gene-sequencing, that often attempt to reify their active and contingent liveliness into inert representational maps. I am proposing a performative account of the Human Genome Project that emphasises this entanglement of the biological and social. This is important in the following discussion of specific research carried out in the 1990s that claimed to discover a genetic basis for homosexuality, because it seeks to resist narratives of genetic determinism wherein active genes *cause* sexual identities and behaviours as well as resisting the false distinction between ‘born’ and ‘made’ in debates about the origin of homosexuality. This approach also demands a more thorough biological understanding of the gene, which I will outline in terms of some of the findings of the Human Genome Project.

Entanglement

Entanglement is central to Barad’s performative account of matter and meaning, and to my thesis as a whole. Throughout this thesis I employ the term ‘entanglement’ to refer to a number of different connections and relationships, in a number of different contexts. Entanglement is more than simply a connection or a relationship, however, and it is important to draw out some of the meanings and associations that I want to evoke when I use the term. Before discussing the specific research done in the 1990s that attempted to find a genetic or biological basis for homosexuality, I will briefly outline what entanglement is in terms of ‘quantum entanglement’ before exploring

⁶⁴ Haraway, *Modest_Witness*, p. 135.

Barad's insistence on the entanglement of matter and meaning. (Although I am not suggesting that my use of entanglement corresponds to the very specific meaning it is assigned in quantum physics, the scientific definition is implied in the word's use and a basic understanding of quantum entanglement is illuminating when considering my more general use of the term.) I will also explicitly link my use of entanglement with Haraway's discussion of the game of cat's cradle in a number of ways. Drawing out some of the threads of meanings and associations that are themselves tangled up in entanglement will give a clearer understanding of what work I want the term to do within my project.

Entanglement represents one of the counterintuitive elements of quantum mechanics. Quantum mechanics allows for two or more particles to interact in a specific way which leaves them entangled – such that future measurements of one of the entangled partners simultaneously reveals the outcome of measurement on the other partners. This, at first, seems to defy one of the founding theories of quantum physics, Heisenberg's uncertainty principle. Very briefly, the uncertainty principle specifies a limit to the precision with which particular physical properties of a particle can be known simultaneously. Position and momentum of particles are two such properties. The more precisely the position of a particle is determined, the less precisely its momentum can be known; similarly, as momentum is more precisely determined, the position of the particle becomes more indeterminate.⁶⁵ Albert Einstein, who was critical of the Copenhagen Interpretation of quantum mechanics (built upon the uncertainty principle), used the phenomenon of entanglement to question the efficacy of quantum mechanics. In a paper written with Boris Podolsky and Nathan Rosen, Einstein claimed that because measurement of one entangled particle would reveal measurement outcomes in its entangled partner, then either the particles interacted upon measurement (despite having been separated), or the measurable outcomes were intrinsic properties of the particles and should be considered hidden variables (this was named the EPR

⁶⁵ For more detail on the uncertainty principle and its relation to indeterminacy see Barad, *Meeting the Universe Halfway*, pp. 19–20, and pp. 295–302.

paradox after the authors' surnames). Einstein, Podolsky and Rosen suggested that the first option was impossible as it contravened relativity (the interaction would also have to be faster than the speed of light as the effect was instantaneous), and therefore suggested that, as quantum mechanics did not allow for hidden variables, the theory was 'incomplete'.⁶⁶ Subsequent theoretical developments and, more recently, experimental tests support quantum mechanics and the uncertainty principle, rather than the EPR paradox.⁶⁷

Barad elaborates the metaphysical consequences of quantum entanglement to emphasise the entanglement of matter and meaning. In particular, she draws upon Niels Bohr's disagreement with the EPR paradox. Importantly, for Bohr, measurement is not a disturbance, but rather a specific arrangement of the elements of the phenomenon which always includes the observer – the one doing the measuring – and all apparatuses of observation. Barad calls this specific arrangement of observers and the objects of observation an 'agential cut'. Barad distinguishes the agential cut from a Cartesian cut which involves an inherent distinction between subject and object. She argues that:

boundaries and properties are only determinate *within* a given phenomenon through the enactment of an agential cut. The agential cut is determined by the materiality of the larger experimental arrangement, which delineates 'measured object' from 'measuring agency', while providing the material conditions of possibility for particular concepts to be meaningful at the exclusion of others.⁶⁸

For Bohr, theoretical concepts such as position and momentum are not intrinsic properties of objects or particles, but rather abstractions which are only 'definable and observable through their

⁶⁶ Albert Einstein, Boris Podolsky, and Nathan Rosen, 'Can Quantum-Mechanical Description of Physical Reality be Considered Complete?', *Physical Review*, 41 (1935), 777–780.

⁶⁷ The paper generally associated with disproving the EPR paradox is John Stewart Bell, 'On the Einstein Podolsky Rosen Paradox', *Physics*, 1:3 (1964), 195–200. Experimental support can be found in Alain Aspect, Jean Dalibard, and Gérard Roger, 'Experimental Test of Bell's Inequalities Using Time-Varying Analyzers', *Physical Review Letters*, 49:25 (1982), 1804–1807. Barad also discusses experimental support for the uncertainty (or indeterminacy) principle and its relation to entangled particles in *Meeting the Universe Halfway*, pp. 287–317.

⁶⁸ Barad, *Meeting the Universe Halfway*, p. 333 and p. 345.

interactions with other systems'.⁶⁹ Barad suggests that Bohr's approach be called the 'indeterminacy principle' rather than the uncertainty principle, as the emphasis is the ontological indeterminacy of 'reality', rather than epistemological uncertainty about a pre-existing reality. Developing this, Barad argues that matter and meaning are always entangled and thus inseparable. The 'real' world does not have definite properties; rather, qualities and states can be measured through specific arrangements of the world, in which the observer is a part, rather than separated from the objects of observation. Matter is always entangled with meaning, and produced through specific arrangements of observers and objects of observation – through specific agential cuts.

As well as evoking the quantum associations of entanglement, I also want to explicitly link entanglement to Haraway's game of cat's cradle. Haraway suggests cat's cradle as a way of thinking through interdisciplinarity. She states:

I would like to make an elementary string figure in the form of a cartoon outline of the interknitted discourses named (1) cultural studies; (2) feminist, multicultural, antiracist science projects; and (3) science studies. Like other worldly entities, these discourses do not exist entirely outside each other [...] the three names are place markers, emphases, or tool kits – knots, if you will – in a constitutively interactive, collaborative process of trying to make sense of the natural worlds we inhabit and that inhabit us.⁷⁰

Cat's cradle, for Haraway, is a way of seeing interdisciplinarity as an entanglement. In Haraway's account, this entangled way of approaching interdisciplinary projects emphasises that disciplines and discourses – like other worldly entities such as particles – are not discrete individual entities with intrinsic and independent properties. Cat's cradle also emphasises the constitutively interactive, collaborative and situated character of all knowledge production. Significantly, Haraway's cat's

⁶⁹ Barad, *Meeting the Universe Halfway*, p. 296.

⁷⁰ Donna Haraway, 'A Game of Cat's Cradle: Science Studies, Feminist Theory, Cultural Studies', *Configurations*, 1 (1994), 59–71, p. 66. See also Katie King, 'Pastpresents: Playing Cat's Cradle with Donna Haraway', *Party Writing for Donna Haraway!* (2010) <<http://playingcatscradle.blogspot.co.uk>> [accessed 7 March 2013].

cradle, like Barad's agential elaboration of Bohr's quantum indeterminacy, emphasises the 'realness' of the 'real world', while also emphasising the situated and contingent nature of any and all knowledge claims about this world. As Haraway states: 'the issues here are not "mere" metaphors and stories; the issues are about the semiosis of embodiment'.⁷¹ Haraway's cat's cradle, then, tangles up situated knowledges with agential cuts.

Entanglement is important throughout my thesis, and I use the term in a number of different contexts to think about multiple connections, networks and relationships. The word evokes a specific scientific tradition, that of quantum mechanics. Although I use the term in a more general sense than its specific use in quantum mechanics, I want to evoke this discourse in my use of the word for a number of reasons. In particular, quantum entanglement (read through Bohr and Barad's elaboration) is both a description of the 'real' world, and recognises the fact that the 'real' is inseparable from the situated practices that produce the knowledge about the 'real'. In my description of entanglements, I also want to evoke Haraway's cat's cradle, and the knotting and interknitting of different situated discourses, disciplines and knowledges. This knitting, knotting and entangling is always constitutively interactive and collaborative, and is as much about working within disciplinary boundaries, as performing the agential cuts that draw these boundaries and create the possibility of their redrawing. This is particularly pertinent in this chapter where I am putting genetic science, quantum physics, deconstruction and queer theory into conversation with each other. These are not discrete areas of definite independent knowledges, but are always already entangled, only made intelligible by specific situated agential cuts.

Gay Gene Research

It was against the backdrop of expensive gene sequencing and optimism for the discovery of a 'map' or comprehensible 'book' of life in the Human Genome Project that research into a biological

⁷¹ Haraway, 'A Game of Cat's Cradle', p. 71.

basis for homosexuality began to search for a hypothetical gay gene. In the early 1990s, two influential pieces of scientific research into the genetic basis of sexual orientation were published: J. Michael Bailey and Richard Pillard's twin study, and Dean Hamer's study of so-called genetic markers for homosexuality on the X chromosome.⁷² I will describe these two pieces of research briefly, before analysing some of the claims made and discussing some of the methodological problems with the research. Bailey and Pillard published 'A Genetic Study of Male Sexual Orientation' in 1991.⁷³ In this study, Bailey and Pillard advertised in magazines for gay men with a twin brother, or an adoptive brother who had been adopted into the family at an age less than three. These gay men were interviewed about their sexuality and the sexualities of their twin, or adoptive, brothers. The brothers were then sent questionnaires to determine their sexuality. The twin brothers were also asked to confirm if they were monozygotic (identical – from a single egg) or dizygotic (non-identical – from two eggs) twins. Of the participants included in the final sample, '52% (29/56) of monozygotic cotwins, 22% (12/54) of dizygotic cotwins, and 11% (6/57) of adoptive brothers were homosexual'.⁷⁴

⁷² Other relevant and influential research contemporary to Bailey and Pillard's twin study and Hamer's chromosome markers includes Simon LeVay's famous research into the relationship between brain structures and homosexuality ('A Difference in Hypothalamic Structure between Heterosexual and Homosexual Men', *Science* 253:5023 [1991], 1034–1037). LeVay's study suggested a size difference in a cell group of the interstitial nuclei of the anterior hypothalamus (INAH 3) between homosexual and heterosexual men. LeVay's research was widely publicised and he enjoyed something of a celebrity status, appearing on numerous television news programmes and chat shows, as well as hosting a documentary for Channel 4 (Simon LeVay, *Born That Way?* [Channel 4, 1992]. See also LeVay's personal website, Simon LeVay, <www.simonlevay.com> [accessed 29 April 2011]). He published three popular science books on science and sexuality and co-authored a textbook on sexuality as well as a book on lesbian and gay history (Simon LeVay, *The Sexual Brain* [Cambridge, MA: MIT Press, 1993]; *Queer Science: The Use and Abuse of Research into Homosexuality* [Cambridge, MA: MIT Press, 1996]; *Gay, Straight, and the Reason Why: The Science of Sexual Orientation* [Oxford: Oxford University Press, 2011]; Simon LeVay and Sharon M. Valente, *Human Sexuality*, 2nd edn [Basingstoke, Palgrave, 2006]; Simon LeVay and Elisabeth Nonas, *City of Friends: A Portrait of the Gay and Lesbian Community in America* [Cambridge, MA: MIT Press, 1995]). LeVay's research has been very thoroughly critiqued. See, for example: Anne Fausto-Sterling, *Myths of Gender: Biological Theories about Women and Men*, 2nd edn (New York: Basic, 1992), especially p. 249; Marjorie Garber, 'The Return to Biology', in *Bisexuality and the Eroticism of Everyday Life* (New York: Routledge, 2000), pp. 268–283; Ruth Hubbard and Elijah Wald, *Exploding the Gene Myth: How Genetic Information is Produced and Manipulated by Scientists, Physicians, Employers, Insurance Companies, Educators, and Law Enforcers*, rev. edn [Boston, MA: Beacon, 1999], p. 94; and Rebecca M. Jordan-Young, *Brain Storm: The Flaws in the Science of Sex Differences* (Boston, Mass: Harvard University Press, 2010), pp. 101–106.

⁷³ J. Michael Bailey and Richard Pillard, 'A Genetic Study of Male Sexual Orientation', *Archives of General Psychiatry*, 48:12 (1991), 1089–96. Bailey also authored one of the rarer studies of the time on female homosexuality: J. Michael Bailey, and D. S. Benishay, 'Familial aggregation of female sexual orientation', *American Journal of Psychiatry*, 150:2 (1993), 272–7.

⁷⁴ Bailey and Pillard, 'A Genetic Study of Male Sexual Orientation', p. 1089.

These results led Bailey and Pillard to conclude that there is a genetic basis for homosexuality.

Pillard, in fact, took this claim further; in an interview in the journal *GLQ* he stated, 'we think that the hypothesized gay genes are real'.⁷⁵ Many critics have suggested that the numbers simply do not support this genetic conclusion. William Byne and Bruce Parsons state that:

the concordance rate for homosexuality in nontwin biologic brothers was only 9.2% – significantly lower than that required by simple genetic hypothesis, which, on the basis of shared genetic material, would predict similar concordance rates for [dizygotic] twins and nontwin biologic brothers. Furthermore, the fact that the concordance rates were similar for nontwin biologic brothers (9.2%) and genetically unrelated adoptive brothers (11.0%) is at odds with a simple genetic hypothesis, which would predict a higher concordance rate for biological siblings.⁷⁶

Monozygotic twins share identical DNA, yet close to half of the sampled monozygotic twins did not share a sexual orientation. Despite this, Pillard interprets the results as proof not only of a genetic basis for homosexuality, but as suggesting the existence of a specific gene – or genes – that code for homosexuality.

Among the methodological problems with Bailey and Pillard's twin survey is that the sample is not random. Bailey and Pillard recruited participants for their research through advertisements in gay and lesbian publications. This method of sampling could have affected the results of the survey. As clinical psychiatrist Miron Baron argues:

This method can be deemed questionable because it is highly dependent on the readership of these publications and on the motives of those who opt to respond. It may thus lead to

⁷⁵ Edward Stein, 'Evidence for Queer Genes: An Interview with Richard Pillard', *GLQ*, 1:1 (1991), 93–110 (p. 94).

⁷⁶ William Byne and Bruce Parsons, 'Human Sexual Orientation: The Biologic Theories Reappraised', *Archives of General Psychiatry*, 50 (1993), 228–239 (p. 229). See also Hubbard and Wald, *Exploding the Gene Myth*, p. 97; and William Byne, 'The Biological Evidence Challenged', *Scientific American*, 270 (1994), 50–55.

skewed results – for example, inflated rates of concordant [monozygotic] twins owing to preferential participation.⁷⁷

The survey method is also not a completely accurate way of testing zygosity of twins. Baron argues that although ‘Some data suggest that "perceived" zygosity corresponds to "real" zygosity in 80%-90% of twin pairs, provided the interviews and questionnaires are thorough and meticulous throughout’, this cannot be guaranteed and blood-typing to test for zygosity would be more accurate.⁷⁸ Another problem with Bailey and Pillard’s research is the definition of bisexuality. Although participants were asked to score themselves on the Kinsey scale and therefore not necessarily categorise themselves along the binary of heterosexual/homosexual, homosexual participants and those considered ‘substantially bisexual’ were combined to produce the 52% of monozygotic twins considered to be homosexual.⁷⁹

In 1993, Dean Hamer and others published ‘A Linkage Between DNA Markers on the X Chromosome and Male Sexual Orientation’. Following on from previous work on the biological basis of homosexuality, Hamer took advantage of the developments that the massive multinational funding of the Human Genome Project made possible:

Recent advances in human genome analysis, in particular the development of chromosomal genetic maps that are densely populated with highly polymorphic markers, make it feasible to apply such methods to complex traits, such as sexual orientation, even if these traits are

⁷⁷ Miron Baron, ‘Genetics and Human Sexual Orientation’, *Biological Psychiatry*, 33 (1993), 759–761 (p. 759).

⁷⁸ Baron, ‘Genetics and Human Sexual Orientation’, p. 760.

⁷⁹ Edward Stein, ‘Evidence for Queer Genes’, p. 94. Marjorie Garber discusses in detail the status of the bisexual in Bailey and Pillard’s research, as well as in Hamer’s and LeVay’s, in ‘The Return to Biology’, in *Bisexuality and the Eroticism of Everyday Life* (New York: Routledge, 2000), pp. 268–283. See also Ruth Hubbard’s statement that, ‘This way of categorizing people [into strict categories of heterosexual/homosexual] obscure[s] the hitherto accepted fact that many people do not have sexual relations exclusively with one or the other sex.’ (Hubbard and Wald, *Exploding the Gene Myth*, p. 94).

influenced by multiple genes or environmental or experiential factors, or some combination of these.⁸⁰

The subjects of Hamer's study were self-identified gay men and their relatives over the age of eighteen. The final sample consisted of 38 pairs of homosexual brothers and their relatives, with two families added from a previous sample. The total participants numbered 114. The 38 families were chosen very deliberately, to test the hypothesis that there is a maternally transmitted genetic basis for homosexuality.⁸¹ The sample demonstrated a high number of homosexual maternal uncles and sons of maternal aunts. Following this confirmation of the findings of previous research, Hamer looked at the X chromosome for possible genetic markers for homosexuality that are transmitted maternally.⁸²

Hamer argued that if the X chromosome contained a gene that was in some way related to homosexual behaviour, then chromosomal maps would show similar genetic markers among homosexual participants:

If the X chromosome contains a gene that increases the probability of an individual's being homosexual, then genetically related gay men should share X chromosome markers close to that gene. If no such gene exists, then no statistically significant correlations between sexual orientation and X chromosome markers will be observed.⁸³

⁸⁰ Dean Hamer and others, 'A Linkage Between DNA Markers on the X Chromosome and Male Sexual Orientation', *Science*, 261 (1993), 321–327 (p. 321).

⁸¹ Dean Hamer, 'A Linkage Between DNA Markers', p. 322.

⁸² Previous research on the maternal nature of inherited homosexuality include G. W. Henry, *Sex Variants: A Study of Homosexual Patterns* (Hoeber, New York, 1941); B. Zuger 'Homosexuality in Families of Boys with Early Effeminate Behavior: An Epidemiological Study', *Archives of Sexual Behavior*, 18:155 (1989), 155–166; and R. C. Pillard and J. D. Weinrich, 'Evidence of Familial Nature of Male Homosexuality', *Archives of General Psychiatry*, 43:8 (1986), 808–812.

⁸³ Hamer, 'A Linkage Between DNA Markers', p. 323.

Hamer reports that through chromosome mapping, significant correlations were observed; in particular he identified links between genetic marker Xq28 and self-reported homosexuality in his sample. Hamer concluded that:

We have now produced evidence that one form of male homosexuality is preferentially transmitted through the maternal side and is genetically linked to chromosomal region Xq28 [...] it appears that Xq28 contains a gene that contributes to homosexual orientation in males.⁸⁴

As with Bailey and Pillard's twin studies, there are numerous methodological problems with Hamer's research. Hamer's sample is limited, and there are also issues of sampling bias, as the research focused on a specific group of gay men, with a particular family background. Hamer's conclusions reflect this specificity, as he states that '*one form of homosexuality* is [...] genetically linked to chromosomal region Xq28'.⁸⁵ Not only was the focus on a specific group of gay men, but an adequate control group (such as nonhomosexual brothers) was not included.⁸⁶ Further research has also failed to confirm or replicate Hamer's findings.⁸⁷ Hamer's tone in the *Science* article is speculative – in the article he states that the subject is complex and a single genetic locus cannot account for the variability of human sexuality.⁸⁸ However, in his popular science book, *The Science of Desire: The Search for the Gay Gene and the Biology of Behavior*, Hamer states that 'we didn't isolate a "gay gene"; we only detected its presence through linkage'.⁸⁹ The implication is that although the

⁸⁴ Hamer, 'A Linkage Between DNA Markers', p. 325.

⁸⁵ Hamer, 'A Linkage Between DNA Markers', p. 325. My emphasis.

⁸⁶ This particular methodological problem is emphasised by Anne Fausto-Sterling and Evan Balaban in their letter to *Science*, 'Genetics and Male Sexual Orientation', *Science*, 261 (1993), 1257.

⁸⁷ George Rice and others, 'Male Homosexuality: Absence of Linkage to Microsatellite Markers at Xq28', *Science*, 284:5414 (1999), 665–667.

⁸⁸ Hamer, 'A Linkage Between DNA Markers', p. 325–326.

⁸⁹ Dean Hamer and Peter Copeland, *The Science of Desire: The Search for the Gay Gene and the Biology of Behavior* (New York: Simon and Schuster, 1994), p. 147.

research did not identify a gay gene, its existence is not in question and is, if anything, supported by the study.⁹⁰

What are Genes?

In both Bailey and Pillard's twin survey, and Hamer and others' chromosome research, genes are defined (although not explicitly) as a structural biological unit, a molecule that in some way determines behaviour or identity. The word 'gene' did not always have such a deterministic meaning. In fact, the term was coined in 1909 by botanist Wilhelm Johannsen who wanted a word that could simply refer to the evident fact that characteristics were transmitted across generations. Johannsen stated:

The word 'gene' is completely free from any hypothesis; it expresses only the evident fact that, in any case, many characteristics of the organism are specified in the gametes by

⁹⁰ Another problem with both Bailey and Pillard's twin survey and Hamer's chromosomal research is the lack of an explanation for the hereditary nature of homosexuality. Bailey and Pillard suggest that there is a genetic basis for homosexuality but do not offer a more specific explanation; Hamer proposes a more specific biological theory, yet does not suggest a theory of heredity. The question of how heritability could operate in relation to homosexuality poses serious problems to evolutionary theory. If homosexuality is defined as a trait determined by genetics and homosexuals are assumed to reproduce at a much lower rate than heterosexuals, how can this trait have survived evolution by natural selection? A number of theories have been suggested to respond to this question. In physical theories such as balanced superior heterozygote fitness, homosexuality functions as a recessive trait that actually increases the fitness of a person with both heterosexual and homosexual alleles at a particular genetic locus. A person with both homosexual and heterosexual alleles would be said to be heterozygous, whereas a person with just heterosexual (or homosexual) alleles would be said to be homozygous. If the heterozygous arrangement conferred some evolutionary advantage, this could be selected for, producing sub-populations of homozygous heterosexuals and homosexuals within a majority of heterozygous heterosexuals (see G. E. Hutchinson, 'A Speculative Consideration of Certain Possible Forms of Sexual Selection in Man', *American Naturalist*, 93:869 [1959], 81–91). Social theories include kin selection, in which homosexuality could be selected for if it confers some reproductive advantage on the individual's relatives. Simply put, an individual's siblings share fifty percent of an individual's genes. If homosexuality promotes altruism towards these siblings, and this in turn increases their ability to pass on their genes, then the homosexual individual is indirectly ensuring the survival of his genes (see Edward O. Wilson, *Sociobiology: The New Synthesis* [Cambridge, Mass: Harvard University Press, 1975], especially pp. 343–344). For a discussion of these and other theories of the inheritance of homosexuality within evolutionary narratives, see Michael Ruse, 'Are There Gay Genes? Sociobiology and Homosexuality', *Journal of Homosexuality*, 6:4 (1981), 5–34; Ruse, *Homosexuality: A Philosophical Enquiry* (Oxford: Basil Blackwell, 1988); and Jim McKnight, *Straight Science? Homosexuality, Evolution and Adaptation* (New York: Routledge, 1997).

means of special conditions, foundations, and determiners which are present in unique, separate, and thereby independent ways – in short, precisely what we wish to call genes.⁹¹

Johannsen underscored this point two years later: ‘The “gene” is nothing but a very applicable little word [...] As to the nature of the “genes”, it is as yet of no value to propose any hypothesis; but that the notion of the “gene” covers a reality is evident in Mendelism.’⁹² Despite Johannsen’s desire to keep genes free from any hypothesis, Evelyn Fox Keller argues that by the 1930s, genes had ‘become incontrovertibly real, material entities – the biological analogue of the molecules and atoms of physical science’.⁹³ Proof for the reality and materiality of genes came in 1953 with the discovery of the function and form of DNA.⁹⁴ Keller states that, ‘by midcentury, all remaining doubts about the material reality of the gene were dispelled and the way was cleared for the gene to become the foundational concept capable of unifying all biology’.⁹⁵ Not only this, but the way was cleared for the gene to function in language as a ‘master molecule’ – a word that, far from being free from hypothesis, functions rhetorically to support hypotheses of biological determinism.⁹⁶ Keller refers to

⁹¹ Wilhelm Johannsen, *Elemente der Exakten Erblchkeitslehre* (Jena: Gustav Fisher, 1909), p. 124. Quoted and translated in Evelyn Fox Keller, *The Century of the Gene* (Cambridge, Mass: Harvard University Press, 2000), p. 2.

⁹² Wilhelm Johannsen, ‘The Genotype Conception of Heredity’, *American Naturalist*, 45 (1911), 129–159 (p. 132–134).

⁹³ Keller, *The Century of the Gene*, p. 2.

⁹⁴ The discovery of the helical structure of DNA and the implications for genetic heredity were published across two issues of *Nature* in 1953 and included work by the four main scientists generally considered to be responsible for the discovery: James Watson, Francis Crick, Maurice Wilkins, and Rosalind Franklin. The articles were as follows: Watson and Crick, ‘A Structure for Deoxyribose Nucleic Acid’, *Nature*, 171 (1953), 737–738; M. H. F. Wilkins, A.R. Stokes and H. R. Wilson, ‘Molecular Structure of Deoxypentose Nucleic Acids’, *Nature*, 171 (1953), 738–740; Franklin and R. G. Gosling, ‘Molecular Configuration in Sodium Thymonucleate’, *Nature*, 171 (1953), 740–741; Watson and Crick, ‘Genetical Implications of the structure of Deoxyribonucleic Acid’, *Nature*, 171 (1953), 964–967; and Franklin and Gosling, ‘Evidence for 2-Chain Helix in Crystalline Structure of Sodium Deoxyribonucleate’, *Nature*, 172 (1953), 156–157. Watson, Crick and Wilson shared the Nobel Prize for the discovery in 1962. Rosalind Franklin was unable to be honoured, as she had died from cancer four years earlier. For a discussion of Franklin’s life, contributions to the discovery of the helical structure of DNA, and the controversies linked to Franklin’s role as a woman in a male-dominated profession, see Anne Sayre, *Rosalind Franklin and DNA* (New York: Norton, 1975), and Brenda Maddox, *Rosalind Franklin: The Dark Lady of DNA* (London: Harper Collins, 2002).

⁹⁵ Keller, *The Century of the Gene*, p. 3.

⁹⁶ For discussions of master molecules in biological theory, see Evelyn Fox Keller, *Reflections on Gender and Science*, rev. edn (New Haven: Yale University Press, 1995 [1985]); Richard Lewontin, ‘The Dream of the Human Genome’; and Bonnie B. Spanier, *Im/Partial Science: Gender Ideology in Molecular Biology* (Bloomington: Indiana University Press, 1995).

this rhetorical use of the gene as 'gene talk' and it is a concept I will discuss alongside developments in genetics in the late 1990s and early 2000s that problematise a simplistic and reductive definition of the gene, and thus, the possibility of finding gay genes.⁹⁷

As my project is concerned with putting social theories into conversation with the theory and practice of science, it is essential to briefly explore what the word 'gene' refers to in the work of biologists. Following the discovery of the double helix, the classical view of the gene was that it was a string of DNA that, when translated into messenger RNA (mRNA) would produce a protein. This picture of the gene fits with the neo-Darwinian narrative of evolution: DNA is a molecule that occasionally mutates, producing morphological differences due to the difference in proteins, and evolution proceeds by a cumulative selection of the mutations that result in increased fitness.⁹⁸ One of the unexpected consequences of the large-scale focus on the genome in the 1990s was the realisation that this picture was overly simplistic.⁹⁹ Keller provides a list of some of the discoveries that have troubled the classical picture of the gene:

Techniques and data from sequence analysis have led to the identification not only of split genes but also of repeated genes, overlapping genes, cryptic DNA, antisense transcription, nested genes, and multiple promoters (allowing transcription to be initiated at alternative sites and according to variable criteria). All of these variations immeasurably confound the task of defining the gene as a structural unit.¹⁰⁰

Some geneticists have suggested that the word is no longer useful. William Gelbart suggests that

⁹⁷ Keller, *The Century of the Gene*, especially the conclusion 'What are Genes for?', pp. 133–148.

⁹⁸ Keller, *The Century of the Gene*, p. 35.

⁹⁹ Keller points out that this simplistic picture of the gene was questioned by some scientists before the Human Genome Project. She quotes Barbara McClintock's address following the acceptance of the Nobel Prize in 1983 for her work on genetic transposition, or 'jumping genes', dating back to the 1940s. McClintock describes the genome as 'a highly sensitive organ of the cell, monitoring genomic activities and correcting common errors, sensing the unusual and unexpected events, and responding to them' (Keller, *The Century of the Gene*, p. 33). See also Keller, *A Feeling for the Organism: The Life and Work of Barbara McClintock* (San Francisco: Freeman, 1983).

¹⁰⁰ Keller, *The Century of the Gene*, p. 67.

we may well have come to the point where the use of the term 'gene' is of limited value and might in fact be a hindrance to our understanding of the genome [...] unlike chromosomes, genes are not physical objects but are merely concepts that have acquired a great deal of historic baggage over the past decades.¹⁰¹

The word gene, although useful for scientists working in specific fields, does not refer to a single stable biological entity, and thus must be qualified to have meaning across more than one sub-discipline of genetics. As Gelbart states elsewhere, 'I find it sometimes very difficult to tell what someone means when they talk about genes because we don't share the same definition'.¹⁰² Francis Collins, director of the National Human Genome Research Institute (a role previously held by James Watson), supports this view of the gene, saying 'we almost have to add an adjective every time we use that noun'.¹⁰³ The applicability of Johannsen's little word is not without its problems; ambiguously applied to different biological entities and processes, the word undermines reductive narratives of genetic determinism.

If the term gene is, as Gelbart suggests, a hindrance to our understanding of evolution and heredity, and if geneticists and molecular biologists are suggesting more and more that the gene is no more than shorthand for a range of different biological entities and processes, this has not been reflected in the popular use of the word. During the 1990s when scientists working on the Human Genome Project (as well as those independent from it) were discovering unexpected complexity in the form and function of the genome, gene-talk proliferated. Jenny Kitzinger has traced reports in the media of the 'discoveries' of the early 1990s related to the biological basis of homosexuality, in particular Dean Hamer's chromosomal study. Kitzinger suggests that, while there were some headlines and reports that were heavily based on genetic determinism and which accepted uncritically the reality of a gay gene, the majority of reports were actually more critical and non-

¹⁰¹ William Gelbart, 'Data Bases in Genomic Research', *Science*, 282 (1998), 659–661 (p. 660).

¹⁰² Gelbart, quoted in Helen Pearson, 'Genetics: What is a Gene?', *Nature*, 441 (2006), 398–401 (p. 401).

¹⁰³ Francis Collins, quoted in Pearson, 'What is a Gene', p. 401.

deterministic. Her analysis is primarily of the British print news media, and she references several examples of headlines that challenged the genetic determinism involved in a narrative of gay genes: ‘Don’t Panic: Take Comfort, It’s not all in the Genes’; ‘It’s Not in the Genes, It’s in the Culture’; ‘The Myth of the Gay Gene’.¹⁰⁴ Kitzinger’s research is important because it demonstrates that media reports and public understandings of genetics are not simply deterministic, expecting a one gene – one behaviour relationship. However, the criticisms in the articles tend to be of the narrow definition of human sexuality, rather than of the narrow definition of genes. For example, ‘The Myth of the Gay Gene’ from the *Observer* reflects that:

Sexual preferences come in a broad array, from the exclusive homosexual to the heterosexual [...] who has occasional gay forays, to the exclusive heterosexual who only finds members of the opposite sex attractive. The idea that a single gene could control these widely varying reactions is utterly ridiculous.¹⁰⁵

The article closes with the statement that further developments in the relationship of genetics to behaviour should be anticipated ‘in a spirit of wonderment at their complexity, and not with offensive simplicity’.¹⁰⁶ The implication is, however, that the complexity that is referred to is the complexity of human social behaviour, rather than the complexity of genetics. It is my argument that articles such as this are important to challenge the one gene – one behaviour model, yet do little to question a simplistic view of human biology and, in fact, contribute to the gene-talk that proliferated in the 1990s despite the decline of the master molecule paradigm in genetic research of the time. I

¹⁰⁴ Richard Dawkins, ‘Don’t Panic: Take Comfort, It’s not all in the Genes’, *Telegraph*, 17 July 1993; James Fenton, ‘It’s not in the Genes, It’s in the Culture’, *Independent*, 19 July 1993; Robin McKie, ‘The Myth of the Gay Gene: Fact from Fantasy Stripped after Last Week’s “Revelation” of a Genetic Basis to Homosexuality’, *Observer*, 18 July 1993. Quoted in Jenny Kitzinger, ‘Constructing and Deconstructing the “Gay Gene”: Media Reporting of Genetics, Sexual Diversity and “Deviance”’, in *The Nature of Difference: Science, Society and Human Biology*, ed. by G. Ellison and A. Goodman (London: Taylor and Francis, 2005), pp. 100–117.

¹⁰⁵ ‘The Myth of the Gay Gene’, *Observer*, 18 July 1993, p. 21

¹⁰⁶ ‘The Myth of the Gay Gene’, *Observer*, 18 July 1993, p.21

want to propose an approach that takes into account the complexity and importance of *both* the social and the biological.

Queer Science?

As I discussed in the previous chapter, feminists in the 1970s and 1980s demonstrated that patriarchy structured the theory and practice of science, and they developed a number of critical approaches to patriarchy in science. Although patriarchy and heteronormativity are not coterminous, I argue that they share political investments and support each other in significant ways.¹⁰⁷ With this in mind, it is illustrative to attempt a transposition of feminist approaches to patriarchy into possible queer approaches to heteronormativity in science. A feminist empiricist approach emphasises the importance of the scientific method, and the need to avoid androcentric bias in scientific research. From this perspective, there is a value-neutral set of facts that can be accessed, which are then subsequently used or abused in society. This approach is echoed by Hamer when he states in the conclusion of his paper,

We believe that it would be fundamentally unethical to use [genetic links to behaviour] to try to assess or alter a person's current or future sexual orientation, either heterosexual or homosexual, or other normal attributes of human behavior. Rather, scientists, educators, policy-makers, and the public should work together to ensure that such research is used to benefit all members of society.¹⁰⁸

Although Hamer is sensitive to the ethical and political dangers of genetic determinism in relation to sexual identity, his account assumes that the science itself is value neutral, and it is the responsibility of scientists, educators, policy-makers and the public to ensure that the research is used wisely, and

¹⁰⁷ For a discussion and definition of the term 'heteronormativity', see Michael Warner and Lauren Berlant, 'Sex in Public', *Critical Inquiry*, 24:2 (1998), 547–566.

¹⁰⁸ Hamer and others, 'A DNA Linkage', p. 326.

not abused. This reinforces the distinction between science and society, and between subject and object – that is, between scientist and the object of scientific investigation.

One possible approach, then, would be to apply a feminist postmodernist approach to the kind of research done by Bailey and Pillard, or Hamer. A feminist postmodernist approach interrogates the subject-object split in the traditional scientific method, while problematising the stable identity of the scientist and the possibility of a singular stable set of knowledge about the object on inquiry. This approach is illuminating for a discussion of Bailey and Pillard's and Hamer's research; from this perspective, the research is performed within the productionist or appropriationist logic of the domination of object by subject. Haraway critiques:

the object both guarantees and refreshes the power of the knower, but any status as agent in the productions must be denied the object. It – the world – must, in short, be objectified as thing, not as an agent; it must be matter for the self-formation of the only social being in the productions of knowledge, the human knower.¹⁰⁹

The research by Bailey and Pillard, and by Hamer and his team, focuses on self-reports of sexual orientation. This approach could suggest a productive conversation between the scientists and objects of inquiry, and therefore the reduction of distance between subject and object.

Unfortunately, the strict criteria for categorisation and the underlying assumption of a binary organisation of sexual orientation disallow any true agency to the participants. In his interview with the journal *GLQ*, Richard Pillard suggests an organisation of sexual orientation based on sexual attraction to one of two strictly binarised genders. Not only this, he considers these to be universal human categories; he states that,

I don't agree with the assertion that 'gay' isn't a strong category simply because some tribes in New Guinea or the American plains don't have it. Those are small cultural isolates and

¹⁰⁹ Haraway, 'Situated Knowledges', pp. 183–201 (p. 198).

they might not recognize as many categories as we do just because they lack a large enough data base.¹¹⁰

Bailey and Pillard used a methodology of classification based on the Kinsey scale. Participants were therefore asked to classify their sexuality along a scale, rather than as one of two oppositional sexualities. This could be interpreted as allowing agency to the objects of scientific investigation, and offering situated knowledges of sexuality from the collapse of the subject-object divide. For the purposes of statistical analysis, however, the information gathered is organised so as to categorise participants as either homosexual or heterosexual. As previously noted, the problematic classification of bisexuality illustrates one of the weaknesses with this methodological approach. The classification of bisexual as either heterosexual or homosexual reveals the underlying assumption of the universal nature of a binary organisation of sexuality. This underlying assumption prevents true agency to the participants, for although they are asked to report on their own sexuality, the final classification decision is made by the scientists. This disallows agency to the objects of investigation (the research participants) and precludes the production of connections and conversations between subject and object.

The feminist postmodernist approach outlined in the previous chapter is useful for questioning biological determinism and underlying assumptions in the scientific research on sexual orientation. It does, however, need to be developed to successfully negotiate the false distinctions between biology and culture, and between scientific realism and relativism, while ensuring that distinctions are not reinscribed through reversal. In Derridean terms, the negotiation must not simply be a passing from one concept to another, but rather one that seeks to overturn and displace conceptual and nonconceptual orders. With this in mind, I want to suggest a diffractive and queer approach that takes into account developments in feminist postmodernism, deconstruction, lesbian and gay studies, and science studies. I argue that this approach, informed by Elam's advocacy of

¹¹⁰ Stein, 'Evidence for Queer Genes', p. 101.

groundless solidarity, Haraway's metaphors of networks and diffraction, and Barad's posthuman performativity, can queer genetics and offer productive ways to think about the relationship of biology, behaviour, science and society. Importantly for my project, this can work towards avoiding genetic determinism while attempting to take into account the complexities and specificities of both the biological and the social. As I argued in Chapter One, biological determinism is not inevitable and attention to the entanglement of the biological and social can offer the possibility of alternative narratives, positions and bodies of knowledge.

Queer(ing) Genes

To attempt to approach genetics and the search for gay genes from a queer perspective – to queer genes – is to attempt multiple negotiations. Queer, in the formulation of theorists such as Michael Warner, is necessarily a social process and a negotiation of normativities. Queer theorists have also attempted to negotiate a discursive space different from but contiguous with lesbian and gay studies. It is my argument that queer is also useful for negotiating the seeming oppositions of the real and its representations (an opposition that exists in both realist and constructivist accounts of sexuality and sexual difference), and that of the biological and the social. This relates to the ongoing debate that surrounds scientific research into sexuality – the question of whether homosexuality is biological or social, usually expressed in terms of 'born versus made'. For some commentators, the search for a biological basis of homosexuality is tantamount to a 'new eugenics'. Neuroanatomist Simon LeVay distances his work on structural brain differences in homosexual men, along with the work of researchers such as Bailey and Pillard, and Hamer and others, from the history of eugenics by stating (rather naïvely) that Nazi eugenic programmes were based not on the belief that homosexuality was an immutable biological trait, but rather an infectious social and

behavioural problem.¹¹¹ His argument, in short, is that ‘people who think that gays and lesbians are “born that way” are also the most likely to support gay rights’.¹¹² Many theorists and activists have questioned this argument. Edward Stein, for example, argues that basing the fight for gay rights on biology is dangerous for a number of reasons. In an interview with *The Advocate*, Stein questions the logic behind LeVay’s belief that a biological basis for homosexuality will necessarily promote rights:

Even if sexual orientation is innate, a gay or lesbian person’s public identity, sexual behaviors, romantic relationships, or decisions to raise children are all choices. No theory suggests that these choices are genetic. A homophobic person might easily accept that gay people do not choose their sexual orientation – while still hating gay people and wanting to prevent us from having sex or building queer families.¹¹³

These are important ethical and political issues. However, framing the debate in terms of ‘born or made’ relies upon and reinforces a strict distinction between the biological and the social. Queering genes, and a performative account of the search for gay genes, deconstructs this distinction, while not effacing the important ethical and political implications.

One of the most important aspects of my alternative performative account of genes and sexuality is an expanded notion of agency. In a representationalist account, agency is denied the object of investigation. In a performative account, scientific knowledge is produced within a network of human and nonhuman agency. Scientific knowledge can be thought of as a diffraction pattern,

¹¹¹ LeVay, *Queer Science*, p. 38. For a more convincing account of the necessary links between genetic determinism and the wider history of eugenics, see Kevles, ‘Out of Eugenics’, *The Code of Codes*; Evelyn Fox Keller, ‘Nature, Nurture, and the Human Genome Project’, *The Code of Codes*, pp. 281–199; and Garland E. Allen, ‘Is a New Eugenics Afoot?’, *Science*, 294:5540 (2001), 59–61.

¹¹² LeVay, *Queer Science*, p. 282.

¹¹³ Edward Stein, quoted in Michael Bronski, ‘Blinded by Science’, *The Advocate*, 1 February 2000, pp. 64–66, p. 66. See also, Stein, ‘The Relevance of Scientific Research About Sexual Orientation to Lesbian and Gay Rights’, *Journal of Homosexuality*, 27:3–4 (1994), 269–308; and Stein, *The Mismeasure of Desire* (Oxford: Oxford University Press, 1999). Eve Kosofsky Sedgwick suggests a similar caution towards biological theories of sexuality: ‘If I had ever, in any medium, seen any researcher or popularizer refer even once to any supposed gay-producing circumstance as the *proper* hormone balance, or the *conducive* endocrine environment, for gay generation, I would be less chilled by the breezes of all this technological confidence’ (‘How to Bring Your Kids Up Gay: The War on Effeminate Boys’, *Tendencies* (New York: Routledge, 1994), pp. 154–164 (p. 164)).

produced by particular contingent arrangements of human and nonhuman agencies, or actors, in a biological-social network (in which the biological and social are always already entangled).

Diffraction can intervene in existing networks of actors (both subjects and objects) to produce new actors and new networks between them. Haraway's account privileges 'interference patterns' and the effects of differences and interferences in 'material-semiotic' networks.¹¹⁴ My approach suggests that genetic biology is a biological-social network, rather than a system organised in strict binary oppositions. This is, in part, an answer to the deconstructive imperative not to pass simply between terms but to overturn and displace conceptual and nonconceptual orders, and I suggest that a method of queering genes would be to consider genes as active agential actors within biological-social networks. The Human Genome Project has not revealed genes to provide an interpretable code of human life; rather, it has revealed surprising complexity in the form and function of the genome. This biological complexity challenges the linguistic use of the gene. Simultaneously, the metaphors used to describe the Human Genome Project and other related areas of genetic research trouble the status of the gene as a solely biological entity, revealing genes to be involved in complex biological-social negotiations of power and ownership. My approach is diffractive, accounting for the material quality of genes whilst also recognising that they function through social and linguistic articulation. Furthermore, this diffractive approach emphasises that the biological does not simply reflect the social meanings of genes, just as any language cannot provide a completely faithful representation of the material realm. Instead, it is my argument that genes are biological-social actors within a biological-social network, with agency – not in terms of causing identities or

¹¹⁴ Haraway, *Modest_Witness*, p. 16; Haraway, 'The Promises of Monsters', p. 298. Haraway uses the term 'material-semiotic' whereas Barad uses the formulation 'material-discursive' (Barad, *Meeting the Universe Halfway*, p. 36). Both of these formulations evoke the actor-network theory most commonly associated with Bruno Latour (see Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open University Press, 1987). To preserve the ethical and political questions involved in the distinction between the biological and social in the science of sexuality and the 'born or made' debate, and to signal that I am not, in this chapter, following a specifically actor-network approach, I prefer the term 'biological-social'.

behaviours in a linear fashion, but as always creating interference patterns in both biological and social accounts.

Queering the search for a genetic basis for homosexuality should not stop at a deconstruction of the binary oppositions apparent in the research, its reception, and discussion of its wider implications. It is not simply a matter of 'born versus made', nor a collapsing of the two terms into one another. It is also not a matter of the impartial scientist (the Baconian 'good knower' discussed in the first chapter) discovering the object of scientific inquiry, namely the gay gene. I argue that genes are not inert biological entities awaiting discovery and classification as gay (or not), but are always already queer. Genes are active participants in the networks in which they are researched, eluding biological and linguistic classification and reduction. Francis Collins' statement that scientists need to apply a new adjective to the word gene every time they use it suggests that the gene both eludes definition and places a demand for adjectives to define it. Similarly, David Halperin suggests that the word queer does not have a single referent to which it necessarily refers. Putting these two statements into conversation with each other, I propose that a possible adjective for genes could be queer. Halperin's unassuming word and Johannsen's applicable little word combine to suggest irreducibly complex queer genes. These queer genes are not structural biological units; instead, the term 'queer genes' refers to the complex agential processes of genetics, both in their biological and social meaning. This formulation also draws attention to the strangeness and surprising nature of genetic process, something revealed by the Human Genome Project, and thus linking the social and scientific theories of sexuality and genetics.

These queer genes, creating interference patterns throughout the network, disallow simple biological determinism while never denying the material nature of bodies and sexuality. I want explicitly to associate the idea of a biological-social network with Elam's 'network of responsibility' discussed earlier to emphasise the necessarily political nature of these biological-social networks. To consider genes as actors in a biological-social network, producing diffraction patterns is not to deny

genes their material or a political 'nature'. On the contrary, in my account, the boundaries between the biological and the social are revealed to be not strict boundaries at all, and the deconstruction of the relations between actors in the network is not a deconstruction of politics; instead it establishes human and nonhuman agency as necessarily political. Interference patterns represent the unpredictable ways that calls to duty and responsibility can appear within biological-cultural networks. As this duty cannot be known in advance it is, like Elam's feminist obligation, an 'obligation that, in effect, comes from nowhere'. A queer approach to the science of sexual orientation is a similar obligation; it is an approach that proceeds along connections within biological-cultural networks, forming a groundless solidarity with the multiple and unpredictable biological and social actors within the network.

Conclusion

In the 1990s, feminism met deconstruction, and the field of lesbian and gay studies met the emerging field of queer theory. Both the developments in feminist postmodernism in the 1980s and the theories of deconstruction suggested the need for politics based not on essential identities, but in groundless solidarity within networks of meaning. Similarly, queer theory began to suggest that a queer politics could be formed not through a grounding in lesbian or gay identities, but in contingent solidarities strategically positioned in opposition to conservative normativities. I have outlined some of the problems involved in queer theory but suggested that, when aligned with feminist postmodernism and the groundless solidarity of feminism and deconstruction, queer can be a productive approach that can attempt a negotiation between the supposed opposition of relativism and realism.

In particular, my particular political deployment of queer theory offers a diffractive and deconstructive approach to an overarching trope in the seeming oppositions of realism and relativism, and scientific realism and social constructivism – that of representationalism. By emphasising that the biological is agential and performative, and always already entangled with the

social, human genetics can be interpreted as constituted performatively in both its scientific and social meanings. Genetic research is performed within certain structural conventions; its repetition and iterability is integral to its successful function as legitimate research. However, I have argued that quantum physics links productively with performativity, suggesting that the world is not full of objects with determinate properties, awaiting measurement, classification, or scientific intervention. Instead, I propose an extended diffractive approach that sees the world as full of human and nonhuman agency, in which the Human Genome Project and research into human genetics are specific interactions and arrangements of agency whose scientific legitimacy is inseparable from their social and political meanings and implications.

This performative account also converges with a deconstructive and queer account, in which the queer and non-normative character of the biological is preserved as constitutive and not awaiting the conscious intervention of a subject. This builds on the previous chapter, suggesting that the boundary breakdown between the subject and object of scientific inquiry can be productive – creating the possibility for radical alternative narratives and positions. The agency of the objects of scientific inquiry is an important consequence of this approach, and I propose that this does not necessarily lead to genetic determinism and conservative social theory and politics. On the contrary, my queer account of genetics seeks to attend to the queerness of genes – a queerness that is ongoing, and always deconstructively queering itself, producing patterns of interference in biological and social accounts that can be never fully known in advance. These insights will be developed further in the following chapter on more-than-human agency and kinship, as well the final chapter on health, biomedical knowledge and living well.

Chapter Three

Symbiosociality: Bacteria, Humans and More-than-Human Kinship

If humans are thought of as a composite of microbial and human cells, the human genetic landscape as an aggregate of the genes in the human genome and the microbiome, and human metabolic features as a blend of human and microbial traits, then the picture that emerges is one of a human 'supraorganism'

Peter J. Turnbaugh and others, 'The Human Microbiome Project'¹

In the first chapter I discussed Edward O. Wilson's 'extension' of biology and evolutionary theory to social organisation which he named sociobiology. Analysed in the terms of feminist engagements with science in the 1970s and 1980s I suggested that Wilson's sociobiology reified a distance between scientific subject and object, and thus precluded connections and new knowledges of the object – instead reinforcing the identity of the subject. As an alternative to this I explored Elaine Morgan's Aquatic Ape Hypothesis in the light of feminist standpoint and postmodernist epistemologies and Donna Haraway's situated knowledges. Crucial to this investigation was the idea of contingent and situated connections, for example between contemporary feminism and the female prehuman ape. Essential to this connection is the concept of agency, traditionally denied to everything but the scientific subject. In Morgan's narrative, the prehuman ape is allowed agency and the subject-object relation changes from one of distance and identity-reification to one of partial connection which allows for the production of situated knowledges.

¹ Peter J. Turnbaugh and others, 'The Human Microbiome Project', *Nature*, 449 (2007), 804–810 (p. 804).

In the second chapter, to continue the interrogation of the relation between the biological and social, and in particular the ideas of connections and agency, I discussed genetic determinism in the 1990s and its relation to developments in gender and sexuality studies and critical theory. In particular I situated attempts to find 'gay genes' alongside the development of queer theory and feminist engagements with deconstruction. I proposed a diffractive account of gay genes, or perhaps more appropriately, 'queer genes'; rather than thinking of homosexuality in terms of 'born' or 'made', I suggested a deconstructive approach to these oppositions. This approach privileges the agential character of genes, reconfiguring genes as queer performative actors in biological-social networks, in which the biological and the social are always already entangled. The idea of networks is important as it can be explicitly linked both to the agency of the human and nonhuman world (what I will go on to describe as the 'more-than-human' world) and to Diane Elam's feminist deconstructive insight that subjects are not sovereign and autonomous but are always already involved in networks of responsibilities to others.

In this chapter I will explore Donna Haraway's work on companion species as a way of rethinking the human, and the human's relationship with the nonhuman or 'more-than-human' world. In particular I will focus on relations between the human and the bacterial, considering whether Haraway's companion species framework is sufficient for thinking becoming-with the nonhuman, when the nonhuman is also non-animal. To conceptualise kinship relations and community formations across human-bacterial boundaries, I will explore Lynn Margulis's scientific work on symbiogenesis alongside some work on kinship from gender and sexuality studies that emphasises non-voluntary, performative and horizontal kinship, rather than heterobiological family models. Building on this, I will expand Paul Rabinow's concept of biosociality to take account of the emergent and always already entangled and entangling relationship between the biological and social. I will use insights from previous chapters on human connections with the nonhuman and the idea of networks of agency and responsibility to suggest a merger of symbiogenesis and biosociality to form *symbiosociality*. I will explore symbiosociality as a possible way of understanding the

relationship between the biological and the social and will explore how this formulation can develop queer kinship and rethink more-than-human relations and the emergence of multispecies becoming-with. Symbiosociality as a word and approach is a merger, combining elements of different theories and scientific practices to attempt to preserve the entangled nature of all life. I will be using symbiosociality to think human becoming-with bacteria and to raise questions about health and the relating to human and more-than-human others. This is important as living well, which I will discuss in more detail in the final chapter, is always a negotiation of multispecies relationships, particularly with bacteria and viruses.

Donna Haraway's Companion Species

Much of Donna Haraway's work on feminism and technoscience has interrogated the meanings of kinship and explored ways of expanding and rethinking kinship's boundaries. In 'A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s', Haraway suggests that the cyborg is a figure for 'crucial boundary breakdowns'.² It is through these boundary breakdowns – between humans and animals, between animals and machines, and between the physical and non-physical – that new kinship relations are formed. These relations, as Haraway states elsewhere, are not based on essential identities, but founded upon 'partial, locatable, critical knowledges sustaining the possibility of webs of connection called solidarity in politics and shared conversations in epistemology'.³ Haraway suggests that 'a cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints', and asks: 'What kind of politics could embrace partial, contradictory, permanently unclosed constructions of personal and collective selves and still be faithful, effective – and ironically, socialist-feminist?'⁴ Boundary

² Donna Haraway, 'A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s', *Signs*, 4 (1987), 1–42 (p. 4).

³ Donna Haraway, 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Simians, Cyborgs, and Women: The Reinvention of Nature* (London: Free Association Books, 1991), pp. 183–201 (p. 191).

⁴ Haraway, 'A Manifesto for Cyborgs', p. 8 and p. 11.

breakdowns create the possibility of the kinds of connection that Haraway speaks of. The cyborg offers Haraway a way of rethinking human and nonhuman connections and relationships as a web of partial connections between humans, animals and machines.

Haraway expands upon her model of cyborg kinship in *Modest_Witness@Second_Millennium.FemaleMan@_Meets_OncoMouseTM: Feminism and Technoscience*. Kinship (and the rethinking of kinship's possibilities) is a major focus in *Modest_Witness*. Haraway builds upon the possibility of connections between the human and nonhuman, and between the organic and inorganic, to draw parallels between transuranic elements on the periodic table and transgenic creatures or organisms. Haraway suggests that the periodic table 'stood for traditional family values in the culture of chemistry', and that the 'kinship relations of the elements are a natural-technical object of knowledge that semiotically and instrumentally puts terrans in their proper place'.⁵ Importantly, for Haraway, the periodic table suggests a 'natural limit' to the family of elements with uranium, the naturally occurring earthly element with the highest atomic number, 92. Simultaneously however, the periodic table allows for the inclusion of elements with higher atomic numbers, including plutonium, a transuranic element with an atomic number of 94.⁶ Haraway likens the transuranic elements to transgenic creatures or organisms, organisms that carry and transmit exogenous genes (genes from other organisms) to their offspring.

Like the transuranic elements, transgenic creatures, which carry genes from 'unrelated' organisms, simultaneously fit into well-established taxonomic and evolutionary discourses and also blast widely understood senses of natural limit. What was distant and unrelated becomes intimate.⁷

⁵ Donna Haraway, *Modest_Witness@Second_Millennium.FemaleMan@_Meets_OncoMouseTM: Feminism and Technoscience* (New York: Routledge, 1997), p. 54.

⁶ Haraway, *Modest_Witness*, p. 54.

⁷ Haraway, *Modest_Witness*, p. 56.

The idea of 'trans' in both these examples allows Haraway to think a kinship beyond the traditional boundaries of human-animal and organic-inorganic. *Modest_Witness* places an important emphasis on the necessary and non-voluntaristic nature of these kinship relations. As Haraway states: 'Like it or not, I was born kin to Pu²³⁹ and to transgenic, transspecific, and transported creatures of all kinds; that is the family for which and to whom my people are accountable.'⁸ For Haraway, kinship both suggests classification and ideas of 'natural' limits, whilst also offering the possibility of transgressing these limits and subverting classification.

In more recent work, Haraway has focused on relationships between humans and animals, stating: 'I have come to see cyborgs as junior siblings in the much bigger, queer family of companion species, in which reproductive biotechnopolitics are generally a surprise, sometimes even a nice surprise.'⁹ Haraway's queer family of companion species is introduced in *The Companion Species Manifesto* (2003), and elaborated in *When Species Meet*, published in 2008. Haraway explores the etymology of the terms involved in companion species to foreground some of the reasons for bringing these words together: '*Companion* comes from the Latin *cum panis*, "with bread". Messmates at table are companions'. Companion also suggests a military company, a guide or handbook, and as a verb, '*to companion* is "to consort, to keep company", with sexual and generative connotations always ready to erupt'.¹⁰ Haraway continues, stating that the word 'species' is 'equally promiscuous, but in the visual register rather than the gustatory':

The Latin *specere* is at the root of things here, with its tones of 'to look' and 'to behold'. In logic, *species* refers to a mental impression or idea, strengthening the notion that thinking and seeing are clones. Referring both to the relentlessly 'specific' or particular and to a class of individuals with the same characteristics, *species* contains its own opposite in the most

⁸ Haraway, *Modest_Witness*, p. 62.

⁹ Donna Haraway, *The Companion Species Manifesto: Dogs, People, and Significant Otherness* (Chicago: Prickly Paradigm Press, 2003), p. 11.

¹⁰ Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), p. 17.

promising – or special – way. Debates about whether species are earthly organic entities or taxonomic conveniences are coextensive with the discourse we call ‘biology’. Species is about the dance linking kin and kind.¹¹

In the joining of the terms ‘companion’ and ‘species’, Haraway links *specere* to *respecere*, the act of respect, arguing that:

To hold in regard, to respond, to look back reciprocally, to notice, to pay attention, to have courteous regard for, to esteem: all of that is tied to polite greeting, to constituting the polis, where and when species meet. To knot companion and species together in encounter, in regard and respect, is to enter the world of becoming with, where *who and what are* is precisely what is at stake [...] Species interdependence is the name of the worlding game on earth, and that game must be one of response and respect. That is the play of companion species learning to pay attention. Not much is excluded from the needed play, not technologies, commerce, organisms, landscapes, peoples, practices. I am not a posthumanist; I am who I become with companion species, who and which make a mess out of categories in the making of kin and kind. Queer messmates in mortal play, indeed.¹²

Haraway’s companion species approach suggests a set of kinship relations beyond the human: relations of regard and respect. Importantly for my project, these relations precede the individuals that relate, as each individual is who they become with their companion species. Haraway also argues that the multispecies becoming-with that makes up companion species relationships is a way of refusing human exceptionalism without invoking posthumanism.

¹¹ Haraway, *When Species Meet*, p. 17.

¹² Haraway, *When Species Meet*, p. 19.

Posthumanism and the Bacterial

The refusal of human exceptionalism is important to Haraway's companion species, and is essential to my formulation and articulation of symbiosociality in this chapter. Phil MacNaghten and John Urry define the 'doctrine of human exceptionalism' as encompassing the following beliefs:

that humans are fundamentally different from and superior to all species; that people can determine their own destinies, and learn whatever is necessary to achieve them; that the world is vast and presents unlimited opportunities [to humans]; and that the history of human society is one of unending progress.¹³

MacNaghten and Urry argue that human exceptionalism, and the implied juxtaposition of society and nature, 'reached its fullest development in the nineteenth century in the "West"', and state that:

Nature came to be degraded into a realm of unfreedom and hostility that needed to be subdued and controlled. Modernity involved the belief that human progress should be measured and evaluated in terms of the domination of nature, rather than through any attempt to transform the relationship between humans and nature.¹⁴

The doctrine of human exceptionalism, then, converges with what I described in Chapter One as an appropriationist approach to the relationship between human individuals and 'nature'. Nature, in this approach, becomes solely a passive resource to be appropriated by the only true agents: humans. This links to Haraway's feminist project, as she explicitly links the doctrine of human exceptionalism to androcentrism. She argues that,

Humanity is a modernist figure; and this humanity has a generic face, a universal shape. Humanity's face has been the face of man. Feminist humanity must have another shape, other gestures; but, I believe, we must have feminist figures of humanity [...] Feminist

¹³ Phil MacNaghten and John Urry, *Contested Natures* (London: Sage, 1998), p. 7.

¹⁴ MacNaghten and Urry, *Contested Natures*, p. 7.

humanity must, somehow, both resist representation, resist literal figuration, and still erupt in powerful new tropes, new figures of speech, new turns of historical possibility.¹⁵

Thinking beyond human exceptionalism (and specifically proposing feminist figures of humanity) is thus an important project for Haraway, and offers ways of thinking beyond androcentrism and patriarchy in science and society, as well as being an attempt at a transformation of the relationship between humans and 'nature'.

This is, for Haraway, also a process of 'other-worlding'. Haraway associates this idea of other-worlding with Beatriz Preciado's expressions: *autre-globalisation* and *autre-modialisation*, as well as Isabelle Stenger's cosmopolitics.¹⁶ For Haraway, companion species are always about worldly encounters; that is, the becoming-with of companion species relationships always emphasises the entanglement of the individual in worldly ecological biological-social networks. She argues that:

To knot companion and species together in encounter, in regard and respect, is to enter the world of becoming with, where *who and what are* is precisely what is at stake. [...] Species interdependence is the name of the worlding game on earth, and that game must be one of response and respect.¹⁷

For Haraway, species interdependence or entanglement is unavoidable; it is the name of the worlding game on earth. Not only this, but knotting companion and species together suggests possible *other-worldings*. My use of the term 'more-than-human' (often as an alternative to nonhuman that suggests a rather impenetrable barrier between human animals and 'nonhuman' animals) seeks to invoke this worldly becoming that is at the heart of companion species, and is

¹⁵ Donna Haraway, 'Ecce Homo, Ain't (Ar'n't) I a Woman, and Inappropriate/d Others: The Human in a Post-Humanist Landscape', *The Haraway Reader*, ed. by Donna Haraway (New York and London: Routledge, 2004), pp. 47–61 (p. 47). This article was originally presented in 1989 at meetings of the American Anthropological Association.

¹⁶ Haraway, *When Species Meet*, p. 3. See also Isabelle Stengers, *Cosmopolitics I*, trans. by Robert Bononno (Minneapolis: University of Minnesota Press, 2010).

¹⁷ Haraway, *When Species Meet*, p. 19.

never finished, but always open to difference, change, and *other-worlding*.¹⁸ This is especially important to my proposal that human health and flourishing – living well – is always entangled with worldly multispecies agencies.

At this point it is useful to explore Haraway's use of figures. Figuration, for Haraway, is an important rhetorical practice and is 'about resetting the stage for possible pasts and futures'.¹⁹ For Haraway, figuration represents a rhetorical strategy that offers radical possibilities of political change. Figures themselves are not immaterial but rather real and material entities that are also historically and culturally specific sites of meaning. As she argues:

Figures are not representations or didactic illustrations, but rather material-semiotic nodes or knots in which diverse bodies and meaning co-shape one another. For me, figures have always been where the biological and literary or artistic come together with all the force of lived reality. My body itself is just such a figure, literally.²⁰

Examples of figures in Haraway's work include the cyborg, gene, chip, bomb, foetus, and more recently companion species. These are not metaphors, but rather sites where the material and the semiotic, the biological and social, come together to produce bodies and meanings in a performative co-constitution. In this chapter, I am approaching the bacterial in a similar way. Bacteria do not function in my project as an immaterial metaphor; instead they are real material sites (or nodes, or knots) where the biological and social are co-constituted and produce and shape a diverse set of meanings and bodies, and contribute to transformations in more-than-human relationships.

¹⁸ Haraway adopts the phrase 'more-than-human' from Thom van Dooren's 'Seeding Property: Nature, Human/Plant Relations and the Production of Wealth' (unpublished thesis, Australian National University, 2007). Van Dooren's published work on the more-than-human world includes 'Terminated Seed: Death, Proprietary Kinship and the Production of (Bio)wealth', *Science as Culture*, 16:1 (2007); 'Inventing Seed: The Nature/s of Intellectual Property in Plants', *Environment and Planning D: Society and Space*, 26:4 (2008); and 'Genetic Conservation in a Climate of Loss: Thinking with Val Plumwood', *Ecological Humanities in the Australian Humanities Review*, 46 (2009).

¹⁹ Haraway, 'Ecce Homo', p. 47.

²⁰ Haraway, *When Species Meet*, p. 4.

There is a shift in Haraway's work between 'Ecce Homo' and her work on companion species. Whereas in previous work she uses posthumanism as a useful way of thinking through possible alternatives to the modernist figure of humanity, and suggesting figures of feminist humanity, in her work on companion species she deliberately tries to avoid using posthumanism. In fact, Haraway sees companion species as a refusal of both human exceptionalism *and* posthumanism. She argues that,

human/posthuman is much too easily appropriated by the blissed-out, 'Let's all be posthumanists and find our next teleological evolutionary stage in some kind of transhumanist techno-enhancement.' Posthumanism is too easily appropriated to those kinds of projects for my taste. Lots of people doing posthumanist thinking, though, don't do it that way. The reason I go to companion species is to get away from posthumanism.²¹

Haraway sees posthumanism as being too easily associated with and appropriated by transhumanism – with a humanist project informed by teleological narratives of evolution and the use of technology to enhance the human and thus supporting the idea of the sovereign stable human subject. Her approach is to move away from posthumanism to companion species, with the focus on the more-than-human and the responsibility that the human bears for its kinship in multispecies relationships and becomings.

A more equivocal approach to the issues involved in posthumanism and transhumanism can be found in the work of sociologist Richard Twine. Twine uses the tensions in the arguments and histories of different posthumanisms as a way to think about the ways in which 'nature' and 'the human' is conceptualised in genomics. In particular, he suggests that, 'The various constellations of posthumanist thought are invested in rethinking the "human" albeit in different ways.'²² Twine

²¹ Nicholas Gane, 'When We Have Never Been Human, What Is to Be Done? : Interview with Donna Haraway', *Theory, Culture and Society*, 23:7–8 (2006), 135–158 (p. 140).

²² Richard Twine, 'Genomic Natures Read Through Posthumanisms', *The Sociological Review*, 58 (2010), 175–195 (p. 175).

outlines humanism in similar terms to MacNaghten and Urry's articulation of human exceptionalism, describing critical posthumanism as a challenge to humanism's 'view of the "human" as the measure of all value, the axiomatic pinnacle of evolution, and the taken for granted mastery of other species'.²³ Although Twine associates transhumanism with this 'mastery of "nature" and celebration of the autonomous subject', he proceeds to outline his methodological approach as '*including* transhumanism, critical posthumanisms and also antihumanism as all residing within the posthuman, speaking to a plural and partially overlapping terrain of posthumanisms'.²⁴ Twine's image of a 'terrain' of the posthuman (resonating with Haraway's 'post-humanist landscape') is useful as it allows for an engagement with Haraway's companion species, without necessarily abandoning critical posthumanism. I would align my approach with Twine's, suggesting that the terrain of the posthuman can include critical posthumanism and companion species, without either being appropriated by a transhumanist project that simply reiterates the doctrine of human exceptionalism. Specifically I take a critical posthumanist approach, but one that explores the importance of the idea of 'species' as well as ideas of connection, kinship and companionship between the human and the more-than-human through the entanglement of the human and the bacterial.

It is important to refuse human exceptionalism in my project for a number of reasons. Certain scientific controversies such as climate change – coupled with the extinction of human and nonhuman populations due to human activities such as deforestation – provide a striking example of the role of the human in more-than-human environmental phenomena.²⁵ As well as environmental arguments, there is the question of how the nonhuman is used in science for human benefit. Thinking this question through thoroughly requires an ethics of the more-than-human, a politics

²³ Twine, 'Genomic Natures', p. 180.

²⁴ Twine, 'Genomic Natures', p. 176. For further detail on what constitutes *critical* posthumanism, see Neil Badmington, 'Theorizing Posthumanism', *Cultural Critique*, 53 (2003), 10–27.

²⁵ See Deborah Bird Rose, 'Love in the Time of Extinctions', *Australian Journal of Anthropology*, 19:1 (2008), 81–84.

beyond human exceptionalism. There is also a scientific argument to be made, that considering the human as the pinnacle of evolution obscures evolutionary science with unhelpful metaphors of progress. These metaphors of progress distort, as they locate the human in the more-than-human world, whilst simultaneously lifting the human above the nonhuman. This is particularly evident in work on non-animal life, as is my focus in this chapter. Bacteria have functioned as a model organism in science since the early twentieth century. Different bacteria (most significantly, *E. coli*) have been put to use in an attempt to solve human problems including those relating to health and disease. The bacterial ability to swap genes, along with *E. coli*'s long history being cultured in the lab and the ease with which it can be manipulated, has made it a model organism for the study of genetics. *E. coli* was integral in the work in the 1930s on recombinant DNA that became the foundation of modern biotechnology.²⁶

Currently, bacteria are used in the laboratory in the hopes of finding bacterial answers to very human problems.²⁷ Bacteria are regularly used in experimental science where it would be considered unethical to use human subjects. This both suggests the proximity of bacteria and humans (otherwise *E. coli*'s role as model organism would be redundant) as well as drawing a clear ethical distinction between the two.²⁸ This both acknowledges and attempts to ignore the bacterial ancestry of human bodies (a point that is key to my thesis, and to which I will return later in the chapter). This is also illustrated in the fact that bacteria generally fall outside animal rights discourse (as, taxonomically, bacteria are not animals), the academic discourse of animal studies and philosophical questions of human-animal relations. The importance of bacteria to biological sciences (in particular biochemistry, biotechnology and bioengineering) as well as the bacterial ancestry of

²⁶ Eugene Russo, 'The Birth of Biotechnology', *Nature*, 421 (2003), 456–457.

²⁷ These include: producing human hormones such as insulin and a range of other pharmaceuticals, fuel, plastics, amino acids, and food; being used in bioremediation of polluted environments, water purification, and pest control; and being used as a model organism for the study of human evolution and disease.

²⁸ For an exploration of the epistemological function of model organisms and some of the issues involved in this, see Rachel A. Ankeny, 'Wormy Logic: Model Organisms as Case-Based Reasoning', *Working Papers on The Nature of Evidence: How Well Do 'Facts' Travel?* (2006) <<http://eprints.lse.ac.uk/22541/1/0706Ankeny.pdf>> [accessed 28 February 2012].

human physiology and the importance of bacterial processes (such as production of ATP by mitochondria and the production of enzymes in the gut for the digestion of food to be discussed in more detail later in the chapter) for human life call for a rethinking of human-bacterial boundaries in biology, philosophy and discourses of the animal. This rethinking of human-bacterial boundaries also offers possible rewards in the area of health care and medicine. An example of this approach in scientific practice is the Human Microbiome Project. Described as the 'logical conceptual and experimental extension of the Human Genome Project', the Human Microbiome Project proposes that the human body be thought of as a 'supra-organism' (a collection of organisms that function as an organic whole, such as an ant colony).²⁹ Peter J. Turnbaugh and others suggest that applying this approach to genomic science demands the sequencing of the genetic material from all the organisms that make up the human body, referred to as the microbiome. Specifically, they claim that the Human Microbiome Project can have positive effects on personal medicine (in particular for the treatment of malnourishment, obesity, autoimmune disorders, and some cancers) as well as providing answers to 'some of the most inspiring, vexing and fundamental scientific questions today'.³⁰ It is, of course, important not to frame the bacterial as passive resource or non-agential object for the improvement of the human subject. (Bacteria clearly demonstrate their agency in relation to health practices in the example of bacteria's – including in particular human gut microbiota – increasing resistance to antibiotic medicine.)³¹ Rather, I propose an approach that recognises bacteria as agential and which emphasises the symbiotic (and what I will come to call 'symbiosocial') entanglement of all life, but in particular the co-constitution of the human and the bacterial.

²⁹ Turnbaugh and others, 'The Human Microbiome Project', p. 804.

³⁰ Turnbaugh and others, 'The Human Microbiome Project', p. 805, p. 804.

³¹ See Abigail A. Salyers, Anamika Gupta and Yanping Wang, 'Human Intestinal Bacteria as Reservoirs for Antibiotic Resistance Genes', *Trends in Microbiology*, 12:9 (2004), 412–416.

Symbiogenesis

Haraway's 'world of becoming with' through species interdependence suggests that the human is necessarily involved in more-than-human networks of regard, respect and responsibility. As anthropologist Anna Tsing argues: 'Human nature is an interspecies relationship'.³² Haraway suggests that becoming with the more-than-human converges with the scientific theories of Lynn Margulis, who has written extensively on symbiosis in evolution. Haraway focuses on 'one kind of transformative merger practice' in theories of symbiogenesis: failed digestion.³³

Trying to make a living, critters eat critters but can only partly digest one another. Quite a lot of indigestion, not to mention excretion, is the natural result, some of which is the vehicle for new sorts of complex patternings of ones and manys in entangled association.³⁴

Failed digestion is just one kind of transformative merger practice; Haraway states that 'critters form consortia in a baroque medley of inter- and intra-actions'.³⁵ Haraway employs Karen Barad's term 'intra-action' here to stress the performative and entangled nature of these symbiotic relationships and the identities that emerge. Haraway states:

Yoking together all the way down is what sym-bio-genesis means [...] It is turtles all the way down; the partners do not pre-exist their constitutive intra-action at every folded layer of time and space. These are the contagions and infections that wound the primary narcissism

³² Anna Tsing, 'Unruly Edges: Mushrooms as Companion Species', *Party Writing for Donna Haraway!* (2010) <<http://tsingmushrooms.blogspot.com/>> [accessed 30 November 2011] (para 9 of 35).

³³ Haraway, *When Species Meet*, p. 31.

³⁴ Haraway, *When Species Meet*, p. 31.

³⁵ Haraway, *When Species Meet*, p. 31. Haraway explains her use of the term critter: 'I use the idiomatic term *critter* to mean a motley crowd of lively beings including microbes, fungi, humans, plants, animals, cyborgs and aliens. Critters are always relationally entangled rather than taxonomically neat' (*When Species Meet*, p. 330 n. 33). See also Jeffrey J. Williams, 'Donna Haraway's Critters', *The Chronicle Review*, 18 October 2009 <<http://chronicle.com/article/A-Theory-of-Critters-/48802/>> [accessed 12 December 2011].

of those who still dream of human exceptionalism. These are also the cobblings together that give meaning to the 'becoming with' of companion species in naturecultures.³⁶

Margulis's work, first on the endosymbiotic theory of cell evolution and then on symbiogenesis as the main mechanism by which evolutionary novelty is created, is important for considering Haraway's companion species, and for thinking human-bacterial relations as a performative becoming-with the more-than-human.

Although previous scholars had suggested endosymbiotic theories as early as 1905, Margulis formalised and substantiated this theory in her 1967 article, 'On the Origin of Mitosing Cells'.³⁷ In this article, Margulis suggests that eukaryotic cells (cells with a membrane-bound nucleus) originated through the merger of previously free-living prokaryotic cells (cells lacking a nucleus). In particular, she hypothesises in the article that mitochondria, the basal bodies (organelles that form the bases of the flagella), and the photosynthetic plastids (such as chloroplasts in plants) can all be 'considered to have derived from free-living cells, and the eukaryotic cell is the result of the evolution of ancient symbioses'.³⁸ Margulis suggests that mitochondria – organelles within the eukaryotic cell that have distinct DNA and are involved in the production of adenosine triphosphate (ATP), a source of chemical energy – were once non-nucleated prokaryotes that survived absorption by another cell. The surviving prokaryote's (now defined as an endosymbiont, a symbiotic organism

³⁶ Haraway, *When Species Meet*, pp. 31–32. The phrase 'turtles all the way down' refers to the problem of infinite regress. The 'turtles all the way down' story was popularised in Stephen Hawking's *A Brief History of Time: From the Big Bang to Black Holes* (London: Bantam, 1988) in which he wrote: 'A well-known scientist (some say it was Bertrand Russell) once gave a public lecture on astronomy. He described how the earth orbits around the sun and how the sun, in turn, orbits around the center of a vast collection of stars called our galaxy. At the end of the lecture, a little old lady at the back of the room got up and said: "What you have told us is rubbish. The world is really a flat plate supported on the back of a giant tortoise." The scientist gave a superior smile before replying, "What is the tortoise standing on?" "You're very clever, young man, very clever," said the old lady. "But it's turtles all the way down!"' (p. 1). For an investigation of infinite regress in epistemology, see Yair Neuman, 'Turtles All the Way Down: Outlines for a Dynamic Theory of Epistemology', *Systems Research and Behavioral Science*, 20:6 (2002), 521–30. Neuman suggests that the most basic unit of epistemology is always a process of self-referential differentiation. Haraway argues that the weakness of Neuman's argument is the reliance on self-referentiality: 'The self-referential part is the trouble. I want an idiom for both—and: "self-other referential" all the way down.' (*When Species Meet*, pp. 315–16 n. 41).

³⁷ Lynn Margulis [published as Lynn Sagan], 'On the Origin of Mitosing Cells', *Journal of Theoretical Biology*, 14:3 (1967), 255–274.

³⁸ Margulis, 'On the Origin of Mitosing Cells', p. 226.

living within a host) ability to provide energy through respiration provided the host cell with an evolutionary advantage. Similarly, chloroplasts – organelles that convert carbon dioxide into organic compounds including sugars using energy from sunlight – are thought to have once been photosynthesising prokaryotes that survived absorption. Like the mitochondria, chloroplasts offered their host cells an evolutionary advantage through the production of energy. Margulis suggests that this originary absorption and symbiosis happened somewhere between 2.7 and 1.2 billion years ago, due to geological evidence that poisonous oxygen began to flourish in the atmosphere during this time.³⁹ Although not accepted at the time they were published, Margulis's theories on the origins of mitochondria and chloroplasts have since become widely accepted.⁴⁰ It is important to understand Margulis's original proposal as it structures all her following scientific work, as well as Haraway's work on companion species. It also demonstrates the bacterial ancestry of parts of the human cell which is an essential part of my argument in this chapter.

Margulis has subsequently developed this theory and published widely on endosymbiosis, and her theory of symbiogenesis.⁴¹ Symbiosis refers to long-term stable physical and behavioural association of different types of organisms. Symbiogenesis refers to a long-term stable symbiosis

³⁹ Margulis, 'On the Origin of Mitosing Cells', p. 226.

⁴⁰ Other scientists have recognised Margulis's refusal to give up on her endosymbiotic theory against the prevailing paradigm science of the time. Richard Dawkins stated: 'I greatly admire Lynn Margulis's sheer courage and stamina in sticking by the endosymbiosis theory, and carrying it through from being an unorthodoxy to an orthodoxy. I'm referring to the theory that the eukaryotic cell is a symbiotic union of primitive prokaryotic cells. This is one of the great achievements of twentieth-century evolutionary biology, and I greatly admire her for it.' (Quoted in Margulis, 'Gaia is a Tough Bitch', *The Third Culture: Beyond the Scientific Revolution* [New York: Simon and Schuster, 1995], pp. 129–146 [p. 129]).

⁴¹ Margulis expanded her 'On the Origin of Mitosing Cells' article into a book: *The Origin of Eukaryotic Cells* (New Haven: Yale University Press, 1970). *The Origin of Eukaryotic Cells* was subsequently expanded and republished as *Symbiosis in Cell Evolution: Life and its Environment on the Early Earth*, currently in its second edition (San Francisco: W.H. Freeman, 1981). Margulis describes this book as her 'life's work' (Margulis, 'Gaia is a Tough Bitch', p. 136). For further articulation of Margulis's symbiogenesis theory, see Margulis, 'Big Trouble in Biology: Physiological Autopoiesis versus Mechanistic neo-Darwinism', in *Slanted Truths: Essays on Gaia, Symbiosis, and Evolution*, eds. Lynn Margulis and Dorion Sagan (New York: Springer-Verlag, 1997); Lynn Margulis, *Symbiotic Planet: A New Look at Evolution* (Amherst, MA: Perseus, 1998); Lynn Margulis and Rene Fester, *Symbiosis as a Source of Evolutionary Innovation: Speciation and Morphogenesis* (Cambridge, MA: MIT Press, 1991); Lynn Margulis and Dorion Sagan, *Acquiring Genomes: A Theory of the Origins of Species* (New York: Basic, 2002); and Lynn Margulis and Karlene Schwartz, *Five Kingdoms: An Illustrated Guide to the Phyla of Life on Earth*, 3rd edn (New York: W.H. Freeman, 1998).

that leads to evolutionary change.⁴² Symbiogenesis theory emphasises the creative force of symbiosis. Free-living organisms are usually considered the object of natural selection; however, if two individuals form a close enough symbiotic relationship the association of organisms – or assemblage – can become the target of selection. For example, certain animals have acquired photosynthetic symbionts, just as did the eukaryotes that became plants.⁴³ Examples include the green sea slug *Elysia viridis*, whose ancestors failed to digest certain green algae which now permanently reside in the slug's tissue. Adult green sea slugs do not gain their energy from digestion, but rather from sunlight, in much the same way as plants do. As Margulis states: 'Green animals provide graphic examples of symbioses that lead to symbiogenesis.'⁴⁴ Margulis argues that symbiosis is actually the primary mechanism of evolutionary novelty and speciation, rather than the gradual accrual of genetic mutation and variation. Margulis and Sagan describe their approach as 'Darwinism not neodarwinism'.⁴⁵ Margulis and Sagan argue that 'random mutation, a small part of the evolutionary saga, has been dogmatically overemphasised' in paradigmatic neo-Darwinism.⁴⁶ Symbiogenesis is not anti-Darwinian; on the contrary, 'symbiogenetic acquisition of new traits by inheritance of acquired genomes is rather an extension, a refinement, an amplification of Darwin's idea'.⁴⁷ The ancestors of *Elysia viridis* failed to digest green algae which provided the slug with an evolutionary advantage – the ability to gain energy directly from sunlight. The strong and stable symbiotic merger of slug and algae became the target of selection, or – for the purposes of natural selection – the individual. Slugs with the evolutionary advantage were selected for and produced more offspring, whereas those without did not. Margulis argues that this example of symbiogenesis

⁴² Margulis and Sagan, *Acquiring Genomes*, p. 12.

⁴³ Margulis and Schwartz, *Five Kingdoms*, p. 207. The word 'assemblage' has Deleuzian connotations that I will not be exploring in this chapter. For assemblages in Deleuze's theory, see Gilles Deleuze and Felix Guattari's *A Thousand Plateaus*, trans. Brian Massumi (London: Continuum, 2004 [1984]). *A Thousand Plateaus* also includes Deleuze and Guattari's engagement with the animal. For Haraway's critique of Deleuze and Guattari's argument see *When Species Meet*, pp. 27–30. In my use of the term 'assemblage', I am following Margulis's use, as well as biologists Ruth E. Ley and others, whose work on gut microbiota I will be discussing later in the chapter.

⁴⁴ Margulis and Sagan, *Acquiring Genomes*, p. 13.

⁴⁵ Margulis and Sagan, *Acquiring Genomes*, pp. 3–33.

⁴⁶ Margulis and Sagan, *Acquiring Genomes*, p. 15.

⁴⁷ Margulis and Sagan, *Acquiring Genomes*, p. 15.

is not an anomaly, but rather illustrates the fact that symbiosis is the major force of novelty and speciation in evolution. Importantly, this approach emphasises the role of natural selection, but deemphasises random variation and mutation – Darwinism, but not neo-Darwinism.

It is important to note that Margulis's theory of symbiogenesis does not simply suggest that metaphors of competition should be replaced with cooperation. For Margulis, these are both imperfect metaphors that do not successfully represent the complexity of biological and evolutionary processes. Social analyses that favour symbiotic cooperation over neo-Darwinian competition include Peter Kropotkin's *Mutual Aid: A Factor of Evolution*.⁴⁸ Published in 1902, *Mutual Aid* was part of a tradition of Russian evolutionary thought that emphasised symbiosis and cooperation over competition and struggle.⁴⁹ Written in response to the social Darwinism of the late nineteenth century, Kropotkin argues that competition is overemphasised in evolutionary and social accounts and cooperation (or mutual aid) is the most important factor in the evolution and development of species and society. In contrast, Margulis argues that competition and cooperation are both insufficient terms:

The time has come in serious biology to abandon words like competition, cooperation, and selfish genes and replace them with meaningful terms such as metabolic modes (chemoautotrophy, photosynthesis), ecological relations (epibiont, pollinator), and measurable quantities (light, heat, mechanical force). So many current evolutionary metaphors are superficial dichotomizations that come from false clarities of language. They do not beget but preclude scientific understanding.⁵⁰

⁴⁸ Peter Kropotkin, *Mutual Aid: A Factor of Evolution* (London: William Heinemann, 1904 [1902]).

⁴⁹ For an example of Russian work on symbiosis and evolution see Boris Mikhaylov Kozo-Polyansky, *Symbiogenesis*, trans. by Victor Fet, ed. by Victor Fet and Lynn Margulis, and introduced by Peter H. Raven (Cambridge, MA: Harvard University Press, 2010). This book translates Kozo-Polyansky's 1924 work, as well as providing commentary on which parts of his work can be translated into modern scientific terms, and which statements do not hold up alongside contemporary science.

⁵⁰ Margulis and Sagan, *Acquiring Genomes*, pp. 16–17.

For Margulis, symbiosis is not about cooperation rather than competition, as both of these terms are too closely linked to economic metaphors of cost and benefit: 'Symbiosis has nothing to do with cost or benefit. The benefit/cost people have perverted the science with invidious economic analogies.'⁵¹ Metaphors of competition and cooperation are both abstractions and do not aid scientific understanding, but rather obscure the biological complexity of evolutionary processes. I would link this to my discussion of scarcity and competition for resources and their relation to patriarchy in Chapter One.

Species Problems

One of Margulis's main arguments with neo-Darwinism is its focus on organisms 'big like us', in particular animals – a phenomenon she names 'zoocentrism'.⁵² Margulis and Sagan define the features of zoocentrism thus:

Preoccupation with animals, including humans, as if animals were the main organisms in existence, and/or the only ones worthy of study. Great disregard for members of the other four kingdoms of life, dismissal of them as 'lower' forms, ignores the major impact that these four kingdoms have upon members of the animal kingdom and Earth's ecosystems.⁵³

In *Five Kingdoms: An Illustrated Guide to the Phyla of Life on Earth*, Margulis and Schwartz describe the history of the classification of life on earth, stating that from Aristotelian classifications to the middle of the twentieth century, life was generally divided into two kingdoms: plant and animal.⁵⁴ Scientific developments, particularly in electron-microscopy and biochemistry, led to a proposal of a

⁵¹ Margulis, 'Gaia is a Tough Bitch', p. 135

⁵² For an elaboration of the 'big like us' approach, see Myra J. Hird, *The Origins of Sociable Life: Evolution after Science Studies* (New York: Palgrave Macmillan, 2009), pp. 21–26. I find the phrase 'big like us' useful as it illustrates the anthropocentrism that is inherent in zoocentrism.

⁵³ Margulis and Sagan, *Acquiring Genomes*, p. 217.

⁵⁴ Margulis and Schwartz, *Five Kingdoms*, p. 6.

five-kingdom classificatory system by Robert Whittaker in 1959. Margulis uses this system of five kingdoms throughout her work:

Briefly, our five kingdoms are Bacteria (with its two subkingdoms, Archae and Eubacteria), Protoctista (algae, protozoa, slime molds, and other less-known aquatic and parasitic organisms), Animalia (animals with or without backbones), Fungi (mushrooms, molds and yeasts), and Plantae (mosses, ferns, and other spore- and seed-bearing plants).⁵⁵

Alternatives to the five-kingdom system include Carl Woese's system of three domains: 'two domains (Archaea and Bacteria) consisting of prokaryotic cells and one domain (Eukarya) containing all other organisms'.⁵⁶ Margulis favours the five kingdom system as it emphasises the importance of symbiogenesis 'as the major source of innovation in the evolution of eukaryotes'.⁵⁷ Also, Margulis argues that the three-domain system is based solely on molecular sequencing, whereas each kingdom in the five-kingdom system can be 'uniquely defined by using all features of the whole organism – molecular, morphological and developmental'.⁵⁸ The five-kingdom system offers Margulis a scheme that recognises the importance of symbiogenesis, as well as one that attempts to avoid the reductionism that occurs in classificatory systems that focus solely on the molecular and ignore morphological and developmental traits. It is not my intention to comment on the scientific legitimacy of this or any other form of taxonomic classification; rather, I include it here to draw attention to the intellectual and practical labour that goes into making the agential cuts that produce taxonomy.

Scientists use a system of binomial nomenclature at the level of species, a practice that was established by Carl Linnaeus in the eighteenth century. (Species are grouped into genera, genera into families, families into orders, orders into classes, classes into phyla, phyla into kingdoms.) The

⁵⁵ Margulis and Schwartz, *Five Kingdoms*, p. 7.

⁵⁶ Margulis and Schwartz, *Five Kingdoms*, p. 7.

⁵⁷ Margulis and Schwartz, *Five Kingdoms*, p. 9.

⁵⁸ Margulis and Schwartz, *Five Kingdoms*, p. 9.

first part of the name represents the genus, and the second refers to the species within the genus. Margulis and Schwartz give the example of three species of the *Acer* genus, the maple tree: *Acer saccharum*, the sugar maple; *Acer nigrum*, the black maple; and *Acer rubrum*, the red maple.⁵⁹ In 1942, biologist Ernst Mayr wrote that ‘species are groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups’.⁶⁰ This is generally known as the Biological Species Concept, which defines species as groups of organisms that can reproduce with each other and are unable to reproduce with organisms of other populations. There are many other species concepts, but the Biological Species Concept is generally the concept used by zoologists, and is useful for botanists as well.⁶¹ However, this species concept is limited when applied to the kingdoms Animalia, Fungi and Protocista, as it favours organisms that reproduce through sexual reproduction (the terms ‘sex’ and ‘reproduction’ will be considered in more detail later). W. Ford Doolittle and R. Thane Papke suggest that ‘the exercise of formulating a useful “species definition” and the quest for an underlying “species concept” are not the exactly same [*sic*]’.⁶² Speaking of bacterial species problems, Doolittle and Papke argue that a species definition must provide a ‘set of easily applied and stable rules by which to decide when two organisms are similar enough in their genomic and/or phenotypic properties to be given the same name’, whereas a species concept should provide ‘a genetic and/or ecological model of bacterial diversification and adaptation’.⁶³ They argue that, ideally, the species concept ‘would make sense of our definition, justifying the choice of one particular set of rules for defining species as less arbitrary, or more natural, than another’.⁶⁴ A unifying species concept would be one that would fit with species definition, and reveal a ‘natural’ and ‘objective’ definition of species. As Doolittle and Papke state,

⁵⁹ Margulis and Schwartz, *Five Kingdoms*, p. 3.

⁶⁰ Ernst Mayr, *Systematics and the Origin of Species* (New York: Columbia University Press, 1942), p. 120.

⁶¹ Margulis and Sagan, *Acquiring Genomes*, pp. 4–5.

⁶² W. Ford Doolittle and R. Thane Papke, ‘Genomics and the Bacterial Species Problem’, *Genome Biology*, 7:9 (2006), 116.

⁶³ Doolittle and Papke, ‘Genomics and the Bacterial Species Problem’, p. 116.

⁶⁴ Doolittle and Papke, ‘Genomics and the Bacterial Species Problem’, p. 116.

however: ‘The more we learn about genomes, however, the more unlikely it seems that any unifying species concept will be possible.’⁶⁵

Margulis and Sagan argue for a symbiogenetic species concept, based on a traditional morphological model. Importantly, this model is based on how an organism *looks*. As noted by Haraway earlier: ‘The Latin *specere* is at the root of things here, with its tones of “to look” and “to behold”.’⁶⁶ The morphological species concept assumes that organisms can be meaningfully grouped into species based on observable morphological similarities. Margulis and Sagan argue that the ‘morphological species [...] is the external manifestation of the symbiogenetic species’.⁶⁷ Margulis and Sagan elaborate their symbiogenetic species definition as follows:

We suggest that if organism A belongs to the same species as organism B, then both are composed of the same set of integrated genomes, both qualitatively and quantitatively. All organisms that can be assigned to a unique species are products of symbiogenesis. That is, because A and B share the same number of the same different kinds of integrated genomes that are assigned to the same species.⁶⁸

Margulis and Sagan argue that the Biological Species Concept should be renamed the ‘zoological-botanical concept of species’, as it only applies to those animals and plants that reproduce sexually.⁶⁹ Bacteria prompt Doolittle and Papke to suggest the necessity of redefining species concepts, while they prompt Margulis and Sagan to suggest that they simply do not have species, and that the traditional morphological model is adequate. Crucially, the species problems discussed in this section illustrate the taxonomic difficulties posed by bacteria. If companion species frameworks are to work with human-bacterial entanglements, as is my proposal in this chapter, then they must inherit this difficulty, and not offer a simplistic view of the work of the term ‘species’. This

⁶⁵ Doolittle and Papke, ‘Genomics and the Bacterial Species Problem’, p. 116.

⁶⁶ Haraway, *When Species Meet*, p. 17.

⁶⁷ Margulis and Sagan, *Acquiring Genomes*, p. 6.

⁶⁸ Margulis and Sagan, *Acquiring Genomes*, p. 6.

⁶⁹ Margulis and Sagan, *Acquiring Genomes*, p. 7.

also goes some way to support Haraway's claim in *Modest_Witness* that kinship relations can both support and breach ideas of 'natural' limits. Bacteria draw attention to the problems inherent to taxonomic classificatory practices. They both emphasise and problematise the theory and practice of boundary-making in biological science.

Horizontal Gene Transfer

Another way that bacteria complicate species boundaries is through the phenomenon of horizontal gene transfer. Horizontal (or lateral) gene transfer is the process whereby organisms obtain genetic material, or even whole genomes, through horizontal rather than vertical inheritance. That is, an organism gains genetic material from another organism, rather than from an ancestor. At this point, it is important to be clear about some of Margulis and Sagan's terms – in particular the difference between sex and reproduction. In *Origins of Sex*, Margulis and Sagan define sex as follows:

By sex we mean a process characteristic of live organisms only: the complex set of phenomena that produces a genetically new individual, an individual that contains genes (genetic material, DNA) from more than one single source [...] It is crucial to understand that sex as the production of genetically new beings from different parents has nothing necessarily to do with reproduction, often an entirely different process.⁷⁰

They define reproduction and explain the crucial difference between this process and sex:

Reproduction is an increase in the number of individuals. Whereas sex means the mixing of genetic sources, *reproduction* means copying resulting in the creation of additional live beings. Beings can be both new in the sexual sense and additional in the reproductive sense,

⁷⁰ Lynn Margulis and Dorion Sagan, *Origins of Sex: Three Billion Years of Genetic Recombination* (New Haven: Yale University Press, 1986), p. 9.

in which case they are members of a sexually reproducing species. But this need not be the case.⁷¹

Margulis and Sagan argue that the focus on sexual reproduction and the assumption that sex and reproduction are necessarily linked is zoocentric. This is crucial for my argument in this chapter, linking scientific classification with social theories of gender and sexuality. As Margulis and Sagan emphasise: 'Most organisms in the world in fact reproduce asexually, whether they sexually recombine or not.'⁷² Furthermore, sexual reproduction is relatively recent, in evolutionary terms, starting only 300 million years ago.⁷³ Sex is not necessarily reproduction: the phenomenon of horizontal gene transfer results in mixed genetic material, but no increase in the number of organisms. Reproduction can also occur without a mixing of genetic material, for instance the reproduction of a new organism from one asexual member of the genus *Amoebae*.⁷⁴

Horizontal gene transfer and bacterial sex problematises bacterial species distinctions, as there is seemingly no reproductive isolation among different species of bacteria. Bacterial species groups can be suggested based on common features, but these groupings are contingent and constantly changing due to the transfer and swapping of genes. As Margulis and Sagan state:

Bacteria pass genes back and forth. All can simply reproduce, and thus at any given time have but a single parent. The intervention of sex, the formation of a new bacterium with genes from more than a single source is a unidirectional affair. The genes pass from a donor

⁷¹ Margulis and Sagan, *Origins of Sex*, p. 9.

⁷² Margulis and Sagan, *Origins of Sex*, p. 9.

⁷³ J. L. Mackay, 'Why Have Sex?', *British Medical Journal*, 322:7286 (2001), 623. Margulis and Sagan describe the familiar mammalian form of sexual reproduction as 'a very late and special variation on a far more general theme' (Margulis and Sagan, *Origins of Sex*, p. 2). Sexual reproduction poses a very specific problem to evolutionary biologists. In an article in *BioScience*, Julie Schecter asks: 'Sex is ubiquitous... Yet sex remains a mystery to researchers, to say nothing of the rest of the population. Why sex? At first blush, its disadvantages seem to outweigh its benefits. After all, a parent that reproduces sexually gives only one-half its genes to its offspring, whereas an organism that reproduces by dividing passes on all its genes. Sex also takes much longer and requires more energy than simple division. Why did a process so blatantly unprofitable to its earliest practitioners become so widespread?' ('How Did Sex Come About?', *BioScience*, 34 (1984), 680). It is worth noting that from a symbiogenetic point of view, rather than a zoocentric one, sex is hardly ubiquitous, and sexual reproduction (which is what Schecter means by 'sex' in this article) is certainly not.

⁷⁴ Margulis and Sagan, *Origins of Sex*, p. 10.

individual to a recipient ... but donors can change to recipients and vice versa in minutes. Furthermore the gene swapping is entirely optional. If a bacterium can survive and grow under conditions in which it finds itself, sex is dispensable at all times. Indeed bacteria are willing and able to 'have sex' with naked DNA molecules that they absorb from the water in which they are bathed.⁷⁵

Bacterial features are contingent, and depend upon a history of opportunistic gene-swapping in response to environmental pressures. As noted above, Doolittle and Papke attempt to alter the criteria by which bacterial species are defined, in order to make the taxonomic concept of species fit with the biological reality of the microbiological. Margulis and Sagan take a different approach, arguing after Sorin Sonea and Léo G. Matthieu that 'bacteria do not have species at all (or, which amounts to the same thing, all of them together constitute one single cosmopolitan species)'.⁷⁶ This view fits with Margulis's theory of symbiogenesis:

Since no bacterium (whether eubacterium or archaebacterium) evolved from symbiotic integration of formerly independent cells, bacteria lack species; the process of speciation began with the earliest eukaryotes (the first protists, or organisms with nuclei).⁷⁷

The behaviour and contingent morphological features of bacteria problematises species boundaries. Among the findings of the microbiological sciences, the widespread practice of horizontal gene transfer – the sharing of genetic material among bacteria in close proximity – further problematises the attempt to designate fixed bacterial species boundaries.

Horizontal gene transfer, and what Margulis and Sagan call the 'prokaryotic brand of sex', are essential to the symbiogenetic theory of the origin of life and the evolution of species.⁷⁸ Margulis

⁷⁵ Margulis and Sagan, *Acquiring Genomes*, p. 55.

⁷⁶ Margulis and Sagan, *Acquiring Genomes*, p. 55. See Sorin Sonea and Léo G. Mathieu, *Prokaryotology: A Coherent View* (Montreal: University of Montreal Press, 2000).

⁷⁷ Margulis and Sagan, *Acquiring Genomes*, p. 6.

⁷⁸ Lynn Margulis and Dorion Sagan, *Microcosmos: Four Billion Years of Microbial Evolution* (California: University of California Press, 1997 [1986]), p. 85.

and Sagan argue that ‘bacteria-style sex’ was important in the Archean Eon to respond to environmental changes and emergencies, and essential in the evolution of nucleated cells, ‘as a way of genetically “locking” together symbiotic mergers between very different organisms’.⁷⁹ This locking together of symbiotic mergers problematises any attempt to create a universal ‘tree of life’. (I will return to the practices of constructing phylogenies, or trees of life, in the following chapter.) For now, it is important to stress that sex and reproduction are not necessarily linked and not all genetic inheritance is vertical. The over-emphasis on sexual reproduction is a zoocentric view of the many and complex ways that organisms have historically transformed and gained new genetic material, and how this process continues today. It is also important to note that in this chapter I will be referring to bacterial species, while keeping in mind the difficulties that bacteria pose to the process of taxonomic classification. I am using bacterial species (rather than ‘strains’ for example) to emphasise the contingent nature of all taxonomic practice, and to inherit what could be called ‘species trouble’ into my symbiosocial account of more-than-human kinship and multispecies becoming-with. As Haraway argues, ‘Species is about the dance linking kin and kind.’⁸⁰ Bacterial species illustrate the entanglement and negotiation – or dance – linking more-than-human kinship and the classification practices that define biological kinds.

The Human Body as an Ecosystem

The ability of bacteria to share genetic material is particularly evident in the genetic make-up of the bacteria that permanently live inside the human alimentary tract, or gut. These gut bacteria (or ‘human gut microbiota’) supply the human body with energy from food through the production of carbohydrate active enzymes, or CAZymes. Specifically, gut bacteria produce enzymes absent from the human genome, which allow humans to gain energy from polysaccharides in terrestrial

⁷⁹ Margulis and Sagan, *Microcosmos*, p. 85

⁸⁰ Haraway, *When Species Meet*, p. 17.

plants.⁸¹ As Ruth E. Ley and others emphasise, these plants have dominated diet throughout human evolution. Ley and other's research demonstrates the symbiotic relationship between human and bacteria, through a comparison of 'the bacterial assemblages that are associated with humans and other mammals, metazoa and free-living microbial communities that span a range of environments'.⁸² Importantly, this research emphasises the consequences this symbiotic relationship has had on bacterial, as well as human evolution. They state that their 'analyses indicate that gut-associated microbiotas are profoundly different from other free-living microbiotas from across the biosphere'.⁸³ The symbiotic co-evolution of human and gut bacteria has shaped the morphology and behaviour of both humans and gut bacteria. Neither is viable without the other; human gut microbiota have evolved to live in the specific environment of the human gut, while humans have evolved to depend upon food that could not be fully digested without this specific internal symbiotic community.

The community of human gut microbiota is also a site of gene sharing among symbiotic and non-symbiotic bacteria, illustrating bacteria's ability to use horizontal gene transfer to 'their' and 'our' advantage (the distinction is often hard to make – a point which has consequences for health practices and scientific research such as the Human Microbiome Project). Research into the diversity of gut microbiota in humans has discovered that the array of CAZymes in gut microbes is highly diverse.⁸⁴ Jan-Hendrik Hehemann and others used comparative gut metagenome analyses to research the possibility that 'this diversity evolved by acquiring new genes from microbes living outside the gut'.⁸⁵ In their analyses they characterised enzymes from a particular species of marine bacteria which live with marine red algae of the genus *Porphyra*. Importantly, their research

⁸¹ Jan-Hendrik Hehemann and others, 'Transfer of Carbohydrate-Active Enzymes from Marine Bacteria to Japanese Gut Microbiota', *Nature*, 464 (2010), 908–912 (p. 908).

⁸² Ruth E. Ley and others, 'Worlds within Worlds: Evolution of the Vertebrate Gut Microbiota', *Nature Reviews Microbiology*, 6 (2008), 776–788 (p. 776).

⁸³ Ley and other, 'Worlds within Worlds', p. 786.

⁸⁴ J. Xu and others, 'A Genomic View of the Human-Bacteroides Thetaiotaomicron Symbiosis' *Science*, 299 (2003), 2074–2076.

⁸⁵ Hehemann and others, 'Transfer of Carbohydrate-Active Enzymes from Marine Bacteria to Japanese Gut Microbiota', p. 908.

demonstrates that genes coding for the enzymes that specifically aid digestion of *Porphyra* algae have been transferred to a particular gut bacterium isolated from Japanese individuals. Hehemann and others show that these CAZymes and the genes that code for them are frequent in the Japanese population and are absent from North American individuals. They suggest that nori seaweed makes a large contribution to daily diet in Japan, and hypothesise:

seaweeds with associated marine bacteria may have been the route by which these novel CAZymes were acquired in human gut bacteria, and [...] contact with non-sterile food may be a general factor in CAZyme diversity in human gut microbes.⁸⁶

Human digestion is dependent upon the diversity of enzymes produced by the population of microbiota living in the gut. This community of bacteria, living in a symbiotic relationship with and within the human body, illustrates the importance of horizontal gene transfer to both bacterial and human life. Genes for an enzyme that specifically targets *Porphyra* have been transferred laterally into the genome of a bacterium in the gut of Japanese but not North American individuals. The example of human gut microbiota illustrates that human living and digestion is dependent upon multiple genomes, and that these genomes are not just inherited vertically. This demonstrates that the multispecies (or more-than-human) community commonly thought of as a human individual eats well (and lives well), to a large extent, due to the bacterial phenomenon of horizontal gene transfer.

It is my argument that, based on the scientific research just discussed, the human body can be thought of as an emergent multispecies assemblage. The essential process of human digestion is, in fact, a co-evolved multispecies phenomenon. Gut microbiota illustrate the boundary breakdown between 'human' and 'nonhuman' within the traditional boundary of the human.⁸⁷ This is further

⁸⁶ Hehemann and others, 'Transfer of Carbohydrate-Active Enzymes from Marine Bacteria to Japanese Gut Microbiota', p. 908.

⁸⁷ Hird suggests that the biological contributes to the production and breakdown of boundaries between human and nonhuman and self and other in other ways. She considers the porosity of the skin, and suggests that: 'Only by taking our skin as a definitive impenetrable boundary are we able to see our bodies as discrete selves.' Myra J. Hird, 'Re(pro)ducing Sexual Difference', *Parallax*, 8:4 (2002), 94–107 (p. 100).

complicated by Margulis's research on the endosymbiotic origin of organelles within the human cell. Margulis's theory that organelles, in particular mitochondria, are bacterial in origin (a theory borne out by research made possible by recent advances in genome sequencing technology) makes it impossible to make a distinction between human and bacteria, even at the level of the cell.⁸⁸ As sociologist Myra J. Hird states, 'animals are, both ancestrally and currently, literally made up of bacteria'.⁸⁹ Hird's approach is useful as she emphasises the need to recognise the agential nature of bacteria as well as the difficulty of making the agential cut between human and nonhuman. She emphasises that,

my encounter with bacteria must somehow recognize that bacteria *do* precede my relating with them. It must also somehow recognize that 'I' am bacteria, that bacteria are us [...] The animal cell, typically understood as the smallest unit of structure and function, is already a symbiont.⁹⁰

Human cells are bacterial in origin and human living and digesting is made possible by bacteria. It is impossible to separate the human from the bacterial, either in the context of evolutionary ancestry or in the context of the current response of the human organism to its environment. It is important to stress, however, that although bacteria do precede the human in evolutionary terms, in my performative account neither the human nor the bacterial (in contemporary terms) precede their relating: both are co-constituted and co-shaped in their biological-social intra-action.

This symbiogenetic view of the human, which Hird describes as 'thinking (with) bacteria', prompts a rethinking of the body.⁹¹ Specifically, symbiogenesis and becoming-with the bacterial

⁸⁸ For an example of recent work that corroborates Margulis's theory as set out in her 1967 article, see Siv G. E. Andersson, and others, 'On the Origin of Mitochondria: A Genomics Perspective', *Philosophical Transactions of the Royal Society of London, B*, 358 (2003), 165–179.

⁸⁹ Hird, *The Origins of Sociable Life*, p. 26.

⁹⁰ Hird, *The Origins of Sociable Life*, p. 26.

⁹¹ See in particular the chapter 'Plenty of Room at the Bottom: Thinking (with) Bacteria' in Hird, *Origins of Sociable Life*, pp. 21–57.

redefines the human body as an assemblage. Margulis and Sagan draw attention to the fact that this redefinition of the body opens up a number of questions:

The idea that people are really walking assemblages, beings who have integrated various other kinds of organisms – that each of us is a sort of loose committee – opens up too many challenging speculations. When ‘the committee’ gets sick, is simply a single animal getting sick, or is illness more a rearrangement of the members? We imagine that pathogenic microbes attack us, but if such pathogens are part of the committee that makes up each of us to begin with, isn’t health less a question of resistance to invasion from the outside and much more an issue of ecological relationships among committee members? Yes.⁹²

The human body is an ecology at the level of bodily functions such as digestion as well as at the level of the cell. Thinking of the human body as an ecology, assemblage, or committee prompts a rethinking of the relationship of the human to the microbiological. Crucially, it encourages thinking of relationships with microbiological organisms outside the frame of pathogenesis. The ecological more-than-human body is necessarily a network of kinship relations that precede the agential cuts that produce recognisable human and bacterial ‘individuals’. As Hird states, “‘I’ am bacteria [...] bacteria are us’.

Human-Bacterial Kinship

Thinking with bacteria, and conceptualising human-bacterial kinship relations poses certain difficulties. The prevalence of zoocentrism, along with ‘big like us’ approaches, in the study of the more-than-human and multispecies relationships makes conceptualising kinship relationships between the human and bacterial difficult. For this reason, I will discuss some work from gender and sexuality studies that can help conceptualise more-than-human kinship. In particular I am focussing on Judith Butler’s work on the performative nature of kinship relations and Michael Warner’s work

⁹² Margulis and Sagan, *Acquiring Genomes*, p. 19.

on non-familial kinship and the importance of horizontality in the formation of kinship relations and communities. Both of these theorists are important to my argument in this chapter as they help to think of kinship beyond choice and voluntarism, suggesting that significant and meaningful kinship relations are not necessarily chosen; rather, individuals are always already involved in a number of different relations, are in fact co-constituted by these necessary and obligate relationships.

Feminist and queer scholars have suggested that traditional models of familial kinship – that is, Western heterobiological models of the nuclear family – are inadequate to describe or account for human relations and intimacy.⁹³ Judith Butler argues that:

If we understand kinship as a set of practices that institutes relationships of various kinds which negotiate the reproduction of life and the demands of death, then kinship practices will be those that emerge to address fundamental forms of human dependency, which may include birth, child-rearing, relations of emotional dependency and support, generational ties, illness, dying, and death (to name a few).⁹⁴

Through an exploration of, and critical engagement with, traditional anthropological kinship models, Butler emphasises this performative nature of kinship. Crucially, for Butler, kinship is a set of practices – a doing that enacts its own assemblage of significations.⁹⁵ Kinship relations are enacted through the practices of human intimacy and dependency. In her performative account of kinship, ‘not all kinship relations last, but whatever relations qualify for kinship enter into a norm or a convention that has some durability, and that norm acquires its durability through being reinstated time and again’.⁹⁶ Kinship is a set of practices that create enduring and significant relationships. Importantly for Butler, it is the repetition and reiteration of norms that produce kinship relations

⁹³ See David Eng’s, ‘Transnational Adoption and Queer Diasporas’, *Social Text*, 21:3 (2003), 1–37. In this article, Eng suggests that thinking kinship and family outside of the parameters of what he calls the ‘model of the white heterobiological nuclear family as the standard against which all social orderings must be measured’ can lead to reimagining family and kinship, as well as recasting diaspora (p. 33).

⁹⁴ Judith Butler, ‘Is Kinship Always Already Heterosexual?’, *Differences*, 13:1 (2002), 14–44 (p. 14–15).

⁹⁵ Butler, ‘Is Kinship Always Already Heterosexual?’, p. 37.

⁹⁶ Butler, ‘Is Kinship Always Already Heterosexual?’, p. 37.

through their enactment. Butler uses debates surrounding gay marriage to argue against reducing sexuality to the parameters of kinship, and reducing kinship to marital and familial relations. For Butler, although rights to marriage, adoption and reproductive technologies should be secured for individuals outside of the frame of marital kinship, if marriage and the family define the parameters within which sexual life could be thought then this would be a drastic curtailment of sexual politics.⁹⁷

Queer scholar Michael Warner also discusses the debates around gay marriage in terms of kinship in *The Trouble with Normal*, published in 1999. For Warner, traditional models of kinship do not adequately allow for the kinds of performative, shifting and non-normative kinship relations he sees at work in the gay community. Warner states:

There are almost as many kinds of relationship as there are people in combination. Where there are patterns, we learn them from other queers, not from our parents or schools or the state. Between tricks and lovers and exes and friends and fuckbuddies and bar friends and bar friends' tricks and tricks' bar friends and gal pals and companions 'in the life', queers have an astonishing range of intimacies.⁹⁸

For Warner, these relationships are important because, 'only a fine and rapidly shifting line separates sexual culture from many other relations of durability and care'.⁹⁹ Warner suggests that non-normative sexual relationships can produce non-normative cultures, as well as durable queer kinship relations of responsibility and care. Interestingly Warner suggests that there are as many

⁹⁷ Butler, 'Is Kinship Always Already Heterosexual?', p. 40. As Haraway complains: 'I am sick to death of bonding through kinship and "the family", and I long for models of solidarity and human unity and difference rooted in friendship, work, partially shared purposes, intractable collective pain, inescapable mortality, and persistent hope. It is time to theorize an "unfamiliar" unconscious, a different primal scene, where everything does not stem from the dramas of identity and reproduction. Ties through blood – including blood recast in the coin of genes and information – have been bloody enough already. I believe there will be no racial or sexual peace, no livable nature, until we learn to produce humanity through something more and less than kinship.' (Haraway, *Modest_Witness*, p. 265).

⁹⁸ Michael Warner, *The Trouble with Normal: Sex, Politics, and the Ethics of Queer Life* (Cambridge, MA: Harvard University Press, 1999), p. 115–16. Laurent Berlant and Michael Warner make a similar point in 'Sex in Public', *Critical Inquiry*, 24:2 (1998), 547–566.

⁹⁹ Warner, *The Trouble with Normal*, p. 116.

kinds of relationship as there are people in combination which motions towards Karen Barad's argument that the relation always precedes the individuals that relate, and is suggestive in the light of Haraway's statement that 'I am who I become with companion species'. These accounts converge in the idea that it is the relationship and the relating that is important for thinking communities, rather than individuals. For Warner, the important point is specifically that thinking of kinship and intimacy only within a single frame (that of the heterobiological family) is insufficient as this could never possibly cover the many and varied relations of durability and care. Warner's polemical book suggests that kinship and community possibilities within the legitimacy of marriage are impoverished compared to the possibilities of queer kinship and for this and other reasons, Warner argues that gay marriage would be normalising and preclude the possibilities of queer kinship.

In a sociological study published in 2004, Judith Stacey suggests that Warner is right to argue that non-normative sexual encounters can lead to enduring social relations. Queer kinship, or 'rainbow kinship', is for Stacey both a subversion of traditional norms and a set of practices that can instate new kinship norms. As she states:

The gay cruising arena of unencumbered, recreational sex certainly does disrupt conventional family norms and practices. At the same time, however, it also generates bonds of kinship and domesticity. Gay male sexual cruising serves, I suggest, as an underappreciated cultural resource for the creative construction of those 'families of choice' and 'invincible communities' that scholars have identified as the distinctive character of non-heterosexual family and kinship formations.¹⁰⁰

¹⁰⁰ Judith Stacey, 'Cruising to Familyland: Gay Hypergamy and Rainbow Kinship', *Current Sociology*, 52:2 (2004), 181–197 (183). Stacey adopts the phrase 'families of choice' from two sources: Kath Weston's *Families We Choose: Lesbians, Gays, Kinship*, (New York: Columbia University Press, 1991); as well as Jeffrey Weeks, Brian Heaphy and Catherine Donovan's *Same Sex Intimacies: Families of Choice and Other Life Experiments*, (London: Routledge, 2001). The phrase 'invincible communities' is from Peter Nardi, *Gay Men's Friendships: Invincible Communities*. (Chicago: University of Chicago Press, 1999).

Stacey suggests that rainbow kinship is a conscious coalition of relationships and practices that both disrupt and affirm familial kinship. Stacey argues that 'gay male "promiscuity" is not as inherently antithetical to healthy, committed, or even to comparatively conventional, family values, as its critics and some of its champions imagine'.¹⁰¹ Stacey's research supports Butler's claim that new kinship structures are possible through the creation and repetition of norms. Stacey's research is, however, committed to expanding familial kinship to include a rainbow alliance of queer relations. It is my argument that this approach is ultimately limited, and I would develop Butler and Warner's warning against reducing kinship to familial relations to argue that although Stacey's approach may expand the terms of kinship to include many queer relationships, thinking in terms of 'families of choice' may overemphasise either family kinship relations or voluntaristic relations of choice, and therefore may ignore many important non-familial and obligate relationships of responsibility and care.

Butler and Warner's approach to kinship are useful for thinking through human-bacterial kinship. In this approach, kinship relations are performative, and individuals and communities are constituted through horizontal connections: connections that cannot always be predicted in advance. Thinking of kinship in terms of the family (or even *families*) threatens to ignore or efface the many complex ways in which people relate to other people and is consequently an inadequate way of thinking multispecies becoming-with and more-than-human kinship. Similarly, thinking of kinship in terms of choice and voluntarism effaces and ignores the many important and constitutive relationships that are not chosen, but which individuals are always already involved and entangled within. Companion species relationships are not necessarily family relationships, nor are they necessarily deliberately chosen and constructed. What they must be, however, is relationships of respect (of *respecere*). That is, this queer kinship must be developed to take into account the demand of response and responsibility in more-than-human kinship relations. For this reason I turn to Jacques Derrida's work on sociality and responsibility to the nonhuman.

¹⁰¹ Stacey, 'Cruising to Familyland', p. 193.

More-than-human Sociality

Thinking with bacteria prompts a rethinking of sociality as always including the more-than-human. Derrida, in his 1997 lecture published in 2002 as 'The Animal That Therefore I Am (More to Follow)', recounts the experience of standing naked before his cat in his bathroom one morning. This encounter provokes Derrida to consider seeing and being seen by the animal. Derrida suggest that this encounter, this being seen naked by the animal, is missing from the work of Western philosophers such as Descartes, Kant, Heidegger, Lacan and Levinas: 'The experience of the seeing animal, of the animal that looks at them, has not been taken into account in the philosophical or theoretical architecture of their discourse.'¹⁰² Derrida suggests that this is part of the reason that, since Descartes, animals have been accorded only the ability to react, as animal-machines.¹⁰³ This tradition suggests that animals are capable of reacting, but not of communication, or speaking. Interestingly, Derrida identifies the critical question as not whether the animal can speak instead of just reacting, but rather whether it is possible to know what it means to respond, to be responsive, or response-able. The question is not whether animals communicate, or can speak, but rather whether the human can be open to the possibility of response. Ultimately, this responsiveness (a response-ability) relates to an ethical responsibility. To be open to response is to be open to a responsibility to the more-than-human. This is fundamental to my approach, as I will argue that human-bacterial kinship is always open to a number of transformative relationships of respect and responsibility that cannot be known in advance.

Haraway emphasises the importance of Derrida's meeting with his cat. In particular, Haraway emphasises the need to follow Derrida in considering animals: 'He understood that actual animals look back at actual human beings [...] Further, Derrida knew he was in the presence of

¹⁰² Jacques Derrida, 'The Animal That Therefore I Am (More to Follow)', *Critical Inquiry*, 28:2 (2002), 369–418 (p. 383).

¹⁰³ Derrida, 'The Animal That Therefore I Am', p. 391. See also Erica Fudge, *Animal* (London: Reaktion, 2002), especially the second chapter: 'Real and Symbolic: Questions of Difference', pp. 67–112.

someone, not of a machine reacting'.¹⁰⁴ Derrida is clear that his cat is a single, individual, real cat and not a representation of all cats, or of all animals. However, as Haraway argues: 'Even if the cat did not become a symbol of all cats, the naked man's shame quickly became a figure for the shame of philosophy before all of the animals.'¹⁰⁵ I agree with Haraway that shame is an important and legitimate response as it leads to important philosophical questions of suffering and pity, but she suggests that curiosity may be full of more promise. Haraway argues that 'with his cat, Derrida failed a simple obligation of companion species; he did not become curious about what the cat might actually be doing, feeling, thinking, or perhaps making available to him in looking back at him that morning'.¹⁰⁶ For this reason, she argues that Derrida 'came right to the edge of respect, of the move to *respecere*, but he was sidetracked by his textual canon of Western philosophy and literature and by his own linked worries about being naked in front of his cat'.¹⁰⁷ Companion species demand curiosity; in fact, Haraway describes curiosity as 'one of the first obligations and deepest pleasures of worldly companion species'.¹⁰⁸ Haraway argues that Derrida's meeting with his cat offered an opportunity of response and respect through curiosity about this specific nonhuman other. She emphasises that Derrida's engagement with the textual canon of Western philosophy and literature is important, but that from the perspective of companion species this represents a lack of curiosity and engagement with the more-than-human.

In *When Species Meet*, Haraway emphasises this curiosity as the obligation of becoming worldly with companion species. In particular, she asks the curious question:

Whom and what do I touch when I touch my dog? How is becoming with a practice of becoming worldly? When species meet, the question of how to inherit histories is pressing,

¹⁰⁴ Haraway, *When Species Meet*, p. 19.

¹⁰⁵ Haraway, *When Species Meet*, p. 23.

¹⁰⁶ Haraway, *When Species Meet*, p. 20.

¹⁰⁷ Haraway, *When Species Meet*, p. 20.

¹⁰⁸ Haraway, *When Species Meet*, p. 7.

and how to get on together is at stake. Because I become with dogs, I am drawn into the multispecies knots that they are tied into and that they retie by their reciprocal action.¹⁰⁹

Haraway suggests that through touching her dog, she is interpellated into kinship relations beyond human-animal relations, traditionally conceived. She suggests that these kinship relations demand a consideration of histories (both biological and social), and the responsibilities that these histories entail. Here, Haraway's multispecies knots converge with her discussion of nonhuman kinship in *Modest_Witness*. As discussed earlier, In *Modest_Witness* Haraway states that: 'Like it or not, I was born kin to Pu²³⁹ and to transgenic, transspecific, and transported creatures of all kinds; that is the family for which and to whom my people are accountable.' Haraway's phrase, 'like it or not' is important here, as it illustrates her argument that kinship relations are not always chosen. Rather, individuals are 'drawn into' kinship relations with the more-than-human. Haraway's multispecies knots are performative kinship relations that, like Butler's elaboration of kinship, are sets of practices – each a doing that enacts its own assemblage of significations.

Hird employs Haraway's companion species framework to explore what it takes to 'meet well with' the more-than-human, suggesting that 'considering an ethics of (human)animal relations confronts enduring humanist foundational assumptions [...] To think beyond the animal seems literally and figuratively beyond our ken'.¹¹⁰ Haraway's main focus in *When Species Meet* is the relationship of human and dog. Hird's work attempts to elaborate this, in the light of Margulis's symbiogenesis to think a more-than-human ethics that is decidedly non-zoocentric. Hird draws attention to the fact that bacteria problematise taxonomic definitions such as species, and sketches a 'microontology' of kinship relationships with companion species that are not species at all: 'companion with not-species as it were'.¹¹¹ Hird elaborates microontologies of self, sex and environment. Hird's microontology of self focuses on the relationship between self and other in

¹⁰⁹ Haraway, *When Species Meet*, p. 35.

¹¹⁰ Hird, *The Origins of Sociable Life*, p. 133.

¹¹¹ Hird, *The Origins of Sociable Life*, p. 135.

terms of the economies of gift-giving and the importance of symbiosis with the bacterial. Through microontologies of sex, Hird suggests that thinking sex and reproduction outside of the frame of the human could add to feminist work on sex and gender. Finally, microontologies of environment look at Margulis's work with James Lovelock on the Gaia hypothesis to consider how Gaian theories of the environment could inform social science.¹¹² Hird's work demonstrates the ways in which curiosity about bacteria can have effects on other discourses, such as sociology and feminist projects.

Haraway argues for curiosity as a critical practice. She claims that curiosity is 'one of the first obligations and deepest pleasures of worldly companion species' and requires 'knowing more at the end of the day than at the beginning'.¹¹³ Curiosity is a useful critical practice; however, it needs careful elaboration, so as to differentiate curiosity from scopophilic or voyeuristic practices that maintain distance between subject and object. Haraway argues that curiosity is about knowing more at the end of the day than the start. This could be read as dangerously close to suggesting that curiosity as a practice stabilises, or perhaps enhances and improves, the position of the sovereign knowing subject. I want to argue, however, that the practice of curiosity is not just about knowing more, but also includes the possibility of knowing less, nothing, or questioning the ability of the individual to know at all. The important element of curiosity, and that which must be emphasised, is danger. The phrase 'curiosity killed the cat' is a familiar warning about the dangers of curiosity, and I argue that curiosity as a critical practice is always dangerous and threatens the position of any knowing subject. Curiosity is about entering into a series of relationships that can forever alter the individuals relating and the relationships between them. This is, consequentially, about knowing more at the end of the day than at the start, but with knowledge understood as a particularly

¹¹² Margulis's work with Lovelock on the Gaia Hypothesis, the theory that the earth (taken as a sum of all interacting conditions and living matter) is a self-regulating system, includes the following books published by the authors independently: James Lovelock, *Gaia: A New Look at Life on Earth* (Oxford: Oxford University Press, 2000); *The Ages of Gaia: A Biography of our Living Earth*, 2nd edn. (Oxford: Oxford University Press, 2000 [1988]); Lynn Margulis (ed.), *Slanted Truths*; and Margulis, *Symbiotic Planet*.

¹¹³ Haraway, *When Species Meet*, p. 7, p. 36.

situated biological-social practice. I would link this to Haraway's work on situated knowledges discussed in the first chapter, rather than the production of knowledge through separation of subject and object. As Haraway states, '[c]uriosity should nourish situated knowledges and their ramifying obligations'.¹¹⁴ The collapse of distance between subject and object is threatening to both, and enters both into a relationship of danger where each can be radically changed, but can produce new knowledges and responsibilities in a multispecies becoming-with.

Eating Well, and Failing to Digest

The collective more-than-human community commonly recognised as the human body relies upon bacterial digestion to live. Gut microbiota provide the clearest and most readily observable example of this (although the ATP-producing mitochondria of human cells provide another important example). Unlike plants (and some bacteria and green animals such as *Elysia viridis*) that gain energy directly from sunlight, human beings must digest organic and chemical compounds in order to gain energy. The enzyme-producing gut microbiota are essential for the process of breaking down matter into these digestible compounds. The entanglement of human and bacteria is therefore essential to eating and digesting. Gut microbiota are the living descendants of free-living bacteria eaten but not digested by organisms that would evolve (or more precisely co-evolve with their bacterial symbionts) into humans. Not only this, but the process of digestion is a human-bacterial co-evolved phenomenon; deriving energy from food is impossible without bacteria. Eating and digestion, then, are important processes and phenomena for thinking human-bacterial relations. Bacteria enable the human to 'eat well', and human-bacterial digestion illustrates the more-than-human kinship relations that the human is always already entangled in and provides ways of thinking through questions of sociality and ethical relating to the other. In particular,

¹¹⁴ Haraway, *When Species Meet*, p. 289.

human-bacterial digestion provides an illustration and elaboration of some of Derrida's arguments on social relations.

Derrida explores the question of eating, subjectivity and relating to the other in "'Eating Well", or the Calculation of the Subject'. In this interview Derrida suggests that with the limits between the living and non-living and between human and animal put into question, the morality of killing and eating animals as well as the ethics of relating self to other become about eating well, rather than eating or not eating (or eating *this* and not *that*). Derrida argues,

if, in the (symbolic or real) experience of the 'eat-speak-interiorize' the ethical frontier no longer rigorously passes between the 'Thou shalt not kill' (man, thy neighbor) and the 'thou shalt not put to death the living in general', but rather between several infinitely different modes of the conception-appropriation-assimilation of the other, then, as concerns the 'Good' [*Bien*] of every morality, the question will come back to determining the best, more respectful, most grateful, and also most giving way of relating to the other and of relating the other to the self.¹¹⁵

For Derrida, the question is not one of whether or not it is good to eat the other, or if the other is good to eat; rather, the relationship of eating must be considered as necessary and reciprocal and eating must be a relation of giving as well as receiving. Derrida argues that: "'One must eat well" [*il faut bien manger*"] does not mean above all taking in and grasping in itself, but *learning* and *giving* to eat, learning-to-give-the-other-to-eat."¹¹⁶ Eating is always a social experience; that is, it involves the eating individual in networks of response and responsibility. As Derrida states: 'One never eats entirely on one's own: this constitutes the rule underlying the statement, "One must eat well". It is a

¹¹⁵ Jacques Derrida, "'Eating Well", or the Calculation of the Subject: An Interview with Jacques Derrida', in *Who Comes After the Subject?*, trans. by Peter Connor and Avital Ronnell, ed. by Eduardo Cadava, Peter Connor, and Jean-Luc Nancy (New York: Routledge, 1991), pp. 96–119 (p. 114).

¹¹⁶ Derrida, "'Eating Well'", p. 115. The phrase, '*il faut bien manger*' can mean both 'one must eat well' and 'everyone has to eat'. When the adverb '*bien*' is used as a noun, '*le Bien*', this also has the connotations of 'eating the Good'.

rule offering infinite hospitality.¹¹⁷ Nowhere is Derrida's argument more evident than in failed digestion. Gut microbiota have been eaten but not digested, illustrating that eating is a process that opens the individual up to the possibility of internalising but not destroying or assimilating what is eaten and thus becoming a host to the surviving organisms. Eating well is a process that is always open to the failure of digestion and the internalisation but non-assimilation of the other. Eating well offers infinite hospitality; to eat well is to be open to becoming-host.¹¹⁸ The dangers of this must not be underplayed, and I will discuss this in more detail when considering the infection of bodies with viruses (becoming-host to viral inhabitants) in the final chapter.

Haraway develops Derrida's notion of eating well to suggest that companion species relationships are always about learning how to eat well together. Haraway explicitly links companion species to the breaking bread of the Latin, *cum panis*, suggesting that companion species are always '[q]ueer messmates in mortal play'.¹¹⁹ Crucially, Haraway recognises the importance of indigestion and the fact that eating well is always open to failed digestion and becoming-host. Eating well is an example of Haraway's becoming-with: it depends upon nonhuman others and involves the 'eater' in more-than-human kinship networks of responsibility.

Multispecies human and nonhuman ways of living and dying are at stake in practices of eating [...] Derrida argued that any real responsibility must be excessive. The practice of regard and response has no preset limits, but giving up human exceptionalism has

¹¹⁷ Derrida, "'Eating Well'", p. 115. For Derrida's work on hospitality see 'The Politics of Friendship', *Journal of Philosophy*, 85:11 (1988), 632–644; *Of Hospitality*, trans. by Rachel Bowlby (Stanford, CA: Stanford University Press, 2000); and 'The Principle of Hospitality', *Parallax* 11:1 (2005), 6–9.

¹¹⁸ I adopt the phrase 'becoming-host' from Joost van Loon, 'Parasite Politics: On the Significance of Symbiosis and Assemblage in Theorizing Community Formations', in *Politics at the Edge: The PSA Yearbook, 1999*, ed. by Chris Pierson and Simon Tormey (New York: St Martin's Press, 2000), pp. 241–253. Van Loon's article is useful for rethinking relations between parasite and host, and community-formation in the light of the parasite. I am not exploring his work in detail here due to Van Loon's sole focus on the relationship of pathogen to host. Becoming-host is not necessarily tied so intimately to the assumption of pathogenesis in microbiological relations. A range of relations, including predator and prey, are open to the infinite hospitality always present in the possibility of becoming-host. For further work on the parasite in philosophy see Michael Serres, *The Parasite*, trans. by Lawrence R. Schehr (Baltimore: John Hopkins University Press, 1982). I will return to parasitism in the next chapter, in the form of viruses.

¹¹⁹ Haraway, *When Species Meet*, p. 19.

consequences that require one to know more at the end of the day than at the beginning and to cast oneself with some ways of life and not others in the never settled biopolitics of entangled species.¹²⁰

For Haraway, 'nourishing indigestion' is necessary for eating well together.¹²¹ Specifically, to eat well, the other must never be fully digested; companion species 'cannot and must not assimilate one another but [...] must learn to eat well, or at least well enough that care, respect, and difference can flourish in the open'.¹²² Eating is attempted assimilation; indigestion is eating well and failing to assimilate. Nourishing indigestion and eating well together is, for Haraway, an essential part of becoming-with the more-than-human in companion species relationships. This is a particularly pertinent example for my thesis of the ways that health and living well depend upon the more-than-human world.

Indigestion is also integral to the process of symbiogenesis. Symbiogenesis argues that the main mechanism of evolutionary novelty and speciation is the ingestion, but not digestion, of the other within the self. As Margulis and Sagan state:

Symbiotic relationships occur under specific environmental conditions. In some of these relationships, one partner in the symbiosis feeds off the other to its detriment and even death. Such exploitative associations are called 'parasitic' or 'pathogenic'. They tend to be highly sensitive to environmental stress. The parasite that invariably and virulently kills its partner kills itself. With time and circumstance the nature of associations tended to change. The relationships that interest us most here are modulated coexistence between former predators, pathogens and their hosts, their shelter and food sources. As members of two

¹²⁰ Haraway, *When Species Meet*, p. 295.

¹²¹ Haraway, *When Species Meet*, p. 300.

¹²² Haraway, *When Species Meet*, p. 287.

species respond over time to each other's presence, exploitative relationships may become convivial to the point where neither organism exists without the other.¹²³

Gut microbiota (along with the previously discussed example of mitochondria in the human cell) are observable in their current form because of symbiotic relationships that have developed over time. Crucially, these relationships were varied and included that of predators, pathogens and their hosts, shelter and food sources. These relationships can change and over time become a long-term inextricable symbiosis. Margulis and Sagan's notion of 'modulated coexistence' is interesting as it illustrates the productive and transformative effect that relationships have on all of the organisms relating. Modulated (and modulating) coexistence converges with Haraway's notion of becoming-with, as each organism or individual is formed only in and through more-than-human kinship networks of otherness.

The symbiogenetic focus on the relations between and with the bacterial – or as Hird describes it, 'companion with not-species' – problematises any strict boundary between self and other, as well as suggesting the possibility of human-bacterial kinship outside of the frame pathogenesis. Symbiogenesis suggests that in every relationship of eating or attempted assimilation, there is the radical possibility of indigestion and modulated (and modulating) coexistence. In Haraway's terms, this possibility must be nourished for species-meetings that promote the flourishing of care, respect and difference. In a symbiogenetic framework the self is always already host to communities of organisms, or others. Importantly, and building on insights from the previous chapters, these 'others' are active and agential, and the entangled relationship produces biological-social effects and consequences for all the partners that are entangled. A symbiogenetic eating well with bacteria prompts questions of how to relate to the other, how to formulate kinship and how to think about sociality beyond the human.

¹²³ Margulis and Sagan, *Acquiring Genomes*, p. 12.

Biosociality

More-than-human kinship depends on an entanglement of the social and biological. Sociologist Paul Rabinow, writing in 1992, suggests that this entanglement is particularly noticeable in sociality produced, affected, or made visible by new genetic technologies, such as the large-scale gene sequencing made possible by the Human Genome Project. Rabinow argues that new genetic technologies create new bio-social identities and communities (he gives the example of support groups for people with neurofibromatosis – a genetically inherited disorder that causes nerve tissue to grow tumours). He argues that these new relations, which are at once biological and social, do not replace ‘older forms of cultural classification of bio-identity such as race, gender and age [...] although the meanings and the practices that constitute them certainly are changing’.¹²⁴ He does, however, argue that ‘these older cultural classifications will be joined by a vast array of new ones, which will cross-cut, partially supersede and eventually redefine the older categories in ways that are well worth monitoring’.¹²⁵ It is these new classifications, new ways of producing and performing kinship relations that Rabinow calls ‘biosociality’.

In the future, the new genetics will cease to be a biological metaphor for modern society and will become instead a circulation network of identity terms and restriction loci, around which and through which a truly new type of autoproduction will emerge, which I call ‘biosociality’. If sociobiology is culture constructed on the basis of a metaphor of nature, then in biosociality, nature will be modelled on culture understood as practice. Nature will become known and remade through technique and will finally become artificial, just as culture becomes natural. Were such a project to be brought to fruition, it would stand as the basis for overcoming the nature/culture split.¹²⁶

¹²⁴ Paul Rabinow, ‘Artificiality and Enlightenment: From Sociobiology to Biosociality’, in *Incorporations* (New York: Zone, 1992), pp. 234–253 (p. 245).

¹²⁵ Paul Rabinow, ‘Artificiality and Enlightenment’, p. 245.

¹²⁶ Paul Rabinow, ‘Artificiality and Enlightenment’, pp. 241–242. For further elaboration of Rabinow’s biosociality, see Rabinow, *French DNA: Trouble in Purgatory* (Chicago: University of Chicago Press, 1999).

Rabinow's term biosociality is partly an attempt to subvert the determinism of sociobiology and works to question the relation of the biological to the social. It is important for my project, however, not to approach biosociality in too naïve or uncritical a light, as the hypothetical 'overcoming' of the nature/culture split through technology such as gene-sequencing (to use Rabinow's example) can have problematic consequences.

Sarah Franklin discusses some of the problematic conservative dimensions of thinking kinship through new genetic technologies in her article 'Biologization Revisited: Kinship Theory in the Context of the New Biologies'. Franklin suggests that despite the transformations made to kinship theory, the question of the significance of biological facts in kinship is 'as easy to fall into as it is difficult to leave behind'.¹²⁷ Franklin suggests that the meanings associated with biology have shifted from being those of stability and fixity to being visibly associated with innovation and change. She suggests, however, that there are both possibilities and dangers involved in thinking kinship through new biological technology and innovation. She suggests that the dangers are threefold: first, there is an assumption that new forms of biological reproduction are places to look for new forms of kinship which could further the association between genealogy, biology and kinship; second, there is a danger of overestimating the novelty and determinism of new forms of technological innovation (for example cloning, transgenics and new reproductive technologies); and third, there is the fact that biological innovation is not of interest to everyone in the same way – the question of for whom biological innovation is of interest represents an important discourse.¹²⁸ Franklin argues that new biological technology and innovation prompts a number of questions about kinship and the relationship between the biological and social. Crucially she emphasises the need to be vigilant against complacency about the 'overcoming' of the boundary between nature and culture.

¹²⁷ Sarah Franklin, 'Biologization Revisited: Kinship Theory in the Context of the New Biologies', in *Relative Values: Reconfiguring Kinship Studies*, ed. by Sarah Franklin and Susan McKinnon (Durham, NC: Duke University Press, 2001), pp. 302–325 (p. 302).

¹²⁸ Franklin, 'Biologization Revisited', p. 317.

Ian Hacking explores biosociality and the formation of new identities in the light of the findings of the Human Genome Project. He argues that the complexity that the project discovered created opportunities to produce and perform new identities and communities. He states:

After an initial deterministic enthusiasm, almost everyone came to realize that everything is not in our genes [...] Nevertheless, the biological, and then the genetic, imperatives are facts of modern life. And far from increasing determinism and limiting opportunity, the life sciences are creating more choices. On the one hand, we have, in a sense, more biologies to choose from than we anticipated. On the other hand, new societies form along newly recognized (or, at any rate, newly asserted) biological or genetic lines, forging new alliances and loyalties. Forging new identities.¹²⁹

Hacking's emphasis on genetic technologies and biosociality is important as it illustrates the fact that the Human Genome Project problematised genetic determinism through its scientific findings. His use of the term, however, does not fully inherit the important Foucauldian connotations of biopower that Rabinow makes explicit in his articulation of biosociality, and which are important in the light of Franklin's elaborations of the dangers of thinking kinship through biological technologies and innovation. Rabinow describes his work as 'a new articulation of the discourses and practices of biopower', defined by Michel Foucault as that which 'brought life and its mechanisms into the realm of explicit calculations and made knowledge-power an agent of transformation of human life'.¹³⁰ Rabinow draws on Haraway's approach to biopower in 'A Cyborg Manifesto', where she argues that contemporary forms of biopower function differently to that described by Foucault in *The Birth of the Clinic*: 'Our dominations don't work by medicalization and normalization anymore; they work by

¹²⁹ Ian Hacking, 'Genetics, Biosocial Groups and the Future of Identity', *Dædalus*, 135:4 (2006), 81–95 (p. 82).

¹³⁰ Rabinow, 'Artificiality and Enlightenment', p. 234; Michel Foucault, *The Will to Knowledge*, trans. by Robert Hurley, *The History of Sexuality*, Vol I, 3 Vols (Hammondsworth: Penguin, 1990), p. 143. For further articulation of Foucauldian biopower see Michel Foucault, *The Birth of the Clinic: An Archaeology of Medical Perception*, trans. by A. M. Sheridan (London: Routledge, 2003 [1963]), and Paul Rabinow and Nikolas Rose, 'Biopower Today', *BioSocieties*, 1 (2006), 195–217.

networking, communication design, stress management.’¹³¹ New technologies create opportunities for the production and performance of new identities and communities. These new biosocial arrangements also entail new discourses and practices of biopower, which do not replace older forms of biopower, but rather add to, change, or redefine them. It is essential, in my use of the term, to emphasise that biosociality is an elaboration of biopower and as such, always entails consideration of the political nature of kinship networks.

Biosociality is important to my project as it recognises the entangled relationship of the biological and the social. As I argued in the previous chapters, the biological and social are performatively co-constituted, rather than discrete areas or terms in opposition. Neither the biological nor the social acts as the solid ground beneath the other. Once again, it is ‘turtles all the way down’. Biosociality is also useful as it stresses the political nature of kinship relations and highlights the fact that kinship is never solely familial or biological, but rather a set of practices that are historically specific, as well as biologically, socially and technologically mediated. It is important for my project, however, that the entangled and performative nature of the relationship between biology and sociality is emphasised and maintained. To these ends, I find Margulis’s symbiogenesis theory a helpful resource for stressing the entangled nature of the biological and the social, as well as the creative force of symbiotic connection and relation. With this in mind, I suggest thinking of biosociality as necessarily a *symbiosociality*. Life is always an entangled process of becoming with. Symbiosociality also gestures to a linguistic symbiosis of symbiogenesis and biosociality (both already symbiotic mergers themselves). The symbiotic nature of this term is also reflected in its mixed pedigree (canine pun intended). The Greek *symbios* and the Latin *socius* are from different linguistic stock, but in their merger they produce something new. Neither is assimilated wholly by the other, but rather contributes to etymological novelty and the creation and proliferation of

¹³¹ Donna Haraway, ‘A Manifesto for Cyborgs’, p. 6.

multiple shifting meanings. Hacking emphasises that Rabinow's biosociality was invented 'partly as a joke' and I suggest symbiosociality in a similar manner.¹³²

Symbiosociality and Networks of Responsibility

One of the most important consequences of symbiogenesis (and thus one that must be preserved unassimilated – eaten but not digested – in symbiosociality) is the impossibility of thinking in terms of individuals. As Margulis states:

of all the organisms on Earth today, only prokaryotes (bacteria) are individuals. All other live beings ('organisms' – such as animals, plants and fungi) are metabolically complex communities of a multitude of tightly organized beings. That is, what we generally accept as an individual animal, such as a cow, is recognizable as a collection of various numbers and kinds of autopoietic entities that, functioning together, form an emergent entity – the cow. 'Individuals' are all diversities of co-evolving associates.¹³³

This diversity of co-evolving associates is observable at the level of symbiotic gut microbiota and at the level of the human cell. It is impossible to think in terms of individual human bodies, as these bodies are emergent entities formed through the co-evolution of more-than-human agencies. As Dorion Sagan describes: 'The human body [...] is an architectonic compilation of millions of agencies of chimerical cells.'¹³⁴ Symbiosociality emphasises the necessarily entangled symbiotic community nature of 'individuals'. One of the most important implications of Rabinow's biosociality is the impossibility of maintaining a clear distinction or boundary between the biological and social. The kinship relations that are made possible by new technologies emphasise the boundary breakdown

¹³² Hacking, 'Genetics, Biosocial Groups and the Future of Identity', p. 81.

¹³³ Lynn Margulis, 'Big Trouble in Biology: Physical Autopoiesis versus Mechanistic Neo-Darwinism', *Slanted Truths*, p. 273. See also Scott F. Gilbert, Jan Sapp and Alfred I. Tauber, 'A Symbiotic View of Life: We Have Never Been Individuals', *The Quarterly Review of Biology*, 87:4 (2012), 325-341. In this article, Gilbert, Sapp and Tauber argue that humans cannot be thought of as individuals in any of the traditional ways of defining biological organisms: in terms of anatomical, developmental, physiological, genetic, immune, or evolutionary individuality. They conclude their article with the evocative statement: 'We are all lichens' (p. 336).

¹³⁴ Dorion Sagan, 'Metametazoa: Biology and Multiplicity', *Incorporations*, pp. 362–385 (p. 367).

between the biological and the social, including the technological. In Rabinow's example of communities formed around genetic diseases, the kinship relations that individuals are interpellated into through genetic screening and related technologies are both biological and social, though not necessarily familial. Not only are individuals not individuals at all but entangled symbiotic communities, but these are also always already involved in performative kinship relations that are themselves entanglements of the biological and social. This understanding of kinship relations as biosocial is essential for my articulation of the concept of symbiosociality. 'Individuals', symbiotic entanglements themselves, are always already interpellated into symbiotic entanglements of the biological and the social.

I want, at this point, to explicitly link these entangled symbiosocial kinship networks with the biological-social networks discussed in the previous chapter in reference to queer genes. As in its formulation in the previous chapter, a biological-social network is formed by often unpredictable and incalculable partial connections between historically situated human and nonhuman agency. Again, this follows Andrew Pickering's insight that the world is composed of human and nonhuman agency:

One can start from the idea that the world is filled not, in the first instance, with facts and observations, but with *agency*. The world [...] is continually *doing things*, things that bear upon us not as observation statements upon disembodied intellects but as forces upon material beings.¹³⁵

The bacterial and the human are constantly 'doing things', things that bear upon each other as material forces, for example in the co-evolution of human and gut microbiota. In this way, a symbiosocial approach is also a diffractive approach, as it privileges the active agential nature of matter. Symbiosociality focuses on the potential of connections and relations to produce

¹³⁵ Andrew Pickering, *The Mangle of Practice: Time, Agency and Science* (Chicago: University of Chicago Press, 1995), p. 6.

interference and difference. It also elaborates on the ability of symbiotic connection and merger to produce evolutionary novelty, suggesting that thinking of becoming-with the more-than-human in this way is an opportunity for new ways of thinking of relating to the other, as well as emphasising the imperative of response and responsibility.

Symbiosocial kinship networks are biological-social networks and as such are always necessarily political, always about the move to *respecere*. Once again, Diane Elam's notion of 'networks of responsibility' is useful here.¹³⁶ Derrida emphasises the importance of being open to animal response in 'The Animal That Therefore I Am (More to Follow)', and it is the obligation to openness to the response of nonhuman others that he privileges over discussions of whether or not the animal can speak. Haraway develops Derrida's argument by suggesting that curiosity is a way of being open to nonhuman response, as well as asking what networks of connection, histories and responsibilities are inherited in the connection to the more-than-human. Crucially, symbiosocial kinship networks are always networks of responsibility, with the recognition that human and more-than-human agencies bear upon each other with both biological and social effects. Not only this but being open to more-than-human response, and responsibility to the more-than-human, is also a radical openness to change and an infinite hospitality. As human geographer Nigel Clark argues, 'to enter into a close relationship with another species is not to enter a circle of calculable effects of equivalent exchanges, but to open a network of unknowable and immeasurable outcomes'.¹³⁷ My articulation of symbiosociality suggests the possibility of becoming-with unknown human and more-than-human others, as well as the necessity of being open to networks of unknowable connections, responses and responsibilities, and the infinite hospitality of becoming-host.

¹³⁶ Diane Elam, *Feminism and Deconstruction: Ms. en Abyme* (London: Routledge, 1994), p. 105.

¹³⁷ Nigel Clark, 'Disaster and Generosity', *The Geographical Journal*, 171:4 (2005), 384–6 (p. 7).

Queer kinship: Becoming-with the More-than-human

Symbiosociality is a queer approach to sociality. In the previous chapter I suggested that 'queer' is a useful term for attempting to preserve the strangeness of scientific objects, and thus the active agential nature of the biological. Simultaneously, I suggested that it gestures to the constructed nature of all knowledge. Symbiosociality converges with this queer approach as it emphasises the queerness of the biological; the complexity and non-determinism of symbiogenesis and biological becoming-with suggests an openness and hospitality to networks of unpredictable outcomes and responsibilities. Simultaneously, it emphasises the entanglement of the biological and the social; biosociality illustrates both the effects of biology and biological technologies on the social, but also the political nature of connections between the biological and social. Symbiosociality is a queer approach to the entanglement of biological and social and also an approach that attempts to avoid human exceptionalism by emphasising the importance of curiosity about symbiosocial connections to the more-than-human world. I agree with Hird that the imperative is to 'survive humanism', and with Haraway that 'we have never been human'.¹³⁸ Thus, symbiosociality is a more-than-human approach – that is, a critical posthumanist *and* companion species approach.

Symbiosociality, as a queer approach, suggests ways of rethinking kinship. Warner suggests that: 'There are almost as many kinds of relationship as there are people in combination.'¹³⁹ A symbiosocial approach suggests that in every relationship to the other there is the possibility of radical change; to eat well with the other is to offer infinite hospitality, to be open to the possibility of becoming-host. For this reason, then, I want to take Warner's claim even further: each relationship with the other opens up the individuals relating to many new unpredictable kinship relationships. It is also essential to remember that in this approach, the 'people in combination' are

¹³⁸ Hird, *The Origins of Sociable Life*, pp. 142–143; Haraway uses the phrase 'we have never been human' to emphasise her alliance with Bruno Latour, in particular his *Politics of Nature: How to Bring the Sciences into Democracy* (Cambridge, MA: Harvard University Press, 2004) and *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993). See *When Species Meet*, p. 305 n. 9.

¹³⁹ Warner, *The Trouble with Normal*, p. 115.

always already more-than-human combinations. There are at least as many kinds of relationship as there are people in combination (if not more), and there is always the possibility of the radical shifting and multiplication of these relationships. Symbiosociality also offers an approach to evolutionary narratives such as Elaine Morgan's Aquatic Ape Hypothesis. Morgan's narrative of the descent of the female ape begins from female embodiment and attempts to rethink the evolution of the species with the agential nature of the female body taken into account. Although Morgan ultimately falls back on biological determinism, symbiosociality can once more provide a more positive (re)reading of her project. Morgan's Aquatic Ape Hypothesis attempts to create a connection between the contemporary female human and the prehominid ape. This is both an attempt to forge a political connection, and a recognition of the biological evolutionary links between humans and prehominid ancestors. Entering into a close relationship with the nonhuman other is, in Clark's terms, to open a 'network of unknowable and immeasurable outcomes'. The Aquatic Ape Hypothesis describes a close relationship between contemporary female embodiment and the female prehominid ape which, although not a becoming-with in the sense of a symbiosis, opens a network of unknowable and immeasurable outcomes. This is the promise of any close relationship to the other: the possibility of mergers that can create radical and unpredictable novelty. In this example, the novelty that becomes possible is the rethinking of the androcentrism of evolutionary narratives, as well as the way female embodiment and experience is thought in contemporary society. Through the forging of a kinship connection to the more-than-human world, Morgan opens up networks of relationships and responsibilities, creating the possibility of new and politically useful situated knowledges.

Earlier I suggested that Haraway's becoming-with is supported by the emphasis in symbiogenetic research on the modulated coexistence of symbiogenetic mergers. Both of these notions – becoming-with and the idea of modulated coexistence – are integral to symbiosociality. It is important to emphasise this, as symbiosociality illustrates that being is always a becoming, and becoming is always entangled and entangling: a becoming-with. Thus, symbiosociality is always

about emergence; it emphasises the openness of all relationships (whether peaceful or defined by struggle) to connections that are themselves emergent and entangled networks of unknowable and immeasurable outcomes and responsibilities. Symbiosis is never complete; it suggests a radical openness to change and further symbiotic merger. Hird's microontologies provide a necessary elaboration of Haraway's companion species framework. Crucially, for Hird, being human is always a becoming-with the bacterial. In both ancestral terms and in the ability of the human to live (and eat) well, the human and bacterial are always symbiotically entangled. Hird's work is also important as it emphasises Margulis's warning against zoocentrism in its attempt to think with bacteria. It also offers a way to think a critical posthumanism and companion species framework together and do the important work needed to refuse human exceptionalism.

The kinship between symbiosociality and Haraway's companion species means that curiosity must be an imperative of symbiosocial approaches. Haraway's question of who and what she touches when she touches her dog can be rephrased as a useful interrogation of the more-than-human symbiosocial relations that the human is always already involved in, for example kinship with gut microbiota. Who and what am I already touching (and being touched by) in the process of digestion, when I eat? A symbiosocial approach to this question emphasises the more-than-human entanglements that make living and eating possible. It thus interpellates the human into an evolutionary history of ingestion but failed digestion of more-than-human others and the collective assemblage-nature of the individual human body. The curiosity of companion species demands an investigation of the specifics of these internal nonhuman others. This curiosity, then, also involves the human in specific cultural histories of food production (as illustrated clearly in the example of the differences between the genomes of gut microbiota in Japanese and North American people). Not only does this emphasise the diversity and specificity of the body in response to environment, but actually reframes the body as itself an environment and ecology, which I will discuss in the next chapter. This in turn prompts a rethinking of health in different terms than a bounded self protected from infection from the outside by pathogens. Symbiosocial kinship relations with internal more-

than-human others also prompts a rethinking of health practices in relation to the sequencing of the human microbiome and the phenomenon of bacterial antibiotic resistance. This approach stresses the agency of bacteria and emphasises the fact that human health and flourishing is always and necessarily entangled with bacterial and more-than-human health and flourishing.

Symbiosociality, as a symbiotic merger of symbiogenesis and biosociality is a queer approach that privileges the active and agential nature of the biological, whilst emphasising the social and political histories that are always performatively entangled with the biological. As an approach to kinship it is an attempt to respond to Haraway's call, in her famous article, 'A Manifesto for Cyborgs' for a world of 'lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints'.¹⁴⁰ Symbiosocial kinship recognises the more-than-human biological networks that sustain human life, while simultaneously emphasising their social and historical construction and mediation. In the process, symbiosociality prompts the rethinking of bodily boundaries as well as social relations between the self and other, as well as redefining human health in terms of entanglement – both with the internal and external more-than-human world.

Conclusion

In this chapter I expanded upon earlier discussions of agency. In the first chapter, the female prehuman ape was reinterpreted through the work of Morgan and Haraway. Chapter Two sought to reconceptualise genes as queer, active and agential – always already entangled in performative constitutive biological-social relations. To explore agency beyond the human, in this chapter I explored Haraway's articulation of a companion species framework, and explored the possibilities for applying this to human-bacterial relationships and kinship. Human-bacterial entanglements and kinship can be a useful resource for refusing human exceptionalism and conservative narratives of

¹⁴⁰ Haraway, 'A Manifesto for Cyborgs', p. 8.

humanism that place humans at the pinnacle of evolution and grant them mastery over that which is defined as not-human. To explore the material specificity of bacteria and human-bacterial entanglement I analysed Margulis's theory of symbiogenesis. Among the implications of Margulis's work is the difficulty of thinking in terms of individuals *and* types. Bacterial entanglement draws attention to the biological-social boundary-making practices (or agential cuts) that go into producing the idea of individual and discrete human bodies. The material specificity of bacteria also draws attention to the agential cuts involved in taxonomic practice, and the difficulty of producing and maintaining clear species categories.

Human-bacterial kinship reconfigures the body as an ecosystem – as entangled in an ecology, but also an ecology itself. To think through the possibilities of human-bacterial kinship I turned to feminist and queer engagements with kinship theory in the late 1990s and early 2000s that suggested exploring kinship outside of familial relationships. Some critics in this area argued that the reduction of kinship to biological-familial relations represents a curtailment of sexual politics. In particular, questions of queer community and the political call for gay marriage were considered within the frame of traditional kinship and non-normative sexual community formation. At the same time, scholars were starting to question how the changing theories, practices, technologies and innovations of biological science affected models of biological kinship. With this context in mind, Haraway's notion of being interpellated into obligate kinship relations whether you 'like it or not' is particularly informative. Some queer scholars focusing on non-normative sexual communities have suggested a focus on 'families of choice', a reinterpretation of queer community and expansion of the boundaries of the family. In this chapter I argued that this is limited as it ignores many important and constitutive relationships, connections and responsibilities. Haraway's focus on kinship relations that are not chosen, but rather that individuals are always already involved in, is more useful, and this converges productively with Butler's performative view of kinship as a set of practices that enacts its own assemblage of significations.

To think through the political and ethical dimensions of this kinship, I used resources from deconstruction, specifically associating Derrida's notion of eating well with Haraway's notion of indigestion. Indigestion is an important part of companion species, and offers insights both into the material specificity of human gut microbiota, and into the entangled and entangling relationships that the human is always already involved in. I argued, using Haraway's companion species framework, that these more-than-human kinship relations (that the human is always already involved in) are performative and constitutive. In particular, I argued that the relationship between the bacterial and the human is actually a complex network of connections that involves evolutionary history, new biological technologies such as genome sequencing, and specific environmentally-determined histories of individual organisms. To produce a framework with which to conceptualise this complex network of biological and social connections, I explored Margulis's symbiogenesis and Rabinow's biosociality, before suggesting a merger of the two into symbiosociality.

Symbiosociality is a queer approach to kinship relations, emphasising that the world is full of agency and that human and nonhuman biological agencies are always acting upon each other with biological and social consequences. In fact, I argued that the human is not singular and stable, nor can the human be defined independently of nonhuman (or more-than-human) bodies and agencies. Symbiosociality emphasises the entanglements, connections and symbioses that are performative and constitutive, and *all the way down*. Focusing on the examples of the importance of human gut microbiota in digestion and the material specificity of mitochondria in all cells, I argued that humans and bacteria are always already involved in obligate and queer kinship entanglements. I also emphasised the political nature of all connections and entanglements, and the fact that in any relation to the other, the self is opened up to multiple networks of responsibility. Symbiosociality is thus a useful tool with which to rethink kinship and becoming-with the other in the more-than-human world. This is of particular significance when thinking about health, and in the next chapter I will explore possible ways of conceptualising more-than-human kinship with another microorganism: the virus. Once again, agency and the possibilities offered by the conversations

between scientific and social theories will be key, particularly concerning biomedical knowledge and human health practices.

Chapter Four

Interruptions: Viral Biopolitics, Queer Ecologies and Monstrous Futures

‘If anything, life is catastrophic, monstrous, nonholistic, and dislocated, not organic, coherent, or authoritative. Queering ecological criticism will involve engaging with these qualities’

Timothy Morton, ‘Queer Ecology’¹

The previous chapters have developed an approach to the relationship between the biological and the social that relies upon notions of connection, entanglement and symbiosis. In the third chapter I named this approach ‘symbiosociality’, having developed it as a response to the conservatism of sociobiology, and subsequently elaborating it alongside and through notions of diffraction and interference, as well as the evolutionary phenomenon of symbiogenesis. Essential to the symbiosocial approach is the idea that the world is active and agential, unpredictable and lively, prior to human intervention. I engaged with this insight from a number of different science studies scholars, and linked it to a queer approach that emphasises the strangeness of material bodies and the non-normative meanings that these bodies can produce.

Throughout this thesis I have focused on the biological so as to trouble a series of binary oppositions. These have included the opposition between the active and passive, agent/resource

¹ Timothy Morton, ‘Queer Ecology’, *PMLA*, 125:2 (2010), 273–282 (p. 275).

binary in evolutionary narratives; the false choice between born and made in discussions of hypothetical gay genes; and between the biological and social and the human/nonhuman distinction. A binary opposition left uninterrogated so far is that between the living and the non-living. This is a fundamental opposition which I will argue structures biological science and has real consequences for individuals and communities. This final chapter serves as an interruption to the trajectory of the thesis so far; in fact, I will argue that interruption is a necessary and productive critical practice. In particular I will be focusing on viruses as interruptive material agents, to interrogate whether the symbiosocial framework developed in earlier chapters is useful for thinking about companion species relationships with biological or material agents that are arguably neither organisms nor alive. The description of viruses as either biological or material agents reflects the problematic status of viruses as either living or non-living. The question of whether the *bios* (life) of biology can fully be applied to such liminal agents is discussed in more detail later in the chapter. Viruses are material agents that problematise and draw attention to the culturally and historically situated nature of the agential cut that distinguishes between living and non-living.

The boundary between the living and non-living structures the theory and practice of the science of biology. In this chapter I will be arguing that the virus, as an ‘organism at the edge of life’, interrupts understandings of life and death as well as interrupting linear, teleological and progressive narratives of evolution.² I will argue that the living/non-living binary (with its corollaries of life/death, animate/inanimate, organic/inorganic) is important as it not only influences how life forms are defined, but also how ‘forms of life’ and ways of living are defined and perceived. This is a political point, and I will use the example of human immunodeficiency virus (HIV) and theories that address people living with HIV/AIDS, to interrogate the relationship between the problematic liminal status of the virus and the forms of life that are considered acceptable in the wake of the AIDS

² I take the description of viruses as ‘organisms at the edge of life’ from E. P. Rybicki, ‘The Classification of Organisms at the Edge of Life, or Problems with Virus Systematics’, *South African Journal of Science*, 86 (1990) 182–186.

epidemic. To argue this I will also be focusing on the role of viruses in human genomics as well as in evolution, to suggest that the virus is a figure that interrupts linear temporalities of evolution and queers any attempt to produce heteronormative and linear genealogies of the natural world. I will use work from recent developments in the field of queer ecologies to once again contextualise the human (biologically and socially) within the more-than-human world; this, along with companion species insights from the previous chapters will offer a way of resisting heteronormative and reified 'tree' metaphors, whether in genealogy or evolutionary phylogeny. I will also argue that this approach, focusing on the biopolitics of HIV/AIDS, can be a useful way of thinking through how different individuals, groups and communities can wield or resist biopower, and how to live with the virus. This builds on the insight from previous chapters that attention to the biological sciences (and the complex agency of the biological) can offer the possibility for new and alternative positions, narratives and bodies of knowledge. This has clear political consequences, as these alternative positions, narratives and knowledges can resist conservative or oppressive regulatory mechanism relating to life forms and forms of life. This is as much about dying as it is about living, and about practices of dying as much as ways of living.

In the previous chapter I focused on Donna Haraway's companion species and Myra J. Hird's microontologies to elaborate the notion of symbiosociality. In this chapter I want to suggest that Hird's microontologies and Haraway's becoming-with dogs need to be carefully analysed and employed, as they could be read in a too positive light: too much emphasis on becoming without adequate focus on the negative and threatening possibility of unbecoming. As I described, Hird's bacteria are productive, creative, constitutive others that the human is always necessarily entangled with, and Haraway's curiosity about her dog is formulated as a responsibility to the more-than-human, one that demands knowing more, and becoming-with. Both of these approaches are important to my queer project of more-than-human relations and responsibilities. However, it is critical that these approaches are not simply read as emphasising production, creation, and becoming, as this risks a return to overly romantic notions of nature, a reinvestment in the idea of

the self (now multiple) and the uncritical appearance of narratives dependent upon normative linear temporality, ideas of development and progress. Rather than criticising Haraway or Hird, I want to suggest that there is a risk, a tension, and a political urgency in their writing that must be maintained and not collapsed. As Haraway states: 'My multispecies storytelling is about recuperation in complex histories that are as full of dying as living, as full of endings – even genocides, the killing of kinds – as beginnings.'³ I gestured towards this in the previous chapter in my discussion of Haraway's proposed use of curiosity as a critical practice. Curiosity must be as much about the danger of knowing nothing, of unbecoming, as of becoming-with and knowing more. As I argued in the previous chapter, knowing itself can be read as dangerously close to a distancing of subject and object; the kind of 'knowing' that Haraway is suggesting here, however, is the situated knowledge of connections and conversations, as articulated in the first chapter. Haraway's situated knowledges and multispecies becoming-with are integral to my project. For this queer project, unbecoming is also important; unbecoming can counter narratives of development and progress – narratives that are linked to heteronormativity in ideas of reproduction, family and vertical inheritance.⁴ Unbecoming is also important as becoming-with the virus – I will be specifically discussing the example of people living with HIV/AIDS – is also a biopolitical unbecoming, and this must be reckoned with, as it has real biological-social effects for the possibility of some biopolitical citizens to live well.

I will be using the virus as a figure, to think through knots of meaning that are at once biological and social. To link the virus and the queer I will be focusing on an additional figure – that of the monster. I will suggest that the knotting of the queer, the virus and the monster can offer

³ Donna Haraway, 'Cosmopolitical Critters: Companion Species, SF and Staying with the Trouble', unpublished paper presented at *Cosmopolitan Animals*, John Coffin Memorial Lecture, Institute of English Studies, 26 October 2012. A recording is available online at *Youtube*, 19 November 2012 <<http://www.youtube.com/watch?v=fMIm0SeRRY4>> [accessed 17 February 2013]. See also Haraway, 'When Species Meet: Staying with the Trouble'.

⁴ Unbecoming also has queer connotations related to 'proper' or normative behaviour. Behaviour unbecoming of an individual is that behaviour that is deemed improper, inappropriate, or unseemly. Unbecoming, in this chapter, carries all these non-normative connotations.

ways of rethinking possibilities of queer futurity – not only beyond norms of heterosexual reproduction but also for possible future ways of living-with the virus. In this final chapter, then, I will go beyond bacterial becoming-with, and employ a symbiosocial approach to the role of viruses in human genomics and evolution. I will explore the role of viruses as integral to life yet also threatening to it (in fact as questioning the very meaning of ‘life’); as productive in the phenomena of horizontal gene transfer and gene-shuffling; as dangerously interruptive to narratives of development, production and creation; and as figures that – through their liminal status and their interruptive abilities – can be useful for thinking futurity outside the normative concepts of familial kinship, development, progress and vertical inheritance. I will argue that this is especially pressing, as imagining and bringing about a future where we live *without* AIDS is important, but this can threaten to relegate people currently living with HIV/AIDS to a non-living category. Imagining and bringing about alternative futures of living *with* the virus is thus also essential for living well and dying well in the more-than-human world.

What is a Virus?

I will be exploring the virus as a figure, but as I discussed in the previous chapter, figures are not metaphors or representations, but rather ‘material-semiotic nodes or knots in which diverse bodies and meaning co-shape one another’.⁵ Figures are ‘real’ material entities and also culturally and historically situated sites of meaning. It is therefore important for my project, which emphasises the agential character of the more-than-human, to explore the material and biological specificity of viruses (including their discovery/construction in and through the discourses of the biological sciences). Scientists had been aware that diseases could be caused by infectious microbes since the

⁵ Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), p. 4.

work of Louis Pasteur in Paris and Robert Koch in Berlin in the mid-nineteenth century.⁶ Robert Koch, in particular, conclusively demonstrated in 1876 that *Bacillus anthracis* caused anthrax disease.⁷ Around the same time, German agricultural chemist Adolf Mayer was attempting to isolate the cause of the tobacco mosaic disease, which was devastating Dutch tobacco crops, stunting plant growth and causing mosaics of living and dead tissue on the plants' leaves.⁸ Mayer eliminated the possibility of fungi and parasites, and began to investigate the possibility of infectious bacteria. He incubated cultures of bacteria from the sap of the plants, but failed to infect healthy plants with these bacteria, and his research concluded unsuccessfully. Then Martinus Beijerinck, a Dutch soil microbiologist, who had been working with Mayer, ground up diseased plants and passed the resultant fluid through a filter fine enough to block plant and bacteria cells. Beijerinck found that not only could he infect healthy plants with this filtered fluid, but he could then repeat the process with the newly-infected plants and infect more healthy plants. He thus concluded that there was something smaller than bacteria in the liquid, something that could spread disease and could self-replicate.⁹

The properties of viruses were not defined scientifically until Pierre Roux, Director of the Pasteur Institute in Paris, described three characteristics of viruses: viruses were filterable (they could pass through filters which retained bacteria), invisible (they could not be seen with a light microscope), and non-culturable (unlike bacteria, they could not be grown on culture plates).¹⁰ It is

⁶ Dorothy H. Crawford, *The Invisible Enemy: A Natural History of Viruses* (Oxford: Oxford University Press, 2000), especially pp. 11–15. My account of the discovery of viruses in the biological and chemical sciences is taken mainly from this source, and from Carl Zimmer, *A Planet of Viruses* (Chicago: University of Chicago Press, 2011). These are accounts of the discovery and spread of specific viruses, written for a lay audience. They are both useful texts for this chapter, as they place the discovery of viruses within social and historical contexts as well as exploring the relationship between the material specificity of HIV and other viruses and their personal and global effects.

⁷ This was published in German as Robert Koch, 'Untersuchungen über Bakterien: V. Die Ätiologie der Milzbrand-Krankheit, begründet auf die Entwicklungsgeschichte des *Bacillus anthracis*' ['Investigations into Bacteria: V. The Etiology of Anthrax, based on the Ontogenesis of *Bacillus anthracis*'], *Cohns Beiträge zur Biologie der Pflanzen*, 2:2 (1876), 277–310.

⁸ Carl Zimmer, *A Planet of Viruses*, p. 13.

⁹ Carl Zimmer, *A Planet of Viruses*, pp. 13–14.

¹⁰ Crawford, *The Invisible Enemy*, pp. 13–14.

interesting to note that even when defined in this way, viruses are still problematic. Two out of three of these criteria are negative characteristics: a material agent's invisibility or non-culturability makes it difficult to isolate, define and study. Filterability is also somewhat of a negative criterion: the ability to pass through a filter also represents the inability to capture the virus in a filter. Because of their invisibility to a light microscope, the physical structure of viruses was not revealed until the invention of electron microscopy in the 1930s. Wendell M. Stanley received the Nobel Prize for Chemistry in 1946 for his role in isolating, purifying and crystallising the tobacco mosaic virus in 1935 and providing evidence that viruses are molecules similar in some respects to inert chemical substances. Stanley stated in 1961 that viruses are notoriously difficult to define. He argues: 'About the only definition that *all* scientists will accept is: *Something* ... infectious and extremely small, which has the ability to cause disease in almost all living things, and which can reproduce only within living cells.'¹¹ The advent of genomics has expanded this definition only slightly. N. J. Dimmock, Andrew J. Easton, and Keith Leppard's *Introduction to Modern Virology* provides, by way of a definition, a list of six properties common to all viruses:

- Viruses have a nucleic acid genome of either DNA or RNA.
- Compared with a cell genome, viral genomes are small, but genomes of different viruses range in size by over 100-fold (c. 3000 nt [nucleotides] to 1,200,000 bp [base pairs])
- Small genomes make small particles – again with a 100-fold size range.
- Viral genomes are associated with protein that at its simplest forms the virus particle, but in some viruses this nucleoprotein is surrounded by further protein or a lipid bilayer.
- Viruses can only reproduce in living cells.
- The outermost proteins of the virus particle allow the virus to recognize the correct host cell and gain entry into its cytoplasm.¹²

¹¹ Wendell M. Stanley, *Viruses and the Nature of Life* (London: Methuen, 1961), p. 8.

¹² N. J. Dimmock, Andrew J. Easton, and Keith Leppard, *Introduction to Modern Virology*, 6th edn (Oxford: Blackwell, 2007), p. 5.

The essential definition remains the same. Viruses are extremely small, infectious, and can only reproduce within living cells. Electron microscopy and genomics have shown that viruses are comprised of a genome and a protein layer. The question of whether or not viruses are classified as alive, however, is still highly problematic and it reinforces and expands the taxonomic difficulties posed by bacteria discussed in the previous chapter.

The classification of viruses as living or non-living is a contemporary concern in the biological sciences. The question relates to issues of phylogenetics and the construction of a tree of life, the origins of living matter, and what exactly counts as living and non-living in biological scientific theory and practice. In 2009 two articles were published in *Nature* that argued opposite sides of the debate. The first was entitled, 'Ten Reasons to Exclude Viruses from the Tree of Life', and the second – a response – was published four months later under the title, 'Reasons to Include Viruses in the Tree of Life'. I will briefly summarise some of the main arguments put forward in these articles, with the intention of emphasising the problematic liminal nature of viruses: 'organisms on the edge of life'. It is not my intention to attempt to settle the debate, or to agree with either of the two opposing views. Rather, I want to preserve the liminal status of the virus. I also want to draw attention to the fact that the definition of the boundary between life and death, much like the taxonomic practices involved in defining species boundaries, discussed in the previous chapter, is complicated and problematic, as well as being always a socially and historically contingent practice. This has particular relevance as I am arguing that the boundary not only structures the theory and practice of science, but has political consequences for human health and living well.

It is important, at this point, to emphasise that there are a number of different oppositions relating to life that are at work throughout this discussion, and which function in slightly different ways. These oppositions are not just living/non-living, but also (and this is not an exhaustive list): life/non-life, living/dying, life/death, organic/inorganic, animate/inanimate (with its connotations of spirit), functioning/non-functioning (or 'junk', in genetics and genomics), and the distinction

between citizenship or political life (*bios*) and bare life (*zoē*) from Agamben which I will explore in more detail shortly. These oppositions are similar and are at times intersectional and contiguous; however they are not interchangeable. In this chapter I will be focusing mainly on the virus as a material agent and some of the ways in which it problematises the living/non-living binary. However, thinking with the liminal virus can complicate the other related binary oppositions. Crucial to my project is the liminal status not just of the virus, but of people living with the virus – specifically their relation to the oppositions of living/dying and life/bare life. More specifically, people living with viruses are placed into a complicated relationship with the living/non-living status of their viral companions, their own life and death, as well as with their ability to live a political life, and to resist their categorisation as bare life.

Evolutionary biologist David Moreira and microbiologist Purificación López-García's article, 'Ten Reasons to Exclude Viruses from the Tree of Life', suggests that it could be argued that viruses' status as either living or non-living is somewhat arbitrary. The authors, however, argue that: 'We believe that considering viruses alive or not is not just a matter of opinion, contrary to a commonly held view, but rather is a matter of inference and logic starting from any given definition of life.'¹³ Moreira and López-García's argument is that from an agreed definition of life, viruses can be unproblematically defined as either living or not. From this starting-point, they outline ten reasons why viruses should not be considered living within their definition of life. These include the lack of an identifiable viral lineage correspondent to a genetic lineage or phylogeny, as well as the lack of an inherited structure that would suggest a common ancestor, unlike that which can be suggested for cells. Also, viral dependence on other organisms to self-sustain and self-replicate is used as evidence of the virus's status as non-living. For an organism to be alive, in Moreira and López-García's view, it

¹³ David Moreira and Purificación López-García, 'Ten Reasons to Exclude Viruses from the Tree of Life', *Nature Reviews Microbiology*, 7 (April, 2009), 306–311 (p. 307).

must self-sustain and self-replicate autonomously, and be classifiable within a vertical scale of genetic or biological inheritance.

In their letter of response, microbiologist Nagendra R. Hegde and others outline the opposite view, that viruses should be considered living organisms. They argue that it is misleading to classify organisms as living or not depending on whether they can autonomously self-sustain and self-replicate. They argue that:

Although viruses need host cells for survival and replication, we cannot argue that viruses will not survive in nature if we leave them alone, as hosts themselves are part of the continuum of nature. In fact, even animals and birds are not sustained in nature unless they obtain food from other sources of life, that is, plants or other animals. Thus, similarly to viruses, animals and birds are dependent on other species to be sustained in nature.¹⁴

Hegde and others propose that to argue that viruses are non-living, due to their dependence upon other organisms, would call into question the status of all living organisms; all organisms are, in some sense, dependent upon other organisms for their survival. They also argue that evidence from virus-plant interactions suggests that viruses have existed and evolved since the origin of life, although they have evolved at a much higher rate than other organisms. This, for the authors, would explain the polyphyletic character of viruses – the fact that viruses resist being classified into a single branching tree or phylogeny. Viral evolution seems to emphasise the impossibility of producing a clear singular tree of life, or at least draw attention to the contingency of boundary-making practices such as taxonomic classification.

The liminal status of the virus, and the difficulties that arise in the classification of viruses as either living or non-living, draw attention to the distinction between the living and non-living and how this distinction is maintained. Viruses draw attention to the agential cut that produces the idea

¹⁴ Nagendra R. Hegde and others, 'Reasons to Include Viruses in Tree of Life', *Nature Reviews Microbiology*, 7 (August, 2009), 615 (p. 615). Birds are, of course, animals. It is unclear why the authors make this distinction.

of the living and non-living in opposition to each other. Essential to this cut is the way in which 'life' is understood and defined. Crucially, I will argue that the agential cut that defines life in opposition to the non-living has consequences for how 'forms of life' and ways of living are considered. I will give a brief and selective history of the concept of 'life' in order to draw out some of the implications for the definition of viruses and their role in evolution and contemporary genomics. Taking this a step further I will introduce the example of the HIV virus to illustrate that the liminal status of the virus and the material bodily experience of people living with viruses are entangled with both the definition of life forms and forms of life or ways of living. Initially, however, I will explore contemporary understandings of the virus in relation to genomics, to illustrate how contemporary scientific theory and practice negotiate the liminal status of the virus, and how the virus problematises any clear distinction between living and non-living.

Viral Genomes

As discussed in Chapter Two, one of the consequences of the Human Genome Project, and the related large-scale focus on gene-sequencing in the 1990s was the realisation that genes were more complex than previously thought, and that only a small percentage of the genome actually coded for proteins. Previously, scientists had estimated that the human genome would contain 50-100,000 protein-coding genes yet the Human Genome Project revealed that it only included 20-25,000 (as a comparison, fruit flies have 13,000, roundworms 19,000 and some plants, such as rice, have as many as 46,000).¹⁵ Also, it became clear that these protein-coding genes actually make up only roughly 1.5% of the genome. Viral or viral-like genetic material is more prevalent than protein-coding genes in the human genome. Human endogenated retroviruses (HERVs), ancient viruses that have been integrated into the genome, make up about 9%, and virus-like material makes up roughly

¹⁵ Carninci Piero and Hayashizaki Yoshihide, 'Noncoding RNA Transcription beyond Annotated Genes', *Current Opinion in Genetics and Development*, 17:2 (2007), 139-144.

another 34% of the human genome.¹⁶ The material in the genome that does not code for protein, or whose function is unknown, is often referred to as 'junk DNA'.

The term 'junk DNA' was coined in 1972 by geneticist and evolutionary biologist Susumu Ohno to refer to sequences of amino acids that make up genes, but that seemingly have no function.¹⁷ The term continues to be used to refer to any portion of genome sequences that have no known function, even though the term is potentially misleading. It has been suggested that the term 'junk DNA' actually holds back research.¹⁸ Theresa Marie MacPhail argues that the distinction between coding and non-coding genes (or between functioning and 'junk' DNA) is closely related to the distinction between the living and the non-living.¹⁹ To illustrate this point, and to put into question the gene as symbol for life, she uses the example of pseudogenes or 'dead genes'. She refers to an article in *Science*, where Michael Snyder and Mark Gerstein define pseudogenes as:

similar in sequence to normal genes, but they usually contain obvious disablements such as frameshifts or stop codons in the middle of coding domains. This prevents them from producing a functional product or having a detectable effect on the organism's phenotype.²⁰

MacPhail argues that pseudogenes are still classified as genes, albeit false or dead versions of their living or functioning counterparts. This classification is not always easy to make, as non-functioning (or 'dead') genes in one organism can be functional (or 'living') in another, even within the same species. Snyder and Gerstein make this clear when they state: 'The boundary between living and dead genes is often not sharp.'²¹ Contemporary research into 'junk DNA' is also beginning to suggest that non-coding genetic material has a variety of genomic functions, complicating and questioning

¹⁶ Frank Ryan, 'I, Virus: Why you're Only Half Human', *New Scientist*, 29 January 2010.

¹⁷ Susumu Ohno, 'So much "Junk" DNA in our Genome', *Brookhaven Symposium on Biology*, 23 (1972), 366–70.

¹⁸ Wojciech Makalowski, 'What is Junk DNA, and what is it Worth?', *Scientific American*, 296:5 (2007), 104 (p.104).

¹⁹ Theresa Marie MacPhail, 'The Viral Gene: An Undead Metaphor Recoding Life', *Science as Culture*, 13:3 (2004), 325–345.

²⁰ Michael Snyder and Mark Gerstein, 'Defining Genes in the Genomics Era', *Science*, 300 (2003), 258–260 (p. 258).

²¹ Snyder and Gerstein, 'Defining Genes in the Genomics Era', p. 259.

the distinction between the functioning/non-functioning, living/non-living, alive/dead in genomics.²² The classification of genes as either living or 'dead', based on whether they code for proteins or have a known function, draws attention to the agential cut being made between life and non-life. At the same time, the prevalence of 'dead' material within a 'living' genome further complicates our understanding of genomics, as well as problematising the practice of creating and maintaining a distinction between the living and non-living.

The prevalence of virus-like material, as well as HERVs in the human genome further problematises the distinction between living and non-living in relation to genetic material. As MacPhail asks: 'What would it mean if some of that non-coding "junk" were viruses or leftover viral remnants? Where would that leave the boundary between coding and non-coding, gene and virus, living and non-living, human and non-human?'²³ Viruses are liminal material agents 'on the edge of life', not easily classified as either living or non-living. Within the gene, the virus's liminality is compounded. As part of what was once considered 'dead' or 'junk' material within the genome, material that is only very recently being thought of as having a more active role, the virus somewhat collapses or threatens the distinction between the living and the non-living in genomics. MacPhail appropriates the metaphor of genes writing the book of life, and suggests thinking of the 'viral gene' as 'death "scripting" life'.²⁴ Importantly, the distinction between the living and the non-living is brought into question by the virus, and it is this interruptive ability of the virus – the ability to

²² The Encyclopedia of DNA Elements (ENCODE) published their findings in several articles in the journals *Nature*, *Genome Biology*, and *Genome Research*. In these articles they claim that approximately 80% could be functional, ascribing more functionality to genetic material that regulates the expression of the coding genes. The publications are all collected, along with further information, at 'Research Papers', *Nature: ENCODE* <<http://www.nature.com/encode/category/research-papers>> [accessed 24 February 2013]. Biologists are not, however, in agreement with the ENCODE findings. For particularly strident criticism, see Dan Graur and others, 'On the Immortality of Television Sets: "Function" in the Human Genome according to the Evolution-Free Gospel of ENCODE', *Genome Biology and Evolution*, published online 20 February 2013 <<http://gbe.oxfordjournals.org/content/early/2013/02/20/gbe.evt028.full.pdf+html>> [accessed 24 February 2013].

²³ MacPhail, 'The Viral Gene', p. 332.

²⁴ MacPhail, 'The Viral Gene', p. 337.

interrupt and threaten normative classificatory practices – that I will draw on later in this chapter in relation to heteronormativity and temporality.

MacPhail's figure of the viral gene emphasises the existence of viral material in the human genome. She suggests that the distinction between genes and life, and viruses and death (or non-life) is unsustainable:

Genes are viruses are genes. From this perspective, there are no metaphysical polar opposites; therefore the definition of the gene must expand to include the possibility of non-coding viruses or viral segments acting as exons. The comfortable conception of the gene as the fundamental unit of life and of the virus as an agent of disease or death becomes untenable. A new metaphor begins to emerge – one that draws upon 'death' as one of the central 'authors' of life.²⁵

It is worth noting that for MacPhail, this is a new metaphor; however, as I will discuss shortly, Michel Foucault argues that death is both frontier and structural interior to life and the very theory and practice of biology as a science, despite the attempt to enforce a living/non-living opposition. In Chapter Two I argued that genes are active agents, causing interference within biological-social diffraction patterns. Viral material with the genome further emphasises the complexity and non-fixity of genomics. Viral agency within the gene also reflects the symbiosocial character of this diffraction pattern: genes themselves are not individual actors, but entangled biological-social agencies that are themselves formed in assemblage and relation with, among other agencies, the viral. Once again, it is turtles all the way down. As I explained in the previous chapter, symbiosociality inherits a Foucauldian history and is always about situated and specific instances and negotiations of biopolitics and biopower. The definition and maintenance of the boundary between living and non-living is an historically and culturally situated practice. The definition of life is always

²⁵ MacPhail, 'The Viral Gene', p. 340.

socially mediated; as I will argue, the definition of life forms is always entangled with the definition and consideration of forms of life, or ways of living. To make this connection explicit I will explore the scientific question of what constitutes life, before looking at theorists that have elucidated the links between the biological and social definitions of life: that is, between life forms and forms of life.

Life Forms and Forms of Life

The question of how to define life was posed by physicist Erwin Schrödinger in his 1944 book, *What is Life?*, written for a lay audience. In this book, he approaches the question of how to define life from the perspective of physics and chemistry. Specifically, he asks: ‘How can the events *in space and time* which take place within the spatial boundary of a living organism be accounted for by physics and chemistry?’ The book is short and speculative, both in terms of physics and philosophy. However, Schrödinger states that the ‘inability of present-day physics and chemistry to account for such events is no reason at all for doubting that they can be accounted for by those sciences’.²⁶ Schrödinger, one of the founders of quantum mechanics, held that life is material, and must be inherited through a molecule that repeats its structure. Published before the discovery of the helical structure of DNA, *What is Life?* suggests the existence of an ‘aperiodic crystal’ that he tentatively calls a ‘gene’ and suggests could be the ‘material carrier of life’.²⁷ Lynn Margulis and Dorion Sagan, writing more than 50 years later suggest that Schrödinger’s original text was, despite his insistence on the materiality of life, a celebration of the complexity of life rather than a reduction of life to mechanical principles.²⁸ In their book, *What is Life?* Margulis and Sagan attempt to ‘put the life back into biology’ and update Schrödinger’s enquiry.²⁹ Throughout the book Margulis and Sagan define life as the complex relations between organisms of all sizes that make up the biosphere.

²⁶ Erwin Schrödinger, *What is Life? The Physical Aspect of the Living Cell* (Cambridge, Cambridge University Press, 1951 [1944]), p. 1–2.

²⁷ Schrödinger, *What is Life?*, pp. 3 and 29.

²⁸ Lynn Margulis and Dorion Sagan, *What is Life?* (London: Weidenfeld and Nicolson, 1995), p. 1. See also, *What is Life? The Next Fifty Years*, ed. by Michael P. Murphy and Luke A. J. O’Neill (Cambridge: Cambridge University Press, 1995).

²⁹ Margulis and Sagan, *What is Life?*, p. 12.

Crucial to their definition of life is the concept of autopoiesis. Margulis and Sagan define autopoiesis as metabolism, self-perpetuation through chemical activity, energy expenditure and 'the making of messes'.³⁰ For Margulis and Sagan, an organism is alive if it self-perpetuates, metabolises and increases the disorder in its immediate environment. Using this set of criteria, Margulis and Sagan reject reproduction (or replication) as a criterion of life, arguing that focusing on replication rather than autopoiesis would, for example, relegate mules (the sterile offspring of a horse and a donkey) as well as 'humans who no longer, never could, or simply choose not to reproduce' to the status of 'nonliving'.³¹ Interestingly, this comment gestures to (even though it avoids fully commenting on) the close relation between how life is defined biologically and how ways of living are considered socially.

Michel Foucault emphasises the relation between the definition of life and the discourse of science as a social practice in *The Order of Things: An Archaeology of the Human Sciences*. Foucault argues that at the end of the eighteenth century the classificatory practices of natural history began to change; specifically he claims that a new division between the living and non-living – between the organic and inorganic – began to structure the theory and practice of a new science, called biology.

Historians want to write histories of biology in the eighteenth century; but they do not realize that biology did not exist then, and that the pattern of knowledge that has been familiar to us for a hundred and fifty years is not valid for a previous period. And that, if biology was unknown, there was a very simple reason for it: that life itself did not exist. All that existed was living beings, which were viewed through a grid of knowledge constituted by *natural history*.³²

³⁰ Margulis and Sagan, *What is Life?*, p. 8.

³¹ Margulis and Sagan, *What is Life?*, p. 8.

³² Michel Foucault, *The Order of Things: An Archaeology of the Human Sciences* (London: Routledge, 2002 [1966]), p. 139.

Foucault argues that classification and the practice of taxonomy existed in the eighteenth century as part of a discourse of natural history. Biology, however, was fundamentally structured over the binary oppositions of living/non-living, organic/inorganic. He states that at the end of the eighteenth century:

The organic becomes the living and the living is that which produces, grows, and reproduces; the inorganic is that non-living, that which neither develops nor reproduces; it lies at the frontiers of life, it is so as that element within it that destroys and kills it.³³

For Foucault, the discourse of biology and the opposition of life and death – of the living and non-living – were co-constitutive. The emergence of ‘something resembling a biology’ enabled and was enabled by the emergence of a fundamental opposition of life and death.³⁴ Foucault draws attention to the fact that the seeming opposition of living and non-living in biology does not, in fact, function as an opposition. This insight supports MacPhail’s work on viral material within the human genome. Nonlife is both life’s frontier and internal to its structure and function.

Nikolas Rose expands upon Foucault’s argument, as well as that of Giorgio Agamben in *Homo Sacer*, in his influential work on the politics of ‘life itself’.³⁵ Agamben argues in *Homo Sacer* that the definition of life is always political. In particular, he claims that a healthy body politic requires the control and elimination of individuals and communities that are perceived as threatening its health. Agamben draws a distinction between *zoē*, what he calls ‘bare life’ and *bios*. Agamben describes the difference as follows: *zoē* refers to ‘the simple fact of living common to all beings’ or ‘bare life’, while *bios* indicates ‘the form or way of living proper to an individual or a group’.³⁶ For Agamben, biopower functions through defining and excluding bare life from the life of

³³ Foucault, *The Order of Things*, p. 252.

³⁴ Foucault, *The Order of Things*, p. 252.

³⁵ Nikolas Rose, ‘The Politics of Life Itself’, *Theory, Culture and Society*, 18:6 (2001), 1–30; and *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century* (Princeton: Princeton University Press, 2007).

³⁶ Giorgio Agamben, *Homo Sacer: Sovereign Power and Bare Life* (California: Stanford University Press, 1995), p. 1.

the body politic. As Rose summarises, 'Agamben asserts that "the camp" is the "biopolitical paradigm of the modern": when the collective body of the people becomes the principal resource for politics, the purging of defective individuals becomes an essential part of the care of life.'³⁷ Rose agrees with Agamben's formulation of biopower as far as the first half of the twentieth century is concerned. He claims, with Agamben, that:

Health was understood as fitness, and the problem was framed in terms of the political importance attached to the fitness of the national population considered en masse, as it competed with other national populations. Population fitness was liable to threats from within and without, and national governments had the obligation to guard against these threats and to take measures to enhance that fitness through policies that were formulated by, and enacted through, the apparatus of the state.³⁸

Rose argues, however, that biopower does not function in quite the same way in contemporary science, politics and health practices. In a conclusion that I will return to and question in relation to HIV/AIDS and recent US immigration policy, he claims that biopower no longer functions through the classification, identification, elimination or constraint of individuals considered dangerous to the overall health or fitness of the population, nation or race. Rather, he claims that contemporary biopolitics functions primarily through risk management.³⁹

The interpretation and elaboration of Foucault's biopolitics, Rose's 'politics of life itself', and Agamben's bare life that I find most useful for my project and will be employing here is that put forward by Stefan Helmreich in *Alien Ocean: Anthropological Voyages in Microbial Seas*. Helmreich usefully explores the distinction and relation between biological 'life forms' and social 'forms of life' (as corollaries to Agamben's *zoē* and *bios*).⁴⁰ For Helmreich, Rose's formulation of a molecular

³⁷ Rose, 'The Politics of Life Itself', p. 3.

³⁸ Rose, 'The Politics of Life Itself', p. 5.

³⁹ Rose, 'The Politics of Life Itself', p. 6–7.

⁴⁰ Stefan Helmreich, *Alien Ocean: Anthropological Voyages in Microbial Seas* (Berkeley: University of California Press, 2009), p. 82.

biopolitics suggests the possibility of transfer, building on the phenomenon of horizontal gene transfer, as well as protein and tissue transfer and transplantation: ‘*transfer* may be the practice through which new biopolitical links – between persons and patent, polymorphisms and politics – will be forged’.⁴¹ Helmreich suggests that:

The mobility and delocalization facilitated by the dynamics of transfer also mean that nation-states are no longer the exclusive bankers of biopower; corporations, universities, patient advocacy groups, and many others reshuffle not just the substance at stake in biopower but also relations between society and biology to begin with.⁴²

Crucial to my project is Helmreich’s articulation of ‘life forms’ and ‘forms of life’. Although the virus is arguably not a life form, its classification matters and is caught up in the biopolitics of what forms of life are proper or acceptable to individuals or groups. The virus is part of the body politic in that it must be closely identified, watched, detected, and controlled. It is, in fact, central to biopolitics.

Also, Helmreich emphasises the always political nature of this distinction; in the example I will explore shortly – people living with HIV/AIDS – individuals are often relegated to the status of bare life and denied political citizenship. Not only this, but practices and communities (forms of life) are also placed under threat. Importantly for my argument, however, is the possibility of alternative positions. In this articulation, communities such as patient advocacy groups can resist dominant deployments of biopower, through horizontal community formation, and the mobilisation and delocalisation of knowledge and power through the dynamics of transfer.

Living with the Virus: HIV

While still preserving the problematic and liminal position of the virus somewhere between living and non-living, between an organism and the inorganic, I want to discuss a particular example of a virus. I will be applying Haraway’s insistence upon curiosity as the first obligation of companion

⁴¹ Helmreich, *Alien Ocean*, p. 101.

⁴² Helmreich, *Alien Ocean*, p. 101.

species, asking – in a similar vein to the bacterial question posed in the previous chapter – who and what are the biological-social partners touching in human-viral relations? Specifically I will be focusing on HIV and exploring the companion species relationships between humans and viruses, and thinking through some of the biological and political consequences. As I have previously stated, it is important for my project to pay close attention to the specificity of the material agent in question when starting from the assumption that the world is active and agential, and not just a passive resource for either scientific or social theories. Thus, a brief exploration of HIV's material specificity is important. HIV, or human immunodeficiency virus, is a retrovirus. Virologist Dorothy Crawford (who, interestingly, describes viruses as 'organisms' – and therefore presumably living – throughout her work *The Invisible Enemy*) describes retroviruses as follows:

Retroviruses [...] are so called because of their unique survival strategy. Their genetic material is carried as RNA, whereas in all organisms except RNA viruses the genetic code is carried as DNA which is only translated into RNA as a prelude to making protein from an individual gene.⁴³

Retroviruses contain their RNA and an enzyme called reverse transcriptase which reverses a cell's usual process of converting DNA into RNA so as to convert the viral RNA into a DNA copy. This copy is then integrated into the host cell's own DNA and can remain inside the cell for its lifetime as a latent infection.⁴⁴

With HIV, the latent infection stage is an average of 10 years in the west. Initial infection results in mild flu-like symptoms or an illness similar to glandular fever. Crawford explains:

At this stage, levels of HIV in the blood are very high, the virus spreads throughout the body in CD4 T cells [important white blood cells that activate or direct other immune cells] and even lodges in the brain. This infection is brought under control 2–3 weeks later when the

⁴³ Crawford, *The Invisible Enemy*, p. 126.

⁴⁴ Crawford, *The Invisible Enemy*, p. 126–127.

immune response is fully operational and the person recovers to remain healthy for an average of 10 years.⁴⁵

Initially, the immune system controls the spread of the virus through the body, but the virus reproduces extremely quickly and every time it reproduces it produces mutations that can evade detection. Viruses that have mutations that can evade the immune system are favoured by natural selection; they therefore proliferate wildly until the immune system catches up, by which time new mutations have arisen and the process repeats.⁴⁶ HIV can destroy 1 to 2 billion CD4 T cells every day throughout this process.⁴⁷ In the early stages of the infection, new cells made in the bone marrow make up for the deficit, but Crawford uses the metaphor of a sink with inflowing water from a running tap and outflowing water through a drain. As soon as outflow (the number of cells killed by HIV) exceeds inflow (new CD4 T-cells from the bone marrow), immune deficiency follows.⁴⁸ This, along with opportunistic infections from other viruses, bacteria and fungi, can lead to the final stage of infection – AIDS (acquired immune deficiency syndrome).⁴⁹

The origin of HIV is hard to determine, but many virologists and epidemiologists believe that it originated in sub-Saharan Africa, and crossed the species barrier from monkeys and chimpanzees.⁵⁰ Robin A. Weiss and Richard W. Wrangham, molecular biologist and primatologist respectively, emphasise in an article in *Nature* that the hypothesised origin of HIV-1 in chimpanzees

⁴⁵ Crawford, *The Invisible Enemy*, p. 130.

⁴⁶ Crawford, *The Invisible Enemy*, p. 130.

⁴⁷ See D. D. Ho and others, 'Rapid Turnover of Plasma Virions and CD4 Lymphocytes in HIV-1 Infection', *Nature*, 373 (1995), 123–6.

⁴⁸ Crawford, *The Invisible Enemy*, p. 131.

⁴⁹ This is the generally accepted view in the biomedical and activist community – that HIV causes AIDS. However, not all scientists, sufferers or patient groups have always agreed with this paradigm, and some continue to question it today. See Steven Epstein, *Impure Science: Aids, Activism and the Politics of Knowledge* (California: University of California Press, 1996), especially pp. 45–78. It is also worth noting that Lynn Margulis is sceptical of a viral cause to AIDS, suggesting that AIDS may in fact be caused by syphilis (Dick Teresi, 'Discover Interview: Lynn Margulis Says she's not Controversial, she's Right', *Discover Magazine*, April 2011 <<http://discovermagazine.com/2011/apr/16-interview-lynn-margulis-not-controversial-right>> [accessed 29 August 2012]).

⁵⁰ See P. M. Sharp and others, 'The Origins of Acquired Immune Deficiency Syndrome Viruses: Where and When?', *Philosophical Transactions of the Royal Society B: Biological Sciences*, 356:1410 (2001), 867–76; and F. Gao and others, 'Origin of HIV-1 in the Chimpanzee *Pan troglodytes troglodytes*' *Nature*, 397 (1999), 436–41.

(HIV-2, the strain of the virus localised to West Africa is thought to have originated in monkeys) bears upon a number of issues including viral evolution, disease transmission including trans-species infection, and conservation.⁵¹ The virus's origin story is, in fact, not what is most important here; what is important is rather that even in its hypothetical origin, the virus is entangled up in multispecies knots.⁵² Furthermore, upon spreading worldwide and becoming a pandemic, HIV also became a site of intersection for a number of other issues. HIV is primarily spread by sexual intercourse but has also spread through needle-sharing in drug use, emphasising the role of drug policies and enforcement. Crawford describes how policies in Edinburgh at the beginning of the 1980s – such as discouraging pharmacists and surgical supply shops from supplying needles to drug users, as well as the removal of injection equipment whenever drugs were seized – led to a greater number of cases of HIV than anywhere else in the UK. Chief among the dangerous phenomena that arose in the face of such drug policy was that of 'shooting galleries', where numerous intravenous drug users would gather and inject on site, sharing equipment between up to forty people, and leave without incriminating evidence such as syringes. Drugs policy, as well as complex issues of class (as Crawford points out, 'most intravenous drug users in Edinburgh were young, local people who never left the city') here intersect with virology, disease transmission and public health.⁵³

I am exploring HIV/AIDS as a figure – a very real biological-social agent that knots together a number of biological, social and political threads, including issues of class, nation, policy and conservation. HIV/AIDS has been devastating to gay communities as well as to black and disadvantaged communities across the world. The virus, and its dangerous and deadly effects, illuminates the intersections of class, sexuality and race through the definition of both life forms and forms of life. As early as 1983, Larry Kramer drew attention to the intersection of class, sexuality and race in the biopolitics of HIV/AIDS and its scientific research and medical treatment:

⁵¹ Robin A. Weiss and Richard W. Wrangham, 'From *Pan* to Pandemic', *Nature*, 397 (1999), 385–86.

⁵² See Deborah Bird Rose, 'Multispecies Knots of Ethical Time', *Environmental Philosophy*, 9:1 (2012), 127–140.

⁵³ Crawford, *The Invisible Enemy*, p. 66.

There have been no confirmed cases of AIDS in straight, white, non-intravenous-drug-using, middle-class Americans. The only confirmed straights struck down by AIDS are members of groups just as disenfranchised as gay men: intravenous drug users, Haitians, eleven haemophiliacs (up from eight), black and Hispanic babies, and wives or partners of IV drug users and bisexual men.⁵⁴

Although the spread of HIV/AIDS has affected many other groups since the early 1980s, disenfranchised communities are still disproportionately affected. As an example of complex and intersectional biopolitics, the example of HIV/AIDS also prompts a reconsideration of Rose's argument that biopower no longer functions through the classification, identification, elimination or constraint of individuals considered dangerous to the overall health or fitness of the population, nation or race. Until 2010, the United States continued to deny immigrants citizenship on the basis of HIV/AIDS status. The ban on people with HIV/AIDS entering the USA and becoming US citizens was enacted in 1988 and only lifted in 2010.⁵⁵ Considering this alongside Kramer's statement from 1983, demonstrates the complex ways in which forms of biopower have in some sense changed and in some sense remain the same. In Rose's formulation of biopower, the nation state no longer protects itself and the notion of national health by identifying and eliminating or constraining individuals considered dangerous. The US ban demonstrates, however, that biopolitics can still function by eliminating groups or individual from the body of the nation, despite a shift in biopolitical meaning such as Rose describes.

Crucially, the US ban suggests that an individual with HIV/AIDS is considered a dangerous entity – much like a virus – that must be prevented from entering the body of the nation. The law led

⁵⁴ Larry Kramer, '1,112 and Counting', *New York Native*, 59 (1983). Reprinted in *Queer Theory*, ed. by Iain Morland and Annabelle Willox (Basingstoke: Palgrave, 2005), pp. 28–39 (p. 30).

⁵⁵ See 'US Lifts HIV/AIDS Immigration Ban', *BBC News*, 4 January 2010
<<http://news.bbc.co.uk/1/hi/world/americas/8438865.stm>> [accessed 24 August 2012].

to many people living with HIV/AIDS in the US becoming liminal figures, not just in terms of their illness but in terms of their national identity. Judith Butler, glossing Agamben, states that:

a subject deprived of rights of citizenship enters a suspended zone, neither living in the sense that a political animal lives, in community and bound by law, nor dead and, therefore, outside the constituting condition of the rule of law.⁵⁶

Thus, a person living with HIV/AIDS is reconfigured as a threat to the nation state, a dangerous liminal individual positioned somewhere between life and non-life. However, the mobility and delocalisation facilitated by the dynamics of transfer, as outlined by Helmreich, may also allow for the wielding and resisting of biopower by interest groups other than the nation state. This is an important point and can be seen in the ways that patient advocacy groups have worked to change the meanings associated with living with HIV/AIDS as well as reconfiguring infected bodies as active sites of biomedical knowledge rather than passive resource for biomedical science.⁵⁷ A more complex formulation of biopower and biopolitics is needed for the consideration of HIV/AIDS – a formulation that also takes into account the complex intersection of sexuality, economic power and race, as well as virology, epidemiology, national and international legal policy and issues of ecology, conservation, and multispecies worlding.

Queer Ecologies and Viral Evolution

I want to propose a queer ecological approach that recognises the fact that the human is always already embedded in networks of more-than-human agency, as well as stressing the biological-social, and also political, character of these networks. A queer ecological approach, I want to suggest, emphasises the entanglement of the biological and the social, and the ways in which life forms and forms of life are connected. My queer ecological approach will also be symbiosocial; the constitutive entanglements never resolve into individual actors. Sketching a preliminary framework

⁵⁶ Judith Butler, *Precarious Life: The Powers of Mourning and Violence* (London: Verso, 2004), p. 67.

⁵⁷ See Epstein, *Impure Science*, especially the second section: 'The Politics of Treatment', pp. 179–329.

of queer ecology, Timothy Morton asks: 'Ecology stems from biology, which has nonessentialist aspects. Queer theory is a nonessentialist view of gender and sexuality. It seems the two domains intersect, but how?'⁵⁸ Morton's framework of queer ecology is useful as he recognises the dangerous and chaotic character of the world. As he states, 'If anything, life is catastrophic, monstrous, nonholistic, and dislocated, not organic, coherent, or authoritative. Queering ecological criticism will involve engaging with these qualities.'⁵⁹ Morton's queer ecology is non-deterministic, something which he claims sets it apart from feminist ecocriticism. (Morton implies, rather unfairly, that the majority of feminist ecocriticism relies too heavily on rigid gender binaries and biological determinism.) Morton's framework embeds the human in a network of living and non-living agencies, and through doing this, opens the human up to unpredictable encounters with strange and unknowable others. For Morton, queer ecologies are always 'to come', echoing Derridean concepts of the future and the monstrous *arrivant*: a figure that I will discuss in more detail towards the end of this chapter.

As I argued in Chapter Two, queering is about relationality. My queer account is one that draws attention to discourses, narratives, bodies, communities and practices and how they intersect and relate, and how these relationalities can structure and be structured by norms of gender and sexuality. More specifically, my queer account draws attention to the political uses of scientific narratives and the fact that narratives and knowledges are formed in a dynamic relationality with each other and issues of gender and sexuality, as well as social and political forces of normativity and resistance. In Chapter Three I looked at queer kinship to rethink the definition of the human, and to question individuality and autonomy in biological and social accounts of organisms. What is clear from Chapter Three's discussion of Lynn Margulis's theory of symbiogenesis is that all bodies are full of multispecies agencies and entangled in multispecies relationships. In fact, all bodies are always

⁵⁸ Morton, 'Queer Ecology', p. 275. See also *Queer Ecologies: Sex, Nature, Politics, Desire*, ed. by Catriona Mortimer-Sandilands and Bruce Erickson (Indiana: Indiana University Press, 2010).

⁵⁹ Morton, 'Queer Ecology', p. 275.

already infected. If we have never been individuals, then neither have we been uninfected and pure. Although there remains a pervasive social stigma attached to particular infected, ill or diseased bodies, all bodies are always already infected, even from before birth. Viewing all bodies as multispecies assemblages – rather than seeing bodies as either clean, healthy and pure, or infected, unhealthy and impure – could have consequences for how infected bodies are conceived of, and therefore treated and cared for. This is both a biological and a political point, and is central to my queer account of the body, and of non-normative practices and communities.

A queer ecological approach draws attention to the innumerable constitutive relations and interconnections in which the human is always already entangled. The virus is an interesting figure, or knot, within this entangled ecology. Human entanglement with the virus is not just a contemporary phenomenon, but is also historical, temporal and ancestral. Scientists have speculated that viruses may have had a more active role in the evolution of, and possibly the origins of, life than previously thought. Also, scientists are increasingly recognising the importance of horizontal gene transfer to evolution, and recognising viruses' roles within this phenomenon.⁶⁰ Helmreich suggests that, since Darwin, evolutionary biologists have tended to try to arrange evolutionary descent in a tree-like system. However, microbiological research suggests that this practice may be misinformed:

It may be difficult to build trees, not only because of the tools scientists use, but because genes may often be transmitted laterally, within generations, in addition to cascading vertically 'down' generations. Microbes shuffle genes back and forth with their contemporaries, an activity mixing up their own and others' genealogies. Such lateral gene transfer could make it extremely difficult to arrive at a root for the tree of life.⁶¹

⁶⁰ For an example of the role of viruses in lateral gene transfer see Carlos Canchaya and others, 'Phage as Agents of Lateral Gene Transfer', *Current Opinion in Microbiology*, 6:4 (2003), 417–24.

⁶¹ Helmreich, *Alien Ocean*, p. 82.

The prevalence of horizontal gene transfer in bacterial evolution and the importance of bacterial symbiogenesis in the process of speciation and descent complicate the overly-simplistic metaphor of the tree of life. Helmreich recounts a conversation with biochemist Ford Doolittle, an opponent of the view of evolutionary descent as a bifurcating tree stemming from a single common ancestor, in which Doolittle complains that ‘people have deep paradigmatic commitments to trees; they are wedded to genes and trees’.⁶² Elsewhere Doolittle has questioned whether this commitment to trees in fact limits and obscures attempts to study the evolutionary histories of organisms:

To what extent is our desire to look at early evolution in terms of cellular lineages preventing us from seeing that it is about genes and their promiscuous spread across taxonomic boundaries, which then have no permanent significance?⁶³

Doolittle and his colleagues’ suggestion is a ‘Synthesis of Life’ which involves a rethinking of phylogenesis as the ‘development of a species or other group of organisms through a succession of forms’, which, ‘in no way requires that species or other groups be produced solely through divergence, nor that diagrammatic representation of the evolutionary development of species must be a bifurcating tree’.⁶⁴ While Helmreich agrees with Doolittle’s argument that the tree of life metaphor does not accurately represent microbial evolutionary relations, he draws attention to the fact that this ‘Synthesis of Life’, although it questions the reliance on trees, does not question the reliance on the symbol of the gene as ‘life itself’, and thus reifies the boundary between life and non-life. As Helmreich states: ‘What is preserved in this new map [...] is the figure of the gene, continuing to serve as a token, a black box, representing the flow of “life”’.⁶⁵ It is my argument that viruses act as an interruption to this flow of ‘life’ through the gene, and draw attention to the blurring of the

⁶² Ford Doolittle, quoted in Stefan Helmreich, *Alien Ocean: Anthropological Voyages in Microbial Seas* (Berkeley, CA: University of California Press, 2009), p. 88.

⁶³ Ford Doolittle, ‘Fun with Genealogy’, *Proceedings of the National Academy of Science USA*, 94 (1997), 12751–12753 (p. 12753).

⁶⁴ Eric Baptiste and others, ‘Phylogenetic Reconstruction and Lateral Gene Transfer’, *Trends in Microbiology*, 12:9 (2004) 406–411 (p. 409).

⁶⁵ Helmreich, *Alien Ocean*, p. 90.

boundaries of the life/non-life binary in the ecological mesh. Through their real material interruption and penetration of cells, they also further demonstrate the contingent and situated definition of autonomy and individuality, an important point for my thesis as a whole.

I employ the term 'mesh' at this point, following Morton, as he uses this image to think through the interconnectedness of all living and non-living agencies. For Morton, a mesh is a better metaphor than a tree. He argues that with a mesh there is no clear starting point, and that the relations and connections between organisms (or, more properly, all living and non-living agencies) are not linear. In the mesh, each point is 'both the center and edge of a system of points, so there is no absolute center or edge'.⁶⁶ Furthermore:

'Mesh' can mean the holes in a network and the threading between them. It suggests both hardness and delicacy. It has uses in biology, mathematics, and engineering and in weaving and computing – think stockings and graphic design, metals and fabrics. It has antecedents in mask and mass, suggesting both density and deception. By extension, 'mesh' can mean 'a complex situation or series of events in which a person is entangled; a concatenation of constraining or restricting forces or circumstances; a snare'. In other words, it's perfect.⁶⁷

For Morton, the mesh is both a network and the spaces in between. I find the mesh a useful figure, as it suggests at once the possibilities that interconnectedness bring while also emphasising the constraining or restricting nature of connections: the responsibilities that are inherent in all relationships to the other. The mesh is also analogous to a diffraction pattern – a biological-social network where relations, connections, interferences and differences matter. I do not agree that the mesh should necessarily replace the idea of the network, especially when considering the importance of 'networks of responsibility' described in previous chapters. The mesh is useful, however, for considering the interconnectedness of human agency with viral and bacterial agencies

⁶⁶ Timothy Morton, *The Ecological Thought* (Cambridge, MA: Harvard University Press, 2010), p. 29.

⁶⁷ Morton, *The Ecological Thought*, p. 28. The definition of 'mesh' that Morton employs is taken from the *Oxford English Dictionary*.

that rely on horizontal gene transfer, complicating and challenging attempts to construct and reify a model of a tree.

Viruses are also thought by some scientists to be intimately linked to the origin of life itself. The discovery of a virus bigger than some bacteria and visible with a light microscope prompted some scientists to suggest a viral ancestry to the nucleus in the cell (similar to the bacterial ancestry of mitochondria).⁶⁸ The virus was named the mimivirus and was previously thought to be a bacterium. Some go further, suggesting that the mimivirus is evidence that the Last Universal Common Ancestor to all life on earth, or LUCA, was viral. Interestingly, a single universal common ancestor is only possible with very strict and straight phylogenies or trees, and it is exactly these trees that viral gene-shuffling and evolution make impossible to construct. Virologist Luis Villarreal, a proponent of the theory that LUCA was viral said of the mimivirus discovery: 'The genes and gene functions suggest that we're dealing with one of the earliest and oldest forms of life. Mimivirus really stretches our sense of scale of what a virus can be.'⁶⁹ For some scientists, the discovery of mimivirus and other findings in the field of virology suggest that ancient viruses were significant in the creation of DNA from its chemical constituents, and thus the creation of life.⁷⁰ Once again, the gene as a symbol for life, strictly distinct from non-life, is interrupted by the virus. The suggestion that DNA, the sacred symbol for life, was 'born' of viruses, material agents that are so closely associated with disease and death, further complicates the 'viral gene' framework that MacPhail suggests. Villarreal suggests that this confusion and complication can be explained by a misunderstanding of viruses' parasitic nature:

⁶⁸ P. J. Bell, 'Sex and the Eukaryotic Cell Cycle is Consistent with a Viral Ancestry for the Eukaryotic Nucleus', *Journal of Theoretical Biology*, 243:1 (2006), 54–63.

⁶⁹ Luis Villarreal, quoted in Charles Siebert, 'Unintelligent Design', *Discover*, March 2006 <<http://discovermagazine.com/2006/mar/unintelligent-design/>> [accessed 17 May 2012], p. 2.

⁷⁰ For more recent discoveries in virology that support this theory, see Bob Holmes, 'First Glimpse at the Viral Birth of DNA', *New Scientist*, 2861 (2004), <<http://www.newscientist.com/article/mg21428613.500-first-glimpse-at-the-viral-birth-of-dna.html>> [accessed 29 August 2012].

I think what confuses people is their assumption that parasites are only damaging things [...] How do you get creation and complexity out of them? You do because they persist, and to do that you have to take on all comers. You come up with inventions that prevent you from being displaced.⁷¹

It is important to emphasise that Villarreal does not suggest that viruses be thought of as creative rather than destructive, but rather that through their capability for infection and destruction, they have ‘come up with inventions’, in an evolutionary sense, that may have had significant effects on the creation and evolution of life. Viruses are not replacements as symbols for the creation of life, nor do they simply represent death and disease. Rather, they are liminal agents that draw attention to the boundary-making practices that go into defining the relationship of life and death, or creation and destruction.

Interruptions: Failure and Unbecoming

Viruses function as interruptions to attempts to construct or reify a tree of life, suggesting that a mesh-like network of connections, entanglements and transfer is more appropriate. The idea of interruption is important here. I propose that interruption is an important and useful critical practice, not only because critical interruption can function as an intervention to narratives, theories or practices going awry, but also because interruptions can deliberately trip, skew, queer or encourage their going awry.⁷² Interruptions can be moments of potential difference – or interference, to evoke interruption’s diffractive character – within narratives of progress that reinforce or unquestioningly reproduce the status quo. Not only does classifying organisms within an ossified ‘tree of life’ not reflect the work of horizontal gene transfer, symbioses and viruses in evolution, but it implicitly supports human exceptionalism and an overemphasis on sexual reproduction and vertical inheritance. Mary Midgeley draws attention to the humanist undertones

⁷¹ Siebert, ‘Unintelligent Design’, p. 2.

⁷² See also Haraway on the links between tropes and tripping, *The Companion Species Manifesto: Dogs, People, and Significant Otherness* (Chicago: Prickly Paradigm Press, 2003), p. 20.

of the tree metaphor when she claims that Darwin, in fact, ‘developed his own view of selection on the humbler model of a bush – a rich radiation of varying forms, in which human qualities cannot, any more than any others, determine a general direction for the whole.’⁷³ Midgeley’s argument suggests that attempts to arrange organisms into trees are inclined to organise the tree in terms of human qualities which would determine direction, progress and norms. A classification of organisms into a ‘tree of life’ also focuses on sexual reproduction and vertical inheritance. Lynn Margulis and Dorion Sagan argue that this is zoocentric, while Hird argues that feminist engagements with biology can benefit from a focus on microontologies, as discussed in the previous chapter. Trees of life also function through ‘straight time’: that is, a linear ordering of the past, present and future structured around heterobiological reproduction, normative development and progress.⁷⁴ Once again, scientific narratives can be used for a variety of political purposes. Trees of life can have a number of normative connotations, and can support human exceptionalism as well as overemphasising vertical inheritance and heterobiological reproduction.

In the face of heteronormative narratives of development and progress, Halberstam suggests celebrating what she calls, ‘the queer art of failure’.⁷⁵ Halberstam argues that queer failure is a preferable alternative to conventional understandings of success, which she argues equate ‘too easily to specific forms of reproductive maturity combined with wealth accumulation’.⁷⁶ Halberstam suggests that: ‘Under certain circumstances failing, losing, forgetting, unmaking, undoing, unbecoming, not knowing may in fact offer more creative, more cooperative, more surprising ways

⁷³ Mary Midgeley, *Evolution as a Religion: Strange Hopes and Stranger Fears*, rev. edn (London: Routledge, 2002 [1985]), p. 7. Although Darwin expressed that the metaphor of trees ‘largely speaks the truth’, about the relationship between members of the same biological class (Charles Darwin, *On the Origin of Species by means of Natural Selection: Or the Preservation of Favoured Races in the Struggle for Life* [London: John Murray, 1859], p. 129), Midgeley is right to stress that Darwin’s description of the relation of organisms is decidedly more bush- (or mesh-) like.

⁷⁴ Judith Halberstam, *In a Queer Time and Space: Transgender Bodies, Subcultural Lives* (New York: New York University Press, 2005). See also Tom Boellstorff, ‘When Marriage Falls: Queer Coincidences in Straight Time’, *GLQ*, 13:2–3 (2007), 227–248.

⁷⁵ Judith Halberstam, *The Queer Art of Failure* (Durham, NC: Duke University Press, 2011).

⁷⁶ Halberstam, *The Queer Art of Failure*, p. 2.

of being in the world.⁷⁷ Posing the question, 'What kinds of reward can failure offer us?',

Halberstam suggests:

Perhaps most obviously, failure allows us to escape the punishing norms that discipline behavior and manage human development with the goal of delivering us from unruly childhoods to orderly and predictable adulthoods. Failure preserves some of the wondrous anarchy of childhood and disturbs the supposedly clean boundaries between adults and children, winners and losers. And while failure certainly comes accompanied by a host of negative affects, such as disappointment, disillusionment, and despair, it also provides the opportunity to use these negative affects to poke holes in the toxic positivity of contemporary life.⁷⁸

For Halberstam, success and progress are linked to heteronormative narratives and structures that are both restrictive and conservative. As an alternative, Halberstam suggests celebrating failure, as a way of escaping such norms and gesturing towards different non-normative futures and possibilities.

I want to suggest that failure is a useful interruption to narratives of becoming that I have inherited from Haraway's companion species approach to other-worlding. In the previous chapter I suggested that curiosity as a critical practice must be one that is inherently dangerous, drawing human and more-than-human agencies into networks of responsibility that threaten to undo the identity and position of any and all of the partners in relation. To this end, I suggested that Haraway's demand that we know more at the end of the day than at the beginning be reframed to include the possibility of knowing less or nothing. This, I want to argue, is an essential interruption to Haraway's companion species approach. I also want to expand this to argue that becoming should not be privileged at the expense of unbecoming, or of failing to become. An approach that does not take into account the possibilities and potentialities of failing to become is too dangerously close to

⁷⁷ Halberstam, *The Queer Art of Failure*, p. 2.

⁷⁸ Halberstam, *The Queer Art of Failure*, p. 3.

narratives of progress, development and success that, as outlined by Halberstam, are structured by heteronormativity and the reinforcing or unquestioning reproduction of the status quo. Becoming with companion species must not simply be becoming more, and becoming better. There must always be the dangerous possibility of knowing less and becoming less – of knowing nothing and failing to become. This is especially important in a queer engagement with evolutionary theory that is often used to disqualify any non-heterosexuality as either a failure to develop or as a danger to humanity's future: as, in short, monstrous (something I will return to shortly). Instead of attempting to fit homosexuality into the logic of evolutionary progress and development and thus assigning it a measure of 'success', Halberstam's celebration of queer failure can be appropriated and developed as a political position, suggesting the queer in evolution as a failure that offers other ways of thinking about development and inheritance, as well as temporalities and possible futures.

Halberstam's notion of queer failure and unbecoming can also be developed for political purposes in terms of people living with HIV/AIDS. As I suggested earlier through Butler's reading of Agamben, and in reference to US immigration policy, people living with HIV/AIDS become liminal figures, suspended between life and death in the category of bare life. Individuals become both less-than-human and more-than-human simultaneously as they, to some extent, become the virus – a dangerous entity that it is the state's responsibility to control and eradicate. Becoming-with the virus, therefore, is often a very clear example of unbecoming. While employing Halberstam's failure and unbecoming in this respect, it is very important to remember the danger and 'negative affects, such as disappointment, disillusionment, and despair' that accompany unbecoming.⁷⁹ It is also a dangerous theoretical negotiation, as people living with HIV/AIDS are often vilified (in the conservative press especially) as failures, with HIV/AIDS being interpreted as a punishment or consequence of a dangerous failed 'lifestyle'. HIV/AIDS activists have also worked hard to move beyond characterisations of victimhood to become active in the production of biomedical

⁷⁹ Halberstam, *The Queer Art of Failure*, p. 3.

knowledge.⁸⁰ However, mindful of these dangers, I maintain that the biopolitical unbecoming of people living with HIV/AIDS, and their relegation to the liminal category of bare life has allowed (or perhaps demanded) connections and communities to form, and for activist and patient advocacy groups to demand active involvement in the production of biomedical knowledge. This, I argue, is possible in part precisely because of the liminal status of the virus and the category of bare life within contemporary biopolitics.

Queer Temporalities and Viral Interruptions

The distinction between life and death, or the living and non-living, involves a certain temporal frame. This temporal frame suggests a linear ordering of past, present and future, as well as relying upon traditional notions of genealogy and vertical inheritance. This corresponds with Halberstam's notion of 'straight time'. In the work, *In a Queer Time and Place: Transgender Bodies, Subcultural Lives*, Halberstam suggests that 'part of what has made queerness compelling as a form of self-description in the past decade or so has to do with the way it has the potential to open up new life narratives and alternative relations to time and space'.⁸¹ Alternative relations to time are those that resist the normativities of 'straight time' – that is, temporality structured by reproductive sexuality and familial kinship. I also want to expand Halberstam's argument to include linear tree-like models of evolution and over-investment in biology on sexual reproduction and vertical inheritance. In contrast, the virus seems to follow a very queer temporality. One of the arguments put forward by scientists who argue that viruses are non-living is that their polyphyletic character makes them impossible to incorporate into existing trees of vertical evolutionary inheritance. Viruses resist this linear ordering of temporality. Viruses also interrupt the linear ordering of life and death, drawing attention to the fact that non-life is both life's frontier and its structural interior. The figure of the

⁸⁰ See Max Navarre, 'Fighting the Victim Label', *AIDS: Cultural Analysis, Cultural Activism*, 43 (1987), 143–146.

⁸¹ Judith Halberstam, *In a Queer Time and Space: Transgender Bodies, Subcultural Lives* (New York: New York University Press, 2005), p. 1–2.

virus prompts a rethinking of temporality in terms of non-linearity and outside of the frame of vertical inheritance and heterobiological reproduction.

The living and the non-living are related temporally. The non-living is assumed to be oppositional to the living, both preceding and following it. However, as I have shown, viruses trouble this conception of the relationship between life and non-life, and draw attention to the situated character of the cuts that produce this apparent opposition. Viruses, through their integration into the genome and through the dynamics of transfer that they bring about, also queer any sense of straight time in evolutionary narratives. This has consequences for how we think of the future, and in particular how we begin to think a queer futurity. For José Esteban Muñoz, the idea of the future is always already queer, and queerness is always directed at a future to come. He describes queerness as a horizon, stating that ‘the future is queerness’s domain’.⁸² For Muñoz, queerness is always oriented towards possible alternative futures and is thus utopian. He argues that,

Queerness as utopian formation is a formation based on an economy of desire and desiring. This desire is always directed at that thing that is not yet here, objects and moments that burn with anticipation and promise [...] Queerness is utopian and there is something queer about the utopian.⁸³

My project aligns closely with Muñoz’s formulation of queer futurity and ideas of utopia as a horizon. Specifically, the continual striving for alternative forms of life and ways of becoming-with others in the more-than-human world is always utopian, political, and queer.

Narratives of evolutionary success, based on norms of heterobiological reproduction, are interrupted by viruses that challenge classification and threaten boundary making and normativity. Viruses are, as I argued earlier, interruptive. HIV is a retrovirus, and can be seen to quite literally and

⁸² José Esteban Muñoz, *Cruising Utopia: The Then and There of Queer Futurity* (New York: New York University Press, 2009), p. 1.

⁸³ Muñoz, *Cruising Utopia*, p. 26.

materially interrupt the genomic processes of the cell that it infects to become integrated into the cell's own DNA. In respect of forms of life, viruses also clearly interrupt the temporal life narratives of individuals, including the practices and communities that are possible for and available to individuals. Activist and patient advocacy groups have harnessed the liminality of the category of bare life that people living with HIV/AIDS are relegated to, along with the possibilities of queer horizontal community formation and the dynamics of transfer in order to interrupt the production of biomedical knowledge and the processes of biopower. Viruses thus function as biological-social interruptions in a number of ways. Muñoz argues that thinking in terms of a utopian futurity can 'interrupt the linear temporal ordering of past, present and future'.⁸⁴ I agree with Muñoz's approach but want to suggest that the virus perhaps draws more attention than the idea of horizon to the dangers that are also present in futurity and need to be thought through. The mortal consequences of infection and treatment have emphasised the necessity of activist work and the involvement of patient advocacy groups in the production of scientific and biomedical knowledge about bodies, diseases and treatments. While this project is utopian, it also necessarily emphasises the dangers present in possible future multispecies entanglements and attempts to account for these. As an interruptive agent, the virus is also linked to the final figure I will be discussing in this chapter, that of the monster. I will argue that the monster is useful to knot together queerness and the virus so as to question normativity while also suggesting the necessity of queer politics having an infinite hospitality to monstrous possible futures to come.

Monsters

To fully explore the potential of viruses to queer temporality and futurity, I want to introduce a final figure, one that I will argue links queerness and the virus through the ideas of the subversion of the 'natural' order and functions to interrupt normativities and classificatory practices: the figure of the monster. The word 'monster' derives from the Latin, *monstrum*, from the root

⁸⁴ Muñoz, *Cruising Utopia*, p. 193–194 n. 7.

monere, to warn. As philosopher and cultural historian Stephen T. Asma states: 'To be a monster is to be an omen.'⁸⁵ Monsters are not just physical or biological aberrations that do not fit traditional taxonomy, but also portents, or glimpses, of alternative or non-normative futures. Teratology, or the study of abnormal organisms had been practised since the 17th century, but monstrosity was a particularly important topic in the 19th century and was instrumental in Darwin's formulation of the theory of evolution by natural selection. Asma explores the history of teratology and suggests that, before Darwin, the classifications of monsters as individual deviations from physical and morphological norms led to the question: 'Did mutations in the individual lead to new branches on the phylogenetic tree?'⁸⁶ Asma argues that before Darwin discovered and adapted Thomas Malthus's population theory as discussed in Chapter One, he considered monstrosity to be part of the biological phenomenon of variation and a possible catalyst for evolution. However, once evolutionary descent was framed in terms of environmental pressures and minor mutations, monsters were discounted as creative forces; instead, monstrous individuals were considered as either vestigial remnants or cases of arrested development.⁸⁷ Importantly, monsters not only threaten taxonomic classification or suggest that taxonomic boundaries are not impermeable, but also threaten the delineation of and distinction between the past, present and future. Monsters represent either an omen of a possible future or a reoccurrence of a no-longer-existing past.

I want to suggest that the figure of the monster links queerness and viruses in a number of ways. Viruses are monstrous in a colloquial sense, as dangerous, deadly and infectious material agents. The destruction of vast populations by the spread of tiny material agents such as HIV leaves no doubt as to their monstrous character in this sense. Viruses are also monstrous in the sense that they threaten systems of taxonomic classification. As liminal agents – neither non-living chemical compounds nor living organisms – viruses threaten the very distinction between the living and the

⁸⁵ Stephen T. Asma, *On Monsters: An Unnatural History of our Worst Fears* (Oxford: Oxford University Press, 2009), p. 13.

⁸⁶ Asma, *On Monsters*, p. 163.

⁸⁷ Asma, *On Monsters*, p. 167–69.

non-living. It is no coincidence that the mimivirus, discussed earlier, was described as ‘truly monstrous’ when it was discovered.⁸⁸ Philosopher Noël Carroll describes the monster as ‘a being in violation of the natural order’, and viruses echo this definition as they threaten the biological classification of matter as either living or non-living.⁸⁹ The debate among scientists about whether or not viruses should be considered living or non-living demonstrates that viruses are liminal material agents, and draws attention to the contingent and situated practice of biological classification. Rather than stating that viruses violate the natural order, it is clear that viruses violate and draw attention to the classificatory practices used to produce the *idea* of a natural order. The persistence of ancient viruses in the human genome also demonstrates the virus’s potential to violate the linear temporal ordering of past, present and future through vertical inheritance.

Queerness is linked to the virus through its monstrosity. Queer theory emerged as an attempt to deliberately violate the established binary configuration of homosexuality as oppositional, or marginal, to heterosexuality. Queer theory, given its monstrous birth in the early 90s, represented a celebration of the non-normative. As David M. Halperin describes it, ‘Queer is by definition *whatever* is at odds with the normal, the legitimate, the dominant.’⁹⁰ Queerness is a celebration of the strange, the non-normative and the monstrous. More recent work in queer theory has also suggested that queerness can also subvert the traditional ordering of past, present, future, and prompt a rethinking of temporality and suggest new ways of conceptualising the future.⁹¹ As queer is at odds with normativities and draws attention to the relationalities that allow normativities

⁸⁸ Charles Siebert, ‘Unintelligent Design’, p. 1.

⁸⁹ Noël Carroll, *The Philosophy of Horror or Paradoxes of the Heart* (New York: Routledge, 1990), p. 40.

⁹⁰ David M. Halperin, *Saint Foucault: Towards a Gay Hagiography* (Oxford: Oxford University Press, 1995), p. 62. It is tempting to stretch the monster-queer connection even further, as Teresa de Lauretis’s abandonment of the term ‘queer’ just three years after she announced its birth (discussed in Chapter Two) has echoes of the relationship between Dr Frankenstein and his monster. See Mary Shelley, *Frankenstein, or, The Modern Prometheus* (London: Penguin, 2003 [1818]). However, it is important to note that Victor Frankenstein rejected his creation *because* of its monstrosity whereas de Lauretis felt that ‘queer’ was *not monstrous enough* and had instead become ‘a conceptually vacuous creature of the publishing industry’ (Teresa de Lauretis, ‘Habit Changes’, *Differences*, 6:2–3 [1994], 296–313 [p. 297]).

⁹¹ See, for example, Heather Love, *Feeling Backward: Loss and the Politics of Queer History* (Cambridge, MA: Harvard University Press, 2007); and *Queer Temporalities*, ed. by Elizabeth Freeman (= *GLQ*, 13:2–3 [2007]).

to function, then queer by definition is always already monstrous, and I propose that it is only through monstrosity that it can question, threaten and overcome normativities. Queerness as monstrosity is also important when trying to imagine and bring about alternative futures, for working towards queer horizons, and rethinking futurity outside of heteronormativity. As I have suggested, this has political consequences. There is a social stigma attached to living and dying with particular diseases, illnesses and infections. I argued that this depends upon a conception of the body as pure and sterile, bounded against an infectious exterior world of dangerous and deadly microorganisms, and that this conception is always biopolitical as well as biological. Symbiogenesis and the reconception of the human body as a multispecies community could challenge this, and thus go some way to imagine and bring about more equitable futures for non-normative bodies, communities and practices.

Monsters and the Future

I want, at this point, to link the idea of queerness and futurity to the figure of the monster more explicitly through the work of Jacques Derrida on monstrosity and the future. For Derrida, the future is necessarily monstrous. In *On Grammatology* Derrida states: 'The future can only be anticipated in the form of an absolute danger. It is that which breaks absolutely with constituted normality and can only be proclaimed, *presented*, as a sort of monstrosity.'⁹² In this use of the monster figure, Derrida is drawing on the sense of the word already discussed; monsters are warnings or omens of futures to come.⁹³ For Derrida, the future is radically unknowable and has the potential to break completely with normality and normativity. Derrida speaks of the future in terms of this radical unknowability and the potential for the subversion of normativity through the notion

⁹² Jacques Derrida, *Of Grammatology*, trans. by Gayatri Chakravorty Spivak (Baltimore: John Hopkins University Press, 1976), p. 5.

⁹³ Elsewhere Derrida draws on the similarity between the French word for future (*avenir*), to come (*venir*), and that which is forthcoming (*à-venir*), to emphasise that the future is always to-come, and must never arrive. See Derrida, 'The Force of Law: The "Mystical Foundation of Authority"', in *Deconstruction and the Possibility of Justice*, ed. by Drucilla Cornell, Michel Rosenfeld and David Gray Carlson (New York: Routledge, 1992), pp. 3–67.

of the monstrous *arrivant*, that which (or who) arrives. The monstrous arrivant is always to-come, and is not a person or event but rather hospitality itself to the future and the unknown.⁹⁴ Derrida states in an interview that:

the future is necessarily monstrous: the figure of the future, that is, that which can only be surprising, that for which we are not prepared, you see, is heralded by species of monsters. A future that would not be monstrous would not be a future; it would already be a predictable, calculable, and programmable tomorrow. All experience open to the future is prepared or prepares itself to welcome the monstrous *arrivant*.⁹⁵

A queer project must be open to the future, as it looks to find and create possibilities for alternative future positions, narratives, bodies of knowledge and ways of living well. These are potential futures – futures that break with normativity and are thus more equitable and just. Queer projects, then, must be prepared to welcome this monstrous arrivant and be oriented and open towards unknowable futures.

Derrida's notion of the future to come and the hospitality to the monstrous arrivant informs Haraway's companion species framework as well as her earlier work that is more explicitly concerned with notions of the monstrous. Haraway argues that entering into a companion species relationship is to open both partners in the relationship up to an unknowable future, a becoming-with that is always a becoming worldly.⁹⁶ Haraway's becoming is both non-teleological and, I argue, also utopian in the sense of the term articulated by Muñoz. As Haraway argues, the demand of companion species is to try to 'learn more about how to flourish together in difference without the telos of a final peace'.⁹⁷ Becoming-with companion species, and becoming worldly, is to be open to

⁹⁴ See Derrida, *Aporias: dying--awaiting (one another at) the "limits of truth" (mourir--s'attendre aux "limites de la vérité")*, trans. by Thomas Dutoit (Stanford: Stanford University Press, 1993), especially pp. 33–34.

⁹⁵ Jacques Derrida, 'Passages—from Traumatism to Promise', in *Points ...: Interviews, 1974-1994*, ed. Elisabeth Weber, trans. Peggy Kamuf and others (Stanford: Stanford University Press, 1995), pp. 372–395 (pp. 386-87).

⁹⁶ Haraway, *When Species Meet*, p. 35.

⁹⁷ Haraway, *When Species Meet*, p. 301.

become radically other, which is a hospitality towards an unknowable future. This is one of the reasons that Haraway argues: 'I am who I become with companion species, who and which make a mess out of categories in the making of kin and kind'.⁹⁸ For the purposes of my argument, becoming-with is always a becoming-monstrous; 'who I become with companion species' is always both unknowable in advance and, like the monster, challenges or 'makes a mess out of' normative categories and taxonomies. This becoming is also utopian, or as Haraway describes it, a project of *autre-mondialisation*, or other-worlding.⁹⁹ Becoming-with companion species is both a becoming-monstrous and a becoming-worldly that gestures toward a different worldliness, and other-worldings. This approach is resonant with Muñoz's understanding of queer utopia as world-making:

I see world-making here as functioning and coming into play through the performance of queer utopian memory, that is, a utopia that understands its time as reaching beyond some nostalgic past that perhaps never was or some future whose arrival is continuously belated – a utopia in the present.¹⁰⁰

What Haraway elsewhere describes as the 'promises of monsters' is this ability of the figure of the monster to suggest potential other-worldings that break with normativities and normalisation. Becoming-monstrous is a queer world-making project of hospitality and openness to other and unknowable futures to come.

Glimpsing Possible Futures: Living and Dying with the Virus

As I stated earlier, becoming-with must not be promoted at the expense of unbecoming. Narratives of becoming-with risk being incorporated into overly positive narratives of progress and success that do not take into account the power of failure and unbecoming. Becoming-with must be, as Haraway states, 'as full of dying as living, as full of endings [...] as beginnings.'¹⁰¹ My symbiosocial

⁹⁸ Haraway, *When Species Meet*, p. 19.

⁹⁹ Haraway, *When Species Meet*, p. 1 and pp. 303–304, n. 1.

¹⁰⁰ Muñoz, *Cruising Utopia*, p. 37.

¹⁰¹ Donna Haraway, 'Cosmopolitical Critters'.

and queer ecological approach, that recognises the entangled nature of all living and non-living agency must recognise the dangers inherent in the radical openness of all agencies to unbecoming in their relations with others. This is biopolitical, as it emphasises the danger and threat of unbecoming as individuals living with viruses can experience unbecoming, both as a literal and mortal consequence of their illness, and also through relegation to a less than human, or less than alive, biopolitical position and status. Becoming-with the liminal virus can lead to relegation to this liminal category of not fully living citizenship and not quite dead: bare life. This liminality, however, can provide an opportunity for what Helmreich calls the dynamics of transfer. Although biopower can function to relegate individuals living with viruses to the category of bare life, the dynamics of transfer and the possibilities of horizontal community-formation available in this liminal position can allow for the possibility of alternative narratives, positions, and bodies of knowledge, as well as the formation of powerful communities such as activist and patient advocacy groups.

There is an urgent political need for individuals to use the dynamics of transfer to counter oppressive biopower and form communities of activism and patient advocacy, which is particularly obvious in the case of individuals living with HIV/AIDS. It is important to re-emphasise the integral status of death to life, not only in biology as a science, in biological material such as genes, but also in ways of living. Rosi Braidotti argues that biopower must be always understood, 'not only in the sense of the government of the living but also with relation to practices of dying'.¹⁰² Just as life forms are not in a relation of binary opposition to inorganic matter, forms of life are not in a relation of binary opposition to death or practices of dying. In this sense, the boundary between living and dying is as historically and culturally contingent as is the boundary between the organic and the inorganic. Activist and patient advocacy groups have established themselves as 'lay experts' and demanded to be an active part of the production of biomedical knowledge about HIV/AIDS, both in

¹⁰² Rosi Braidotti, 'The Politics of "Life Itself" and New Ways of Dying', *New Materialisms: Ontology, Agency, and Politics*, ed. by Diana Coole and Samatha Frost (Durham, NC: Duke University Press, 2010), pp. 201–218 (p. 201).

its cause and treatment.¹⁰³ This is essential so that people living with HIV/AIDS are not considered as passive objects or resources for the production of biomedical knowledge. Instead, work done by activist groups and others has reconfigured the infected body as an active and productive site, rather than simply a passive resource to be experimented with and upon.¹⁰⁴ My queer political account also reconfigures *all* bodies as infected, as full of multispecies agencies that include bacteria and viruses. If all bodies are seen as multiple and infected, this could go some way to counter the stigma attached to living and dying with particular infections or diseases.

As well as the question of how to reduce the number of individuals that die as a long-term consequence of infection with the virus, the close relation of life forms and forms of life also raises the question of what forms of life have been lost, and how to properly mourn them. Douglas Crimp, writing in 1989, raised this question:

Alongside the dismal toll of death, what many of us have lost is a culture of sexual possibility: back rooms, tea rooms, bookstores, movie houses, and baths; the trucks, the pier, the ramble, the dunes. Sex was everywhere for us, and everything we wanted to venture: golden showers and water sports, cocksucking and rimming, fucking and fist fucking. Now our untamed impulses are either proscribed once again or shielded from us by latex. Even Crisco, the lube we used because it was edible, is now forbidden because it breaks down the rubber. Sex toys are no longer added enhancements; they're safer substitutes.¹⁰⁵

¹⁰³ Epstein, pp. 8–14.

¹⁰⁴ Epstein, p. 21.

¹⁰⁵ Douglas Crimp, 'Mourning and Militancy', *October*, 51 (1989), 3–18 (p. 11).

It is clear that for Crimp, HIV/AIDS has claimed more than the life of individuals; ways of life have been lost.¹⁰⁶ He identifies a conservative drive to promote certain forms of life at the expense of others; that is, he cites specific examples of gay men being encouraged to 'clean up their act' and present positive images of the gay community. As Crimp notes, this is again at the expense of certain forms of life: 'This means purging our community of "'fringe' gay groups" – drag queens, radical fairies, pederasts, bull dykes, and other assorted scum.'¹⁰⁷ This tension between the celebration of non-normativity and a more conservative assimilationist politics was intensified by the HIV/AIDS epidemic, and is still a concern for contemporary queer politics.¹⁰⁸

Although scientific and cultural work must be done to eradicate the virus in the future, I want to argue that an approach that has this as its *only* goal is too closely aligned with the conservative assimilationist programme that continues to relegate people currently living with HIV/AIDS to the category of bare life – themselves reconfigured as dangerous liminal individuals to be eradicated. Not only is this a dangerous approach for individuals, but the entanglement of life forms and forms of life ensures that certain forms of life will also be reconfigured as a dangerous threat to the health of the majority. Non-normative communities will necessarily lose out, as they must be purged from the community for the sake of overall health. I contend that to open up the most equitable possible futures – to imagine and bring about the sort of utopia Muñoz discusses – queer politics must have an infinite hospitality and openness to unknowable monstrous *arrivants*. Queer politics must be open to innumerable monstrous life forms and forms of life. This entails imagining and bringing about not just futures where we live *without* HIV/AIDS, but also those where

¹⁰⁶ It is arguable that these ways of life have been completely lost, even though it is clear that practices and communities have had to change in the wake of the HIV/AIDS epidemic. Tim Dean, for example, argues that nonmonogamous sex without condoms represents a kind of kinship that is only possible in the wake of the HIV/AIDS epidemic. Specifically, he argues that: 'Bareback subculture reclaims gay sex as *sexuality* by relegating epidemiological concerns to secondary status.' Not all non-normative forms of life have been lost, and some have been created or reconfigured. (Tim Dean, *Unlimited Intimacy: Reflections on the Subculture of Barebacking* [Chicago: University of Chicago Press, 2009].)

¹⁰⁷ Crimp, 'Mourning and Militancy', p. 13.

¹⁰⁸ For work in queer studies that critiques conservatism or assimilationism in queer theory and LGBT activism, see Michael Warner, *The Trouble with Normal: Sex, Politics, and the Ethics of Queer Life* (Cambridge, MA: Harvard University Press, 1999), and Muñoz, *Cruising Utopia*.

we live well *with* the virus. Viral biopolitics must recognise the ability of the state to transfigure people living with viruses into figural viruses themselves, so as to eradicate them from the body politic. Viral biopolitics, however, must also recognise the opportunity for resistance and community through the connections and dynamics of the liminal category that the virus occupies. Focusing on the eradication of the virus is essential, but eradication cannot be the sole focus as this leads to people currently living with the virus being refigured as the virus and individuals and forms of life being eradicated from social life. Queer politics must therefore be open to monstrous futures living with viruses as well as working to produce biomedical knowledge that reduces infection and improves treatment. What is at stake is not just living well, but practices of dying well in more-than-human worlds.

Conclusion

The boundary between the living and the non-living is foundational to the theory and practice of biology as a science. In the first three chapters of my thesis I have left the supposed binary opposition of living/non-living uninterrogated and focused mainly on the oppositions between subject/object, active/passive, born/made, human/nonhuman and the biological/social. This final chapter has therefore functioned as an interruptive to the trajectory of the first three chapters. Also, throughout the first three chapters I have been considering the possibilities and opportunities presented when taking connection, entanglement and symbiosis with the more-than-human world seriously. Again, the final chapter seeks to interrupt this narrative so as to prevent the over-emphasis on positive narratives of becoming at the expense of failure and unbecoming. Specifically I introduced the figure of the virus to suggest that Haraway's companion species approach can be expanded or elaborated to include constitutive relations with all worldly living and non-living agencies.

Viruses problematise the distinction between life and non-life. Scientists disagree as to whether they can be considered to be living organisms. Essential to this debate is the idea that

organisms must be able to self-sustain and replicate without other organisms. Of course, this obscures the fact that all living organisms are dependent upon other living organisms to survive. Also, the classification of viruses within trees of life, or phylogenies, is difficult if not impossible, due to their horizontal gene-shuffling and the rate of viral evolution. Viruses draw attention to the challenges and complexities of taxonomic classification practices. These challenges suggest that perhaps the tree of life is not always the best metaphor for understanding life. A queer ecological mesh could be a better way of thinking the interrelation and entanglement of all living and non-living agencies. Viruses, within the mesh, are neither living nor dead; they are inert outside of host cells, but integral to the human genome and the evolution of life itself. The very idea of 'life itself' is also important for this chapter, read alongside Helmreich's use of Agamben's distinction between *zoē* and *bios* – particularly his useful elaboration of this distinction in terms of 'life forms' and 'forms of life'. The definition of agencies as life forms or not is always intimately entangled with social considerations of forms of life, or ways of living. To illustrate this point I discussed the example of people living with HIV/AIDS.

HIV/AIDS within the mesh knots together a number of biological and social issues. These include issues of sexuality, sex, gender, race and class, as well as issues of ecology, conservation, science, biomedicine, and local, national and international legal policies. I focused on US immigration policy that, until 2010, relegated people with HIV/AIDS to the category of bare life – denying them citizenship. At stake in this is not just the ability to live as a political citizen, but also the care and maintenance of those 'failed' and infected bodies that are relegated to the category of bare life, as well as the rights and practices of dying. Biopower is not, however, solely a matter of oppression from nation states. The dynamics of transfer, facilitated in part by the virus's liminal status, allows for the formation of activist and patient advocacy groups that can successfully question the theories and practices of science and biomedicine that relate to infection and treatment. To some extent, people with HIV/AIDS were interpellated into the role of the liminal virus, and then appropriated this position into a position of knowledge and power. People living with HIV/AIDS demanded to be taken

seriously as subjects producing knowledge, rather than objects for scientific experimentation. People living with HIV/AIDS refused to be victims, and began to be 'people living with HIV/AIDS' rather than just 'sufferers' or 'patients'.

It is my argument that this activist and patient advocacy approach needs to be drawn together with critical theories of queer temporality. In the face of the continuing HIV/AIDS epidemic, with no cure or vaccine available, it is important to not just learn from activist and patient advocacy groups from the early days of the epidemic, but to imagine and bring about futures that deal with HIV/AIDS in the most equitable way possible. To think through possible ways of thinking a queer future both *with* and *without* the virus, I knotted queerness and the virus up with the figure of the monster. A monster is that which confounds classification and refuses normativity, as well as being an omen or portent of alternative futures. Viruses, in their monstrosity, may offer glimpses of possible futures that are both outside of heteronormative reproduction, and committed to forms of life that include living *with* and *without* the virus. This is not a compromise, or an admission of failure, but rather an approach that is utopian in attempting to imagine and bring about better futures, without being naive to the real mortal dangers and consequences that are part of multispecies becoming-with. The threatening, dangerous, and liminal status of the virus allows for the dynamics of transfer to be appropriated by individuals and communities for positive political aims. In one sense, living with HIV/AIDS is both a becoming and an unbecoming; it emphasises the possibilities and dangers involved in negotiating entanglements and connections in more-than-human worlds. Queer politics must take the mesh seriously, as well as the responsibilities and dangers that this symbiosocial becoming-with the more-than-human world entails. From this perspective it is clear that there are different ways of doing science and different ways that biology and biomedicine get knotted up together. Queer ecologies and viral biopolitics raise the question of how scientific and biomedical projects are framed – in the case of HIV/AIDS in terms of complete eradication or in more complex terms where eradication of the virus is one goal among many that include living and dying well with the virus. These are urgent and ongoing political issues, as they are

about caring for those currently living and dying with the virus, as well as those who will come to live and die with the virus in the future. Past, present and future entanglements of the biological and social in multispecies becoming-with have real mortal consequences on individuals, practices, communities and worlds. Life forms, forms of life, and practices of dying are at stake, when attempting to live well in the more-than-human world.

Conclusion

Living and Dying in a More-than-Human World

'Disease is a relationship'

Donna Haraway, *How Like a Leaf*¹

In 2004, British artist Luke Jerram exhibited a collection of glass sculptures of microbiological entities, particularly disease microbes. The sculptures, ranging in size from 10cm to more than two metres tall, are both a visual and tactile prompt to consider the diseases' effects on the world. Jerram is colour-blind, and the project is also a way of questioning the practice of artificially adding colour to medical images. Images of viruses, for example, are often artificially coloured even though they are smaller than the wavelength of light, so therefore have no colour. Jerram's project seeks to question this practice and, in creating intricate glass models of viruses and other microbiological agents (including bacteria and parasitic protists such as *Plasmodium* that cause malaria), explore the tension between the beauty of the object and the often devastating effect on humans of the microbial entity being represented. In an interview, Jerram describes the link between the tactile nature of the objects and the worldwide effect of the disease that they represent: 'Originally, I made a glass sculpture of HIV that people could hold in their hand and contemplate the global issues of what that virus is doing to the world.'² The HIV sculptures are at once a comment on the practices that are involved in the production of scientific meaning (in this case the use of electron microscopy

¹ Donna Haraway, *How Like a Leaf: An Interview with Thyrza Nichols Goodeve* (New York: Routledge, 2000), p. 75.

² Luke Jerram, 'Interview with the Wellcome Collection, London 2009', *Luke Jerram: Glass Microbiology* <<http://www.lukejerram.com/glass/interviews>> [accessed 10 December 2012] (para. 4 of 8).

and artificial colouring) as well as an attempt to represent both the material specificity of the microbiological, and the real and mortal effects of the biological upon the world.

The project's tension between the beauty of the object and the danger of the microbiological agents that are represented is also deeply personal. Published on Jerram's website is the following letter:

I just saw a photo of your glass sculpture of HIV.

I can't stop looking at it. Knowing that millions of those guys are in me, and will be a part of me for the rest of my life. Your sculpture, even as a photo, has made HIV much more real for me than any photo or illustration I've ever seen. It's a very odd feeling seeing my enemy, and the eventual likely cause of my death, and finding it so beautiful.³

This letter illustrates the tensions at work in Jerram's project, as well as those that run through this thesis, with its focus on queer ecological entanglements and multispecies becoming-with. In short, these tensions are always present in attempts to live well in the more-than-human world. The author of the letter is entangled in an obligatory relationship with the viruses inhabiting their cells and body. The lives of both the human and the virus (if a virus does indeed 'live') are, after infection, inextricably and unavoidably entangled. A person living with HIV/AIDS also depends upon the latest scientific and biomedical knowledge to be able to adapt their life so as to live better with the virus. In the letter, HIV/AIDS is presented as both companion and enemy; it is an unavoidable part of the author's life, and the possible cause of their death. The virus, in Jerram's project, is beautiful, while also devastatingly dangerous and deadly, on both a personal and global scale.

³ Luke Jerram, 'HIV', *Luke Jerram: Glass Microbiology* <<http://www.lukejerram.com/glass/gallery/hiv>> [accessed 10 December 2012] (para. 4 of 7).

Knowledges, Agencies

In Chapter One I argued that Edward O. Wilson's *Sociobiology: The New Synthesis* (published in 1975) and the feminist responses to this publication are very significant as a negotiation between the biological and social. Specifically, Wilson's theory of sociobiology represents a particular method of relating evolutionary biology with social structures and norms, for example traditional gendered norms and roles. Using feminist engagements with sociobiology as a lens through which to interrogate broader issues of science and society, I explored feminist epistemologies that analysed the relationship between patriarchal structures in society, and in the theory and practice of science. As an example of a feminist epistemology that engages with the construction of scientific knowledge I analysed Donna Haraway's concept of situated knowledges. Situated knowledges build upon earlier work done in feminist standpoint and postmodern epistemologies and provide a way of thinking through the relationship of the biological and the social without relying on either radical social constructivism or biological determinism. This approach is useful for interrogating the theory and practice of science, as well as interrogating attempts to rewrite scientific theory for positive social purposes, such as Elaine Morgan's exploration of the Aquatic Ape Hypothesis. In Chapter One I employed Haraway's situated knowledges, and argued that Morgan's narrative of evolutionary descent from the perspective of the female ape can be read as drawing attention to the ways in which patriarchy structures and is structured by scientific theory and practice. Not only this, but through the situated connections between contemporary female experience and embodiment and the pre-hominid ape, Morgan's narrative also draws attention to the hierarchical oppositions that structure narratives of evolutionary descent. The female is opposite and hierarchically subordinate to male, and this opposition resonates with those of human/animal, active/passive, and agent/resource. I argued that Morgan's narrative subverts these binary oppositions and allow the female ape (and consequently contemporary female experience and embodiment) an agency that is traditionally denied in evolutionary theory. In this chapter, I emphasised the potential to create

alternative scientific narratives for different political purposes, while being attentive to the constraints on this.

In the second chapter I focused on the ways in which gender and sexuality studies developed in the 1990s alongside scientific developments in the field of genetics. Specifically, I explored feminist engagements with deconstruction, and the birth of queer theory. Feminist engagements with deconstruction built upon insights from earlier feminist epistemologies and the tensions present in these approaches, and responded to a number of questions that these approaches posed. In feminist standpoint epistemologies, for example, how was the category of woman defined, and what counted as female experience? Was there a single stable position from which to claim an identity or experience of the female, and what were the consequences of this for feminist politics? Feminist engagements with deconstruction suggested that there could be shared politics and solidarity *without* recourse to a single shared and grounded identity or experience. At the same time, queer theory was being developed as a similarly deconstructive approach to identity, experience and politics. Both of these theories sought to question determinism and explore the possibilities of partial and contingent connections and political solidarities. The 1990s, however, saw a proliferation of ‘gene talk’ and narratives of genetic determinism, due to the hubris that surrounded the Human Genome Project.⁴ I explored the genesis of the Human Genome Project, as it offers a perspective on specific pieces of research done in the 1990s to discover a biological or genetic basis for homosexuality. Using resources from deconstructive approaches to feminism and queer theory, this chapter developed an account of genes and sexuality that neither argues a genetic basis for sexuality nor attempts to dissociate sexuality from materiality and embodiment and suggest a social or cultural basis for sexuality. Instead, I argued for an approach that goes beyond the crude opposition of ‘born’ or ‘made’ in discussions of sexuality, to consider genes as active biological and social agents that are always already entangled up in and with biological-social bodies,

⁴ Evelyn Fox Keller, *The Century of the Gene* (Cambridge, Mass: Harvard University Press, 2000)

experiences and identities. Once again, this chapter demonstrates that there is the possibility of radical and alternative narratives and positions when the biological and the social are put into conversation.

Chapter Two expanded upon the discussion of the agency of the female ape discussed in Chapter One, to consider the agency of human genes and genetic material. Continuing the roughly chronological trajectory that was followed in the first two chapters, Chapter Three developed the approaches and findings discussed in the first two chapters to more fully discuss nonhuman (or ‘more-than-human’) agency, as well as the political possibility of kinship beyond the human. To interrogate the possibilities for more-than-human agency and kinship, this chapter focused on the obligate kinship entanglements between the human and the bacterial. In order to explore this fully, I used resources from evolutionary biology, specifically Lynn Margulis’s theory of symbiogenesis, and kinship theories developed in gender and sexuality studies in the late 1990s and early 2000s. These approaches to kinship suggest the possibility of thinking kinship beyond familial relations, as well as beyond heterobiological reproduction and vertical inheritance. I develop this suggestion to argue that queer kinship can be expanded to include the more-than-human. I draw from symbiogenesis an insistence that humans are ‘loose committees’ of trillions of more-than-human individuals and genomes, and put this into conversation with social theories about the kinds of human kinship made possible by developments in science and technology such as the Human Genome Project. Specifically, I attempted a merger of symbiogenesis and biosociality into a *symbiosocial* approach. I align symbiosociality with both the diffractive queer approaches outlined in earlier chapters and Haraway’s work on companion species. This symbiosocial approach to kinship suggests that humans are always already entangled in emergent multispecies relationships – relationships that are performative and co-constitutive. Once again, agency is not restricted to humans, but rather found in all of the multispecies biological-social relationships that make up the more-than-human world. Symbiosociality is also a political representation, and inherits from biosociality a Foucauldian

approach to biopower and biopolitics. As such, it is linked to the discussions of viral biopower in the fourth and final chapter.

In the fourth and final chapter I interrupted the trajectory of the thesis set out in the first three chapters. I argued, in fact, that interruption is a necessary and useful critical practice. To this end, I expanded my account of more-than-human agency and kinship to include viruses – liminal material agents that interrupt in a number of ways. Viruses interrupt at a cellular level (and I discussed the specific example of HIV, which interrupts and inserts its genetic material into the host cell upon infection) as well as in genomic and evolutionary narratives through the persistence of ancient viruses in the human genome and the impossibility of constructing unproblematic viral phylogenies. Viruses also interrupt at a personal level, in terms of an individual's health and the ability to live well after infection. Furthermore, I explored the status of viruses as liminal, occupying a problematic position between living organism and non-living chemical – between life and death. Through this liminality they interrupt the seeming opposition of living/non-living that structures the theory and practice of the biological sciences. Chapter Four argued that the interruption of viruses draws attention to mortality, and to the dangerous and deadly in multispecies kinship. This, I argued, is itself a necessary political interruption to narratives of multispecies entanglements that focus on flourishing, becoming more and knowing more. These narratives must be as much about dying and mortality as they are about living and flourishing. To elucidate this point, I discussed the example of people living with HIV/AIDS, and drew out some of the tensions that I identified in Jerram's glass microbiology work. For people living with the virus, they are caught up in an entanglement with viral agency that has effects on forms of life as well as practices of living and dying. Viruses are both companions and enemies, and I explored this in relation to viruses' creative and productive effect within evolution and genomics alongside their destructive effects on individual bodies. Individuals living with HIV/AIDS are subjected to a bodily and often mortal unbecoming, but also to a biopolitical unbecoming whereby they are relegated to a liminal biopolitical category of 'bare life' – comparable to the liminal category occupied by the virus. Putting viral biopolitics into conversation with insights

from previous chapters and work on queer temporality, I suggested that this liminal status can be exploited for positive ends, and I discussed the example of HIV/AIDS activist groups who have reconfigured the infected body as an active site (rather than a passive resource) in the production of scientific and biomedical knowledge. I also argued that the symbiosocial approach reconfigures all bodies as infected, and that this is a political point that could work towards reducing the stigma that surrounds living and dying with particular diseases and infections. Not only are there alternative positions and narratives available in the entanglement of the biological and the social, but there are also alternatives for health practices and ways of living.

Entanglements

Throughout the project, I attempted to develop an approach that recognises the need for faithful accounts of a 'real' material world, full of agencies that do things and bear upon each other with material consequences. Simultaneously I have attempted to recognise the historically constructed, situated and contingent character of any and all knowledge claims about this world. In doing so, I have argued that the seeming opposition of the real and the socially constructed does not hold, and is always already deconstructing itself. Paired terms such as material/semiotic, the biological/the social, born/made, matter/meaning, and nature/culture are not tenable *as* oppositions, and this thesis has tried to demonstrate this in a number of ways. This has been primarily through the exploration of agency, not as a property of individuals (whether human or more-than-human), but as an emergent, performative, and constitutive relationality. This relationality has been explored as 'entanglement' and the biological and social have been argued to be entangled all the way down. Important to my proposed focus on the entanglement of the biological and the social is the demand to take seriously both the material specificity of the biological and the socially and historically specific contexts within which knowledge claims are constructed and maintained. Pre-hominid apes, genes, bacteria and viruses are 'real' material entities that act upon each other and other agencies within complex ecological networks, webs or meshes. At the same

time, they are inseparable from the discourses that articulate knowledge claims about them. I argued in Chapter Two, for example, that ‘real’ material genes and the Human Genome Project and narratives of genetic determinism co-form and co-shape each other in a performative relationality. The biological gene and the social gene are inseparable and co-constitute each other through their entanglement.

Human bodies and experience are entangled in the more-than-human world of multispecies agency. I have developed this idea through existing theories of kinship, particularly those that emphasise the obligate, necessary, and non-voluntaristic nature of kinship relations. Not only this, but these unavoidable and constitutive kinship relations that the human is entangled in also draw attention to the classification practices that go into defining kin and kinds, while demonstrating the contingency of classification. Kinship relations across species boundaries draw attention to boundaries and boundary-making practice, while suggesting the radical possibility of subverting classification and breaking down and redrawing these boundaries. Human-bacterial kinship discussed in Chapter Three, for example, illustrates the practical and theoretical labour that goes into defining species. The difficulty in defining bacterial species draws attention to the fact that the traditional model of species classification, the Biological Species Concept, overemphasises vertical inheritance at the expense of horizontal gene transfer and sexual reproduction at the expense of other forms of biological reproduction. Importantly, the interdependence of the human and the bacterial (which I analyse in terms of digestion and in energy production in the cell) emphasises the classificatory practices that go into defining species boundaries. At the same time, however, this interdependence also suggests that in their material specificity both humans and bacteria are involved in obligate, necessary and cross-species kinship relationships that question the very possibility of isolating individual organisms or defining species.

As well as exploring transgressions of species boundaries, this project has sought to negotiate boundaries that may be thought of as equally, if not even more, rigid: boundaries between

academic disciplines. I have, throughout the thesis, attempted to put seemingly disparate disciplines into conversation with each other not just to interrogate the entanglement of the biological and social, but to attempt to demonstrate that disciplinary boundaries are less rigid than they might first appear. It is not a matter of one discipline opening up its borders to accept another, or being extended into other fields. This is the approach that Wilson outlines in *Sociobiology*. In this book he claims that ‘sociology and the other social sciences, as well as the humanities, are the last branches of biology waiting to be included in the Modern Synthesis’.⁵ A similar claim could be made from the opposite direction: that is, biology is solely social construction and discourse, and should be analysed as such. Despite my attempt to blur disciplinary boundaries, I have not followed this approach, instead suggesting a diffractive approach. This approach, outlined in detail in Chapter Two, suggests that borders between disciplines are, like borders between light and dark created by diffraction patterns, permeable and difficult to define: in diffraction, light spots appear in dark areas, and dark in light. It is not that biology is really social, or the social really biological. Rather, seemingly separate fields can be read diffractively through and against each other to produce interesting and often unpredictable patterns of interference and diffraction. Symbiogenesis and indigestion as discussed in Chapter Three offers another way of viewing the interdisciplinary framework I have tried to work within. Resources and insights from different fields of knowledge can be incorporated but not assimilated – ingested but not digested – by approaches from different fields. This involves maintaining rather than resolving the interdisciplinary tensions that result.

Boundaries and Bodies

With this in mind, I have used resources and insights from a number of different fields. These include (and this is not an exhaustive list): gender studies, feminist theory, feminist science studies, evolutionary biology, neo-Darwinism, quantum mechanics, genomics, lesbian and gay studies, queer theory, deconstruction, feminist technoscience studies, symbiogenesis, bacteriology,

⁵ Edward O. Wilson, *Sociobiology: The New Synthesis* (Cambridge, Mass: Harvard University Press, 1975), p. 4.

kinship theories, animal studies, virology, biopolitics and biopower, ecological thinking, and biomedicine. I have tried to put these resources and approaches into productive conversation with each other, to read different insights *with* and *through* each other, which has also involved drawing on (and redrawing) several existing conversations. The thesis as a whole is therefore analogous to a diffraction pattern itself: the sometimes unexpected pattern that is formed when light waves interfere with each other through superposition. As I explained in Chapter Two, when light waves of different frequencies are passed through a diffraction grating (such as a bird's feather), the superposition and interference of the light waves can produce colourful patterns (such as iridescence), unexpected areas of light where a dark shadow would be expected and dark in areas of light. Similarly, I have attempted to bring together disparate areas of study, to read their insights and approaches with, through, and against each other in the hopes of producing a pattern of (perhaps unexpected) findings, conclusions and insights.

One of the central arguments of my project has been that the body is queer: queer to itself and always already queering itself. This is often ignored or effaced in normative narratives of embodiment or bodily experience. In the introduction I analysed the supposed self-evidence of male and female bodily design. Bodies, in many evolutionary origin stories, are assumed to have been 'designed' by evolution for heterosexual biological reproduction. Physiology, behaviour and pleasure are thus assumed to be adaptations with one sole purpose: the continuation of the species through vertical inheritance. From this follows the seeming self-evidence of the naturalness of heterosexuality and of normative sexual behaviour for the purposes of reproduction. Throughout the thesis I have explored the queerness of the body itself in a number of different ways, as well as building on important work in gender and sexuality studies that has sought to challenge heteronormative accounts of the body. In Chapter One, I analysed narratives of evolutionary descent in which the human body is always linked to its pre-human ancestors. In sociobiological accounts, contemporary bodily experience is explicitly nonhuman and pre-human, being explained through the logic of the adaptations of pre-hominid apes. In Chapter Two I developed upon this strangeness of

the body by exploring genes and genetic determinism. In narratives of genetic determinism, the body is simply a carrier for vertically inherited genes. However, exploring the complexities of genetics and reading genes as active and agential – as strange and queer – once again challenges the idea of an unproblematically human body. Chapter Three explored the more-than-human agencies that live symbiotically within the human gut, and within all plant and animal cells. Thinking of the human body as an ecosystem, a committee, or an assemblage, queers the very notion of a singular and human body; crucially, the human body is always already more-than-human. Chapter Four explored some of the mortal consequences of this way of conceptualising the body. The body is always porous and penetrable, and is always open to a radical more-than-human becoming. Not only this, but the body is always open to infection and the mortal dangers of unbecoming. This, as I have argued, is a political account, and one that could work to challenge the stigma attached to diseased, ill or infected bodies.

The body is always already queer, and queering itself, as well as always being caught up in more-than-human entanglements. The human body is not singular, static, bounded and discrete, but is rather a multispecies becoming, emergent through relationships and entanglements with the more-than-human; as Anna Tsing argues: ‘Human nature is an interspecies relationship.’⁶ Haraway makes a similar point when she states: ‘You don’t become who you are without becoming with who you aren’t.’⁷ Multispecies entanglement is necessary and obligatory, and must be taken into account when exploring the relationship of the biological to the social and the role of the body in this relationship. The theory and practice of biology is entangled with discussions of what counts as living, which is entangled with the material specificity of viruses, themselves entangled with a range of biological and social issues including the troublesome biological-social task of taxonomic

⁶ Anna, Tsing, ‘Unruly Edges: Mushrooms as Companion Species’, *Party Writing for Donna Haraway!* (2010) <<http://tsingmushrooms.blogspot.com/>> [accessed 30 November 2011]

⁷ Donna Haraway, ‘Cosmopolitical Critters: Companion Species, SF and Staying with the Trouble’, unpublished paper presented at *Cosmopolitan Animals*, John Coffin Memorial Lecture, Institute of English Studies, 26 October 2012. A recording is available online at *Youtube*, 19 November 2012 <<http://www.youtube.com/watch?v=fMIm0SeRRY4>> [accessed 17 February 2013].

classification. Classificatory and boundary-making practices are themselves always already tangled up with questions of how to define the individual and the species, which is entangled with issues of biological kinship in phylogenies and social kinship in family trees, ecologies and beyond. In fact, the entanglements themselves get increasingly entangled and never resolve into easy distinctions or diagrammatic structures such as trees. These trees are concerned with vertical inheritance and heterobiological kinship. Crucially, though, inheritance is also always entangled up with horizontal transfer, communities, and kinship. Kinship and transfer entangles human genetics and genomics up with the genes and genomes of bacteria, viruses, and other microbiological agencies. These multispecies biological-social entanglements truly demonstrate entanglement *all the way down*. These more-than-human entanglements all the way down are complex and challenging, but they are also necessary, obligatory and they must be taken into account. Feminist and queer theories of the body offer useful tools or approaches to think through the idea of the human, of multispecies becomings, as well as scientific knowledge-making practices and related medical interventions. I have argued in this thesis, however, that the body itself is not just a passive resource for scientific or social theories; rather the body is always already strange and queer and interrupts both attempts at biological determinism and radical social constructivism. The body is not just strange and agential, but full of agential strangers and entangled with innumerable strange biological-social agencies.

Futures

This project brings new perspectives to the entangled field of enquiry that I have described. The specific way in which I have brought the disparate fields into conversation with each other is an attempt to provide this new perspective for a number of reasons. These include interrogating the idea of the human, conceptualising more-than-human kinship and agency, and thinking through the mortal consequences of multispecies becoming for living well in terms of health and biopolitical citizenship. Foregrounding the queer 'nature' of the body and of 'nature' itself, the project has attempted to contribute to and provide resources for evolutionary theory and practice, non-

deterministic theories and narratives of genetics and genomics, microbiology and kinship studies, as well as the related projects of virology, ecology and biomedical health practices. I would hope that the thesis could make a contribution to and be used as a resource for these and other areas, fields, and bodies of knowledge that are drawn into the entanglement of the biological and the social.

For example, the final chapter demonstrates a mode of thinking through the relationship between the material specificity of the more-than-human and the question of health, illness, and scientific and biomedical theories and practices. This, I would suggest, could be an avenue for fruitful future analysis – building upon some of the insights and approaches that I have developed in the thesis to explore other issues of health and illness that are related to more-than-human entanglement. In particular, viruses are not the only parasitic agencies that have effects on human health and which could be explored using the resources of this project. The word parasite comes from the Greek *parasitos*, meaning ‘person who eats at the table of another’, from *para* (beside) and *sitos* (food). This resonates with a companion species approach, echoing Haraway’s exploration of the etymological origin of ‘companion’ in the Latin *cum panis*, ‘with bread’. As she says, ‘Messmates at table are companions.’⁸ Etymologically speaking, the parasite is always already a companion, whether we like it or not. In many parts of the world, parasitic infections and infestations represent a serious health risk. In western urban centres, however, it has been suggested that the attempt to sever the knots of entanglement between the human and the parasite has led to the rise in autoimmune illnesses and disorders. Specifically, the Hygiene Hypothesis (or Old Friends Hypothesis) states that a lack of early childhood exposure to infectious agents, microorganisms and parasites increases susceptibility to allergic diseases and autoimmune disorders by suppressing the natural development of the immune system.⁹

⁸ Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), p. 17.

⁹ The Hygiene Hypothesis was formalised by David P. Strachan in his article: ‘Hay Fever, Hygiene, and Household Size’, *BMJ*, 299 (1989), 1259–60. Medical microbiologist Graham Rook has suggested that because the focus of the hypothesis is not actually cleanliness, but more specifically co-evolution and interdependence, the hypothesis could be more suitably referred to as the ‘Old Friends Hypothesis’. See Graham A. W. Rook and Laura Rosa Brunet, ‘Old Friends for Breakfast’, *Clinical and Experimental Allergy*, 35:7 (2005), 841–2.

This hypothesis has led to some individuals that suffer with chronic autoimmune disorders or severe allergies attempting to alleviate their symptoms with an experimental treatment: infestation with parasitic worms, or ‘helminths’. This process (evocatively called ‘rewilding’ the body by biologist Rob Dunn) involves introducing hookworm or whipworm into the gut where they take up residence and hopefully regulate the immune system.¹⁰ Scientific research on this subject is in the early stages, but some research shows promise.¹¹ Anecdotally, some people report improvements to their conditions, while others do not.¹² Self-infestation with parasitic worms as a health practice, as well as the biomedical research being done into the role of these worms in regulating the immune system, illustrates the evolutionary entanglement of the human in more-than-human relationships. Furthermore, it suggests that exploring these entanglements might lead not only to better understandings of the relationship between the human and the more-than-human, but might also provide resources for developing biomedical theories and practices that would hopefully alleviate the symptoms of individuals suffering with certain health problems. Similar to my queer political appropriation of symbiogenesis and biosociality in the fourth chapter, where I suggested that living well *with* the virus is important, the practice of deliberate self-infestation with parasitic worms suggests that although work must be done to reduce parasitic infections where they are a problem, it may be necessary to imagine and bring about futures where we live *with* parasites, not just *without* them (through eradication).

¹⁰ Rob Dunn, *The Wild Life of Our Bodies: Predators, Parasites and the Partners that Shape who we are Today* (New York: HarperCollins, 2011), especially pp. 30–58.

¹¹ One of the key researchers in this field is Joel Weinstock. For information about the animal and human research he has done on possible helminth control of autoimmune disorders, see Joel V. Weinstock and David E. Elliott, ‘Helminths and the IBD Hygiene Hypothesis’, *Inflammatory Bowel Diseases*, 15:1 (2009), 129–133. Examples of research that Weinstock has been a part of are: Robert R. Summers and others, ‘*Trichuris suis* Therapy for Active Ulcerative Colitis: A Randomized Controlled Trial’, *Gastroenterology*, 128:4 (2005), 825–832; and Kunihiro Kitagaki, ‘Intestinal Helminths Protect in a Murine Model of Asthma’, *The Journal of Immunology*, 177:3 (2006), 1628–1635.

¹² A number of people suffering from chronic autoimmune disorders or severe allergies who experienced relief from symptoms are interviewed in the film, *Parasites: A User’s Guide*, dir. Sharon Shattuck (Sweet Fern Productions, 2010).

The approach outlined in this thesis does not necessarily need to be restricted to illnesses and health practices that are obviously related to the human body's entanglement with multispecies agencies. The insights in the final chapter, where I suggest that queer temporalities might be explored alongside queer ecologies and the bodily and biopolitical reality of living with HIV/AIDS, could contribute to discourses and practices that surround living with any chronic or serious illness. Living with a chronic or serious illness could be interpreted as an unbecoming; the bringing of mortality, death and dying into the experience of life also suggests that illness is itself a liminal position, somewhere between living and dying. Living with a chronic or serious illness can also lead to alternative relations to temporality and the future. Treatments and health practices often restructure an individual's relation to time, in terms of taking medication and making changes to lifestyle. Some theories of queer temporality suggest a radical break with the idea of the future and futurity. I argued in Chapter Four that imagining and bringing about futures, rather than rejecting them, is politically pressing and necessary for people currently living with HIV/AIDS in the present and those who will come to live with the virus in the future. Similarly, alternative futurities need to be imagined to bring about better and more equitable ways of living well and practices of dying for people currently suffering from chronic and serious health conditions and those who will come to suffer with illness in the future, as well as for all aging mortal bodies.

Like Jerram's Glass Microbiology project, this thesis is committed to representing, as faithfully as possible, the material specificity of the biological organisms, agents and entities discussed. Simultaneously, the thesis has attempted to draw attention to the fact that any representation and knowledge claim about the biological is always produced within situated and contingent historical and social contexts. Just as Jerram attempts to faithfully represent the specificity of the parasites, viruses and bacteria that are represented in his glass sculptures, he also draws attention to the situated practices (such as electron microscopy and artificial colouring of scientific images) that work to produce the objects represented. This thesis has attempted to perform the same double movement to stress the entanglement of the biological and social. Similar

to Jerram's project, the stakes of this thesis are also both personal and global. How the human is defined and the ways that more-than-human agency and kinship are conceptualised has implications and consequences that are both globally significant and intensely personal. Entangled in the mesh of more-than-human agency, scientific theory and practice, and health and illness, is the imperative of imagining and bringing about more equitable futures, with more possibilities for alternative narratives, positions and bodies of knowledge. A matter of life and death, the entanglement of the biological and the social has real mortal consequences for living well in the more-than-human world.

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