THEMES IN SOCIAL THEORY
SERIES EDITOR: ROB STONES

technology & social theory

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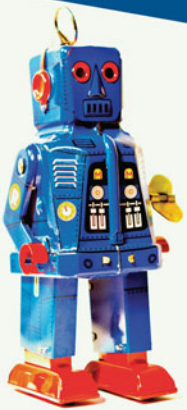

THEMES IN SOCIAL THEORY

Series Editor: Rob Stones

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First published 2011 by
PALGRAVE MACMILLAN

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Palgrave Macmillan in the US is a division of St Martin's Press LLC, 175 Fifth Avenue, New York, NY 10010.

Palgrave Macmillan is the global academic imprint of the above companies and has companies and representatives throughout the world.

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ISBN-13: 978–0–230–57756–5 hardback
ISBN-13: 978–0–230–57757–2 paperback

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources. Logging, pulping and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

A catalogue record for this book is available from the British Library.

A catalog record for this book is available from the Library of Congress.

10 9 8 7 6 5 4 3 2 1
20 19 18 17 16 15 14 13 12 11

Printed and bound in Great Britain by
CPI Antony Rowe, Chippenham and Eastbourne

For Tracey

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Series Foreword

A simple aim lies at the heart of this series. This is to deepen understanding of the role of social theory in the creation and validation of the most valuable empirical research in the social sciences. The series rests upon a commitment to explore the vast terrain upon which theory and the empirical meet, and extends an invitation to readers to share in this exploration. Each book takes on a specialized substantive area of research such as health, international migration, crime, politics, technology, human rights and the environment, and excavates the character of the theory-empirical interplay in relation to key themes within the specialized area.

The authors of the volumes all write clearly and accessibly even when the material they are dealing with is intrinsically difficult. They have a close knowledge of the relevant field, an enthusiasm for the kind of theoretically informed empirical research that has been produced within it, and have themselves a flair for theoretical analysis. Within the general rubric of the series each author (or team of authors) has her or his own style and approach and a distinctive authorial voice. This should translate into a sense of pluralism within the series as a whole, meaning that the investigation of the theory-empirical terrain will take on the broad and varied character required to push forward our understanding in the most open and constructive manner possible.

Each book in the series aims to bring together in one volume some of the most significant theoretically informed empirical work in that sub-field. The opening chapters of each book will outline the main theoretical approaches associated with substantive research in the area, and subsequent chapters will bring out how these approaches have been important in facilitating a range of key empirical studies. It will become apparent that a researcher's focus on a particular empirical case has often led her/him to draw on more than one theoretical approach, and then to creatively combine them in a form appropriate to the empirical case. The value of the substantive findings and arguments produced by each highlighted study is paramount, and will be clearly indicated.

It is hoped that the books from the series will play their part in helping to bridge the harmful gap between theory and the empirical that is still too often present within the social sciences, and that they will not only be used on second and third year undergraduate courses, to train and sensitize the next generation of social analysts, but will also be helpful to researchers at

all levels. The books will demonstrate that there is already a large existing literature in each sub-field that has indeed combined theory and the empirical, and they will clarify the descriptive, explanatory and critical power produced by such combinations.

The notion of 'themes', referred to in the series title, in fact signals two kinds of themes. The ***first*** kind is *substantive* and refers to the overall theme of the respective volume – health, environment, human rights, and so on – and, more subtly, to the sub-types of thematic content to be found within each of the different clusters of studies highlighted in each volume and indicated through the titles of the more substantive chapters. The ***second*** type of theme is *methodological*, and refers to the ways in which theory and the empirical are brought together within each of the studies highlighted. I prefer to refer to this set of themes under the label of 'conceptual methodology', rather than just 'methodology', in order to emphasize the ways in which particular theoretical ideas or concepts (and combinations of these) guide more formal methods such as observation, documentary analysis, surveys, interviews and so on, towards certain types of empirical data. Concepts and theories, here, are seen to have identifiable methodological and empirical consequences.

It is relatively self-evident that the ***key substantive themes*** that emerge in, for example, Fernando De Maio's volume on health – such as those around health inequalities and demographics, the functioning of the sick role or the practices of pharmaceutical companies – will be distinct from those in other volumes such as Karen O'Reilly's on international migration or Steve Matthewman's on technology. This is not to say that there couldn't be fruitful overlap; it is very easy to envisage research projects looking at the health implications of international migration or at the use of technology in health care. However, it is to say that one might expect a series of distinctive thematic concerns to emerge from a focus on studies that have health as their primary concern. It is probable that the lessons to be learnt from the ***conceptual methodological themes*** will be more general. Here, more commonality is likely to emerge across sub-fields in the ways that theory and the empirical are combined together, notwithstanding their different subject matters.

All the authors in the series take it for granted that particular ways of seeing, hearing, interpreting and understanding – to name just some of the ways we apprehend the world – are involved every time a so-called empirical fact is given that status by somebody. That somebody, in turn, may be any kind of everyday participant within society, deploying their own cultural and social standpoint on the world, whether they are a political power broker, a homeless migrant, an environmental activist or an academic researcher. Whoever it is who does the apprehending, all empirical facts – and the stories and arguments through which they are joined together into an account of the social world – are already infused with

their ideas and ways of seeing associated, in turn, with the particular cultures and sub-cultures they belong to. Embedded within these cultures are concepts, presuppositions, categorizations, that can range from a mixture of the simply inherited and/or confused at one end of the spectrum to a mixture of the systematically reflected upon and/or analytically lucid at the other end of the spectrum. Social theory contributes profoundly to our ability to apprehend the social world in ways that are nearer to the latter end of the spectrum than the former.

The degree of rigour and intellectual seriousness implied by these standards, brought into close liaison with the imaginative ways of seeing that good social science seeks constantly to renew, are what should make the activities and claims of social science stand out. Our claim should be that the accounts we produce add something further to public and civic culture, and to political life, than say news journalism or the everyday understandings of ordinary people. Social science has its own generic standards, standards that we constantly need to explore, reflect upon and improve, not least with respect to the relationship between social theory and substantive studies. It is only by doing this that we can genuinely carry forward the ambitious aspirations of a public social science that can play its rightful and much needed part in a thorough and continuing interrogation of the social.

Rob Stones

Acknowledgements

I would like to begin by thanking Emily Salz. It was Emily who first suggested a place for technology in the Themes in Social Theory series while working as a commissioning editor at Palgrave. Without her this book would not have happened.

That a work on technology found a place in this series is due to the series editor, Professor Rob Stones. I thank Rob for being receptive to a book on technology, and for his sage advice and encouragement throughout.

I would also like to record my gratitude to Anna Reeve at Palgrave and to the anonymous manuscript referees, all of whom provided useful feedback that has improved the final version immensely.

Chapter 1 draws extensively on work already published by © Eolss Publishers Co. Ltd: 'Technology' in Charles Crothers (ed.) *Historical Developments and Theoretical Approaches in Sociology.* It is reprinted here with permission from Eolss Publishers Co. Ltd. Some of this material was also published in the chapter 'How Many Media Students Does it Take to Change a Lightbulb? Technology and the Media' in Luke Goode and Nabeel Zuberi's *Media Studies in Aotearoa/New Zealand 2*. I thank Pearson and the editors for permitting its reproduction here.

Many of the ideas in this book were first presented in the Sociology Department's seminar series at the University of Auckland. I am grateful to my colleagues in Sociology for their helpful criticisms and suggestions.

Several colleagues read draft chapters and offered useful suggestions. I would like to thank the following in this regard: Associate-Professor Terry Austrin at the University of Canterbury, Dr Colin Cremin at the University of Auckland, Professor Charles Crothers at Auckland University of Technology, and Professor Barry Smart at the University of Portsmouth.

I would also like to acknowledge the Faculty of Arts at the University of Auckland for financial support made available through their Emerging Research Excellence Fellowship, and the Department of Sociology for its monetary support.

I particularly want to acknowledge the research assistance of Edwin Sayes. Edwin helped with the location of sources. He also offered a critical reading of the entire manuscript. The end product has been greatly enhanced by his efforts which are much appreciated.

Finally I would like to thank my wife Tracey and our extended family for their unfailing love and for the joy that they bring.

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Introduction

Organization of the Material

This book presents a map of 150 years of social theory as it applies to technology. In constructing this map I have aimed for as broad and as meaningful a representation of the field as possible. Chapter 1 critically examines the central significance of technology in our world and lays the groundwork for the substantive chapters that follow. Chapter 2 covers social theory's first material turn with Karl Marx, the critical theory of the Frankfurt school and the labour process tradition. Chapter 3 engages with Michel Foucault and Walter Benjamin's thought, and makes a brief foray into the work of Norbert Elias. Chapter 4 explores the philosophy of technology, science and technology studies (STS), and feminist and urban studies. Chapters 5 and 6 look at the two most prominent theoretical schools in STS: the social construction of technology (SCOT) and actor-network theory (ANT). Chapter 7 focusses on psychology, and on cultural, sound and sensory studies. Our final substantive chapter considers the more recent, ethnographically-informed, material turn to 'Thing Studies' which draws on anthropology, posthumanism and later waves of feminism. This survey, then, combines individual thinkers like Karl Marx, Langdon Winner, Sherry Turkle and Donna Haraway with theoretical schools like Marxism, the Frankfurt scholars, SCOT and posthumanism.

The map has also tried to incorporate a range of locations: factories, prisons, arcades, the public sphere, private homes and intimate spaces. Technology is charted in relation to industrial machines and the media (Chapter 2), buildings (Chapter 3), public infrastructure (Chapter 4), personal transportation (Chapter 5), scientific experimentation (Chapter 6), gadgets and devices (Chapter 7), personal possessions and companion species (Chapter 8). This sees us engage with a range of topics such as economics (Chapter 2), architecture (Chapter 3), space (Chapter 4) leisure (Chapter 7) and the environment (Chapter 8).

My aim was to produce a book that would appeal to students of social theory, sociology, STS and material culture studies. I also wanted to include writers that are not always thought of as theorists of technology. People like Walter Benjamin, Mike Davis, Norbert Elias, and George Orwell feature here because they have important things to tell us about

technology. They assist us in our navigation through, and comprehension of, the world of technology. The usual suspects – the stars of technological theorizing – are here: Bruno Latour, Wiebe Bijker, John Law. But so too are lesser-known figures who help us in our task. For this reason Brian Wynne, Bryan Pfaffenberger and Olga Sezneva take up a number of our pages.

While there are slight variations in the organization of each chapter they all follow a similar logic. Each is devoted to a thinker, a theme or a theoretical school. Their key thoughts and key points on technology are explained, and if the individuals under discussion are not known primarily as technological theorists, these thoughts are set within the wider context of their scholarship. We look at what thinkers and theoretical schools have concentrated on, what they were reacting to or what they were influenced by. We also offer criticisms of their approaches. Each substantive chapter closes with a summary discussion and annotated suggestions for further reading. As a rule, these readings are not referred to in the main body of the text. Instead, the intention is to expand and update the material under discussion, and to offer some alternative ways of thinking about the topics at hand. The works therefore suggest unexplored territories; they invite the reader to stray from the map.

Chapter 1 sets the scene for the discussion that follows. It looks at what technology is, what technology does, how technology has been theorized and what we as social theorists should be mindful of when studying it. We begin with three basic ways of defining technology: as objects (artifacts), activities and knowledge. As our discussion progresses we add new layers of complexity. We move from individual tools and objects to machines, buildings, sociotechnical systems and companion species, and to thinking of such technologies as ways of ordering worlds rather than simply as objects in that world. Additionally, then, we come to think about technologies as modes of organization.

Most of the substantive chapters are arranged chronologically. The earliest thinker, Karl Marx (1818–1883), his followers and their publications are discussed in Chapter 2. The most recent theorizing is to be found in Chapter 8. However, some of the chapters are organized thematically. For example, it made sense to discuss Walter Benjamin (1892–1940) and Michel Foucault (1926–1984) together in Chapter 3 because both were interested in architectures of control. Together these writers provide a useful way into the discussion of the social significance of the built form. As such they set the scene perfectly for the following chapter on the politics of artifacts. Similarly, many of the theories developed contemporaneously. For example, the social construction of technology (SCOT) school and actor-network theory (ANT) developed in critical dialogue with each other.

Thematically, the book charts a number of important theoretical shifts. It begins by considering the world of production while later chapters focus

on the world of consumption. Across the pages the reader will also notice an associated shift from what Michel Foucault called 'technologies of power' – those technologies and techniques that are used to dominate and control individual behaviour – to what he called 'technologies of the self' – the technologies and techniques through which individuals remake their persons. Put more simply, the earlier chapters focus on what technologies do to people, the later ones on what people do with them. Thus the question of use assumes greater significance in Chapters 7 and 8.

Like any map, this work is not without distortions. Maps reduce the three-dimensional world to two dimensions. In scaling down the world, maps may need to focus on specific areas, perhaps at the expense of surveying other provinces. This book does not go into lengthy discussion of science and the media. These topics are engaged with, although perhaps not as extensively as some would like. In truth both deserve book-length studies of their own, and both could find places within the Themes in Social Theory series. I wanted to attempt something broader than a science-studies or media-theory text. These are the ways in which technology is normally approached and, in consequence, they are very well served by existing publications. Still, important theories within science studies take up the content of Chapters 5 and 6, and there is also a place for media theorists like the Frankfurt School (Chapter 2) and Marshall McLuhan (Chapters 1 and 7), and media examples (beginning in Chapter 1). Students of science and the media are encouraged to proceed as the theories that are surveyed can be usefully applied to their areas of interest.

As with all maps there are always alternative ways of making sense of the terrain. Two points are worth mentioning in relation to this. First, this book places more emphasis on contemporary features of the theoretical landscape than on older ones. This reflects the profusion of theoretical orientations and empirical case studies over recent decades, but it does not discount early theorists if they inspired theoretical schools or primary research. The foundational sociologists Karl Marx and Émile Durkheim figure here. Both feature as important thinkers in their own right. Marx also inspired the Frankfurt School and the researchers of the labour process tradition, while Durkheim can now be seen as one of the progenitors of 'Thing Studies'. Second, greater emphasis is placed on artifactual definitions of technology than on other ways of thinking about technology. There is a great deal of discussion of physical things which I take to be an accurate reflection of the theoretical literature which overwhelmingly stresses technology as objects. This seems to be particularly true of that work which progresses to empirical study, and such work is our real interest here. How does theory guide academic study? How does this study amend theory? These need to be primary considerations in a work entitled *Technology and Social Theory*.

The Point of Social Theory

Before we go any further it is worth taking a moment to discuss the point of social theory. Theories provide us with frameworks for understanding social life. They too are maps; they act as guides that help us navigate through the social world. They also frame the topic, in our case technology. They give us a stock of knowledge as well as questions to ask in order to advance that knowledge. Those questions are answered by research. Theories illuminate aspects of society that would otherwise remain concealed. Talcott Parsons (1937, p. 17) suggested that we think of theories as spotlights. This imagery is useful. A spotlight will only illuminate so much. With any theory there will always be things that are left in darkness, still unexamined and unexplained. Parsons referred to these as 'residual categories'.

During the course of this book we will encounter many theorists and theoretical schools. Since there is no perfect theory that will explain everything, no all-encompassing spotlight, no perfect guide, I will admit only to a preference for theoretical pluralism. Let me give a couple of examples. Chapter 8 surveys the material turn in social theory. These Thing Studies yield important insights. They are typically informed by empirical research which demonstrates the importance of objects to their possessors. Strong emphasis is placed on consumption. If I wanted guidance on the meaning of objects to their owners I would look to this literature. But, these objects appear to be ready formed. The conditions of their production are a residual category. If I wanted to know more about the conditions of their manufacture I might want to consider the original material turn in social theory through the work of Karl Marx (Chapter 2). Similarly, while Marx excelled at articulating the fate of workers in capitalist society and at making sense of the technologies of the factory, he was hardly writing at a time of great environmental awareness. To get a more nuanced green sensibility on the machinations of capitalism you will have to look elsewhere. Alf Hornborg (2001) thinks that Marx focusses too heavily on the exploitation of labour and on the British Isles. In his opinion (pp. 61-–3), industrial capitalism is not self-sustaining. It needs to exploit the labour and natural resources of non-capitalist countries in the periphery. These two elements are residual categories in the work of Marx. Marx was correct to say that Britain's industrial might was built on the backs of its working class, but it also required African slaves, American soil, Scandinavian forests, Australian and New Zealand pasture. The list could go on, as could the catalogue of environmental consequences: soil erosion in the American South, Indian deforestation, the loss of native forest in New Zealand.

We will assess the merits of each approach in relation to the key points of theory: navigation, illumination and comprehension. How do they represent the world? How well do they guide us? What features do they regard

as being most salient? What do they omit? What do they teach us? How do they advance our knowledge? How do they relate to other thinkers and theories?

Key Themes

In addition to the chronological and thematic organization of the material, it is also given coherence by the recurrence of five connecting themes. They are:

- the politics of artifacts
- the materiality of power
- non-human agency
- subjectivity and technology
- technology and society.

The first theme concerns the politics of artifacts. While technologies frame our world they are socially shaped. Embedded within technologies are rafts of goals: social, cultural, economic, political, military and so on. These goals may conflict. Technological artifacts can be said to be political as they are the outcome of competing agendas. They typically involve compromise, and they could have appeared differently. For these reasons, Wiebe E. Bijker and John Law (1992a, p. 3) inform us that:

> The idea of a 'pure' technology is nonsense. Technologies always embody compromise. Politics, economics, theories of the strength of materials, notions about what is beautiful or worthwhile, professional preferences, prejudices and skills, design tools, available raw materials, theories about the behavior of the natural environment – all of these are thrown into the melting pot whenever an artefact is designed or built.

When we think of technology we should think of contingency. Since all of these points refer to design and construction we can say that they relate to the 'internal' politics of technological artifacts. This issue is discussed most fully in Chapter 5 when we look at SCOT's work on bicycle design. Technologies also have 'external' politics. They are designed to do things, to allow some behaviours and uses, and to prevent others. How do they help us? How do they constrain us? What do they force us to do? Who has decided this? And, crucially, who benefits from such arrangements? Many theorists have attempted to answer these questions. We begin our discussion of the external politics of design in Chapter 1 with a feminist interpretation of the baby bottle. In Chapter 2 we think about it in connection to numerically controlled machine tools. In Chapter 3 Michel Foucault writes about embedding social control in prison design while Norbert Elias thinks about the ways in which buildings are designed to collect and connect

people and also to correct behaviours that are deemed improper. As we will see, the conclusion of some scholars is that even seemingly benign technologies are designed to dominate. This theme receives its fullest treatment in Chapter 4.

The external politics of artifacts links very obviously to a second theme which Foucault called 'the materiality of power'. What role does technology play in controlling the conduct of others? What is its part in the order of things? This theme is also pronounced in the work of Karl Marx, David Noble, Langdon Winner and actor-network theory (see Chapters 2, 4 and 6). We introduce it in a number of ways, in discussion of such topics as productive forces, buildings and public infrastructure. Technologies are interpreted as weapons of class (and gender and race) war. Some, like Marx, regard technologies as tools of the powerful. They may be carriers of power relations, but they are politically neutral in themselves. Others, such as Foucault, actor-network theorists (ANT) and posthumanists, do not see technologies simply as the bearers of power relations but as powerful actors in their own right. They help to create power relations. Foucault and ANT both make the case for technologies to be considered as the very stuff of power.

The third theme flows on from the second. If such things as power and action are interactive effects – if they really do come about thanks to people and technologies in combination – we should think about distributed agency. Many thinkers suggest the need to come to grips with the possibility of non-human agency. In what senses do technologies act? What do they do? What are their effects? We first raise this theme in Chapter 1, we return to it in Chapter 3 where Walter Benjamin and Michel Foucault discuss the behaviour-shaping possibilities of buildings, it is covered again in Chapter 4 where Langdon Winner urges us to think of technologies as types of life, and is considered most fully in Chapter 6 where ANT admits of no difference in kind between human and non-human actors. Where it was once common to regard technologies as non-political entities there is now broad agreement that technological artifacts 'bear responsibilities, express commitments, and assume roles as agents in the realm of human relationships' (Winner, 2006, p. 278).

The fourth theme flows on from the third. It concerns the connections between subjectivity and technology. Selves are agents, but so are technologies too. To what extent do technologies make us what we are? How do they help shape, inform or, as we put it in Chapters 5, 6 and 8, *perform* us? We have been evolving with our technologies across the millennia. They are an indisputable part of our human being. But what sorts of subjectivities do they produce? How do they help shape us and organize our lives? There are many technologies and therefore many answers to such questions. In consequence our discussion keeps returning to this theme, for example through Theodor Adorno and Jean Baudrillard in Chapter 4.

We address such issues as technology's role in the production of alienated, docile, second, tethered and networked selves. Subject/object relations are a staple of the book, although the greatest emphasis is placed on them in Chapters 7 and 8.

Individuals are the domain of subjectivity. What is the place of technology in the production of collective identities? Our fifth and final theme is the broadest one of all: the place of technology in society. Karl Marx and Erving Goffman both give examples of the technological generation of social categories. Marx identified the machinery of the ruling class as mechanisms for producing the working class (Chapter 2), while Goffman (1977, pp. 315–16) gives us the example of the role of the built environment and technologies of sanitation in the production of gender difference. While all men and women need to evacuate waste there is nothing to say that they must do so in physically separate facilities. He argues that the provision of separate and unequal bathroom facilities is not simply a mechanism for respecting gender differentiation; it is also a way of creating it. Society is undoubtedly the creation of human interaction. Ours is a human-built world. But it is a dubious claim to say that it is simply a socially constructed world. We form our collectives with material agents. We relate to, with and through technologies. The social is always technological. Technology is everywhere. It is in us (in thought, medical implants, pharmaceuticals, vaccinations), on us (as contact lenses, clothing, glasses, hearing aids, various prostheses), it exists through us (in language, gesture, technique) and around us (as baby bottles, computers, prisons). Just as technologies play a role in the construction of individual subjects they play their part in the construction of society too. They help make society possible; technologies give society sturdiness. As Bruno Latour (2002b, p. 10) states:

> It is only because there exist *long lasting physical manmade structures such as buildings, houses, paintings, large stones* etc. that it is possible to entertain at all the notion of a society overarching individual and local interactions. Without the existence of a material artefactual world of things … it would almost be impossible for us, anatomically modern humans, to think at all about society. (Emphasis in original)

1

Theorizing Technology

Chapter 1 critically examines the central significance of technology in our world. The intention is to lay the groundwork for the substantive chapters that follow, when we will assess particular theorists and theoretical traditions. Here we introduce some general points for the would-be theorist of technology to keep in mind. We think about the nature of technology, what it is, what it does, how social theorists have conceptualized it, and the role social interests play in technological triumph. We consider what might happen when technologies shift settings, contexts and countries. From our example we will see that there is no single trajectory for a technology; rather there are many trajectories and many effects. We therefore suggest positioning technology as ongoing encounter. The mundanity of technology and its complexity are noted. The increased scale and interdependence of technologies are here conceptualized as the rise of sociotechnical systems. We explore some of the consequences of the development of more complex, interdependent and open technologies in relation to notions of expertise and risk. In addition to seeing our technologies as ongoing encounters, we raise the possibility that they might also be ongoing experiments.

What is Technology?

'In a way, everything is technology', so wrote Fernand Braudel (1985a, p. 334), arguably the twentieth century's greatest historian. Just as technology is everything, it is also everywhere, present in all our endeavours, be they exceptional or everyday. Braudel noted technology's role in humanity's great revolutionary moments: gunpowder, the machine, navigation, the printing press. He also saw the part technology has played in those slow accretions which modify what we already know and do (the sailor in the rigging, the peasant following the plough) – the gradual transformations of tools and techniques which add to the stock of accumulated knowledge. Technology helps elucidate history and vice versa. But as the

great historian warned, we should not collapse the history of technology to the level of crude materialism. Artifacts affect history, but they do not necessarily drive it, and they are never divorced from human desires, needs and passions.

Braudel alerts us to the difficulty of defining technology and determining what it does, given its ubiquity. Leo Marx (1997) has even referred to it as a 'hazardous' concept. In doing so he has taken issue with Braudel's way of defining it because the term is drained of any useful meaning. Others have articulated the same concerns, calling technology a 'slippery' term (MacKenzie and Wajcman, 1985, p. 3). In trying to give it some determinacy they draw attention to three separate levels of meaning. The first sees technology as physical things: objects, artifacts, tools, machines and so on. Of course, few theorists are happy to stick to this limited 'hardware' definition (Latour, 1988b, p. 199). These days many of our technologies are virtual, and we must reckon with the salience of software in our world. In Western societies these codes influence ever-more aspects of social life. Software has spread into communication devices, toys, domestic appliances, automobiles, elevators, traffic light and surveillance systems, to name but some. Society is populated with various animated smart devices, so much so that software can be said to be an important actor in the modern world. Computerization has radically altered the 'technical substrate' of society (Thrift, 2005, p. 197). While we are still confronted with fixed, stable and bounded things, we increasingly interact with intangible products and with things in transition. Software gives us time-restricted rights to access content streams, ongoing development, openness and upgrading possibilities. Saskia Sassen (2002, p. 369) identified digitization as the main driver in the transformation of the nature of things. It has increased

> those capacities that make possible the liquefying of what is not liquid … [it] raises the mobility of what we have customarily thought of as not mobile or barely mobile. At its most extreme, this liquefying de-materializes its object. Once de-materialized, it gains hypermobility – instantaneous circulation through digital networks with global span.

We therefore need to be mindful of what Nigel Thrift (2005, p. 10) called 'shifts in the nature of materiality'. New media technologies especially stress interactivity and convergence. They seem to be constantly transforming (we return to this point in Chapter 5). Mobile phones were once just that; senders of disembodied voices across distance. Now they also send text, capture and store images, download and play music, access and surf the web. To say that today's mobile phones are simply phones is to sell them short. While they remain communication devices they are also computational ones. This multiplication of functions also multiplies the potential uses, and the potential effects. Mobiles destroy the tyranny of distance and allow for 24/7 communication, they provide for novel forms of

entertainment and new ways of knowing, being and seeing. However, they also present us with new problems: happy slapping, sexting, text bullying, upskirting, another way to get into debt, another target for muggers, and new forms of tracking and surveillance.

The definition of technology as objects (which we have upgraded to actual or virtual objects, fixed or in flux) still requires expansion. Two other definitions are offered: technology as human activities, and technology as knowledge (MacKenzie and Wajcman, 1985, p. 3). Technologies are produced to create certain effects. In order for these to be realized we need to know how to use them. This takes us into the realm of technique. It entails what Raymond Williams (1975, p. 134) said of culture – right knowing and right doing. Even a simple tool can be useless in the hands of an untutored user. While three different definitions of technology have been identified, they all combine in use. For example, you are currently reading this chapter. To do so requires an object (this book), an activity (reading) and knowledge (of the English language). Should any of these three technological elements be removed the enterprise will fail.

We already have a sense of why technology is slippery – many technologies seem to be in a permanent state of transition and a single technology can have multiple uses and meanings. Yet another reason for the slipperiness of technology is that its meaning – what we understand by the word – has changed across time, as has its perceived relationship to terms like science. The origins of the word 'technology' are in the Greek root '*techne*', relating to art or craft (with '-ology' referring to knowledge about *techne*). When technology came into English usage in the seventeenth century it was tied to a particular type of learning, that of the mechanical arts. Even after the Industrial Revolution and well into the nineteenth century 'technology' referred to a type of book. It was only with the dawn of the twentieth century that sociologists like Thorstein Veblen began to use technology to refer to the whole of the mechanical arts. Leo Marx (1997) identifies ideological and substantive drivers for this shift: changing conceptions of the mechanical arts and changing organizational structures. These social changes resulted in the deployment of the word 'technology' in the sense that we understand it today.

The ideological spur came from the perception of new connections between science and the mechanical arts, married to a powerful belief in progress. That belief in progress, while ushered in by Enlightenment thinkers, was given a massive boost by the scale of scientific and technological advance. Refrigeration, steam power, the power printing press, the telegraph and scientific medicine had profound effects in the West. Here we see the emergence of a specific (and particularly common) understanding of technology as applied science. There are some objections to this. In the broad sweep of history science and technology have had separate trajectories. Moreover, the causal chain is just as easily reversed: science itself is

produced by technologies. Technologies are required to facilitate experiments and to measure outcomes. These days the word 'technoscience' is often used to denote their mutual constitution. Leo Marx (1997) singles out the chemical and electrical industries as particularly important sites of scientific and technological convergence at the turn of the twentieth century. This period, which ushered in air travel, automobility, electrification, film, radio and the telephone, is often labelled the Second Industrial Revolution.

Leo Marx (1997) also notes the growing range and effects of various technologies, in addition to their increased scale and interdependence. While the early phases of the Industrial Revolution were marked by individual machines (the spinning jenny, the power loom), across time isolated devices lost in significance to sociotechnical systems, of which the mechanical component may only constitute a small proportion. (The next chapter considers the politics of industrial technology with reference to another Marx – Karl.) Leo Marx's example is the railroad, one of the epitomes of modernity. Here we can revisit our three definitions of technology, and once again we can see how they combine in practice. To be sure, the railroad involves a physical object, the train. But to operate it requires many other objects, activities and knowledge sets. The first necessary physical thing was the track itself. Englishman George Stephenson built the first locomotive in 1814, but it was only with the mass manufacture of iron rails from 1820 onwards that the rail*way* was a possibility (Benjamin, 1999b, p. 563). Other necessary objects included bridges, tunnels, rolling stock, signals and stations. As to activities, there are numerous skilled workers involved in the construction, operation and maintenance of railroads. These activities entail specialist knowledge such as railroad engineering and telegraphy. The scope and complexity of these new systems also necessitated a new 'organizational matrix of the mechanic arts' (L. Marx, 1997). For the American railroads to be possible large corporate business structures with significant capital investment needed to be in place. The institutional framing of railroad operations also included standardization of track gauges and time zones. The combination of different types of railway technologies – objects, practices, knowledges – results in a sociotechnical system. Leo Marx adds a fourth useful definition of technology here: technology as a mode of social organization (see also Winner, 1977, p. 12). Interestingly, social theorists already seemed to be working with such definitions. In 1941 Herbert Marcuse wrote 'Some Social Implications of Modern Technology'. He defined technology 'as a mode of production, as the totality of instruments, devices and contrivances which characterize the machine age [and] at the same time a mode of organizing and perpetuating (or changing) social relationships, a manifestation of prevalent thought and behavior patterns, an instrument for control and domination' (Marcuse, 1995, p. 124).

To summarize, we are defining technology as:

- objects (virtual or actual)
- activities
- knowledge
- modes of organization
- sociotechnical systems.

What Does Technology Do?

Most dictionary definitions of technology stress its utility. We use technologies to improve our existence, to make our lives easier, to save time. Technology, then, appears to be the solution to a problem. We use technology to enhance ourselves, to magnify our force or efficacy, usually for purposes of environmental adaptation or control. This prompted media theorist Marshall McLuhan (2005) to discuss technologies as prostheses. Simply put, technologies are extensions of our bodies, physical forces and senses. (We expand on these points in Chapter 7.) How have we primarily extended ourselves in the world? Thrift (2005, p. 155) argues that the two main technological extensions of the human body have been through the inventions of writing/print and machines. We might think of these two extensions in terms of software and hardware. Until recently they have had separate existences, but thanks to advances in computer programming the two are converging. As Thrift puts it, software is 'becoming so pervasive and complex that it is beginning to take on many features of an organism' (2005, p. 155). Technologies, in this sense, can be said to act. Four ways in which information communication technology (ICT) assumes agency in the so-called New Economy are outlined:

1 The issue of sunk costs – massive investment in ICTs means that they *have* to be used;
2 The expectation of use produced by this – good companies use ICT;
3 It provides a new way of perceiving the world;
4 Software forbids some things and allows others – this is seen as the virtual and effective equivalent of barriers and tolls, walls and fences.

The idea of non-human agency is still controversial, but if we think of agency in terms of creating effects it is less threatening. This, after all, is the *point* of technology.

Another related way of thinking about the point of technology is by reference to mediation. Technologies mediate between the physical world and culture, between matter and meaning (Lemonnier, 1993, p. 10). This

meshes with the notion of technologies as agents. We use technology to act on and in the world, and technologies reciprocate. 'What humans are and what their world is receive their form by artifactual mediation. Mediation does not simply take place *between* a subject and an object, but rather *coshapes* subjectivity and objectivity' (Verbeek, 2005, p. 130). In other words, we should not think of technologies as neutral intermediaries interposed between humans and the physical world, but as full-blown mediators affecting what it is to be human in the world. Peter-Paul Verbeek uses the simple example of wearing glasses. When he wears his glasses he is different. Glasses give him additional competencies and experiences. Without his glasses activities like writing are impoverished and other activities, like driving and piano playing, are utterly impossible. For more on mediation see Chapter 6.

Peter-Paul Verbeek (2005, p. 114) also wrote of the train coshaping the presence of landscape. We can expand upon this point by drawing on the work of historian Wolfgang Schivelbusch (1986, pp. 52–69). This provides us with an opportunity to develop McLuhan's ideas about technology and sense perception. In pre-industrial times the fastest collective transport was the horse-drawn coach. The steam train accelerated, and significantly altered, the experience of travel. The train was seen as a projectile hurtling through, even destroying, time and space. Humanity had experienced nothing like it. Passengers conceived of themselves as packets, separated from the landscapes they traversed, propelled from A to B. Recalling McLuhan's arguments about technology and sense extension, we find the new railways altered the sense ratio and thus perception. Stagecoaches permitted subjective connection with landscape, a direct experience of the immediate environment. Railways offered a more objective perspective, a mechanization of the senses, a run through geographic space. Trains destroyed depth perception. The increased velocity caused the foreground to vanish. Old ways of observing were obsolete. You could still fixate on what was closest, but it came at the price of nausea and fatigue. Sensory retraining was required. This demanded a focus on the distance where things pass at a more leisurely pace. The existing ratio of proximity and distance in equal proportions was duly recalibrated. The new technologically-enabled, *mediated*, perceptions of time and space were at first shocking. Neither strictly in the landscape any more, nor in the company of intimates of equal social standing, when compared to coach travel this was first felt as a form of estrangement. But people adjusted. The increased speed and the new spatiality gave rise to a novel mode of apprehension, a moving vision. Things previously perceived as separate were now connected in a seamless, albeit fleeting, unfurling. What had emerged was the panoramic sensibility.

We have noted that we relate to, with and through technologies, that they are mediators, elements of our human being. Philosopher Martin

Heidegger (1977) offers further insight here. Joost Van Loon (2002, p. 90) says that Heidegger's work treats 'the notion of technology as a culmination of modern thought, a mode of being in which modernity reveals and conceals itself most fully'. For Heidegger the fixation on objects existing only to be used conceals the fundamental truth of technology. The essence of technology – what technology actually does – is not to be found in narrowly instrumental terms as means or in anthropological expressions as human action. Heidegger draws on philosophical wisdom since the time of Aristotle. He tells us that philosophy identifies four causes: content (matter), form, end and effect. These are united by a bringing-forth, a process involving a coming to presence or, as Heidegger (1977, p. 12) prefers, revealing. This revealing is the very essence of technology. Technology, then, is a form of knowing. Its import is metaphysical, but metaphysical in two distinct senses: the denial of truth as disclosure, and the sense that every disclosure also conceals (Heidegger, 1969). What marks modern technologies as distinctive is the particular type of revealing they entail. All seek to challenge nature, to unlock, transform and store its energy. The world appears as resource, as standing-reserve (Heidegger, 1977, p. 17). Heidegger uses the word 'enframing' to describe modern technology's way of revealing the world as standing-reserve. The crucial point about enframing is not that it is a method of unveiling but that it is a method of disclosure that forgets that truth itself is a disclosure. Enframing excludes all other methods of unveiling. One of Heidegger's most famous examples concerns a hydroelectric power plant on the River Rhine. The plant sets the river to work. In earlier times bridges and mills might be built into the river, now the reverse holds: the river is built into the plant, its current challenged to deliver energy. Its hydraulic pressure turns the plant's turbines which power the machines that generate the electricity: 'even the Rhine itself appears as something at our command' (Heidegger, 1977, p. 16).

Technologies in the broadest sense (as objects, activities, knowledge, organizations and, in combination, as systems) therefore do very important things. Drawing on Heidegger, Van Loon (2002, p. 91) tells us that technology 'shows us something: it discloses a specific trajectory of a particular matter, through its formation in production, its purposeful utility in action, but also its consequences, both manifest and latent'. Technologies go to the very core of our being, shaping how we are in the world, and how the world appears to us. They frame our relationship to the environment and to each other, impacting upon our perception, cognition and interactions. At the level of the individual they make us human, and at the level of the collective they make society possible. Michel Callon and Bruno Latour (1992, p. 359) are of the opinion that 'there is no thinkable social life without the participation – in all the meanings of the word – of non-humans, and especially machines and artefacts'. Such points are elaborated throughout the book, but are particularly emphasized in Chapters 6 and 8.

To recap, technologies:

- help us adapt to or control environments
- solve problems (and create new ones)
- extend human forces and senses
- mediate between the physical world and the cultural one
- are modes of being and knowing, revealing and enframing
- are agents.

How has Technology been Theorized?

There have been a wide variety of ways of theorizing technology, change and agency. We can impose a sense of order on them by separating them into three broad schools:

- anti-humanist ones that privilege the role of technology in social explanations,
- humanist ones that privilege the role of society, and
- posthumanist ones that refuse to privilege either.

The anti-humanist approach is often referred to as 'technological determinism', where technology is taken to be the decisive force. Being the prime actor it shapes social relations and causes social change. The humanist approach is sometimes referred to as 'social constructionism'. This has tended to be the province of most social theory and of mainstream sociology. Here humans take centre stage. They are the main actors. In preference to any form of determinism the posthumanist school simultaneously considers people, technologies, companion species, non-human organic agents and environmental forces. Here agency is not located at either end of an axis labelled technology and society; instead it is distributed widely amongst all those seen as actors (see Chapter 8).

The technological determinist position has been referred to as anti-humanist because humans are a secondary consideration to technology. We might say that from this perspective it is all about the object, as opposed to other definitions such as technology as activity, technology as knowledge, technology as organization. Indeed, all of these other elements are seen as the *effects* of material artifacts. Technology structures the social. From this perspective technology is viewed autonomously, it seems to exist outside of social relations. It is a-social. It is only when the technology is introduced into society that politics come into play. All of this can be illustrated by the following quotation: 'They say that no totalitarian regime, no matter how great its political, military, or even its economic strength, can survive above a certain threshold in the density of the telephone network.

Once this threshold has been crossed, police control is no longer possible, and the totalitarian straightjacket cannot hold' (Derrida in Derrida and Stiegler, 2002, p. 72). In this example the telephone network is introduced into totalitarian society and destroys authoritarian government. It necessarily creates democracy. While technologies have strong effects (as in the example, the telephone determines an entire political system), there are no *internal* politics to artifacts. Technological determinists tend to assume that technologies exist in the form that they do because it is rational, indeed inevitable, that they do so.

There are several objections to technological determinism, prime amongst them is that you cannot abstract technology from its social context. Technologies are social through and through. They are designed, manufactured, marketed, accessed and used by humans. For these reasons they can never exist outside of society. People like Bijker and Pinch have alerted us to the internal politics of technological construction (see Chapter 5), and social issues like the ownership and control of technology are important, if not decisive. As our definitions of technology made clear, it is not just about things, but about action, knowledge, organization and systems. We also need to think about the vitally important category of use. Is a single technology used in a single way? Few scholars would say 'yes'. Multiple cultures of use can develop around the same device. Europe and North America show marked differences in patterns of uptake and types of use regarding laptops, mobile phones and PDAs (Thrift, 2005, p. 163). The same technology can be called different things in different national settings. This can speak to very different perceptions of the same technology. In the US the 'cellular' phone references technological infrastructure, in the UK the 'mobile' stresses liberation from a fixed location, while in Japan the 'keitai' (roughly 'something you carry with you') speaks neither to technological possibility nor new-found freedoms but rather to an 'intimate technosocial tethering' (Ito, 2005, p. 1). Moreover, while some of the applications and uses of technologies are anticipated by the manufacturers, the history of technology shows us that they can frequently be used for unintended and unofficial ends, as in hacking.

While it is all too easy to conflate technology with complex high-technology, Ruth Schwartz Cowan reminds us that even simple devices can be deeply problematic when transposed from their original cultural context of use to another. The original rules may no longer apply. The humble baby bottle serves as a good example. Cowan (1979, p. 52), a feminist historian of technology, has taken male technology writers to task for focussing on the complex and spectacular, in a phrase, on Big Boys' Toys:

> The indices to the standard histories of technology … do not contain a single reference … to such a significant cultural artifact as the baby bottle. Here is a simple implement which, along with its attendant delivery

> systems (!), has revolutionized a basic biological process, transformed a fundamental human experience for vast numbers of infants and mothers, and been one of the more controversial exports of western technology to underdeveloped countries – yet it finds no place in our histories of technology.

In the developing world this overlooked technology is an entirely different entity. The basic operating assumptions – that constant access to clean drinking water is guaranteed, that the bottles and teats can be properly sterilized, that the product is easily affordable and will not be watered down or withheld, that consumers are literate and can follow written instructions, and that written instructions will be in a language appropriate for the market – do not necessarily hold. The latter problem is routinely reported by organizations like the International Baby Food Action Network.

To be successful this technology requires a background infrastructure of education, health and water delivery systems – a sociotechnical complex. Only when this system is properly working can we say that consumers make informed decisions. Formal education, especially for females, is far from certain in developing countries. Subsequent education from healthcare professionals may also be compromised by the heavy lobbying of representatives of the baby formula industries eager to push their products. Aggressive marketing tactics have also been reported. New mothers are given free samples which continue up until the point at which lactation stops. Mothers are then locked in to using the technology. Dr Anahit Demirchyan, UNICEF's Armenian coordinator of the Baby Friendly Hospital Initiative, claimed that the distribution of baby formula as humanitarian aid nearly ended their breastfeeding programmes (International Baby Food Action Network). Given the educational uncertainties in developing countries it is by no means definite that those using baby bottles know that breast milk provides babies with antibodies and nutrients that infant formula does not. Conversely, as the 300 000 victims of the Sanlu Group's melamine-tainted baby formula in the Peoples' Republic of China in 2008 show (Barbosa, 2009), the notion that baby formula is as safe as breast milk can also be erroneous. This is compounded by hygiene and sanitation issues: what is the quality of the water that is mixed with the baby formula? Clean drinking water is a pressing problem for a massive proportion of the planet's population: 1.1 billion people lack water security and 2.4 billion are without basic sanitation (World Health Organization, 2009).What is essentially a lifestyle decision in the West can be a life-chance gamble for the Rest, because in countries where diarrhoea is a killer this can be the difference between life and death. World Health Organization (2009) statistics put the yearly deaths from diarrhoea at 2.2 million people, most of whom are under five years old. This accounts for 4 per cent of all annual global deaths.

As the above example showed, there is no single trajectory for a technology, or single effect. This helps to explain why technological determinism has fallen from favour. Largely discredited by the humanists, it has become a term of abuse. For humanists, it is all about the subject. Humans are centre stage. The chain of causation is thus reversed: technology is an effect, not a cause. Society structures every aspect of technology. This also challenges the technologically-determinist idea of technological autonomy. The notion that technology is a-social is rejected. Humanists oppose the ideas that technology exists as it does because it is rational and logical that it does so, and that politics only come into play after a technology is introduced into society. For them, elements of society are already impressed into technology. Technologies have embedded social relations. They incorporate competing aesthetic, design, economic, engineering, production and marketing interests. These various interests are often hotly contested. Consequently, instead of the idea of a pure technology we need to pay heed to the 'politics of artifacts' (see Chapter 4), and against the cast-iron control posited by the technological determinists we need to speak of contingency.

The insights of humanists are useful. Recent work in social constructionism has been informed by empirical case studies (see Chapter 5). It is markedly more nuanced than the older technologically-determinist literature. That said, such approaches are not beyond criticism. At the extreme end of social constructionism (what we could call social determinism) material artifacts are forgotten altogether. Everything focusses on the social. The functionality and physicality of technologies disappears. Materiality is relegated to a residual category. Technologies are merely social constructions. This means that they exert no agency of their own, they have no effects. Their significance is only symbolic. As Bruno Latour (2000, p. 112) put it, the 'thingness' of things is forgotten. This is a problem. While society is the creation of humans and is doubtlessly constructed, it is 'not just *socially* constructed' (Latour, 1994b, p. 793). Indeed, 'for a few million years, [people] now have extended their social relations to other actants with which, with whom, they have swapped many properties, and with which, with whom, they form a *collective*'. The other actants Latour has in mind here are our technologies. Technologies function beyond the symbolic realm. They give society durability. For Latour and like-minded actor-network theory thinkers, society is best conceived as a series of sociotechnical assemblages (see Chapter 6).

Thus far we are still stuck with the same binary oppositions: technology versus society. The debate is over which leads which, the technological or the social. Even Braudel (1985b, p. 68) went down this road, asking if technology was civilization's body or soul. He decided on the former. But is it correct to pose an either/or proposition? An emergent posthumanist literature argues not. Neither the social determinism of humanists nor the anti-humanism of technological determinism pass muster, as we are always

faced with a sociotechnical order. Instead, posthumanists advocate distributed agency, which is to say the idea that humans *and* technologies (and a host of others) have agency and create their own effects. Such accounts are about objects and subjects (and objects acting as subjects, and vice versa). Here humans are decentred: 'There are no humans in the world. Or rather, humans are fabricated – in language, through discursive formations, in their various liaisons with technological and natural actors, across networks that are heterogeneously comprised of humans and non-humans who are themselves so comprised' (Michael, 2000, p. 1). Posthumanists therefore transgress the technology/society binary and stress co-agency, collective production and interaction, or what Verbeek called 'coshaping'. This seems to be a useful theoretical advance in as much as it retains the technological determinists' insistence on materiality (the 'thingness of things') and the social constructionists' take on the symbolic significance of technology, accepting the agency of technologies and humans simultaneously. Technical properties and social meanings are entertained. Both, after all, are vital.

To help us understand the admittedly challenging posthumanist position we will use Mike Michael's example of the couch potato. (We will discuss posthumanism in more detail in Chapter 8, particularly in relation to 'living technologies'.) In a way, the couch potato is also a living technology. The television-watching creature that never strays far from the sofa is best seen as a collective; a heterogeneous mixing of soft human and soft furnishing with hard television and hard remote control. It is a human/couch/television/remote hybrid. All are necessary elements. Without a place to lounge you fail to qualify as a couch potato, ditto without a remote – you will have to make the walk to the television set to adjust channel or alter volume all by yourself. The remote control therefore acts in important ways. We cede a complex of bodily functions to it. It works as our legs and arms. It does our walking for us. However, it does not substitute for the body entirely because we still need our fingers to press its buttons.

Who gets to do the pressing is also of great concern. And again we have a merging of the functional and the symbolic, technical property and social meaning, the material and the social, 'body and soul'. It is illuminating to see how a household technology gets domesticated. Who has possession of the TV remote? Who decides what will be watched? What is the etiquette? Is channel surfing permissible? Does the possessor of the remote accept requests? Will he or she relinquish it on demand? Michael cites David Morley's case studies of television viewing. Overwhelmingly Morley found the 'man of the house' in control and making all of the real decisions. The remote was used as yet another tool to reinforce the privileged position of the senior male, prompting Morley to urge us to think of remotes as congealed power relations. Thus the most modest of artifacts – as with our baby bottle example – can be seen to have considerable significances.

The remote extends the human senses, it receives a delegation of bodily actions and it is a repository (and producer) of family power relations. No innocent bystander in these family dramas, the television remote is also an actor: it 'also mediates – symbolizes, crystallizes and materially affects – these relations' (Michael, 2000, p. 105).

In sum, theorists have approached technology in three broad ways:

- by privileging technology
- by privileging society
- by thinking about the mutual entanglement of technology, society and other things besides.

In thinking about technology it is a good idea to be mindful of issues like:

- ownership
- control
- access
- use
- unintended consequences.

Technology, Systems and Social Interests

People, things, activities, knowledges and organizational structures are all part of the human story. As our previous sections made clear, we need to think beyond things in isolation to things in combination, to what we have been calling sociotechnical systems, and to what Manuel De Landa (1997, p. 77) calls 'meshworks of mutually supporting innovations'. De Landa makes the point with reference to the Industrial Revolution, the age of coal, cotton, iron and steam. Why did it happen in Britain in the nineteenth century and not Germany in fifteenth-century Lübeck or Cologne with their mining industries and system of large-scale credit, or in Italy given Milan's booming textiles and its links to commercialized agriculture? De Landa's conclusion is that technological artifacts in and of themselves do not suffice. The successful positively-reinforcing interactions of institutions, skills, processes and systems are vital. Britain could sustain its industrial take-off while Germany and Italy could not because it had upskilled its population through industrial espionage and the importation of expert labour. This created a reservoir of skill. Big business and the new technological artifacts were additionally catalyzed by a national market, a secure financial system of banking and credit, long-established global networks of trade (including colonial acquisitions), and an expanding agricultural sector which could in turn feed the growing population which was the very source of labour and skills.

An important lesson is to be drawn: technologies can not be abstracted from the environments which they help to create. This systemic focus helps us to understand why technical efficiency is not enough. Contrary to common sense, the best-designed technology does not necessarily win. Writing on Alexander Graham Bell's invention of the telephone, Bruce Sterling (1994, p. 6) tells us that it succeeded, not because it was an obvious technical improvement upon rival systems like telegraphy, 'but … due to a combination of political decisions, canny infighting in court, inspired industrial leadership, receptive local conditions, and out-right good luck'. He says that the same holds for more recent communications systems. There is nothing inherent in any technology to guarantee success. Matsushita's VHS triumphed over Sony's Betamax format video-cassette recorder, yet it was widely held that the latter was technically superior. If our spotlight focussed on the technological artifacts alone this would make no sense. But if we broaden our vision beyond technologies as objects to see the wider context of the consumer electronics market (and the heavy competition between Japanese and Pacific Rim producers) we can see why Betamax lost market share: a number of Sony's rivals supported Matsushita and refused to release films in Sony's format. This is sometimes referred to as the bandwagon effect. In this case they ensured that VHS was locked in as the industry standard (Du Gay et al., 1997, p. 76). We could also add the knock-on network effects as video renters and retailers observed the increasing demand for VHS. Noticing this they stopped stocking Betamax machines and video cassettes for which profitability was declining. Here we need to remind ourselves that politics are not only a matter of concern during the production of material artifacts – *they could be different* (Bijker and Law, 1992b, p. 3) – but also in terms of advertising, marketing, distribution and uptake. Power, capital and the ability to persuade are ongoing considerations, and they are central to technological triumph.

The ways in which 'our' decisions about the technologies we adopt are actually shaped by a series of prior decisions is known as path dependency. This impresses upon us the importance of events removed from us by time (history) and the potentially self-reinforcing nature of events (positive or negative feedback, or what we just called the bandwagon effect). This explains why your computer keyboard begins with the letters QWERTY when the alphabet begins ABC. They are 'governed by other laws than those of chance' as Foucault (2002, p. 96) wrote. Today's computer keyboards are arranged as they are because of the typewriter layout of the 1890s. The early typewriters were temperamental creatures. Typebars would jam if the keys were hit in quick succession. To minimize this inconvenience frequently used letters were spaced out across the keyboard. The result of this experimental work was the QWERTY keyboard, produced by Remington. This had the additional marketing merit that the product

name could be typed easily by travelling salespersons wanting to impress: the word 'typewriter' uses only the keyboard's top row. Engineering advances soon meant that typewriters did not need the QWERTY keyboard layout. However, it strengthened its dominance against rival layouts and became the standard because keyboard design was part of a bigger, technically entwined organizational matrix (David, 1985, p. 334). The operators were used to the QWERTY layout, as were the training establishments geared to their instruction, particularly so following the advent of touch-type training which was tied specifically to Remington's machine. The need for software (training, technique) and hardware (keyboard) compatibility became paramount. Typists did not want to waste time learning several different keyboard arrangements and employers did not want to waste money buying different models of typewriter.

Finally, the stress on dynamics, relations and exchanges – on seeing things in their combination – is valuable because it moves us away from thinking about the isolated genius, the lone heroic (usually male) inventor, and technology as fixed and stable entity. Instead, as David Spitz and Starling Hunter (2003, p. 1) suggest, we should conceptualize technology as 'ongoing encounter'. Who created the file-sharing program Napster? The standard answer is Shawn Fanning, an eighteen-year-old college drop-out. But, Fanning had help. He was assisted by his friend Sean Parker for the beta release of the software. That they could even develop something like Napster also presupposed the existence of a properly working background infrastructure. The existence of the internet is a given. In addition, they required the existence of the MP3 digital audio encoding format. Fanning also confessed to direct influence from internet relay chat (IRC) rooms. 'In fact, the closer "his" concept came to "thing-ness" the more social it became' (Spitz and Hunter, 2003, p. 5). Websites announced the beta release, which had been modified by early users, and Download.com hosted the program. Opinion is divided as to whether or not Napster even worked at this point in time. Its final success was due to a combination of factors: Fanning, Parker and their investors, a community of engaged users who helped eliminate bugs and improve upon the product, the existence of MP3s, IRC and peer-to-peer networks, Download.com and legal loopholes created by the Digital Millennium Copyright Act (Spitz and Hunter, 2003, p. 6). Once again we see that the actors are people and things, and that success rests on the combination of people, skill sets, artifacts and modes of organization. Such actor networks are the topic of discussion in Chapter 6.

To extend our knowledge of technology we should:

- think beyond the lone genius inventor
- include considerations of power, capital and the ability to persuade – they are all important factors in technological success

- look to the positively reinforcing interactions that sustain sociotechnical systems
- appreciate previous events (that past informs the present) and their potentially reinforcing nature (positive or negative feedback).

Our Times: Technology, Complexity and Risk

It is commonplace to argue that our technologies are more open, more fluid, more interdependent, and more complex than ever before. In consequence, we struggle to comprehend them. Jean Baudrillard (2005, p. 124) asserts that we are all 'Sunday drivers', entirely mystified by our technologies. Jacques Derrida (Derrida and Stiegler, 2002, p. 57) raises the same concern: we lack the ability to comprehend the very technologies that constitute our environment. We are useless in the face of modern technologies. For Derrida this is a root cause of today's existential struggles. While this state of affairs is worrying in itself, anxiety levels are further increased by the growing recourse to technology as the solution to seemingly any problem (Bauman, 1993, p. 187). In everyday talk this is referred to as the 'technological fix', the ready resort to technology, indeed the proffering of technology as the only source of legitimate action.

While we have noted the problem-solving nature of technology, and our baby bottle example introduced its problem-creating potential, we have no idea if a technology is a help or a hindrance until we see it used in a concrete context. Disjunctures between intention and outcome present with technologies as with everything else. The unintended consequences of human activity are long familiar to sociologists. Peter Berger elaborates, telling us that sociologists understand history as something more than the triumph of collective will or the rule of great ideas. For example, the notion of unanticipated outcomes is a recurring motif in the work of early sociologist, Max Weber. In *The Protestant Ethic and the Spirit of Capitalism* Weber noted the linkages between religious and economic practice. Calvin's doctrine of predestination led people to act ascetically in all aspects of life, especially economic life. This, he argued, gave rise to the ethos of capitalism, something that the founders of the Calvinist Reformation never envisaged. 'In other words, Weber's work … gives us a vivid picture of the *irony* of human actions' (emphasis in original) (Berger, 1968, p. 52). Technological examples of this abound. When the British Royal Commission on the Automobile convened in 1908, the biggest predicted problem was dust from unmetalled roads (Collingridge, 1980, pp. 16–17). No one predicted that it would supercharge teenage sexuality, destroy the inner city, kill and maim more people than firearms or give us a range of contemporary ailments from gridlock to road rage. Edward Tenner (1996) calls the unforeseen negative aspects of technology their 'revenge effects'.

Suffering, like privilege, is distributed unevenly, and sociologists also ask which groups bear the brunt of these revenge effects. Sticking with our automobile example Ian Roberts (2003) asserts that it is the young rather than the old, the poor rather than the rich, the people of the global south rather than the north, the pedestrian rather than the driver that pay the price: 'Every day about 3,000 people die and 30,000 people are seriously injured on the world's roads in traffic crashes. More than 85% of deaths are in low and middle-income countries, with pedestrians, cyclists and bus passengers bearing most of the burden. Most of the victims will never own a car, and many are children'.

Bryan Wynne (1988) offers us no comfort. His work shows us that even the experts might be at a loss to determine the consequences of any technologically-mediated activity, and these days most activities are technologically-mediated, which explains the growing interest of technology in social theory. Wynne considers several cases – the Challenger space shuttle disaster, the handling of highly toxic methyl isocyanate (MIC), fire aboard a passenger jet, leaks of radioactive gas at a nuclear power plant, and a methane explosion at a water pumping station – none of which he takes to be exceptional. He argues that experts work under greater ambiguity than is ordinarily supposed, particularly when they are involved with diffuse multi-sited systems. The bulk of our technologies are precisely these complex and interlinked systems (they are 'extensive' and 'open-textured' in his terminology). It is commonly believed that we have rules and then practices. The idea that we normally have a system in which devices, power sources and people operate with a shared logic of rational, rule-bound expected behaviour is refuted. Gaps exist between technology in theory (design and rational planning: what it *should* do) and technology in practice (use and emergent rule-making: what it *actually* does). The latter is never a final accomplishment; it always remains an ongoing process or what Spitz and Hunter called an ongoing encounter. These practices of contextualization and informal rule development impact upon the technology, complicating notions of risk. As Wynne sees it, technologies are 'normalized' through unanticipated developments, and accidents are the events which bring normal technology into question.

In the case of the Challenger space shuttle, NASA was fully aware that some components and subsystems were not in proper working order. This had been the case with previous missions, none of which came to a catastrophic end. The Challenger explosion was caused by leaking O-ring seals on the solid rocket boosters. Earlier launches demonstrated thermal stressing of the O-rings and leak paths in the surrounding insulation. In fact it was widely agreed that the O-rings had never performed as they should. They were frequently burned or broken and they were liable to leak. Their performance was acceptable as opposed to optimal. Many other components were not working to script. The result was that notions of safety

shifted. What was taken to be safe was negotiated informally in-house. Observable failures were a matter of ongoing debate, but it was agreed (wrongly in hindsight) that all failures were within acceptable limits.

Wynne identifies three elements of technological normalization: institutional, contextual and systemic. First, as the work of organizational sociologists has demonstrated, organizations develop working routines and rules that are frequently at odds with official organizational norms. The NASA example is pertinent here. Second, technologies work in concrete and complex circumstances, including ones for which they were never originally designed (our baby bottle discussion serves as a good example of this). Slippage can occur between various contexts of use as technologies are adapted for local conditions. Third, slippage is exacerbated in the case of large-scale systems where contextualization may only be partial. For example, parts are absorbed (or not) into the local regulatory structures and because of this the overall operating system is fragmented. When we have cross-cutting rationalities we have the potential for yet further problems. Wynne cites the case of a French factory that was storing and distributing MIC, the chemical responsible for thousands of deaths in Bhopal when it leaked from a Union Carbide plant. Bhopal is regarded as one of the world's worst industrial disasters. Stringent safety procedures for dealing with the chemical were introduced in its aftermath. While the factory was exercising due care, at another point in the sociotechnical system (the port in Marseilles) the MIC was being processed as if it were any other substance. The dockworkers were used to standardized productivity-based pay and so they were unloading it as quickly as possible when extreme care was required. In conclusion, Wynne (1988, p. 149) thinks that we should see 'technology as a form of large-scale "real-time" experiment' which enmeshes us all. Put another way, it is an accident waiting to happen.

While all eras have known natural disaster, the industrial epoch ushers in the time of the mass accident, these being the very consequence of our technological achievements. Indeed, '[o]ne might say that the more civilized the schedule and the more efficient the technology, the more catastrophic its destruction when it collapses. There is an exact ratio between the level of technology with which nature is controlled, and the degree of severity of its accidents' (Schivelbusch, 1986, p. 131). Paul Virilio (2003a) has pushed this thinking even further: to his mind a full understanding of our history and our technology is not possible without coming to terms with the accident. Whenever we invent a new technology we also invent the possibility of unintended and unfortunate outcomes. The invention of the ship creates the shipwreck, the invention of the airplane the plane crash. Invention spawns catastrophe. Virilio feels that this proliferation of disaster has created conditions of deep unease. The twentieth century was marked by mass-produced disasters, with signal events like the sinking of the unsinkable Titanic (1912) and the meltdown of Chernobyl's nuclear

reactor (1986) which had been celebrated under the title of 'Total Safety' in the previous month's edition of *Soviet Life*. Industrial accidents – whether on land, water or in the atmosphere – continue, and these are supplemented by new postindustrial accidents in genetic and information technology. Such events move us towards what Virilio calls the 'generalized accident'. This condition is best symbolized by the attacks on the World Trade Center on 11 September 2001:

> Indeed, not to use weapons, not military instruments, but simple vehicles of air transport to destroy buildings, while being prepared to perish in the operation, is to set up a fatal confusion between the attack and the accident and to use the 'quality' of the deliberate accident to the detriment of the quality of the aeroplane and the 'quantity' of innocent lives sacrificed, thus exceeding all limits previously set by religious or philosophical ethics. (Virilio, 2003a)

Ulrich Beck makes related points. His thinking about risk society also includes 'risk technologies'. Beck (2004, pp. 30–1) notes the shift from local to global technological risks with the transition from first to second modernity. He defined first modernity as: social relations founded on the collective, full employment, a bounded nation-state and the relentless exploitation of nature. Under first modernity the effects of risk were limited to clearly defined temporal and spatial domains (Beck, 2004, p. 115). Second modernity is marked by the opposite traits: individualization and fragmentation, growing unemployment, globalization and environmental catastrophe (Beck, 2000, p. 18). Gene technology, human genetics and nano-technology are all examples of global risks. '[B]ecause such risks are systematic, they change the concept of risk, from one of probability to one of radical uncertainty' (Beck, 2004, p. 31). They are difficult to contain or demarcate, generic and porous. In these respects the Chernobyl reactor meltdown is the exemplar of contemporary risk. It affected a poorly-defined community spread over an ill-defined territory over an imprecise time period (Beck, 2004, pp. 115–17). Chernobyl burst through all earlier attempts at defining risk. Its consequences were unbounded. This is 'modernity radicalized' (Beck, 2004, p. 115). New risks, then, gather communities separated by time and space. They are unpredictable, uncontrollable, unavoidable and uninsurable (Beck, 2004, p. 131). Beck (1997, p. 23) believes that these risks and their very real dangers now drive the motor of social change.

Technology is a major source of social anxiety:

- modern technologies are extensive and open-textured, even experts may struggle to master them
- the intended outcomes for technology might not work out in reality

- technologies are real-time experiments, they have revenge effects, they are accidents waiting to happen
- ours is a world of technologically-induced global risk.

Conclusion

We began by discussing the ubiquity of technology, it seems to be everything. To understand this 'hazardous' concept we suggested thinking about it in four ways: as artifacts, activities, knowledge and modes of organization. We also noted the connections between various forms of technology, stressing the ensemble, the sociotechnical system. How a sociotechnical system works out, indeed *if* it works out, will depend in large measure upon background infrastructures and cultures of use. This in turn is shaped by social interests (current and historic), the operations of power, and the context in which the technology is concretized. We need to be mindful of the politics of technological construction, ownership, operation and regulation. Any technology could have evolved differently. The form that technology takes is the outcome of contestation, including that between social classes (considered in the next chapter) and between the limitless human imagination and those constraints imposed by the laws of nature.

Further Reading

The most comprehensive hard-copy overview of the field is Rayvon Fouché's (2008) edited 4-volume series *Technology Studies* (London: Sage) containing 62 applied and theoretical pieces by authorities in the field. Authors include: Ruth Schwartz Cowan, Jacques Ellul, Jürgen Habermas, Donna Haraway, Martin Heidegger and Steve Woolgar. The series is organized around several themes: theorizing technology, technological change, technological politics, and technology and culture.

It is perhaps overstating the case to argue that Humphrey Jennings' (1995) *Pandaemonium* (London: Papermac) should be seen as England's *Arcades Project* (see Chapter 3) but it does deserve to be regarded as a classic in its own right. Jennings furnishes us with first-hand accounts of the Industrial Age, or, as he phrases it in the book's subtitle, *The Coming of the Machine As Seen by Contemporary Observers*. Chronologically ordered, the earliest entry in the book dates from 1660 and the latest is from 1886. The organizing themes are: observations and reports, exploitation, revolution and confusion.

David Edgerton's (2006) *The Shock of the Old* (London: Profile) is the best book-length study of the mundanity of technology.

Thomas P. Hughes is obligatory reading for those wanting to gain purchase on the idea of technologies as sociotechnical systems. See his 1983 work *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University).

Nelly Oudshoorn and Trevor Pinch's (2003) book *How Users Matter: The Co-construction of Users and Technologies* (Cambridge, MA: MIT Press) brings together a number of authors. These case studies show the agency of users, highlighting their ability to affect all aspects of technology from design right through to application.

Those interested in gender, technology and development are well served by a Sage journal of that name.

Two articles that deal with technology and development in relation to the digital divide are Tim Bunnell's (2002) 'Multimedia Utopia? A Geographical Critique of High-Tech Development in Malaysia's Multimedia Super Corridor', *Antipode*, 34(2): 265–95, and Melissa Gilbert et al.'s (2008) 'Theorizing the Digital Divide: Information and Communication Technology use Frameworks among Poor Women Using a Telemedicine System', *Geoforum*, 39(2): 912-25.

Michael Adas' (1989) *Machines as the Measure of Men: Science, Technology and Ideologies of Western Dominance* (Ithaca: Cornell University Press) offers a historic analysis of race and technology in the context of Western colonialism.

Contemporary accounts of race, racism and technology can be found in Paul Gilroy's (2001) 'Driving While Black', in Daniel Miller's (ed.) *Car Cultures* (Oxford: Berg), pp. 84–104, and Thuy Linh N. Tu et al.'s (2001) reader *Technicolor: Race, Technology, and Everyday Life* (New York: New York University Press).

Judy Wajcman's (2004) *TechnoFeminism* (Cambridge: Polity) is a good starting point for entry into the topic of technology and gender. It includes a discussion of feminism, technology studies and gender in the virtual world. Linda Layne et al.'s (2010) *Feminist Technology* (Champaign: University of Illinois Press) takes a critical look at technologies that are specifically designed for, and sold to, women.

Steve Redhead's (2004) *The Paul Virilio Reader* (Edinburgh: Edinburgh University Press) is a good starting point for those interested in Virilio's thoughts on technology. It collects 20 of Virilio's works from across his career, finishing with 'The Museum of Accidents'.

2

Marx, Modernity and the Machine

For most sociologists Karl Marx's work marks the beginning of serious systematic social theory. He regarded technologies as indices of social and economic relations. Marx was amongst the first to think through the consequences of the Industrial Revolution. He had admiration for the things that technology could do and contempt for what it was used to do. Machines were dictating the pace and pattern of modern economic life. Where workers had once been in charge of tools, machines now took charge of them. Under capitalism technological innovation was strongly connected to worker domination. Indeed, technologies helped to reproduce a social order that benefitted the ruling class by exploiting the working class. Marx's political project was to harness technology for truly human ends, not for narrow class advantage. In this chapter we begin by acknowledging Marx's novel intervention in modern social thought before looking at the topics of industrial technology, subjectivity in machine culture and technological determinism. Following this we look at two theoretical traditions that extend the work of Marx: the Frankfurt School who apply his insights on industrial production to the realm of cultural production and consumption, and the labour process school. Here we take a single study, David Noble's examination of the introduction of numerical control technology into the American manufacturing industry.

The Material Turn

Karl Marx's writings were heavily influenced by Enlightenment thought. The stimulus for the Enlightenment was born of advances in the physical sciences and the belief that a better society could be built: the future, as opposed to the past with its lingering traditions and superstitions, should

be the source of society's legitimacy. Marx subscribed to the *philosophes*' faith in reason and science, believing wholeheartedly in progress and the perfectibility of humanity. Marx, then, was but one theorist to argue that people make their own history. But whereas the philosophical tradition of the Enlightenment stressed The Great Idea of social change through reason and knowledge alone, Marx offered a *material* narrative of people making their own history by producing the means of their existence. For him, the production of material life – securing food and drink, shelter and clothing – is 'the first premise of all human existence' (Marx, 1978, p. 155). 'For all its difficulties in detailed demonstration', Raymond Williams (1977, p. 19) wrote, 'this was the most important intellectual advance in all modern social thought'. Williams (1977, p. 93) urges us to see beyond interpretations of Marx that stop with labour histories. He makes a point which has great significance for this book: capitalism presents itself as an endlessly perpetuating natural order. In fact, this order is materially produced to the benefit of the ruling bourgeois class. The advocates of a self-organizing and self-regulating 'free' market actively suppress what Williams (1977, p. 93) calls 'the direct material production of politics'. As he explains,

> any ruling class devotes a significant part of material production to establishing a political order. The social and political order which maintains a capitalist market, like the social and political struggles which created it, is necessarily a material production. From castles and palaces and churches to prisons and workhouses and schools; from weapons of war to a controlled press: any ruling class, in variable ways though always materially, produces a social and political order.

The ruling class become the preeminent intellectual force by being the preeminent material force. This identification of the materiality of power is an important one, and as a theme it runs through various tributaries of social theory. We return to it in our discussions of Michel Foucault, Norbert Elias, the politics of artifacts debate and actor-network theory in Chapters 3, 4 and 6.

Marx makes other novel interventions. Paul Sweezy (1968) notes that Marx's scholarship broke with that of the classical economists as well as that of the Enlightenment *philosophes*. Classical political economists were uninterested in changes in production methods. Adam Smith focussed on the division of labour, David Ricardo on income distribution. For them, economic development was the consequence of quantitative changes in population size, capital, wages and so on. Social relations remained the same. Marx did not subscribe to this stationary state of social affairs. For him, the modern industrial phase of the capitalist mode of production was defined by endless accumulation and constant technological innovation. Changes in methods of production inferred qualitative shifts in forms of

social organization and class relations. As Sweezy (1968, p. 110) put it: 'Marx was certainly the first … to develop a rounded conception of the industrial revolution and to take full account of its consequences in building his theoretical model of the capitalist process'.

Despite building this theoretical model of capitalism's dynamics, there is no grand unified theory explaining all of Marx's work, no single map to guide us. Sweeping pronouncements by Marx were rare. In their absence, the preface of *A Contribution to the Critique of Political Economy* provides a useful statement on theoretical orientation. Here Marx (1978, pp. 3–6) offers insight on the materialist conception of history, the 'guiding thread' of his studies insofar as he had one. Marx represented the world as follows. In producing social life people enter into certain relationships – relations of production – connected to concrete productive forces. These relations of production are the economic base of society. They condition social and political existence. Being, in other words, determines consciousness. In the course of their development, material production forces clash with the existing relations of production; social conflict results. Changes in the economic base transform the entire socio-political superstructure.

In a letter to P.V. Annenkov, Marx offered the view that all economic formations (the ways in which we make, trade and consume) are historical and transient. The two great sources of change are the division of labour and machines (Marx, 1978, pp. 138–9). Each division of labour has its own technical apparatus. The point is reiterated in *Capital*. To determine different economic ages we should not look at what is produced but at how production is organized and what technologies are utilized (Marx, 1990, pp. 285–6). Technology connects intimately to humanity. Humans conscript tools as part of culture's battle with nature. Our tool-using abilities distinguish us from other animals. Once these tools reach a certain level of accomplishment individuals produce more than they can consume. Labour's surplus can be shared or appropriated. This is the origin of class society (Kolakowski, 1988, p. 337). Marx determined identity by class and classes by their relationship to the means of production. All societies, with the exceptions of primitive and mature communist ones, have been stratified by class. Each has had a ruling class and a subject class, the former parasitic upon the latter. History's motor is driven by their conflict.

Machine-Made Machines: Modern Industry

It is commonplace for social theorists to conflate industrialization and modernization (Kumar, 1988, p. 4). The Industrial Revolution was a major event – and rupture – in the history of humanity. It broke with all of our previous history as a tool-using culture, and it broke our dependence on organic resources. In so doing the potential locked in human labour was

unleashed. The Industrial Revolution inaugurates modern economic life. It creates monumental increases in economic output and in wealth and living standards, although they are unevenly distributed, hence the existence of different social classes. Some of the features of this modern economic life include the separation of work from home, the rise of the factory system, the detailed division of labour and new forms of surveillance and discipline (on the latter, see Foucault in Chapter 3).

Peter Wagner (1998, p. 227) alerts us to the social divide regarding industrial technology. 'Creative Man' – and he means man – was fabricated as a bourgeois property-owning entrepreneur. Against this ideal-type, workers and children (who were sometimes one and the same) experienced the new machine technology as a worsening of their quality of life. Fears about the negative effects of the Industrial Revolution and the rise of the machine were widespread. Marx and Engels' special intervention was to suggest an alternative to simple refusal: the new technology could be used for the collective social good through a fundamental restructuring of society (Wagner, 1998, p. 228). The solution was to be found through revolution. And so, as Wagner (1998, p. 228) puts it, 'the machinery question' of the early nineteenth century was replaced by 'the social question' of the late nineteenth century. Marx explained Britain's industrial take-off in the nineteenth century by way of three factors: an institutionalized system of inducements for capital accumulation, the development of scientific knowledge that could be profitably applied to industry (meaning research and development replaced individual inventors and skilled labour), and technology of an altogether new character (Rosenberg, 1974, p. 716).

Marx and Engels divided the history of European industrial production from the Middle Ages until the time of their writing into three phases: handicraft, manufacturing and modern industry. In the handicraft phase production is small-scale. Master crafts persons dominate the process. A single worker makes the entire article. The manufacturing phase sees greater numbers of workers concentrated in a single establishment. There is a division of labour under conditions of manufacture. The finished article passes through the hands of all. For most of capitalism's history, approximately the mid-sixteenth until the late eighteenth century, this was the dominant form of production. Its labour process was technologically conservative. The same production techniques might be used for centuries. The manufacturing system was the paradigm for classical political economy. Marx dates the origins of the Industrial Revolution to 1735, with the invention of John Wyatt's spinning machine. So begins the decisive shift from humans to mechanisms, the rise of modern industry. These innovations had profound flow-on effects in related productive spheres:

> Thus machine spinning made machine weaving necessary, and both together made a mechanical and chemical revolution compulsory in bleaching, printing, and dyeing. So too, on the other hand, the revolution

> in cotton-spinning called forth the invention of the gin, for separating the seeds from the cotton fibre; it was only by means of this invention that the production of cotton became possible on the enormous scale at present required. But as well as this, the revolution in the modes of production of industry and agriculture made necessary a revolution in the general conditions of the social process of production, i.e., in the means of communication and transport. (Marx, 1990, pp. 505–6)

With modern industry, which begins in earnest from the mid-nineteenth century, control of the immediate production process was removed from the direct producers. Goods are now the products of power-driven 'cyclopean' machines. Masters no longer supervise apprentices, or workers each other; now employees watch over mechanical agents. '[T]he labourer becomes a mere appendage to an already existing material condition of production' (Marx, quoted in Rosenberg, 1974, p. 721). Prior to this time British society in its handicraft and manufacturing stages simply lacked the technological basis to launch an industrial revolution. What was so special about this new technology?

The decisive shift is from what Marx called subjective to objective technologies: where once the worker was in charge of tools, machines now control the workers. The great leap forward came when technological innovation no longer relied on a limited pool of skilled labour. Under such circumstances machines are restricted by the physical and cognitive capabilities of the workers. Machines making machines is the technical foundation for transformation (Marx, 1990, p. 506). While machines can be endlessly worked upon and continually bettered to increase productivity, humans cannot. Machines transcend these biological limitations (Marx, 1990, p. 495). Machinery reduces the requirement for skilled labour, it creates unemployment in new areas, and its refinement undermines existing jobs. In consequence, labour costs and demand for labour are much reduced. In the battle between capital and labour, machines weigh in for the former. They are implements of class war. Marx (1978, p. 139) attributed all technological innovation since the first crisis of English capitalism to the struggle between workers and bosses. 'It is the capitalistic employment of machinery, and not merely capitalism in general, which generates the modern proletariat as Marx conceived it' (Sweezy, 1968, p. 115).

Prior phases of economic production were conservative, modern industry is revolutionary. The factory system embedded technological innovation into its very organization. Marx (1976, p. 187) provides the following schema of the progress of machinery:

> Simple tools; accumulation of tools; composite tools; setting in motion of a composite tool by a single hand engine, by man; setting in motion of these instruments by natural forces; machines; system of machines having one motor; system of machines having an automatic motor.

This technological innovation is crucial for bourgeois domination. Capitalism actively rewards the adoption of cost-cutting technologies. In fact, '[t]he bourgeoisie cannot exist without constantly revolutionizing the instruments of production, and thereby the relations of production, and with them the whole relations of society. Conservation of the old modes of production in unaltered form was, on the contrary, the first condition of existence for all earlier industrial classes' (Marx, quoted in Rosenberg, 1974, p. 713). In consequence, modernity as a social formation is unlike anything else, even itself. This is because it is primarily defined by change. In *The Communist Manifesto*, published in 1848, Karl Marx and Friedrich Engels wrote that:

> [c]onstant revolutionizing of production, uninterrupted disturbance of all social conditions, everlasting uncertainty and agitation distinguish the bourgeois epoch from all earlier ones. All fixed, fast frozen relations, with their train of ancient and venerable prejudices and opinions, are swept away, all new-formed ones become antiquated before they can ossify. All that is solid melts into air, all that is holy is profaned, and man is at last compelled to face with sober senses his real condition of life and his relations with his kind. (Marx and Engels, 1982, p. 26)

Marshall Berman (1988, p. 21) regards this as 'probably the definitive vision of the modern environment'. While the quotation is justifiably famous, the context of its production is frequently forgotten. Marx was clear on the place of technology in the ecology of modernity: it lies at its very heart. The visions of modernity that social theorists work with are framed by technology. Marx's authoritative statement was prompted by discussion of industry, trade and global navigation, the spread of the railways, new communication technologies and technological innovation. He had unconcealed awe for the unparalleled technical achievements of modern industry and unconcealed disgust for its human consequences. This distinction brings us to the theme of technology and subjectivity.

Machine-Made People: Modern Subjectivity

Marx's early writings show a deep compassion for the individual, contrasting *bildung*, which could be defined as subjectivity, with alienated labour as it exists in the capitalist mode of production. Wage labour is conceived as estrangement because labour is separated from the subject (the worker) and from the object (the commodity). False social demands dictate production. Work is no longer a source of fulfilment, which, for Marx, it should be. He regarded it as our very species being. Instead, work is merely a means to survive. 'This makes man, as far as is possible, an abstract being, a lathe, etc., and transforms him into a spiritual and physical abortion'

(Marx, 1992, p. 269). *Bildung*, Marshall Berman (2002, p. 9) tells us, is a fundamental liberal romantic value. It meshes with Enlightenment aspirations of human creation, development, and fulfilment. Marx takes these modern ideas and creates a social theory out of them.

It is common knowledge that production processes create things. Marx's theorizing went further, proposing that they also produce social relations. In the *Grundrisse* Marx (1993, p. 92) famously stated, 'production not only creates an object for the subject but also a subject for the object'. This is because modes of production are simultaneously modes of cooperation. 'In production, men not only act on nature but also on one another' (Marx, 1978, p. 204). The productive forces available to society define its essence. Consequently, humanity's history 'must always be studied and treated in relation to the history of industry and exchange' (Marx, 1978, p. 157). Marx generates five theoretical concepts to draw attention to contemporary industry and exchange and to comprehend their impact upon human experience:

- labour-power
- surplus-value
- use-value
- exchange value
- commodity fetishism.

Labour-power is the capacity to work. Under capitalism workers must sell their labour-power in order to survive. Selling one's ability to work means selling one's strength, intelligence and energy, in so doing workers sell themselves. Life's very essence is commodified. The subject becomes an object, the personality becomes a thing. Work and its fruits become the alienated antithesis of fulfilment. Once bought, this labour-power can be put to work to create value greater than its own. This concept is used to explain the generation of surplus-value. Workers habitually generate more value in any working day than the value of their labour-power. Five hours may be taken up with necessary labour, which is valued in the form of wages. The next five hours of surplus labour create surplus value which is appropriated by the capitalist. Surplus value is what capitalists call 'profit'. This is the worker's unpaid labour, and as such it amounts to exploitation. Capital's power is based on alienated labour. As capital this alienated labour is employed to take possession of yet more labour. 'Hence the rule of the capitalist over the worker is the rule of things over man, of dead labour over living, of the product over the producer' (Marx, 1990, p. 990).

While labour is the source of all value, workers produce nothing for themselves but wages. Marx observed the unskilled replace the skilled, women replace men, and children replace adults. The individual charm and character of work were replaced by mass monotony. Indeed, wages appeared to have an inverse relationship with toil and horror; the harder the

job the less the remuneration. One of the great contradictions of capitalism, then, is that potential sources of unprecedented wealth are turned into sources of want. The intensity of competition means that capitalists look to constantly reduce labour-time to its bare minimum. This has two consequences: labour productivity is increased to unprecedented levels, the fruits of which are not shared by the masses, and capital accumulates amongst the ruling classes while the lot of the masses is increased poverty.

Tools rely on humans, but in modern industry machines rely on mechanisms. In 'the rule of things over man' the subject is effaced. Labourers are not the masters of the production process, but their effects. Machinery assumes the role of 'animated monster' (Marx, 1993, p. 470). It dissembles the whole human being (Marx, 1976, p. 188). Drudgery and poverty are known to all ages, what made capitalism unique to Marx was 'the loss of human subjectivity' (Kolakowski, 1988, p. 287). The *Economic and Philosophical Manuscripts* (1844), *Communist Manifesto* (1848), *Grundrisse* (1858) and *Capital* (1867) record the processes of degradation which reduce people from cognitive beings to cogs in the machine. The nouns Marx attaches to the industrial worker record this: abortion, accessory, appendage, fragment, organ, part, pauper, punctuation mark, slave. To these seeming bit players Marx ascribed the greatest historical mission of all: revolutionary overthrow of the parasitic bourgeoisie and their exploitative capitalist economics. The workers, having nothing to lose but their bondage, are urged to gain the globe. This will be theirs when a class-free communist society is established. In such a world, ownership of the means of production will be shared, a planned economy will replace the anarchy of the market, and use-values will replace exchange-values.

Use-value is a qualitative measure; things which have use-value satisfy human needs. This is a consequence of their material properties. There is an unmediated relationship between the product and its direct social utility. Exchange-value is a quantitative measure, based on the average socially necessary labour-time needed to produce an object at a given level of human competency and technical proficiency. This measure provides for sale and purchase at a particular rate (Kolakowski, 1988, p. 272). Exchange-value does not relate to material properties, it cannot be discovered in the thing itself. The system of exchange based on standardized labour-time gives rise to commodities and exchange-values. In obtaining a money form, commodified objects also give rise to an ideological form of thinking that Marx called 'commodity fetishism'. This marks a significant transformation in subject/object relations. Expressed simply, commodity fetishism is a form of flawed thinking in which relations between humans as creators and exchangers of objects come to be seen as relations between things. These things assume the qualities that labour has given them, as if they naturally contained them in the first place. Marx (1990, p. 176) likens it to the mistaken belief that rents grow out of the soil rather than out of social

arrangements. Labour is also reified in the money economy. It is thing-like as it too is commodified, bought and sold in the market. Since capitalism is a system wholly committed to the continual increase of exchange-value, human action is harnessed for non-human ends (Kolakowski, 1988, p. 264).

The fetishism of objects has a long history in Western thought. European traders, initially the Portuguese, first began to think about it in their exchanges with West Africans in the sixteenth and seventeenth centuries. From the European perspective the 'primitive' Africans seemed to make random connections with material artifacts (Pietz, cited in Stallybrass, 1998, p. 185). Yet the 'moderns' demonstrate the strangest form of fetishism of all: a love of the object not because it is a useful or meaningful thing, and not because of the sensuous activity that creates it. Their affection for things is reversed. Drained of meaning, memory and history, things assume significance only as equivalence, that is, for their exchange-value, their monetary worth in the market. Thus we have a rejection rather than an appropriation of the object. The opposition between individuals and commodified objects that Marx discusses in *Capital* is historically and culturally novel (Koptytoff, cited in Stallybrass, 1998, p. 185).

Marx and Technological Determinism

It is not possible to complete a discussion of Marx without reference to technological determinism. Critics of Marx have often accused him of this. As we noted in Chapter 1, technological determinists see technology as the driving force of history. At the same time, they grant autonomy to technology – it somehow exists outside of social relations. Once technological innovations are introduced into society they inevitably transform it. Technology structures the social. Social organization is nothing more than the outcome of technological effects. The issue, then, is not one of technology and social theory but technology *as* social theory.

Theorists are called technological determinists as a term of abuse. No one seems to admit to being one, and everyone seems to oppose them. The difficulty arises in making the label stick. Most technology writers make Lynne White Jr (1962) the straw man for his opinions of a single technology (this interpretation may originate with Sawyer and Hilton, 1963). Crudely expressed, White Jr was of the opinion that the invention of the stirrup made mounted shock warfare possible. This new level of lethality was seized upon by the Franks in the eighth century. The warrior training techniques and the resources necessary to sustain them decisively transformed society. Stirrups created feudalism. But White Jr did not express his arguments so crudely himself, and decades later writers were still referring to his work in articles like 'Lynn White's *Medieval Technology and Social Change* After Thirty Years' (Hall, 1996) and 'Once More into the Stirrups'

(Roland, 2003). So it goes with Marx who has been seen as everything from technological determinism's main advocate to its most compelling critic (Winner, 1977, p. 77). One can certainly make Marx a technological determinist by substituting stirrups for mills. As Donald MacKenzie (1996, p. 23) writes, his passage from *The Poverty of Philosophy* – 'The handmill gives you society with the feudal lord; the steam-mill society with the industrial capitalist' – fits the bill admirably. It is one of the best statements of technological determinism available to us. The label starts to fray once we stray from single sentences. As soon as we look at his larger body of work it detaches altogether.

Theodor Adorno (2003, p. 118) calls the attribution of the motive force of history to technology 'theoretical Luddism'. Technology is neither society's driver nor the source of all problems; the issue is technology's integration into society. Technological development is distorted under capitalism because it is impelled by the logics of profit and domination. This is Marx's own argument. Marx (1990, pp. 554, 558–9) had observed that, for the first time, the workers' struggle had raged against the instruments of production themselves. The war against machines was misplaced. It confused machinery's current use for its essence. For Marx, machines are neutral *a priori*. (As we will see in later chapters other theorists will seriously dispute the notion of technological neutrality.) The essence of machinery, so to speak, should not be understood as its current utilization. Marx was abundantly clear on this point:

> The application of machinery in the present day is one of the relations of our present economic system, but the way in which machinery is utilised is totally distinct from the machinery itself. Powder is powder whether used to wound a man or to dress his wounds. (Marx, 1978, pp. 139–40)

In other words, what machinery *is* 'is totally distinct from the machinery itself' (Marx, 1978, p. 140). Productive forces can be harnessed for social good. This brings *relations* of production into focus. True oppression is social not mechanical. The real enemy is the capitalist class. This distinction between forces and relations of production is critical. Marx (1990, pp. 554–5) gives the determining role to the relations of production, defined as the ways in which labour is socially organized.

Marx-the-technological-determinist makes even less sense when we recall the central concern of his studies and what he took to be the true subject of history. Marx had no interest in 'sacred' history in the Hegelian fashion. Instead of a history of ideas he turned to 'profane' history; the history of human beings and their concrete relations. He did not write 'machines make history, but not in circumstances of their choosing'. He wrote about men making their own history, he wrote about the shock of body

against body, he wrote about bloody struggle, and for good reason. For Engels and Marx (1956, p. 125), the only history worthy of the name was embodied history: 'History does nothing, it possesses no immense wealth, it fights no battles. It is instead the real human being, the real living person, who does everything, who owns everything and who fights all battles'.

To summarize, Marx's great theoretical intervention was to advocate and explicate a materialist approach to making sense of society. He paid great attention to the technologies of industrial capitalism and to the important role played by technological innovation. He illuminated the shift in the locus of control from humans to machines. While machines appeared to be the current cause of misery they could be harnessed for the liberation of humanity. Marx therefore looked to the future as the source of society's legitimacy. The current problem did not rest with forces of production – technology – but with relations of production – the ways in which the technology was used.

Extensions of Marx, I: The Frankfurt School and the Culture Industry

In this section we look at the ways in which Marx's theories have been extended and amended by three members of the Frankfurt School: Max Horkheimer, Theodor W. Adorno and Herbert Marcuse. We begin with Horkheimer and Adorno's *Dialectic of Enlightenment*. In Gunzelin Schmid Noerr's (2002, p. 218) opinion it 'is undoubtedly the most influential publication of the critical theory of the Frankfurt School, and one of its most compressed theoretical statements'. Horkheimer and Adorno define Enlightenment as unfettered thought and nature's domination by culture. In their telling, knowledge equals power and power equals technology. *Dialectic of Enlightenment*'s opening essay credits these calculations to Francis Bacon. Bacon identified printing, artillery and the compass as key technologies in the early seventeenth century. Since his time, language and weaponry have been eclipsed by the new 'instruments of power', autonomous machines, 'which are intended to hold everyone in their grasp' (Horkheimer and Adorno, 2002, p. 29). In so doing, the Frankfurt scholars identify another element of Enlightenment which firmly aligns with Marxist thought: domination of nature involves domination of humans (Horkheimer and Adorno, 2002, p. 2; see also Marcuse, 1991, p. 158). By their reading, the masses are misled and free thought is stifled. Their project, then, 'was nothing less than [to] explain why humanity, instead of entering a truly human state, is sinking into a new kind of barbarism' (Horkheimer and Adorno, 2002, p. xiv).

In the Preface to the 1969 edition of *Dialectic of Enlightenment* Horkheimer and Adorno (2002, p. xi) wrote of their commitment to 'a theory

which attributes a temporal core to truth'. For this reason they could not endorse all of the book's original (1944) content. Theory must be disciplined by history, and certain developments rendered aspects of their thesis false. This also separates them from aspects of Marx's theories. Like Marx they retain a fidelity to critiquing capitalism. Under capitalism technology is opposed to life: commodification, commodity fetishism and the unending quest for exchange-values continue to alienate human beings, and the detailed division of labour moulds people to the technical apparatus. Machines have the measure of humans. Like Marx's social theory, theirs is an attempt to comprehend society in its current form. As such, certain historic events separate Marx from the Frankfurt scholars: the industrialized killing of the First World War, the defeat of left-wing working class movements in Western Europe thereafter, the rise of Russian Communism and its ultimate degeneration into Stalinism, Italian and German fascism, Hitler and the Holocaust, the Second World War (during which *Dialectic of Enlightenment* was written), the rise of the monopoly phase of capitalism and of the consumer society.

The changed social conditions also lead to certain theoretical departures from Marx. Adorno (2003, p. 112) wrote:

> we would have to concede that capitalism has discovered resources within itself that have postponed its collapse until the Greek Calends. These resources include, at the top of the list, the immense growth in technical potential and with it the vast increase in consumer goods available to all the members of the advanced industrialized nations. At the same time, faced with this technical development, the relations of production have proved to be more flexible than Marx had expected.

While Marx foresaw the alternatives of barbarism or salvation through socialism, Frankfurt scholars see no escape from the technological matrix: 'all social phenomena today are so completely mediated that even the element of mediation is distorted by its totalizing nature' (Adorno, 2003, p. 124). Technology is fetishized. Its ultimate end should be a life of human worth. Instead, this is hidden from the masses (Adorno, 2003, p. 29). What results is a Weberian pessimism about the spread of instrumental reason, which the Frankfurt School equated with means/ends calculations aimed at technical mastery. 'With the spread of the bourgeois commodity economy the dark horizon of myth is illuminated by the sun of calculating reason, beneath whose icy rays the seeds of the new barbarism are germinating' (Horkheimer and Adorno, 2002, p. 25). Herbert Marcuse agrees. In a single phrase he touches on most of the key themes of this work: 'domination perpetuates and extends itself not only through technology but *as* technology' (Marcuse, 1991, p. 158).

Capitalism's competitive era has come to an end (Adorno referred to 'late capitalism') and no alternative seems possible or preferable (Marcuse, 1991). Minds and bodies are controlled. In Horkheimer and Adorno's writings atomized mass replace the revolutionary class. The closing remarks of Adorno's (1991, p. 92) essay 'Culture Industry Reconsidered' signal the end of the Enlightenment project, chiefly at the hands of an imperious culture industry which dissimulates its messages of domination as it disseminates them:

> The total effect of the culture industry is one of anti-enlightenment, in which, as Horkheimer and I have noted, enlightenment, that is the progressive technical domination of nature, becomes mass deception and is turned into a means for fettering consciousness.

In their original essay on the culture industry Horkheimer and Adorno took issue with sociological theses that the decline of religion and tradition coupled with the technical division of labour and increasing fragmentation would lead to social collapse. This is everywhere disproved. All that is solid does not melt into air. The products of the culture industry, understood as the conjunction of new technologies with economic and bureaucratic monopolies, bind us. Where once cultural products had their own internal logic, autonomy and originality, now they are externally organized by the culture industry. Film, television, radio, magazines, pulp novels and popular newspaper columns have standardized content and rationalized distribution techniques, with the result that the serious and worthy elements of high culture and the rebellious and edgy aspects of popular culture are eradicated. This culture is entirely commodified. It is made for us not by us. 'Each branch of culture is unanimous with itself and all are unanimous together' (Horkheimer and Adorno, 2002, p. 94). Standardized mass-manufactured products are consumed by standardized mass consumers. Under the stamp of sameness, 'pseudo-individuality reigns' (Horkheimer and Adorno, 2002, pp. 124–5). Subjects are drained of their subjectivity. They are little more than ciphers of the culture industry. The Frankfurt School take what Marx wrote about work and production and apply it to the domains of leisure and consumption. Echoing Marx's comments about capitalism producing abstract alienated beings they write:

> The most intimate reactions of human beings have become so entirely reified, even to themselves, that the idea of anything peculiar to them survives only in extreme abstraction: personality means hardly more than dazzling white teeth and freedom from body odour and emotions. (Horkheimer and Adorno, 2002, p. 136)

It is not only the critics of the culture industry who see it through a technological lens. The controllers of the culture industry do the same. In their public pronouncements they claim that standardized (re)production techniques are needed to satiate the mass audience which runs into the millions and occupies countless locations. Industrial organization, planning and distribution are required to reach these far-flung consumers. Their standardized products are said to be nothing more than what the people really want. Horkheimer and Adorno (2002, pp. 95–6) note that the question of power is never openly entertained by the culture industry. In their analysis consumer sovereignty is impossible. Economic elites make the decisions, and they manipulate the masses through advertising, 'mechanical repetition' and 'psycho-techniques' (Horkheimer and Adorno, 2002, p. 133). Thus a strong theoretical spotlight would illuminate the culture industry's rationale for what it is: the logic of domination. 'Conformity to reality, adaptation to power, are no longer the result of a dialectical process between subject and reality but are produced directly by the cogs and levers of industry' (Horkheimer and Adorno, 2002, p. 170). The fate of the worker in the 'house of terror', as Marx (1990, p. 389) labelled the factory, is also the fate of the consumer in the world of leisure. We need to theorize beyond the factory as industrial models and methods are now everywhere (Adorno, 2003, p. 117).

Between 1958 and 1959 Marcuse worked on a series of lectures that would form the foundations of *One-Dimensional Man*. With technology brokering our reality our world is only composed of people and things. It is one-dimensional. Nature has ceased to exist as such. The natural has been transformed into the technical world, a second nature. 'The most fundamental experience is no longer concrete experience, overall social practice, but rather the administrative practice organized by technology' (Marcuse, 1989, p. 121). Marcuse (1989, p. 122, emphasis in original) continued, '[i]t is more than a pun if I say that *technology has replaced ontology*'. Here we can detect the influence of his teacher, Heidegger, but Marcuse also retains a fidelity to Marxist thought. This one-dimensional consumer society intensifies commodity fetishism. The affection we feel for our objects is greater than that which we feel for our fellow subjects. As Marcuse (1995, p. 128) expresses it: 'The average man hardly cares for any living being with the intensity and persistence he shows for his automobile. The machine that is adored is no longer dead matter but becomes something like a human being'. Control is technological in an entirely new way. Such thoughts as we have of ourselves are reflections of the things we possess and desire. 'The people recognize themselves in their commodities; they find their soul in their automobile, hi-fi set, split-level home, kitchen equipment' (Marcuse, 1991, p. 9). We think of ourselves through our relationship to our things. Industrial society manufactures these false needs. As with other Frankfurt theorists, consumption figures as social control. 'The

alarming thing about this – alarming, because combating it can seem so hopeless – is that this trend goes hand in hand with that of the entire civilization' (Adorno, 2003, p. 29).

Extensions of Marx, II: David Noble, *The Forces of Production*

The Marx-inspired works *Dialectic of Enlightenment* and *One-Dimensional Man* are monuments of modern social theory, but neither draws its conclusions from detailed empirical work. In this section we consider a Marx-inspired work which does, David Noble's *Forces of Production*.

Nathan Rosenberg (1982, p. viii) makes the curious point that Marx's blueprint for studying technological change has rarely been followed. There is some mileage in this claim. With the exception of the labour-process tradition (see Braverman, 1974; Edwards, 1979; Friedman, 1977), some of it marrying Marx's theories to ethnographic accounts of factory life (Burawoy, 1979), Marx's analysis of technical change has spawned few imitators. Marx regarded machines as artillery in the class war, one which capital conscripts to full effect. 'It would be possible', he noted, 'to write a whole history of the inventions made since 1830 for the sole purpose of providing capital with weapons against working class revolt' (Marx, 1990, p. 563). But Marx was not interested in writing a history of inventions, of being part of a tradition that spans from Claude Henri de Rouvroy, Comte de Saint-Simon (1760–1825) to Marshall McLuhan (1911–1980) and beyond (Berman, 2002, p. 103). David Noble (1985), the Smithsonian Institution's Curator of Industrial Automation at the National Museum of American History, most certainly was.

Noble made a case study of technological change within the American metalworking industry through the introduction of numerically controlled machine tools (N/C). These tools are used to remove excess material from metal blocks to produce a finished product of the required proportions. 'Machine tools are really the guts of machine-based industry because they are the means whereby all machinery, including the machine tools themselves, are made' (Noble, 1985, p. 110).The new N/C technology was said to be driving two-fold industry changes: shifts in favour of the large corporations that could afford the significant hardware and software set-up costs, and shifts in control from unionized factory floor to non-unionized managerial office. For the technological determinist the discussion ends here, for the critical analyst it begins (Noble, 1985, p. 109).

Prior to the introduction of N/C, machine tooling had been overseen by skilled machinists. Despite the machines, the important factors were the skill and will of their operators. Incremental innovations across the nineteenth century saw these machines get smarter. They became self-acting

in limited senses. This took some of the manual burden away from the worker, and less skilled operators could use them. However, control still ultimately resided with the worker. In the 1930s and 1940s new tracer technology was developed. These hydraulic and electronic devices made more elaborate contour cutting possible. But the automation process was not yet complete; several different templates were needed for the same work piece. Subsequent inventions allowed for better measurement and greater control. Could the process be entirely automated?

Noble (1985, p. 110) notes the complexities involved in automating machine tooling. It is not like automobile manufacturing, for example, where the machinery does a single task, turning out large numbers of a product that is in high demand. Machine tools are broad-purpose flexible machines. The machines tend to be tailored for particular types of client, turning out small runs of parts. This makes them economically vulnerable. The boom times are exaggerated, as are the bad. Compared to the rest of the manufacturing sector their labour cost is high and their efficiency low. The technical challenge was to create self-acting devices that remained multipurpose. This required two components: a mechanism that could translate electrical signals into machine movements, and a means to archive that information so that the same signals could be reproduced. Numerical control is the best-known form of this technology and, as Noble (1985, p. 111) wrote, it heralded 'an entirely different philosophy of manufacturing'. It was as revolutionary in its implications as the assembly line itself. At base it incorporated the transference of intelligence from worker to storage mechanism, which at the time was typically magnetic or paper tape.

Noble (1985, p. 112) makes the same important point as Marx and Foucault (in the next chapter): technical solutions can reconfigure social relations. His is one of the earliest empirical investigations into the social shaping of technology (for an extended discussion of this school see Chapter 5). Social power helps to explain technological design and adaptation. Although the research and development costs for N/C were very high the bill was paid by one of the great constants in the history of scientific and technological development: the military. John Parsons is credited with the idea for the new technology while wrestling with the optimal way to cut the contours of helicopter rotor blades. It was his belief that computers should calculate points for drilling holes (to be filed together to create the contour) *and* position the actual drill. His next innovation was triple-axis drilling for the complex machining of jet engine blades and wing surfaces. In the decade following 1949 the US Air Force spent a minimum of $62 million on N/C. The pivotal year was 1955, when N/C's lobbyists achieved a paradigm shift. Henceforth Air Material Command's budget allocation for machine tools would be shifted from tracer-controlled machines to N/C machines. The single N/C machine at MIT's Servomechanism Laboratory

would be supplemented by a hundred others at various subcontractors. The Air Force literally created the N/C market by fiat, financing the technology's acquisition, set-up, maintenance and training at its subcontractors' factories. As such, they decisively shaped the technology.

One of the obvious consequences of these arrangements was that design costs to N/C users were minimal. The machine-tool industry was relying on state-funded contracts. There was no real incentive to create more cost-effective machinery for the private commercial sector. Technological hardware, however, was only one side of the equation. Without software to mimic the machinists' skills the enterprise would founder. In 1956 Douglas Ross pioneered a generic programming method – Automatically Programmed Tools (APT) – which made the arduous programming of new subroutines for each task redundant. Here was something that was flexible and easily transferable, and it met the Air Force's requirements. The programming language allowed for up to five-axis control. Through the Air Force's approval, APT swiftly became the industry standard, locking out other, often simpler and more robust, programming standards, and locking in large computers and highly skilled programmers.

Having discussed horizontal relations of production between the Air Force and its suppliers, Noble turns to vertical relations of production: the internal workplace organization. Here he considers record-playback, an alternative form of automation that was never implemented commercially. This process recorded the machine's movement on magnetic tape as the machinist created the part. Following manufacture of the initial piece, identical parts could be created automatically by playing the tape and replicating the machine's movement. Outside of the military-industrial complex, record-playback made perfect sense. It was cheaper, more reliable and every bit as accurate. It did not depend upon computers and elaborate programming. Yet we know from our example of video recorder systems in Chapter 1 that the best technology does not always triumph. The industry never got to see record-playback. Noble (1985, p. 115) offers three reasons why.

First, neither manual methods nor record-playback could meet the needs of the Air Force for complex machining of complex parts composed of complex materials. And it was the Air Force that shaped the industry. Second, N/C offered the possibility of reduced labour costs. Third, something beyond base economic considerations was at work, something much more ideological.

> N/C was always more than a technology for cutting metals, especially in the eyes of its MIT designers, who knew little of metal cutting: it was a symbol of the computer age, of mathematical elegance, of power, order, and predictability, of continuous flow, of remote control, of the automatic factory. (Noble, 1985, p. 116)

The problem with record-playback was that it retained a human presence; and that presence ultimately retained control. The champions of N/C were overwhelmingly motivated by a desire to wrest control from skilled workers. Management's distrust of people and fear of their collective bargaining power was disguised by official concerns about human error. Their ideology was embedded into the machinery which was designed to dominate workers. The plan was to deskill and downsize the workforce, changing machinists into button-pushers. Once again we have reminders of the politics of artifacts and the materiality of power.

Noble's reasoning was confirmed by the engineers that he interviewed for his study, and in trade journals, private correspondence and technical reports. When Parsons developed his N/C system he omitted to inform the representatives of the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) at his Traverse City machine shop. Developments at GE were similarly secret. They came about after protracted workplace disputes, including the biggest strike in the corporation's history. The aircraft industry was also beset by a series of bitter disputes. Studies by Erik Christiansen in the UK told the same story. When comparing shop-floor workers in N/C and record-playback settings, he found that the latter kept control and, as a consequence, their former pay levels (Noble, 1985, p. 122).

When Noble's (1984) *Forces of Production*, from which the 1985 case study is a distillation, was published it was hailed as 'the best book-length Marxist study of technology' (Wajcman, 1986, p. 751). The work is typically taken as a Marxist analysis, and one can see why: technological development is seen as being inherently political (Noble, 1984, p. xi), new innovations are weapons wielded against the working class. As with Horkheimer, Adorno and Marcuse there is a strong focus on domination and control. Yet Marx's presence is more implicit than explicit. He is referenced in the title, but is only invoked on three occasions across *Forces of Production*'s 365 pages, each time as a chapter epigraph. Indeed, there is a significant theoretical departure from Marx. Noble argues that private ownership of the means of production and the ongoing appropriation of surplus value are only means to the ultimate end of domination. Technology is the materialization of that will to power (Noble, 1984, p. 321). Judy Wajcman argues that this argument is overstated, and that the significance of the machine-tool industry is similarly exaggerated. She suggests that Noble shares the same fixation on the fate of the skilled craftsman as other labour-process theorists. Women do not figure. While heavily class-conscious, Noble's work is castigated for its gender blindness. Yet engineering culture is engineered to be masculine. 'Marxists do not write about typists being deskilled in the same epic terms' (Wajcman, 1986, p. 751). Wajcman contrasts Noble's work with a contemporaneous publication, Sherry Turkle's *The Second Self*, which we discuss in Chapter 7.

Conclusion

In 'Machinery and Modern Industry' Marx (1990, p. 493, n. 4) made the case that the book of technology was yet to be written: 'Darwin has interested us in the history of Nature's Technology, i.e., in the formation of the organs of plants and animals, which organs serve as instruments of production for sustaining life. Does not the history of the productive organs of man, of organs that are the material basis of all social organisation, deserve equal attention?' The book of Humanity's Technology is now well advanced. Marx (1990, p. 501) prepares its opening chapters, believing that technology expresses or explicates a relationship to nature. He identified the technological core of society, giving us the notion of technology as social relations. Yes, we talk about things, which Marx urges us to see as congealed, and estranged, labour under capitalism. But when we talk about technology we also talk about deskilling, reskilling, discord, dislocation and exploitation (Latour, 1994a, pp. 44–5). Marx is amongst the earliest social theorists to consider the politics of artifacts, and to give due attention to the crucial issues of technological ownership and control. His work is also amongst the first to make the connections between forces and relations of production (De Landa, 1997, p. 281). Marx also makes important comments on technology and the future of humanity, technology and subjectivity, and technology and domination. Regarding the latter, Foucault (1988a, p. 18) wrote, 'one sees the relation between manipulating things and domination in Karl Marx's *Capital*, where every technique of production requires modification of individual conduct – not only skills but also attitudes'.

This chapter has shown why Marx has been important for social theory and technology. Donald MacKenzie (1996, p. 19) gives three reasons why his theories continue to be relevant. First, Marx's analyses offer a rarely surpassed richness. Contemporary actor-network theorists' writings seldom eclipse Marx's descriptions of the ways in which machines help to structure social relations of production. Indeed, their accounts owe an intellectual debt to him (see Harris, 2005, p. 167). Machines helped pacify, counter and stabilize the early resistance to wage labour. Second, and counterintuitively, the collapse of Communist regimes claiming fidelity to Marx's beliefs have increased his salience. Marx had little to say about communism. His critical energies were devoted to capitalism. With the end of the Cold War, the supposed end of history and capitalism globally triumphant, Marx's insights apply all the more. Third, in analyzing market forces Marx reminds us that capital is a social relation, not a thing (and things, when they are commodities, are social relations too). These social relations are mediated via things. MacKenzie finds that many social studies of technology lack Marx's holistic vision, alternating between sociologies of technology that stress social relations minus their mediation through

the capitalist market economy, or economic analyses of technology that marginalize the social basis of economic activity. These points are worth bearing in mind for the discussion on the more recent 'material turn' (Pinch and Swedberg, 2008, p. 2) in social theory (Chapter 8).

From Marx we get the idea of production as the source of identity. Man's true nature was to be found in labour, hence the designation *homo faber* – man the worker. In Chapter 7 we pay more attention to the domain of leisure. A statement taken from Horkheimer and Adorno (2002, p. 102) sums up all of the theorists detailed in this section: 'The producers are experts'. Chapter 7 considers consumers as expert users, and explores what happens when they are left to their own devices. As Andrew Pickering (1995, p. 158) has noted, 'the industrial workplace [is] one of the classic sites for the development of social theory'. In Chapters 3 and 4 we turn to two others: the shopping arcade and the prison. We do so with reference to the work of Walter Benjamin and Michel Foucault, considering architectural constructions as shapers of human experience. This is the first of two chapters to detail the connections between built form, power, order and social action.

Further Reading

In *A Companion to Marx's Capital* (London: Verso) the renowned radical geographer David Harvey (2010) draws on decades of experience of teaching Marx's renowned text. (He also has lectures on YouTube.) Two chapters are particularly pertinent: 'What Technology Reveals' and 'Machinery and Large-Scale Industry', pp. 189–235.

Amy E. Wendling's (2009) *Karl Marx on Technology and Alienation* (Basingstoke: Palgrave Macmillan) offers a book-length study of Marx's thoughts on technology. Amongst the topics covered are: machine fetishism, machines and the transformation of work, and technology and nature. Wendling closes her book with material on 'Technophobia and Twentieth-century Theory'.

Andrew Feenberg, a former student of Marcuse, has continued to develop critical theory in relation to technology. For a representative publication see his (2002) *Transforming Technology: A Critical Theory Revisited* (New York: Oxford University Press).

Peter Stallybrass' article 'Marx's Coat' in Patricia Spyer's (1998) *Border Fetishisms: Material Objects in Unstable Spaces* (Routledge: New York), pp. 183–207, locates Marx's intellectual production within the material conditions of his own existence.

Ross Abbinnett (2006) updates Marxist theory on technology by drawing on more recent theorists in *Marxism after Modernity: Politics, Technology and Social Transformation* (New York: Palgrave). Heidegger and

Marcuse are discussed in relation to technocracy, Deleuze and Negri in relation to 'civilised capitalist machines' and Derrida and Stiegler in relation to technology and ethics.

Marx presents but one way to understand machines and mechanization. Two others are given by Félix Guattari and Siegfried Giedion. See Guattari's (1993) 'Machinic Heterogenesis' in Verena Andermatt Conley (ed.) *Rethinking Technologies* (Minneapolis: University of Minnesota Press), pp. 13–27, and Giedion's (1948) *Mechanization Takes Command: A Contribution to Anonymous History* (New York and London: W.W. Norton & Company).

3

Constructing the Modern: Human-Built World

Genesis seems like a good place to begin a study of the human-built world. Thus Thomas P. Hughes (2004, p. 7) opens *Human-Built World* with Adam and Eve's expulsion from the Garden of Eden: 'Subsequently humans used technology to transform an uncultivated physical environment into a cultivated and human-built one with all of its artefacts and systems'. Hughes (2004, pp. 4–5) sees technology as the creative means to various ends, the construction and control of a world of our creation, incorporating various makers and users, things and processes, tools, symbols and knowledge. But it is not always the case that these are collective, consensual or non-controversial endeavours. The creative means to which ends? Who decides, and who will do the constructing and controlling? Who has the knowledge and the power?

In this chapter we leave the world of workers involved in industrial production and enter that of architectural construction. We consider architectures of control with reference to two well-known social theorists, Walter Benjamin and Michel Foucault. Both show us the ways in which the built environment acts as a powerful determinant of human experience, behaviour and action. Benjamin alerts us to the rich possibilities of experience that the arcades of Paris offer: new forms of freedom, heightened pleasures of consumption, and novel ways of seeing and being, encapsulated in the figure of the flâneur. Foucault directs us towards the prisons of Paris: new forms of domination, heightened powers of social control and novel ways of being seen, summed up by his notion of panopticism. Neither scholar is necessarily interpreted as a technological thinker. Discussions of flânerie (strolling) or discipline and docility tend to be abstracted from the very technologies that afford them. As this chapter demonstrates, these are failures of exegesis, not emphasis, because the analyses of Benjamin and Foucault are intimately tied to technology in the ways that we have been

defining it: as artifacts, techniques and technical knowledge. Technologies, indeed, are seen as channelling action. In the discussion that follows we consider these scholars as technological thinkers, with particular reference to *The Arcades Project* (2004), commenced in the late 1920s but first published in 1982, and *Discipline and Punish* (1979), first published in 1975.

Social Theory in the City

While humanity has only just crossed the threshold point whereby more of us live in cities than in the country, sociology, being centrally concerned with the transition to urban industrial living, has largely fixated on the metropolitan experience. In consequence, cities have served as the major sites of theoretical elaboration. One need only think of the Berlin of Siegfried Kracaeur and Georg Simmel, the Chicago of Everett Hughes, Robert Park and Louis Wirth, the Los Angeles of Mike Davis, the Manchester of Friedrich Engels, the Paris of Michel de Certau, and the New York of Richard Sennet. What sometimes gets lost, particularly in secondary literatures, is the materiality of the city itself, the role it plays in the actions, behaviours, desires and opportunities of its inhabitants. So, while much attention is paid to the social mass, virtually no attention is paid to the ways in which the city helps to structure it. Walter Benjamin's *Arcades Project* cannot be accused of this. As Peter Buse et al. (2005, p. 52) write of this work: 'It is the material culture of the city, rather than the psyche, that provides the shared collective spaces where consciousness and the unconscious, past and present meet'.

Biographers have tended to divide Benjamin's thought into three separate stages, each under the influence of a particular thinker: first, through his friendship with Gershom Scholem, as theological and transcendent; second, under Bertholdt Brecht's sway, as Marxist and grounded; third, in Theodor Adorno's orbit, as the synthesis of the first two. *The Arcades Project*, composed across a thirteen-year period commencing in 1927, was the result of this third stage (Buck-Morss, 1999, p. 6). Intended as a work of 'new and far-reaching sociological perspectives', Benjamin (2004, p. x) described *The Arcades Project* as 'the theatre of all my struggles and all my ideas'. A monumental work of excavation, organized into 48 sections, or convolutes, the *Project* runs to over 800 pages. Benjamin (2004, p. 460) likened his approach to rag-picking, sifting through that which had been forgotten. He described his research as dealing 'with the expressive character of the earliest industrial products, the earliest industrial architecture, the earliest machines, but also the earliest department stores, advertisements, and so on' (Benjamin, 2004, p. 460).

In bringing this tableau of diverse textual resources together Benjamin (2004, p. 475) invoked the notion of the dialectical image – snatches of

experience assembled in new constellations to provide fresh historical insight. The first epigraph in convolute 'S' is from Remy de Gourmont: 'To create history with the very detritus of history'. Images, objects, types of person and practices were thus retrieved from the abyss. One could distil the truth of the present from the debris of the past, for that which has now gone nonetheless informs today. Indeed, Benjamin defined modernity as the association of the new with the ever-present, the novel and the archaic. In undertaking his task he sought guidance from social theorists like Theodor Adorno, Friedrich Engels, Georg Simmel, Siegfried Kracauer, Karl Marx and Henri Saint-Simon. These were supplemented by philosophers such as Georg Hegel, Martin Heidegger, and many literary figures, Louis Aragon, Honoré de Balzac, Charles Baudelaire, Victor Hugo and Marcel Proust among them. Recalling the importance of refuse, Benjamin also looked to old city guides and histories, exhibition catalogues, investor prospectus and industry reports, advertisements, architectural criticism, unpublished manuscripts and works of science fiction. These were sparingly interspersed with his own insights and commentaries.

Benjamin (2004, p. 460) never finished the *Arcades*, and in conventional terms he never could have, because the final publication was intended as a series of quotations, an assemblage: 'Method of this project: literary montage. I needn't say anything. Merely show'. Montage was itself a technological concept, originally used in relation to film. Separate scenes would be edited into a seamless whole, a composite assembled from fragments, insertions and interruptions. Benjamin envisaged his project in similar terms. Although he would have rejected the notion of the seamless whole, he believed that new meanings would emerge from the juxtapositions. This, as Susan Buck-Morss (1999, p. 23) has pointed out, mirrored the lived experience in the metropolis, where new technologies splintered experience in the domains of work and leisure. 'Could montage as the formal principle of the new technology be used to reconstruct an experiential world so that it provided a coherence of vision necessary for philosophical reflection?' The nineteenth century, marked by a cult of mechanism and machinery, made for an historic turning point. In the period stretching from the Middle Ages until 1900 the development of art outstripped the development of technology. Suddenly that state of affairs was reversed. Technology dictated the pace to art. The productive energies unleashed by the Industrial Revolution were such that art, perhaps, may never catch up (Benjamin, 2004, p. 171). For Benjamin (2004, p. 160) the principle of montage was found in technology and architecture before art, film or literature. What, after all, was the Eiffel Tower but the first manifestation of montage?

Benjamin (2004, p. 26) was attuned to our technologically-mediated reality and the ways technical innovation created 'new velocities, which gave life an altered rhythm', citing Maurice Talmeyr's observation of 'the sudden, shock-filled, multiform life that carries us away'. Indeed, shock

frequently features as *the* modern sensibility (see also Benjamin (1999a)). Cities were sites of sensory overload. In the section on the flâneur in *The Arcades Project*, Benjamin cites Edmond Jaloux to articulate the new gestalt. Jaloux tells us that the carefree days of old are gone. The lot of the moderns is a life in fragments. To even cross the road becomes a fraught activity:

> [H]e cannot do this today without taking a hundred precautions, without checking the horizon, without asking the advice of the police department, without mixing with a dazed and breathless herd, for whom the way is marked out in advance by bits of shining metal. If he tries to collect the whimsical thoughts that may have come to mind, very possibly occasioned by sights on the street, he is deafened by car horns, stupefied by loud talkers … and demoralized by the scraps of conversations, of political meetings, of jazz, which escape slyly from the windows (Quoted in Benjamin, 2004, p. 435).

The Arcades Project

Why the arcades? The famous architectural critic Siegfried Giedion wrote that every age has its own architectural fixation: for the Gothic it was the cathedral; for the Baroque the palace; for the early nineteenth century the museum. Benjamin argued that the exhibition hall eclipses the museum from mid-century, but in the 'First Sketches on the Paris Arcades' he asserts that the most important architectural form was the arcade: 'Architecture is the most important testimony to latent "mythology". And the most important architecture of the nineteenth century is the arcade' (Benjamin, 2004, p. 834). Benjamin (2004, p. 125) wrote of the '[r]emarkable propensity for structures that convey and connect – as, of course, the arcades do. And this connecting or mediating function has a literal and spatial as well as a figurative and stylistic bearing'. Following Giedion, Benjamin (2004, p. 455) noted that all of the major architectures of the nineteenth century support the masses, they have collective significance: department stores, exhibition halls, railway stations. They are important because it is within these structures that the masses first enter the stage of history.

Surrealist writer Louis Aragon's *Le Paysan de Paris* was a major influence on *The Arcades Project*. For Aragon, as for Benjamin, the arcades 'deserve ... to be regarded as the secret repositories of several modern myths' (quoted in Benjamin, 2004, p. 539). If, as Benjamin had written, Paris was at the forefront of modernity, 'the capital of the nineteenth century', the arcades were 'the hollow mold from which the image of "modernity" was cast' (Benjamin, 2004, p. 546). Thus arcade life is read as a microcosm of

nineteenth-century existence (Benjamin, 2004, p. 460). To reckon with our immediate history, to achieve 'the now of recognition', to come to terms with our modernity, we must confront industrial culture on all of its fronts: its architectures, technologies, material objects and commodities. In arcades like la Passage Colbert, Passage de l'Opéra, Passage des Panoramas, Passage de la Trinité and la Passage Véro-Dodat the century could look back at itself. 'As rocks of the Miocene or Eocene in places bear the imprint of monstrous creatures from those ages, so today arcades dot the metropolitan landscape like caves containing fossil remains of a vanished monster: the consumer of the pre-imperial era of capitalism, the last dinosaur of Europe' (Benjamin, 2004, p. 540).

In our world of huge department stores and monstrous shopping malls it is hard for us to imagine how the arcades could attract and amaze, beckon and bedazzle the crowds, but the arcades can legitimately be seen as their progenitors (Benjamin would say their *dream prototypes*). From these 'temples of commodity capital' (Benjamin, 2004, p. 37) come today's 'cathedrals of consumption' (Ritzer, 2001).

Benjamin on Flânerie and Technology

In convolute 'K' Benjamin (2004, p. 390) conceptualizes technology as a 'new configuration of nature'. Indeed, he urges us to always consider technologies as configurations. Following his advice we should see the arcades as such, commingling architecture, commerce, consumption, social activity and natural environment. The historical success of the arcades rested on configurations of mutually supporting innovations: new technologies of construction (like iron and glass), coupled with new forms of interior design (mirrors, marble panelling, gas lighting), and new techniques of building, retail and behaviour (construction methods and architectural practices, enhanced strategies of sales and display, flânerie). These innovations centred on the new consumer objects of industrial culture: 'We … are less on the trail of the psyche than on the track of things. We seek the totemic tree of objects within the thicket of primal history' (Benjamin, 2004, p. 212). We pick up this trail again in Chapter 8.

For social theorists the most familiar aspect of this configuration is the flâneur, or stroller, (see, for example, Tester's (1994) edited collection). Benjamin, indeed, takes the flâneur to be an important, if passing, figure of modernity. The flâneur would typically be a man of leisure. He would feel the rhythm of the city but never be ruled by its pace. He could mingle in the crowd, lose himself in the masses, experience privacy in public. For the great new cityscapes of Paris with their open boulevards, pavement cafés, parks and most of all arcades (Benjamin, 2004, pp. 31, 381), provided new

ways of seeing and being seen. Aragon's influential work described the arcades as 'human aquariums' (quoted in Benjamin, 2004, p. 539). To know the city one had to wander through it. In so doing this premier urban figure read and observed the metropolitan scene, decoding the city's many spectacles. In comprehending the city one could reckon with the very condition of being modern.

The arcades drew people to them for several reasons. The new architecture utilized the first artificial building material: iron. These constructions with their glass roofs eliminated environmental excesses. Light was allowed to enter but the weather's vagaries were vanquished, the snow and rain from above, the wind from every direction, the mud from underfoot. Banished too were the extremes of temperature and lighting. The arcades were heated and ventilated. They were the first sites to install gas lighting, beginning with the Passage des Panoramas in 1817. 'The two great advances of technology – gas and cast iron – go together' (Benjamin, 2004, p. 151). The dangers of traffic were also removed. In here the flâneur could wander at leisure. The same could not be said of the streets outside where the horse-drawn carriage ruled. Mirrors enhanced the spectacle. Benjamin (2004, p. 537) declared Paris to be 'the city of mirrors'. The arcades had them in abundance. Mirrors amplified space, creating a disorienting quality. They also enhanced the ability of flâneurs to observe themselves and others. We therefore need to pay heed, as Benjamin does, to the fact that flânerie is in large measure made possible by these combined technologies.

Benjamin (2004, p. 423) called the arcades the 'drawing room' of the collective. In here new things seemed permissible. You could smoke in the arcades at a time when it was not socially acceptable to do so in the streets (Benjamin, 2004, p. 41). Arcades were also known for gambling and prostitution. Most conspicuous of all were the new pleasures of consumption made possible by new practices in seduction and new techniques of display (Benjamin, 2004, pp. 51, 195). 'The arcade is a street of lascivious commerce only; it is wholly adapted to arousing desires' (Benjamin, 2004, p. 42). Even in 'Le Paris futur' the arcade assumed a central place. Arsène Houssaye's (1856) science fiction work considered Paris in 2855, no longer the capital of the nineteenth century but now the centre of the known universe, abuzz with financiers from far-flung galaxies. Visitors from Ursa Major and Mercury beheld a Champs Elysées contained in iron and crystal (quoted in Benjamin, 2004, p. 196). Buck-Morss (1999, p. 39) reminds us why Benjamin was so attracted to the arcades:

> they were the precise material replica of the internal consciousness, or rather, the *un*conscious of the dreaming collective. All of the errors of bourgeois consciousness can be found there (commodity fetishism, reification, the world as 'inwardness'), as well as (in fashion, prostitution,

gambling) all of its utopian dreams. Moreover, the arcades were the first international style of architecture, hence part of the lived experience of a worldwide, metropolitan generation.

The Arcades Project shows Benjamin's (2004, p. 97) conflict over the technology question, noting technology's ability to both raise and raze a city. Benjamin sees the revolutionary potential inherent in the new technology – what it could do for humanity – comparing this to its current class-based use – what it actually does to humanity. In this book, as elsewhere, technology is conceived of as the basis of a properly human history. Such a vision is also articulated in *One-way Street*:

> Men as a species completed their development thousands of years ago; but mankind as a species is just beginning his. In technology a *physis* is being organized through which mankind's contact with the cosmos takes a new and different form from that which it had in nations and families. One need recall only the experience of velocities by virtue of which mankind is now preparing to embark on incalculable journeys into the interior of time, to encounter there rhythms from which the sick shall draw strength as they did earlier on high mountains or at Southern seas (Benjamin, 1979, p. 104).

The concept of the dream prototype appears throughout *The Arcades Project*. This is the tendency to imagine new technologies in terms of established ones. Benjamin discusses the resemblance of the arcades to the cycling arenas of old, of factories to the household, and automobile chassis to carriages (Benjamin, 2004, p. 62). The task, then, was/is to shake technology from the grip of the collective dream. 'Only now are we beginning to guess what forms – and they will be determinative for our epoch – lie hidden in machines' (Benjamin, 2004, p. 155). There are several potential sources of influence for the idea of the dream prototype. Benjamin (2004, p. 167) quotes Léon Pierre-Quint's (1894) observation that, to begin with, railway cars look like stagecoaches, buses like omnibuses, electric lights like gas chandeliers, gas chandeliers like petrol lamps. He also quotes a passage from Marx's *Capital*, in which Marx notes the early development of the locomotive, conceived in terms of feet not wheels. But the dream prototype also resonates with Benjamin's (2004, p. 544) own take on modernity: 'Definition of the "modern" as the new in the context of what has always already been there'. To be sure, this is a sensibility he shares with both Baudelaire and Nietzsche. The fundamental point is that the dream prototype imagined technology as it has always existed, whereas the real task was to imagine it as never before. 'Such mastery demands being receptive to the expressive power of matter, a mimetic, not an instrumental skill; and it is the central intellectual task of the modern era' (Buck-Morss, 1999, p. 70).

Foucault as Technological Thinker

As with Benjamin, Michel Foucault discusses the built world's impact upon human behaviour. *Discipline and Punish* directs us towards the principal institutions of modernity: barracks, factories, hospitals, prisons and schools. In doing so Foucault identifies new forms of domination summed up by the principle of panopticism. Such is the 'architecture that would operate to transform individuals: to act on those it shelters, to provide a hold on their conduct, to carry the effects of power right to them, to make it possible to know them, to alter them' (Foucault, 1979, p. 172). Foucault is almost never interpreted as a technological theorist, although we will immediately see why. He does not spend much of his intellectual energies on the common interpretation of technology as objects but mostly works with other definitions of technology: technology as activities, practices and knowledge.

The Eye of Technology

From the early 1970s technology assumes an increasingly important place in Foucault's writing (Willcocks, 2006, p. 276), although technology has always been present in his work. Most of his major concepts are couched in technological terms. In *The Birth of the Clinic* (2003a, p. 89) the medical gaze – 'the eye that knows and decides, the eye that governs' – is discussed as the conflation of political ideology and medical technology, and knowledge and perception are positioned as 'technological structures' (2003a, pp. 38, 48). Similarly, the hospital is interpreted as a 'therapeutic instrument' in his lecture entitled 'The Incorporation of the Hospital in Modern Technology' (Foucault, 2007, p. 141). In *Discipline and Punish* Foucault (1979, pp. 27, 215, 205, 257, 294) conceives of discipline, panopticism and power as technologies, imprisonment and the transformation of man as a technical project, and those that judge normality as the 'technicians of behaviour'. 'What is Enlightenment?' discusses the rationalities that inform human action, what people do and how they do it as 'the technological aspect' of their existence (Foucault, 1984, p. 46). In *Society Must Be Defended* Foucault (2003b, p. 249) makes the point that if discipline is a micropolitical technology of the body based on drill and aimed at the individual, biopower is the macropolitical technology of security whose target is the population as a whole. Biopower, then, is a 'regulatory technology of life'. *The History of Sexuality* (1990, pp. 44, 90, 105) positions health and pathology, the regulation of sex and sexuality, and processes of normalization and correction as technologies. Governmentality is defined as 'contact between the technologies of domination of others and those of the self' (1988b, p. 18). *Security, Territory, Population* sees government,

police and security similarly interpreted as technologies (Foucault, 2009, pp. 8, 370, 382). The modern state's art of government – the 'technology of state forces' – also finds legitimation through two great technological assemblages, the diplomatic-military system and the police (Foucault, 2009, p. 296).

We might ask ourselves what work technology is doing in Foucault's writings. Technology is a notoriously elastic category that can be made to stretch to the point of meaninglessness. It is a locution in need of clarification. In this book we began by defining technology in four ways: as objects, activities, knowledge and modes of organization (MacKenzie and Wajcman 1985, p. 3; Winner 1977, pp. 11–12). It can legitimately be said that most of Foucault's work concerns these interactions, combined in particular ways. An ongoing preoccupation of his was the manner in which subjects are transformed into objects of knowledge within organizational matrixes. Such is the message of *The Order of Things*, *The Birth of the Clinic* and *Discipline and Punish*. In consequence it is entirely appropriate to interpret Foucault as a technological theorist.

This does still leave us with the question of what technology does. Here Foucault (1997) provides an answer. He argues that there are four types of technology, all with specific functions. They are used by people to comprehend and control themselves and others. All involve the training and manipulation of individuals, the generation of particular attitudes and competencies. He tells us that the first three types were identified by Jürgen Habermas: technologies of production concerned with the creation, conversion and control of things; technologies of sign systems devoted to symbolic communication; and technologies of power which dominate, objectify and ultimately determine individual behaviour. To these he adds a fourth: technologies of the self, 'which permit individuals to effect by their own means or with the help of others a certain number of operations on their own bodies and souls, thought, conduct, and a way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality' (Foucault, 1997, p. 177). Foucault says that most of his work, perhaps too much, has stressed technologies of power, but technologies of the self are a necessary complement if one is to comprehend the development of the Western subject. And the way to do a history of subjectivity would be via a history of care and of techniques of the self (Foucault 1997, p. 88). In his later career Foucault became increasingly interested in those ways in which individuals act upon, and sometimes even dominate, themselves. Irrespective of the emphasis then, we can say that Foucault always had a concern with subjectivity and subjection understood through the optic of technology.

Thus far we have only built a weak case for Foucault to be considered as an important theorist of technology: his conceptual genealogy is traced back to technology, and he locates his intellectual output within a

technological framework. We will strengthen this case by considering his thoughts on technological innovation, the materiality of power and the mediating role of techniques. The body of work detailing Foucault's influence on actor-network theory is discussed in Chapter 6.

Instrumental Change: Technological Innovation

While Foucault did not spend much time thinking about particular technological objects, he did have some interesting observations to make about them on occasion. We consider what he has to say about technical innovation. This gives us the opportunity to see the ways in which technologies (understood as physical objects) transform interpersonal relations in the case of the stethoscope, and institutional relations in the case of the rifle. The stethoscope can be interpreted as a technology of production. It allows for the creation of new medical knowledge and the conversion of a potentially embarrassing situation into a professional medical encounter. The rifle is a driver for changes in the function and staffing of the technological assemblage that is the hospital. The hospital can be interpreted as a technology of power: here deviants from the norm of good health are categorized and corrected.

In *The Birth of the Clinic* Foucault discusses one of the foremost objects of the medical profession, the stethoscope. He interprets this humble instrument as at once a scientific, social and ethical device. Manners and modesty forbade male doctors placing their ears to the chests of female patients. Moral screening was therefore necessary. This came about via technical mediation. The stethoscope created personal distance between doctor and patient while simultaneously permitting unprecedented intimacy:

> [it] transmits profound and invisible events along a semi-tactile, semi-auditory axis. Instrumental mediation outside the body authorizes a withdrawal that measures the moral distance involved; the prohibition of physical contact makes it possible to fix the virtual image of what is occurring below the visible area. For the hidden, the distance of shame is a projection screen. What one *cannot* see is shown in the distance from what one *must not* see. (Foucault, 2003a, p. 164)

Part and parcel of the medical gaze, the stethoscope was one of a series of instruments and techniques that made the silent audible, the undetectable discernable.

Physical technologies could also be the drivers for institutional change. Foucault makes what at first seems to be a highly unlikely claim: that the modern hospital owes its existence to the rifle. By his view, a key institution evolved in the form that we recognize it because of the technological transformation of European armies thanks to their adoption of the rifle.

Widespread uptake of rifles increased the training costs of military force. State budgeting increased accordingly. The military had long been considered liable to be on the front line of disease, and national governments looked to protect their fighting investments. Hospitals took on a new role. No longer the terminus for the poor, the hospital became a place attempting a cure. This incorporated new systems of surveillance and management. No shirking, much less desertion, should be permitted. Medical knowledge required that experts should know both how to cure and when a person was cured. A political technology of discipline developed in which doctors replaced priests as experts and administrators (Foucault, 2007, p. 141). In *Discipline and Punish* the same point about technological invention driving institutional change is made: new weaponry precipitated new disciplinary arrangements, just as industrial inventions led to new ordering regimes in the economic realm (Foucault, 1979, p. 138).

Foucault, then, was attuned to instrumental change in the most literal way. The fundamental point which Foucault wants to stress concerns the connection of technological innovation to novel power relations. New devices could lead to new practices, new observations, new organizations and new knowledge. So too could new architectural forms. As with stethoscopes, buildings could act similarly as scientific, social and even ethical devices. While palaces were built to be seen, and fortresses were built to see out, the panopticon prison was built to see in. Prisoners were arranged so as to be under constant surveillance, and they behaved accordingly. 'He who is subjected to a field of visibility, and who knows it, assumes responsibility for the constraints of power; he makes them play spontaneously upon himself; he inscribes in himself the power relation in which he simultaneously plays both roles; he becomes the principle of his own subjection' (Foucault, 1979, pp. 202–3). Control was embedded in design. The material structure acted on the prisoners, prompting Foucault (1979, p. 172) to state: 'Stones can make people docile and knowable'.

Discipline and Punish: The Technical Solution to a Technical Problem

Foucault (1979, p. 257) identifies 'a technical mutation' beginning in the nineteenth century, namely transformations in social control from public punishment of the body to private punishment of the mind and soul. Training replaced torture as prisons became the new penalty for transgression. Direct physical force diminished. No more flesh torn from the body with red-hot pincers, no more molten lead poured into the wounds. Instead, a regimen of rules and regulations covering every facet of existence, the development of detailed records, individual dossiers, new classificatory systems and timetables dictating activities to be undertaken, all of them

underpinned by constant supervision. The generally accessible spectacles of punishment at the Place de Grève and other civic spaces were now hidden in various houses of correction. In the executioner's place there was a raft of behavioural technicians: chaplains, civil servants, medical doctors, psychiatrists, psychologists and warders. This new form of social control was marked by the twin processes of carceralization and medicalization.

In his lecture on the punitive society Foucault (1997, p. 34) accounts for these transformations thus:

> What brought the great renewal of the epoch into play was a problem of bodies and materiality, a question of physics: a new form of materiality taken by the productive apparatus, a new type of contact between that apparatus and the individual who makes it function; new requirements imposed on individuals as productive forces.

This new physics of power develops simultaneously with modern state structures at the dawn of the nineteenth century. It involves a new optics, mechanics and physiology. Foucault (1997, p. 35) elaborates, telling us that the new optics concerns continual surveillance. Everything is seen, recorded and filed. He calls this panopticism. The mechanics refers to confinement. These closed systems could be interpreted as warehouses for surplus humanity, containing those considered useless or threatening to the social order: the criminal, the indigent, the mad, the poor, the rebellious. Individuals are isolated and regrouped to maximize bodily utility, 'in short, the putting into place of a whole *discipline* of life, time, and energies' (Foucault, 1997, p. 35). Physiology refers to standards, their clinical enforcement, and measures of correction whether curative or punitive. 'In appearance, it is merely the technical solution of a technical problem; but, through it, a whole type of society emerges' (Foucault, 1979, p. 216).

Discipline and Punish, then, is not just about prisons. Foucault (1979, p. 205) made it clear that panopticism was a generalizable principle, 'polyvalent in its applications'. Its institutional form was not restricted to the cell, it was also to be found in the barrack, class room, clinic, cloister, factory and work house. While Foucault's analysis stressed the carceral, educational, military and medical he noted that examples from elsewhere abounded. For example, had he the inclination he could also have drawn from child care, colonization or slavery (Foucault, 1979, p. 314). Suffice it to say that these disciplinary structures and practices occupy central positions in modern social life.

For Foucault the industrial take-off of the West required the accumulation of people as well as capital. The development of industrial capitalism 'would not have been possible without the controlled insertion of bodies into the machinery of production and the adjustment of the phenomena of population to economic processes' (Foucault, 1990, p. 141). Thus the

Industrial Revolution was also a political revolution, resting on a 'calculated technology of subjection' (Foucault, 1979, p. 221). This Foucault ascribed to a commingling of technological innovations, an enhanced division of labour and new techniques of discipline. 'Let us say that discipline is the unitary technique by which the body is reduced as a 'political' force at the least cost and maximised as a useful force' (Foucault, 1979, p. 221).

Various theorizations of technology provide the vocabulary for comprehending the power effects of medicine, psychiatry and so on. For Geertz (1978), an additional benefit of the analysis is that Foucault fleshes out the abstractions of Marxist analysis – those two formless blocs of ruling class and working class squaring off against each other. Foucault also removes domination from a narrow economic stratum to include all of those who are in a position 'to set the limits of other people's lives' (Geertz, 1978).

Foucault and the Mechanisms of Power: The Mediating Role of Techniques

Foucault's presence is an important one in a work on technology and social theory. Most scholarship stresses the physical artifact. Foucault draws our attention to that which is all too frequently overlooked: the non-material technological realm. Indeed, Latour (2005, p. 76) accords Foucault 'now classical' status for his work in materializing non-material technologies, intellectual technologies included. Latour (1988b, p. 199) registers his objection to dominant conceptions of technology thus: 'The word "technology" is unsatisfactory because it has been limited for too long to the study of those lines of force that take the form of nuts and bolts'. This aligns with Foucault's (2000, p. 364) own take: 'A very narrow meaning is given to "technology": one thinks of hard technology, the technology of wood, of fire, of electricity'. By way of example, he reminds us that formations like government are technologies too. Even within Latour's field of Science and Technology Studies (STS), there is an obsession with things, from Michel Callon's (1986b) electric car to Bruno Latour's (1996a) automated commuter system, John Law's (2000) aircraft, Donald MacKenzie's (1990) missile guidance system, Wiebe Bijker's (1995a) bikes, and Trevor Pinch and Frank Trocco's (2002) synthesizer. With the growing salience of material culture across increasing disciplinary domains this trend has intensified. As Steven Connor (2008) puts it, '[r]ecent years have seen in philosophy and cultural studies something like a thingly turn, a *neue Sachlichkeit*, a *nouveau chosisme*. For at least two decades, there has been a slow, incremental, but by now immense stirring of things'.

While things currently enjoy prestige value (see Chapter 8), techniques have pariah status. They have 'received especially poor treatment at the hands of scholars' (Lemonnier, 1993, p. 2). Yet for Lemonnier it is precisely

these techniques which beg sociological analysis for they are unambiguously social productions. Other theorists are wont to go much further; for Michel Serres (1982, p. 91) techniques are what make us. It is to techniques that Foucault is primarily drawn, illuminating this vitally important yet customarily overlooked topic. (*Discipline and Punish* mentions techniques on 96 separate occasions.) Perhaps, then, Thrift's (2007, p. 55) criticism of Foucault for not paying enough attention to things, architecture excepted, should not be upheld. In a scholarly universe now fixated on things, Foucault leads us into one of technology's forgotten domains, the sociological blind spot of technique – technology as activity and practice.

Can techniques be as important as things? Can we compare disciplinary techniques with technological marvels like the steam train and the microscope? On this issue Foucault (1979, p. 225) wavers: 'They are much less, and yet, in a way, they are much more'. The disciplinary techniques of panopticism have garnered far less attention than material technologies like blast furnaces and steam engines (Foucault, 1979, p. 224), yet they represent 'a veritable *technological* take-off in the productivity of power' (Foucault, 1980, p. 119):

> We frequently speak of the technical inventions of the seventeenth century – chemical, metallurgical technology – yet we do not mention the technical invention of this new form of governing man, controlling his multiplicity, utilizing him to the maximum, and improving the products of his labour, of his activities thanks to a system of power which permits controlling them (Foucault, 2007, p. 146).

This is an important point. Prior to Foucault, academic accounts of power fixated on those who were said to hold it, an endless procession of monarchs and generals, or, if not a study of great individuals, then a study of great institutions. The *exercise* of power was seldom discussed: 'power in its strategies, at once general and detailed, and its mechanisms, has never been studied', much less the mutual imbrications of knowledge and power (Foucault, 1980, p. 51). Put this way, power is less something which explains and more something which is to be explained. It is to these very mechanisms that Foucault turned. *Discipline and Punish* identifies the methods through which subjects are rendered docile through the exercise of disciplinary power (Foucault, 1979, p. 138). This results in a politically compliant and economically productive population. Enmeshed in a mechanism of domination people could be known, controlled, transformed and used. Techniques come to the fore as it is through them that power is operationalized (Foucault, 1990, p. 11). Foucault made the question of techniques an ongoing concern of his work, by which he meant the specific practices which concretize political rationalities and tie individuals to social collectives in particular ways.

Foucault 2.0: Technological and Theoretical Upgrades

While it is the case that Foucault is only rarely read as a technological thinker (Gerrie, 2003), numerous writers have applied his ideas to sites that did not exist at the time of his writing, for example call centres (Taylor and Bain, 2000), or to technologies that were still in their early developmental stages, as in networked computing (Aycock, 2006). Unsurprisingly, Surveillance Studies is one area with a significant uptake of Foucauldian ideas. When David Wood (2003, p. 235) signalled his intention to run a special edition of the journal, *Surveillance and Society,* devoted to Foucault's influence in the field the typical response was: 'surely every issue of *Surveillance and Society* is a Foucault issue'. Eugene McLaughlin and John Muncie (1999, pp. 130–1) argue that two broad schools of thought have developed in relation to the profusion of closed circuit television cameras scanning public and private space, and the allied development of new biometric devices and databases: hyper-panoptic and post-panoptic.

Hyper-panoptic scholars argue that the new technologies intensify panoptic abilities, automating, observing, tracking and storing as never before (Gandy, 1993). From this perspective all boundaries (time, space, even human bodies) are rendered meaningless (Corbett and Marx, 1991). Mark Poster (1990), for example, updating Foucault's (1979, p. 217) 'circuits of communication' to include electronic and fibre-optic wiring discusses panopticism freed from the technical constraints of old. The plugged-in panopticon uncouples surveillance from co-presence. We now have the Superpanopticon, 'a system of surveillance without walls, windows, towers or guards' (Poster, 1990, p. 93). Kevin Robins and Frank Webster (1988) had already drawn this conclusion. Information and Communication Technologies (ICTs) move us beyond architectural constraints: 'the social totality comes to function as the hierarchical and disciplinary Panoptic machine'. Manuel De Landa (1991, pp. 205–6) offers another technological upgrade of the panopticon: the panspectron. The panspectron's prehistory is to be found in the development of encryption techniques and wireless communication technologies, linked to the development of Artificial Intelligence and what De Landa (1991, p. 192) calls 'machine vision'. In Deleuze's (1988, p. 116) assessment Foucault had given us a history 'of the conditions governing everything that has a visible existence, namely a system of light'. De Landa's panspectron might be said to be post-optical, shifting attention to the non-visible realms of the electromagnetic spectrum: infrared and ultraviolet radiation, and microwaves. This has 'opened new resources to be exploited as well as new zones to be policed' (De Landa, 1991, p. 205). Such surveillance systems are not centralized as were the panopticons of old, instead they rely on a distributed network of computers linked to 'a multiplicity of sensors … antenna farms, spy satellites and cable-traffic intercepts' (De Landa, 1991, p. 206).

Against this, post-panoptic scholars assert that, in true Foucauldian fashion, power meets resistance, dominant discourses are never totalizing, and surveillance remains partial and fragmentary. Bruno Latour and Emilie Hermant (2006, pp. 1, 28) invoke the oligopticon to refer to those centres of calculation that afford a total view of a limited area, control rooms lined with instrument panels whose data are limited and specific to the purposes directly at hand, the type of organizations that, in their combination, make the smooth running of cities like Paris possible. Included among the oligopticons are various utilities like water provision, traffic management, weather prediction and town planning. Others argue that outside the confines of total institutions panopticism loses its full effect. Successful surveillance requires reflexivity, to be effective we need to know that we are being watched. Besides, surveillance falls on some more than others: the young as opposed to the elderly, the poor as opposed to the wealthy. Experientially, few of us feel like we live a carceral existence (Lyon, 1994, pp. 67–78).

There is yet another approach, which accepts the basic premise of panopticism, indeed extends it, but supplements it with its antithesis. For Foucault (1979, p. 216) the transition to modernity involved a shift in the organizing principle of society, from one based on spectacle to one of surveillance. Thomas Mathiesen (1997, p. 218) agrees that panopticism is a marked feature of contemporary society. Classic disciplinary institutions like schools retain their surveillance function, released prisoners endure ongoing scrutiny as never before, and new categories of criminals *in potentia* also fall under the gaze of the authorities. But the development of the mass media is coeval with panopticism. Foucault is entirely silent on this subject; the media is a residual category in his theory. With the media panopticism finds its precise reversal: the many watch the few. One need only think of the regurgitated surveillance footage served up as Reality Television entertainment or endless iterations of *Big Brother*-type programmes. These have profound disciplinary effects. Indeed, for Mathiesen, synopticism is one of the primary mechanisms through which the modern soul is governed. To say that we live in a surveillance society is not entirely accurate, for ours is a viewer society.

Forget Foucault?

David Rooney (1997, p. 400) praises Foucault's technological overview for the broadness of its take. Technology is seen to capture *techné* and technique in an 'assemblage' approach that includes knowledge and skills, symbols and things. The tendency amongst technological theorists is to regard technology as objects, as activities, as knowledge and as modes of organisation (MacKenzie and Wajcman, 1985, p. 3). It might legitimately be

said that most of Foucault's work concerns these interactions, combined in particular ways, because one of his ongoing preoccupations was the manner in which subjects are transformed into objects of knowledge within organizational matrixes. Such is the message of *The Order of Things*, *The Birth of the Clinic* and *Discipline and Punish*. This combination Olsen (2006, p. 89) takes to be '[o]ne of his important contributions to social theory'. Strangely this is all too frequently forgotten. Commentaries on Foucault tend to ignore the role of technology despite its centrality in his vocabulary. Foucault uses this terminology because technology is the lens through which he made sense of the world. As he said, most of his scholarly energies were devoted to analyzing technologies of power and technologies of the self. It is barely an overstatement to say that if it mattered to Foucault it was posed as technology. Given this, we need to reckon with technology if we are to understand Foucault.

Foucault noted the crucial role of technology in the constitution of the subject and in the constitution of society. In discussing innovation he also showed technology's place in the transformation of personal interactions, public institutions and power relations. The message is clear: the social cannot be abstracted from the technical. Technologies and techniques are the means by which we understand – and transform – ourselves and others. Power is not an internal thing residing within particular people but an interactive effect, disseminated through heterogeneous networks of people and things. Technologies and techniques must necessarily come to the fore as the carriers, conveyors and creators of power relations (Foucault, 1979, p. 201). They are the means through which power is exercised and its very substance.

Excursus: Making Order, I – Norbert Elias and the Politics of Buildings

Foucault is arguably the most famous theorist associated with work on the constitution of the subject in connection to 'the materiality of power'. Having said that, we should not ignore Norbert Elias. Many Foucauldian staples are already present in his work: questions of power and subjectivity, investigations of the built environment, the politics of space and architectures of domination and control.

Elias' first public lecture was delivered on the balcony of Max Weber's home. Its theme was the sociology of Gothic architecture, principally how the structure of French and German cathedrals spoke to differences in respective social composition during the Middle Ages. *The Court Society* (2006), which first took form as Elias' Habilitation thesis, supervised by Karl Mannheim and submitted on the eve of Hitler coming to power, devotes a good deal of its discussion to this motif. In the court we find the concretization of what constitutes the good society. Architectural

arrangements are made so as to facilitate proper conduct. Elias examined the hierarchical ordering of the *hôtels* and *palais* of the *ancien régime*, connecting the reinforcing elements of built and social structure.

Elias proceeds from the premise that buildings are ways of collecting people and of connecting people. Social arrangements are therefore expressed as spatial ones. There is 'a structural aspect of the *network of relationships* of which they are a part' (Elias, 2006, p. 56, emphasis in original). Spaces, and more particularly rooms, can be read as 'precipitates' of social standing, the visible markers of identity. In making this argument he passed comment on the Foucauldian staples of observation and behaviour, surveillance and discipline. For example, in those houses where the lady of the house also occupied the role of housewife or where masters assumed direct control of domestic personnel, servants' quarters were placed so that continuous supervision was possible. Thus Olivier de Serres' (1619) *Le Théâtre d'Agriculture* instructs its readers in the layout of the nobleman's house: the kitchen will be placed on the first floor of the house, level with the dining room which will in turn be joined to the bedroom. In this way the dining room and bedroom will both allow for the supervision of staff, 'those who are in the kitchen *will be under observation and the idleness, shouting, blasphemies, larcenies of servants and serving maids will be suppressed*' (quoted in Elias, 2006, p. 51, emphasis in original).

Connection and disconnection are problematized. Spatial proximity could denote major social distance, as in the extract from de Serres. It was perfectly possible to be apart and together. In wealthier households the building was constructed so as to effect a complete separation of servants from nobles. Servants might still be close, but designated staff would tend to deal with them. The differing sizes and styles of buildings also signified status (social rank rather than wealth) and occupation. As it was put in the *Encyclopédie*: 'We speak of *la maison* of a bourgeois, *l'hôtel* of a noble, *le palais* of a prince or a king' (quoted in Elias, 2006, p. 59).

Having made the above comments we should stress that Elias' analysis was not restricted to that which buildings forbid (relations with social inferiors, poor manners, criminal behaviours). He was even more concerned with what such structures allowed – actions, obligations and duties between equals made possible by layouts that would not be available to those in 'more spatially confined society' (Elias, 2006, p. 54). Thus the lord and lady had separate wings within the *hôtel*. Each *appartement privé* had its own bedroom, a *cabinet* to receive visitors, an antechamber and wardrobe. The wings were screened from each other to allow for a largely separate life. Each partner was able to entertain their respective social circles. The design of reception rooms was also very important. They had to occupy the bulk of the ground floor, and preferably be larger than the *appartement privés* combined. In this way an important message was sent, the significance of the relationship of the occupants to court society as '[t]he centre of gravity of their existence lies here' (Elias, 2006, p. 56).

Conclusion

This chapter has focussed on Benjamin and Foucault, discussing two works in particular: *The Arcades Project*'s 'primal history of the nineteenth century' (Benjamin, 2004, p. 463) and *Discipline and Punish*'s 'history of the present' (Foucault, 1979, p. 31). Both concern buildings that were originally conceived as iron and glass constructions (Evans, 1971, p. 33): the arcade and the panopticon prison. One of the earliest parts of the *Project,* 'The Ring of Saturn', discusses how iron construction has transformed the pan-European world. Iron's import was not lost on Foucault either. In *Madness and Civilization* (1988a, p. 161) he wrote of

> the substance which is both the most solid and the most docile, the most resistant but the most pliable in the hands of the man who knows how to forge it to his purposes: iron. Iron unites, in its privileged nature, all those qualities that quickly become contradictory when they are isolated. Nothing resists better, nothing can better obey; it is a gift of nature, but it is also at the disposal of all of man's techniques.

Benjamin and Foucault shared an interest in new architectures and the production of visibility. The arcade was a place in which one could unreservedly observe, the panopticon a place in which one was compelled to be observed. The former created flânerie, the latter docile bodies. Both thinkers were also attuned to non-human agency: what buildings help afford and enable, proscribe and forbid. As Foucault (1979, pp. 30–1) phrased it in *Discipline and Punish's* opening chapter, '[w]hat was at issue was [the prison's]… very materiality as an instrument and vector of power', adding, 'I would like to write the history of this prison, with all the political investments of the body that it gathers together in its closed architecture'. Similarly, the closing convolute of *The Arcade Project* mentions the strategic nature of post-revolutionary French architecture and 'the effort to generate certain effects by means of structural massing' (Benjamin, 2004, p. 823). In his essay 'The Work of Art in the Age of Mechanical Production', Benjamin writes that '[a]rchitecture has never been idle', indeed it has a 'claim to being a living force' (Benjamin, 1999c, p. 233). Benjamin, Foucault and Elias all alert us to the politics of artifacts. In the following chapter we further consider Foucault's statements on the materiality of power and Benjamin's on architecture as a living force.

Further Reading

The work that inspired the chapter title is Thomas P. Hughes' (2004) *Human-Built World: How to Think about Technology and Culture*

(Chicago: University of Chicago Press). It considers technology as machines, systems and environments suffused with human values.

Walter Benjamin had a long-standing interest in media technologies, writing on such things as film, radio and photography. Many of his pieces have been collected in the 2008 publication *The Work of Art in the Age of its Technological Reproducibility and Other Writings on Media* (Cambridge, MA: The Belknap Press).

Norbert Elias is discussed in an excursus. For more on his engagement with technology the interested reader is directed to an essay he published in 1995: 'Technicization and Civilization', *Theory, Culture & Society*, 12(3): 7–42. His classic work *The Civilizing Process* (2000, Oxford: Blackwell) contains meditations on what we would now call Thing Studies. See his discussion of 'tools of civilization' such as forks, handkerchiefs and nightgowns.

Although the chapter engages with architecture it does not engage with the work of Gilles Deleuze and Félix Guattari. Andrew Ballantyne (2007) corrects this in *Deleuze and Guattari for Architects* (London: Routledge). While we are on the subject, Mark Poster and David Savat's (2009) edited book applies and upgrades Deleuze's work in *Deleuze and New Technology* (Edinburgh: Edinburgh University Press). Topics include technology and new art, internet gaming addiction, new media and pharmaceutical control.

Clare O'Farrell's website http://www.michel-foucault.com/ offers a range of resources on Foucault including quotes, key concepts and Foucault news. Full texts of some of Foucault's work and further material can be found at: http://foucault.info/

Torin Monahan's (ed.) (2006) *Surveillance and Security: Technological Politics in Everyday Life* (New York: Routledge) contains quality essays by such figures as David Lyon, Gary T. Marx and Langdon Winner.

For peer-reviewed articles on all aspects of contemporary surveillance see *Surveillance & Society*. Go to http://www.surveillance-and-society.org/ojs/index.php/journal.

4

The Politics of Artifacts

This chapter and the next consider the social content of technological forms. They are both concerned with issues of design. In thinking about the politics of artifacts one name comes to the fore: Langdon Winner. Arguably his 1980 article bearing that title is the most famous paper in all of science and technology studies (STS), primarily for its reference to public architect Robert Moses' bridge-building programme along the Long Island Expressway. Winner claimed that the bridges were deliberately lowered to prevent ethnic minorities accessing Moses' favourite state park by public transport. Accordingly, Winner is examined here pro and con as a way into exploring the relationship between the political and the technological, and between social and technological determinism. This leads into a wider discussion of our condition as seen through the building of architectural, spatial and human order.

Bernward Joerges (1999, p. 411) claims that Winner's account is one of STS' 'pious stories', having achieved 'almost doctrinal unassailability' in the field. Cited 151 times by 1998 according to the Social Science Citation Index, Joerges (1999, p. 414) adds that Winner told him the example features in almost every technology book on his shelves. In 2010 the somewhat less discerning Google Scholar listed 904 citations for the article and 746 citations for the book in which it later featured (Winner, 1988). These are rare achievements in the social sciences. Strangely, as Joerges observes, while oft-repeated the account is seldom challenged. To date, it has only sparked a minor debate. Berg and Lie (1995) ask 'Do Artifacts Have Gender?' They conclude that they do because they are always created and applied within gendered environments. Joerges (1999) himself enquires 'Do Politics Have Artefacts?' He thinks so, but cautions that there is a need to chart a path between contingency and control, looking at what technologies do, what practices surround them, and how they are both authorized and institutionalized. Steve Woolgar and Geoff Cooper pose the question 'Do Artefacts Have Ambivalence?' They believe that they do.

The meanings of artifacts are to be found in their use. They inevitably resist complete resolution, sometimes they have good effects and sometimes bad. Finally, Latour (2006) wonders 'Which Politics for Which Artifacts?' His response is that artifacts can enforce certain behaviours and make us do things differently but, in accordance with Woolgar and Cooper, he says that they are empowering as well as oppressive. Let us now turn to the instigator of these debates.

Technology as Shadow Constitution

It is no surprise that the technological should be implicated in the political. Heavy industry, warfare and mass communications have changed both the exercise of power and the very meaning of citizenship. But the reverse proposition is more challenging: that the political is embedded in the technological. Politics is ordinarily taken to be the preserve of people. So in what sense do politics inhere in technology? Winner (1980, p. 122) suggests that technology can be political in two ways:

1 technological artifacts that are designed, created and implemented to create a type of order or settle a dispute;
2 artifacts that are political through and through, that of necessity mesh with a particular type of political arrangement. (We think about these below in terms of bridge construction and power generation.)

Although he does not use the terms, Winner implies that the force of technology can have either centripetal or centrifugal effects on relations of authority and control. Indeed, certain technologies seem to necessitate, or at least encourage, centralized or dispersed modes of organization. Here the inspiration is Lewis Mumford's writing on authoritarian and democratic technics. For Mumford (1964) all of Western history has been marked by the contest of these two opposing forms: mechanical collectives versus autonomous human groupings. Authoritarian technics are machine-oriented, centralized, hierarchical and coercive. Democratic technics, on the other hand, tend to be person-centred, independent and decentralized. In our times authoritarian technics prevail. No longer enshrined in people but in systems and things, power loses its visibility: 'the rise of political democracy during the last few centuries has been increasingly nullified by the successful resurrection of a centralised authoritarian technics' (Mumford, 1964, p. 4).

Winner would assent to Leo Marx's (1992, p. 407) point that technology is *the* distinctive feature of modernity. Winner also argues that today's technological artifacts and systems are themselves distinctive, being premised on the following beliefs:

- power should be centralized,
- the few are given voice and the rest should be silenced,
- there are structural constraints between social classes,
- the world is hierarchically ordered,
- good things are unevenly allocated,
- men and women have different abilities, and
- one's life is always open to surveillance and scrutiny.

(Winner, 1993a, p. 288)

Because these beliefs are embedded in the very fabric of our technologies we often fail to interrogate them seriously. Yet question them we must. This is fundamental to the development of a democratic technics. When it comes to technological change two types of question must be asked: should a technology be developed and used, and if so, how is it to be designed and applied (Winner, 1980, p. 127)?

Winner offers strong and weak versions of his thesis on the relationship between politics and technology. The strong version asserts that some technical systems demand a specific type of political arrangement. This is a practical requirement that is needed in order for the technology to function. Winner draws on writers who argue that nuclear power generation requires a strong, centralized and hierarchical state structure to safeguard it. Nuclear power, in other words, necessitates an authoritarian technics. The weaker version has it that some technologies are more suited to certain political relationships but they are not necessary for the technology's inner working. Winner cites solar energy enthusiasts, who suggest that this form of energy generation is more amenable to democratic and equitable forms of governance. Being both safer and simpler than nuclear power it is more open to the possibility of community control. It makes more sense to use it in a widely dispersed manner.

Winner (1980, p. 128) concludes that technologies are ways of structuring the world, and that divisive or unifying issues are settled both in the formal realm of politics proper and materially 'in tangible arrangements of steel and concrete, wires and transistors, nuts and bolts'. Modernity's technological politics are doubly pernicious as they are hidden and conflict deeply with prevailing democratic norms. In Winner's work there are clear affinities with Karl Marx and David Noble's scholarship (see Chapter 2), that technologies – under certain historical conditions – can be used as tools of oppression. Yet, the objects of class struggle are not just the cotton gins and numerically controlled tools of the factory; they can also be things as apparently harmless as bridges. For Winner technologies are 'a 'shadow constitution,' a hidden political power in society, an unwritten set of laws that establish social roles and relations' (Smits, 2001, p. 149). This is what Winner wants to bring into the light.

Other social theorists had noted that objects demand certain forms of action. While these discussions concerned micro-phenomena such as the connections between the artifacts of modern industrial manufacture and gesture, they were offered as generalizable claims that pick out important features of society. As such they point to something quite profound. In *Minima Moralia* Adorno lamented technology's loss of civility. Products are made that require jarring and forceful movement. Doors of refrigerators and cars need to be slammed. Finesse and discretion are banished. The necessary gestures are clear-cut and violent. They make for clear-cut and violent people. 'The new human type cannot be properly understood without awareness of what he is continuously exposed to from the world of things about him, even in his most secret innervations' (Adorno, 2005, p. 40). Baudrillard (2005, p. 60) similarly complained that 'the behaviour that technical objects impose is a broken-up sequence of impoverished gestures, of sign-gestures bereft of rhythm'. Winner takes these concerns and magnifies them to the grandest scale to examine 'technological politics'.

In *Autonomous Technology* Winner (1977) had suggested that technology's political force is enhanced by two mechanisms: the technological imperative and reverse adaptation. Put simply, the technological imperative states that new technologies require the restructuring of their environment; this reordering may be internal (relating to the technology) or external (relating to economics, organization or politics). This imperative drives much of today's social change. Where single tools define a simple society, ours is defined by large complex technological systems. The technologies of modernity typically require other technologies to sustain them. This necessitates a vast array of techniques and institutional arrangements. One needs to provide the means and 'also *the entire set of means to the means*' (Winner, 1977, p. 101, emphasis in original). Here, then, we have a clear illustration of what is meant by technology as a mode of organization.

Modern technologies not only order the world in certain ways and change life's texture in the process, but once embedded they can evade human control. In a simple setting we might conceive of ends and the tools to realize them, and then proceed to use them. If we want to dig a hole, we pick up a spade and get to work. These days few of our tasks are that simple. Rarely, and this particularly applies to our work settings, do we have access to the entirety of the technological process from conception through application and ultimately to resolution. Modern society is marked by complexity, interdependence and specialization. Our relationships to the overall technological system are, at best, partial. These systems also reconfigure ends and rearrange environments to suit their own operation. While we think that we adapt technology to our own ends, complex sociotechnical systems have a tendency to adapt us to their ends. Marx, Noble and the Frankfurt scholars found that workers were moulded to the technical apparatus of

the factory. They became ciphers of industrial technology. Winner (1980, p. 229) calls this 'reverse adaptation'. Technology is supposed to be the means to ends, but it becomes the ends to means. His concern is heightened as he feels that the technological standard has become the measure of all things, that the calculating spirit, the quantitative assessment of everything, and the twin obsessions of speed and efficiency have spilled over into all areas of social life (and see Mumford, 1973, p. 319).

The general failure on the part of social theory to address technological politics means that those in the humanities and social sciences miss the most significant aspect of their study. It remains a residual category. The social shaping of technology thesis (detailed in the next chapter) is a useful counter to technological determinism, and it takes the issues of technological construction, introduction and use seriously. However, cautions Winner (1980, p. 122), it eradicates the possibility of technological agency: 'it suggests that technical *things* do not matter at all'. Once the social origins of a technology are exposed all is explained, the analyst's role ends. This might comfort the classic social scientist as it suggests that there is nothing special about technology or its study. Old models of social power that rest on categories like class, group or administrative caste remain. Winner (1980, p. 128) wants us to think of technologies somewhat differently: as new forms of social power, and like those older orderings, as the equivalent of 'legislative acts'.

Social Engineering: Moses Parts the Bronx and Builds Bridges

In the latter half of the twentieth century large-scale environmental transformations effected through massive public works providing mass accommodation, communication, power generation and transportation became an entrenched part of the modern condition. For Marshall Berman (1988, p. 75), 'the immense construction site, stretching out boundlessly in every direction, constantly changing and forcing the characters in the foreground themselves to change – has become the stage for world history in our time'. Robert Moses epitomizes this 'Faustian developer' (Berman, 1988, p. 75). Enormously powerful – once holding 12 state and city positions at the same time – Moses was in charge of New York's city planning from 1943 to 1968. Few people have left such an impressive mark upon a city: 16 expressways and 16 parkways (landscaped highways) stretching hundreds of miles and entering the city via 7 bridges, 660 playgrounds, and over 1000 public buildings. In addition to constructing more public buildings than anyone else, there were the beaches, bridges, parks, pools, libraries, and Hudson tubes. Key buildings that owe their existence to

Moses include the Lincoln Center, LaGuardia Airport and the UN building (Reitano, 2006, p. 160). His retrofit of one of the world's great cities is 'perhaps the most awesome urban improvement in the history of mankind' (Caro, 1974, p. 20).

These projects of improvement were also projects of displacement. Perhaps as many as half a million city-dwellers were shifted. This earned Moses the moniker of the 'Grand Remover' (Reitano, 2006, p. 160). It is illuminating to see who profited and who suffered from these schemes. Progress came at a price. Planning privileged the private car over public transport and, in doing so, the white upper and 'comfortable middle' classes over the poor and ethnic minorities. Robert Caro (1974, p. 759) contends that the projects that favoured the former were paid for disproportionately by the latter through regressive taxation schemes. Some see him as the Godfather of Gridlock for placing the automobile at the centre of public planning. Others regard him as the 'one man who can be blamed for more single handed destruction of archaeological sites in the New York City area' than any other (Solecki, quoted in Cantwell and Wall, 2001, p. 98). Marshall Berman (1988, p. 309), noting Moses' obsessive (tunnel) vision, called him 'New York's Captain Ahab'. Moses was a great believer in the idea that 'problems could be solved by construction, by the shaping of concrete and steel' (Caro, 1974, p. 242). Winner certainly agrees: political issues can be settled by concrete and steel.

Berman (1988, pp. 292–3) documents the effects of the Cross-Bronx Expressway on his own beloved birthplace. Its decade-long construction cut through the borough's heart. The Expressway obliterated a dozen Jewish, Italian, Irish and African American neighbourhoods. In total, 60 000 people were exiled and an entire town and way of life went with it. The once-vibrant Bronx became a by-word for devastation, a haven for crime and very little else. Berman argues that the community's failing was to cling to the democratic delusion that government was of the people and by the people, and that their voices would be heard. In comparison, Moses' success was 'his ability to convince a mass public that he was the vehicle of impersonal world-historical forces, the moving spirit of modernity' (Berman, 1988, p. 294). Berman suggests that, such was the potency of the vision, even the displaced generally bought into his ideas of progress.

One of Moses' most notable achievements was the reclamation of swamp land to create Jones Beach State Park. Berman (1988, p. 296) praises the purity of this development in two senses: aesthetically – it is scenically uncluttered, just a flat expanse of white sand, two art deco bathhouses and a single water tower, and economically – there is no commercial development whatsoever. Winner (1980) suggests a third form of purity – racial. The low bridges Moses had built over the parkways were a means to prevent ethnic minorities accessing the place. At the time only the wealthiest owned cars, most people relied on public transport, and public transport

was unable to use the parkways. Moses also restricted rapid transit to parks, including the vetoing of a branch of the Long Island Rail Road connecting to Jones Beach (Caro, 1974, p. 318). If people wanted to access the State Park by public transit they would have to take a protracted trip on local roads. Most would be put off by the prospect. 'For the great majority of New Yorkers', writes one of its native sons, 'his green new world offered only a red light' (Berman, 1988, p. 299). The seemingly innocuous bridges suddenly become instances of materialized racism, legislative acts of the most oppressive kind.

Is Winner correct? In a short essay Latour (2006) dismisses 'Winner's' thesis (it is really Caro's) as 'pure ideology' and 'conspiracy theory'. Latour says that Moses designed the parkways to keep trucks rather than buses off them. No evidence is offered to support this, although a New York City bridge inspector is thanked in the footnotes. Latour's piece is accompanied by a photograph of a vehicle accident: a truck turned on its side. It met with this end on Exit 28B. One sign indicates Brooklyn Bridge right lane exit only. Another sign to the side forbids commercial traffic as there is only 11 feet of clearance. Presumably the same would happen to a bus. If Latour is correct, the low bridges are discriminatory. They forbid commercial traffic. But their design cannot be read as race or class bias. Such intentions would need to be demonstrated.

Here Moses' biographer Robert Caro (1974, p. 490) comes to Winner's aid. He charges Moses with systematic underdevelopment in black areas like Harlem, and the South Jamaica and Stuyvesant Heights districts in Queens and Brooklyn. These groups never seemed to be the recipients of Moses' largesse. The first 2 miles of the 6.7 mile expanse of Riverside Park were developed at a cost of US$8 million per mile. From 110th Street onwards as residents' ethnicity changed and levels of affluence dropped the development costs fell similarly. Here the development averaged out at US$1.7 million per mile (Caro, 1974, p. 533). The West Side Improvement reveals a similar story. Railroad tracks were covered to contain sound and noise until they reached Harlem. Between 125th and 155th , which is to say the heart of the African American community, the streets remained exposed to the railroad, allowing sound and stock smells to pollute the area. An additional 132 acres of park were added to areas of Riverside Park where white people were likely to use them. Not so much as a single acre was added in areas African Americans were likely to access. While elsewhere the improvement extended to the use of granite, marble and fancy masonry, this was noticeable by its absence from 125th Street onwards, where everything was done on a markedly more modest scale. Here even the road was elevated. The ugliness of its aesthetics aside, it also meant that more of the area was in shadow and sound travelled much farther. Moses was famed for the decorative touches he added to playhouses and comfort stations. In much of the park these buildings were adorned with designs

like waves. In Harlem, and Harlem alone, the iron trellises were topped with monkeys (Caro, 1974, pp. 557–60).

Strengthening the racist claim, Caro (1974, pp. 318–19) also accuses Moses of holding the view that African Americans were 'dirty'. Whenever African American groups chartered buses to visit state parks they inevitably struggled to secure a permit. The best beaches seemed to be for whites only. This was reinforced by 'flagging' practices. African American lifeguards, of whom there were few, were stationed on far-flung beaches. Moses also believed that African Americans had an aversion to cold water. As a consequence, the pool at Jones Beach was kept very cold. Parking fees were also introduced, creating another financial hurdle for the poor. At Moses' favourite place, Jones Beach, the fee was twice that of anywhere else. In the city the most likely place for racial mixing was at the pool at Thomas Jefferson Park – given its proximity to African American Harlem and the Puerto Rican community that was expanding beyond the bounds of Spanish Harlem. Here again, Moses employed his flagging technique, employing only white staff and ensuring that the pool's heating system was never turned on (Caro, 1974, p. 514). Caro's argument regarding Moses' bridge lowering was corroborated by the planner Lee Koppelman, and by the Board of Estimate's Chief Engineer Philip P. Farley; the flagging issue was confirmed by the engineer Sidney M. Shapiro and the politician Paul Windels; his loathing of the masses was confirmed by Frances Perkins, US Secretary of Labor; and, while Governor, Franklin Delano Roosevelt ordered an investigation into Moses' alleged racism (Caro, 1974, p. 546).

Criticisms of Winner

As already noted, it is curious that Winner's thesis has seldom been challenged, although in its multiple retellings certain details shift. Joerges likens it to Chinese Whispers – Moses' occupation and role, the date of the construction project, the possibility of alternative routes to Jones Beach and so on are subject to alteration. These shifts are explained by the rhetorical uses to which the story is put, leaving in place a general deference towards the idea that they animate it. Joerges (1999) is among the few who buck this trend. He regards Winner's (Caro's) story as counterfactual. It is plausible but untrue. 'Do Politics Have Artefacts?' sets out to destroy this myth. In the process it also suggests that Moses can be seen as something other than 'the big bogeyman of urban studies' (Joerges, 1999, p. 412). In Winner's version power relations are cast in concrete. Seemingly mundane bridges become bearers of racist intent, technologies of discrimination.

Joerges (1999, p. 415) says that Caro constructs his story of Moses' racist bridges from only two informants: Shapiro and Koppelman. This is not enough to convince Joerges of its correctness: 'One might as well assume

that such an intention never existed'. Joerges adds that more recent authors have presented benign and even positive appraisals of Moses and his life's work. Undermining Caro's case further, Joerges (1999, pp. 417–18) has discovered historians who have cast doubt on some of the events he documents. For example, Caro maintains that the Long Island Expressway was built in addition to the parkway, that many routes to Jones Beach were open to all, and that there were plenty of attractive alternatives to the State Park. It was not possible for Moses to embed his will into the parkways even if he wanted to. Civil engineers told Joerges that the low bridges are there to stop all commercial traffic as it is always banned from parkways, and that Long Island was already well serviced in its public transport provision. Raising the bridges would have been unnecessary and financially prohibitive. Joerges argues that Caro and Winner are just plain wrong.

Winner's story is taken to be a well-constructed artifact in itself, a persuasive device that can be made to shore up any number of theoretical positions. Based on a simple and compelling case study, it can be interpreted in multiple ways. 'Artefacts may then, in Winner's sense, have politics: but surely politics have artefacts – well built parables like Winner's' (Joerges, 1999, p. 421). It is not so much a well-made analysis as a story well-told. It is plausible because we know that racism exists. Joerges (1999) thinks that Winner gives us poor history but a compelling moral tale, something which allows us to pronounce on the human condition, particularly as it applies to modern politics.

Woolgar and Cooper (1999) offer another take on Winner's story. They prefer to see it as a cautionary tale or urban legend rather than as a parable. Urban legends have a four-part structure. They begin with a boundary transgression, there follows some type of pollution as a result of this, and later there is realization of what has happened. Finally, there are warnings that this could happen again. Technologies are a perfect topic for urban legends. They often have profound and profoundly unpredictable effects; impacting upon social relations, and not always positively.

In Woolgar and Cooper's opinion Joerges makes some valid points, but he is guilty of two errors. He assumes that a definitive version of Long Island's bridges can be told, and that Moses' true intentions can be known. They believe that the correctness of the story is neither here nor there. The facts are a small part of the matter, although there is agreement to the extent that Joerges, Woolgar and Cooper all see Winner's example as a kind of morality tale. Woolgar and Cooper declare Winner to be wrong and 'proof' is offered in the form of regular bus services to Jones Beach. A Metropolitan Transit Authority timetable is appended to their article. But this does not mean the end of the debate, Woolgar and Cooper say, as any number of things could have happened. Perhaps the buses do not take Moses' route, maybe the bridges have been replaced, Moses could still be racist even if the bridges were not built to his specifications, today's buses

could be shorter, the bus schedules to Jones Beach could be fakes. While Joerges offers a definitive rebuttal to Winner, Woolgar and Cooper (1999, p. 437) argue only for the fundamental ambivalence of artifacts: our experiences of and with artifacts are multiple and varied. 'It is important to recognize that the story is itself a dynamic, shifting and essentially inconcludeable narrative.'

Woolgar and Cooper (1999, p. 439) suggest several reasons for the iconic status of Moses' bridge story: we are enthralled by tales of good versus evil done by heroes and villains, the marked difference between their banal appearance and the hideous reality of a power-crazed tyrant feeds into our paranoid tendencies, the technology in question is very simple, the tale connects politics and technology in a completely straightforward manner. All of which means it serves as a perfect exemplar for STS.

Other criticisms can be made of Winner. Technologies do not always discriminate. Bombs are a famous non-discriminatory technology. When they explode they make no effort to discern friend from foe. As Jörg Friedrich (2006, p. 59) said of the Allied aerial bombing campaign of the Second World War: 'Political leadership … knew that their weapons did not distinguish between production and producers, industry and city, the factory and the children of factory workers'. Similarly, Mike Davis (2007, p. 10) condemns the car bomb as a thoroughly fascist technology because it guarantees collateral damage.

Woolgar (1991, p. 30) cites MacKenzie and Wajcman's (1985) arguments that not all technologies, however useful they appear, are adopted and some are actively resisted. We have repeatedly noted that a single technology can have multiple effects and because of this it is difficult to link political motivation, technological design and social consequences in an unproblematic and obvious way. Allied to this is the question of unintended effects discussed in Chapter 1. By his own admission Winner (1980, p. 125) is not much interested in either intended or unintended consequences, dismissing them as 'simple categories', yet this disjuncture between intention and outcome presents itself with technology as with everything else.

Winner's analysis also suffers from stasis. What something was does not necessarily mean what it now is, much less what it will become. A fixed account of a technology does not sit easily with a theorist like Norbert Elias who stresses fluidity, process and dynamism. Elias was never involved in a debate with Winner, but his life's work constantly took issue with static 'for all time' takes of the social field. He cites the technological example of the automobile, whose meanings are very different today from those at the point of their invention. In 1899 there was a single fatality caused by a motor vehicle accident (Elias, 2008b, p. 68). A century later the estimated figure runs anywhere between 750 000 and 880 000 for the year (Jacobs and Aeron-Thomas, n.d.). Their unintended consequences have magnified massively. Moreover, Winner's case is further undermined by changing cultures

of use. For many theorists, Woolgar (1991, p. 46) included, what a technology is cannot be determined by design. Instead, technological meaning is always to be found in use. He cites the telephone. The telephone was originally designed as a mass broadcast technology, not a person-to-person technology. It was conceived to relay concert music (Grint and Woolgar, 1997, p. 21). Only later did it find other uses. Claude Fischer (1988) also reminds us that what is now commonly seen as a tool for conviviality was unambiguously marketed as a tool of commerce. It was aimed at business*men*. The American telecommunications industry actively discouraged its use for idle chat. It had no place in the domestic sphere. Consumers were key to the technology's transformation. What does this mean for Winner's bridge example? Simply this: even if the original intent of Moses' bridges was racist, and this has not been proved beyond all reasonable doubt, growing levels of motor vehicle ownership and alternative access routes to Jones Beach (including public transportation) significantly undermined this.

Technological Dramas

Bryan Pfaffenberger (1992) rejects claims that technology is simply the bearer of something else, like racism. He is particularly suspicious of arguments that position technology as the unproblematic materialization of political will. As such, he offers a much more nuanced analysis than Winner. He expands on Winner's account of the politics of artifacts by identifying a range of socio-spatial strategies through which politics are constructed by technological means. In Pfaffenberger's (1992, p. 290) theoretical elaboration political groups, values and 'technological artifacts are reciprocally and recursively constructed in interaction with each other, producing an outcome that ideally generates both political authority and a technological system'. To explore this he uses the model of the 'technological drama'. Pfaffenberger (1992, p. 286) prefers the metaphor of drama to that of text (see Woolgar, 1991) as it cuts culturally deeper, implying strong moral concerns. It also speaks to actors (designers, technologies, users), notions of performance (to various audiences in various ways) and the creation of scenes (contexts). A second characteristic of politics advanced by technological means is that designers frequently attempt to influence the legislative framework into which their technologies are inserted. There are also pronounced efforts to mould both social context and social space.

Drawing influence from the Social Construction of Technology School discussed in the next chapter, Bryan Pfaffenberger (1992) argues that technology is political because the final design is always informed by a competing agenda regarding aesthetics, economics and social values. Innovation itself provides the ability to enshrine certain political values into

production processes and technological products. Designers, it is argued, tend to belong to the dominant social classes, and make artifacts that entrench their position of superiority. For example, the surveillance systems that are used to monitor airline reservation operators are designed on the assumption that the standard worker has no allegiance to the company, is poorly educated, will shortly change jobs, and does not provide quality service of their own volition. The surveillance system is used to transform the difficult employee into the model worker. The political message it sends to employees is clear: you are subordinate and replaceable. Feminist theorists of technology make similar arguments. Empirical studies have revealed that household technologies are made to conform to the wishes of their male designers rather than their female users (Berg, 1994): 'A non-competent user is often the point of departure as well as the result' (Berg and Lie, 1995, p. 340).

Technological activity is a process informed by past performances and reactions to them. Technological dramas are simply discourses about technological statements or performances and the responses they generate. Pfaffenberger sees three possibilities for technological activity: routinization, adjustment or reconstitution. In the first case designers create, seize or alter a production process, technology, user activity or system so as to embody political aims into technological features. Here Pfaffenberger is thinking about the distribution of power, status and wealth. These discourses may be contested, in which case technological adjustment or reconstitution applies. In technological adjustment affected groups look to offset the loss in power, esteem or financial resources that the new technology has caused. They attack ambivalences in the technology's frame of meaning, they seek to access the technology, and they try to appropriate it. In cases of technological reconstitution the disenfranchised seek to make meaning anew. They engage in symbolic rebranding which Pfaffenberger calls 'antisignification' (1992, p. 286). Sometimes this will also result in the creation of 'counterartifacts'. The computer can be read as such. What was once the sole property of the military-industrial-university complex became personalized and available to the people.

Pfaffenberger (1992, p. 294) generates a typology of technology, a '"grammar" of sociospatial strategies' with context-fabrication as their core. Through the following means artifacts have politics and create differences:

- *Exclusion:* People of the wrong age, ethnic group, class, gender or skill set are denied access to the technology. Feminists have argued that women are systematically denied access to technology and technological knowledge (Berg and Lie, 1995, p. 340). Similarly, in the case of Jones Beach, technologies worked to hinder access to the public park for some members of the general populace.

- *Deflection:* Technologies can figure as deflections, diverting attention from the machinations of the powerful. Often these technologies are offered as inevitable. Recall the manner in which the Cross-Bronx Expressway was presented as nothing other than the price of progress. The politics of such artifacts are 'the most perverse of all since they hide their biases under the appearance of objectivity, efficiency or mere expediency' (Latour, 2006).
- *Differential incorporation:* Different target groups may have very different experiences of the same technology. In fact, technologies are often structured so that different groups will be involved with them in different ways. For example, Moses' bridges facilitated the rapid movement of one social class but led to the immobility of another. This, and other public works projects, reminded the poor of their place and, as Mike Davis tells us later in this chapter, often keep them in their place.
- *Compartmentalization:* While access appears democratic on the face of things, it is constructed to keep some away. Jones Beach was open to the public in principle, though it really required ownership of a private motor vehicle to access it. Formally, artifacts appear as egalitarian while in practice they are often sectarian.
- *Segregation:* Segregation practices refer to all of those mechanisms that keep people away. High costs (exorbitant car parking fees at the State Park) or overwhelming complexity (arduously long public transport routes to access it) are two of the commonest strategies.
- *Centralization:* Despite appearances, the decisions over who will use the technology and how it will be used are centrally managed. At the centre there may be a high degree of autonomy regarding technological usage, but this will disappear towards the periphery. When Robert Moses ran the Slum Clearance Committee he almost never consulted with the Board of Estimates, which was the governing body charged with budget and land use. Tens of thousands would feel the effects, yet the Board of Estimates was effectively voiceless (Caro, 1974, p. 752). New technologies are often introduced officially to increase productivity, but they also frequently allow for increased managerial control. Such was the lesson of David Noble's study of N/C in Chapter 2.
- *Standardization:* Compliance costs can be so great as to overwhelm the prospect for autonomy or alternative cultures of use. To comply with parkway usage one would need to own a car. This was beyond the financial capacities of many people.
- *Polarization:* Different iterations of the technology are produced to create social differentiation. Endless technologies are produced in male and female versions. For more on technology and the production of gender see Cynthia Cockburn and Susan Ormrod (1993).
- *Marginalization:* Inferior technological models might be produced for audiences deemed inferior. For the less worthy technological products

will be lower quality, less decorative, and less comfortable or durable. Or witness the failure of the West Side Improvement to improve anything in black neighbourhoods. In each instance the quality of treatment impresses upon people their place in the order of things. It tells them whether they are worthy or worthless.

- *Delegation:* This term comes from actor-network theory, Pfaffenberger uses it to denote the moral aspects of a technology. Morality may be delegated to devices in order to counter perceived moral failings in people, like bridges that block the poor. In Chapter 6 we discuss speed bumps and hotel keys in precisely this way.
- *Disavowal:* Those artifacts that are created for people lower down the social order or for those in poorly remunerated occupations, like public buses, are avoided by higher status groups.

The above strategies are not always passively accepted. In moments of 'technological adjustment' people look to read and use technologies in different ways, and to eliminate their negative effects. Pfaffenberger (1992, p. 300) identifies three themes:

1 *Countersignification* – where those whose status suffers adopt a more favourable frame of meaning,
2 *Counterappropriation* – where those who are seen as unfit for the technology claim it regardless, and
3 *Counterdelegation* – where those impacted subvert the dominion of the technology.

There are also social changes across time, unintended consequences, rival technological systems and environmental effects.

Pffafenberger rejects Winner's claim that some technologies are expressly political, even when specific beliefs are built into them, because the context of their use can never be completely controlled. Social practice, not design, ultimately determines meaning. A technology must be '*discursively regulated* by surrounding it with symbolic media that mystify and therefore constitute the political aims' for the politics of the artefact to prevail (Pfaffenberger, 1992, p. 294, emphasis in original). This moves the prominence away from Winner's focus on forces towards theorizations of rituals and discourses. If the rituals are no longer observed, if the discourses cannot be sustained, the political effects of the technology will be lost. The drama ends. The point of ritual is to control the setting, it reinforces that which is seen as proper, and undermines alternatives to it. To be sure, when Pfaffenberger talks about artifacts he is referring to things, on the one hand, and their founding myths, manufactured social settings and rituals of thought control, on the other. Pfaffenberger's bigger point is that we live amongst artifacts that were the product of previous technological dramas, what we have previously referred to as background infrastructure or

technical substrate. Examples include: aviation, rail, radio, and water networks. They are now normalized, part of the taken-for-granted backdrop of our existence. Winner (1980, p. 124) at least recognized this, writing of Moses '[m]any of his monumental structures of concrete and steel embody a systematic social inequality, a way of engineering relationships among people that, after a time, becomes just another part of the landscape'. We can no longer read the grammar of strategies past, yet we live with these artifacts and their contexts, and they may still impact upon our behaviour.

Excursus: Making Order, II – The Politics of Space

It is not difficult to find stories similar to that presented by Winner. In *City of Quartz*, Mike Davis (1990) details the destruction of public space in Los Angeles. One can walk past the opulent mansions of Westside. The carefully attended gardens display a flowering of armed response signs. More affluent suburbs in the canyons and on the hillsides prevent such wandering. Walls, gates, electronic surveillance systems and security guards get the message across: this is not your place, you are not welcome. The rich fence the poor out. Meanwhile, the poor of Westlake and the San Fernando Valley are fenced in. The Los Angeles Police Department keep them like prisoners in their own homes. At the Imperial Courts Housing Projects residents are subject to LAPD pass laws, they carry mandatory identification cards, and they live with curfews. Police frequently order them inside. Guests are routinely searched. For Davis (1990, p. 223), these security systems, designed to enforce social division, define modern urban 'renewal'. Race and class conflict have been concretized. Social relations are also spatial. 'In cities like Los Angeles … one observes an unprecedented tendency to merge urban design, architecture and the police apparatus into a single, comprehensive security effort' (Davis, 1990, p. 224). Downtown, and in other areas of affluence, subtle and not-so-subtle signs warn off the lower classes, even when the space is supposedly public.

Davis (1990, p. 226) sees the same pattern replicated across all US cities. Generally, accessible spaces and facilities are shrinking or becoming less inviting. Street life is downgraded and single-purpose homogenized spaces proliferate under the watchful eye of private security contractors and their technologies of surveillance. Downtown LA is at the vanguard. Here the design effectively insulates professional white collar office workers from contamination by working class streets. 'Indeed the totalitarian semiotics of ramparts and battlements, reflective glass and elevated pedways, rebukes any affinity of sympathy between different architectural or human orders' (Davis, 1990, p. 231). Architecture here figures as war pursued by other means. Around Bunker Hill and the Civic Center built form warns off social undesirables. The objective is simple: make this space as inhospitable

as possible for the poor. Davis uses the Rapid Transit District's bus bench as one example. Completely cylindrical, the 'seat' provides minimal comfort when used as such, but what it absolutely prevents is sleeping. Overhead sprinklers operate at night in nearby parks and on some sidewalks meaning that there will be no rest for the homeless there. Restaurants imprison their food scraps with metal bars, one investing US$12 000 on a state-of–the-art steel cage. There is no such thing as a free lunch either. Public conveniences also proved far too convenient: better to bulldoze toilet facilities. In LA 'toilets … are the real Eastern Front of the Downtown war on the poor' (Davis, 1990, p. 233). East of Hill Street you will search in vain for public sources of drinking water. Even public buildings menace. The Frances Howard Goldwyn Regional Branch Library looks more like a supermax prison. Davis (1990, p. 239) labels this history's most threatening library. The logic of the prison is extended to the shopping mall as well as to the library. This would not shock Foucault. As we noted, he regarded panopticism as 'polyvalent in its applications'. Davis talks about the emergence of the 'panopticon mall'. Some, like the Willowbrook Center, contain unobtrusive LAPD substations. Complete monitoring of those who enter is achieved by all-seeing electronic eyes. Security guards can swiftly dispatch the wrong sort.

James Scott's (1998) *Seeing Like a State* adds context to the stories told of Moses and by Davis. He helps us see the bigger design picture. Scott scrutinizes large-scale schemes across the twentieth century that, while intended to improve the human condition, have resulted in miserable failure. One chapter looks at the high-modernist city. Here the architect and planner Charles-Edward Jeanneret, better known as Le Corbusier, is the leading figure, although Scott (1998, p. 88) also admits Moses into high-modernist city planners' Hall of Fame/Shame. High-modernism is an ideology born of Western faith in progress driven by science and technology, the reflection of machine-age existence. It can be interpreted as the wholesale application of instrumental reason to city living. Informed by an ethos of homogenization, rationalization and standardization, the city is planned in a highly centralized way, with uniform single-purpose zones. High-modernists had no patience with the local, the cultural or the specific. Their plans were generic, to be applied anywhere and everywhere. Le Corbusier's plans for Moscow were dismissed by the Soviet architect and designer Lazar El Lissitsky as a 'city of nowhere'. Proving the point, Le Corbusier served up the same plans as *la ville radieuse* for inner-city Paris (Scott, 1998, p. 114).

Scott cites The Plaza of the Three Powers and the Esplanade of the Ministries in Brasília as fitting examples of high-modernism. The Plaza, and indeed the capital, was built to symbolize a new, forward-looking Brazil, the material embodiment of the motto that adorns the national flag: order and progress. Seen from above, high-modernism may well embody these lofty principles, but in practice it feels like a war on street life, contingency and

history. A six-lane highway flanks two sides of the Plaza, restricting access. The square itself is so large that any collective presence is diminished to pointlessness. Even military parades look out of place. By contrast Tiananmen Square seems warm and inviting. Social intimacy is impossible in The Plaza. Scott (1998, p. 121) suggests that it would be equivalent to meeting a friend in the Gobi Desert. It could still be a fruitless exercise even if you did find your friend, for there is nothing to do once there. Social use has been designed out of existence. Commercial centres are elsewhere. Planned for a singular purpose the Plaza seems to have been singularly successful. All it does is signify the state's might. Eerily unpeopled, the Plaza is a void. Socially speaking, it is non-space.

Non-space has its own social theorist in Marc Augé (2008). Augé uses the concept of 'anthropological space' to describe built environments which inscribe the social bond. This applies to any space with a shared purpose or history, which is to say places that *mean* things. Such space is in decline. Instead we face a surplus of meaningless territory devoid of history, memory or significant social relations. The possibility of organic collective life becomes remote. Individuals are strangers to each other and even themselves in a world marked by media overload and global travel. Globalization, particularly the planetary flow of information, thus displaces people from their physical environs. Distances imposed by time or location no longer hold. Technological innovation has been the driver of these changes. Thanks to revolutions in media and transportation the far draws near. Without our customary organic connections the past confronts the present purely as spectacle. While distant things come to our door or screen, they remain context-free instances of individuality taken from elsewhere, and because of this they are incomprehensible. Ultimately no real connections are made. Given these forces, the prospects for bounded, localized culture are bleak.

Paradoxically, while the anchor points of a collective identity have never been less fraught the individual feels the impress of the collective (authority) as never before. Atomized individuals connect with power via notices or screens. We all live in the transit lounge of life awaiting the order to board. How we think of ourselves and our relationships with others is marked by excess: of events, of space, of individualization. Technologically-mediated 'solitary individuality' prevails under conditions of what Augé terms 'supermodernity'. Under supermodernity we witness the proliferation of anonymous non-places that are transitory and temporary, whether devoted to luxury or mired in poverty: airports, camps, clinics, hospitals, hostels, hotels, shanty towns, shopping malls, sports clubs, temporary buildings. For Augé (2008, p. 64) these non-places are:

> the real measure of our time; one that could be quantified – with the aid of a few conversions between area, volume and distance – by totalling

> all the air, rail and motorway routes, the mobile cabins called 'means of transport' (aircraft, trains and road vehicles), the airports and railway stations, hotel chains, leisure parks, large retail outlets, and finally the complex skein of cable and wireless networks that mobilize extraterrestrial space for the purposes of a communication so peculiar that it often puts the individual in contact only with another image of himself.

Augé's concept of non-space has strong affinities with Fredric Jameson's notion of postmodern space, the space of our times. Jameson argues that since the Second World War classical capitalism predicated on industrial production and ongoing class antagonism has given way to a late capitalism of multinational corporations. We now have a global system of finance and a global division of labour, largely trading information and services. We have witnessed the related phenomena of the media revolution and the masses fragmenting into satiated consumption units. The forces unleashed by late capitalism reach out across the globe, swallow up nature, and colonize our inner lives. This new economic world order rests on new technology. Like Augé, Jameson (1991, pp. xix–xx) notes the media's power in remaking the world. He uses the term 'postmodern' to denote late capitalism's culture. This is a culture of depthlessness (simulacra) which weakens our ties to history.

Culture is also spatialized. Jameson (1991) sees postmodern values embedded in contemporary architecture. The Westin Bonaventure hotel, part of the redevelopment of downtown LA that Davis wrote about, is seen as a postmodern building par excellence. Like other postmodern constructions it represents 'a mutation in built space' (Jameson, 1991, p. 38). No longer in the style of the high-modernist edifices discussed by Scott, the new buildings aim to be worlds of their own. Where high-modernist buildings sought to impose order on the city, the new postmodern buildings turn inward, separating themselves from it (which explains the profusion of mirrored glass). The legibility of the high-modernist building also disappears. A variety of styles may mix, not necessarily comfortably, and at the Bonaventure entrances, exits, the check-in desk and shops are not easily accessed. In fact, orientation is so difficult that repeat custom of the various boutiques is virtually impossible. Shoppers can never navigate their way back again. In sum, Jameson (1991, p. 44) argues that 'this latest mutation in space – postmodern hyperspace – has finally succeeded in transcending the capacities of the individual human body to locate itself, to organize its immediate surroundings perceptually, and cognitively to map its position in a mappable external world'. The disconnections between body and built world are symptomatic of a broader confusion that can be labelled 'the postmodern condition'. This speaks to our inability 'to map the great global multinational and decentred communicational networks in which we find ourselves caught as individual subjects' (Jameson, 1991, p. 44).

Conclusion

Winner adds his voice to one of the strongest in the realm of social theory and technology, that proclaiming technology, under particular historical conditions, as domination (Ellul, 1965; Engels, 1978; Heidegger, 1977; Horkheimer and Adorno, 2002; Marcuse, 1991; Mumford, 1964; Noble, 1984; Virilio, 2005). He offers many insights on what it is to live in a world of large-scale technological systems. His analysis asks us to question the design of artifacts and query why things are the way they are, as well as who exactly gets to shape and embed them. This is important because in an increasingly mediated world discrimination often comes via technologies. Winner's (1980) work persuasively shows the naivety of clinging to a position of technological neutrality. He makes a case for technological agency without lapsing into full-blown technological determinism. At the same time, he draws attention to the politics of artifacts. Indeed, his main message is that political literacy now requires intimacy with technology.

Winner's work is not without its critics. While acknowledging technology and its agency, Winner's argument entertains a full-blown determinacy which ignores human ingenuity, cultures of use and alternative relationships with technologies which may develop across time. In different national settings and at different points in time the same technology can generate very different effects. David Noble's study of N/C (detailed in Chapter 2 and also invoked by Winner in his 1980 article) has been interpreted in other ways by other authors. The politics of N/C play out very differently in the Scandinavian context. Here they do not function as tools of worker domination. Workers are instructed to program the machine tools in an environment that stresses cooperation between shop floor and management (Pffafenberger, 1992, p. 304). Winner wants us to think of technologies as if they are legislative acts, but what about actual legislative acts? Labour legislation in countries like Norway, for instance, creates more benign managerial practices than those found in America. Norwegian workers are guaranteed certain rights by law, including the right to have input into the implementation and use of new workplace technologies, to have a say in health and safety issues, and to have variation and cooperation in their working day (Berg and Lie, 1995, p. 338). Under such conditions N/C is a rather different technology from the American version.

Architects intend certain readings of their buildings, but they cannot guarantee that users will interpret them in the same way. For Joerges (1999, p. 423), buildings are media; they do not necessarily induce a particular reading or behaviour 'but they indicate something'. We should see the built environment, bridges included, 'as *phenomena* "in the middle"' (Joerges, 1999, p. 424). Thus power is not built into form as Winner has it but is mediated by its use. This also helps us move our technological thinking on from positions along a simple control versus contingency spectrum.

Instead we need to think about the processes by which power is authorized, continued, contested and altered in social studies of built environments. Here Joerges finds allies in several social theorists. Despite what he said in *Discipline and Punish*, Foucault went on to deny architectural mastery. Buildings alone cannot support power relationships. In 'Space, Knowledge, Power' Foucault (2000) tells his interlocutor that resistance to power is always a possibility, and any architectural effect can only be realized when set in a wider governmental context. We are not here talking about the politics of artifacts but the politics of their use. The same argument is made by Jameson (cited in Leach, 1999, pp. 118–21). It strikes him as impossible that a building's use could be legislated for all time at the point of construction. Buildings are political in an allegorical rather than a literal sense. For them to have a political effect we need to know their intended message. Even then they can only function politically within the appropriate 'social ground'. Georges Bataille runs the same argument. Buildings mediate our experience, but we still require the memory of church and state for cathedral and palace to function properly (cited in Leach, 1999, pp. 118–21).

An essay by Elias (2008a) offers elaboration. The toilet has been described as the room that even royalty visit alone. This was not always so. Louis XIV received ministers while seated on that other throne. Elias (2008a, p. 41) concludes that privacy is not so much a product of physical location as it is of social convention, part of the civilizing process that also accounts for the increasing individualization and privatization of existence. (To give another example, prior to the modern era the practice of sleeping alone would have been unthinkable.) For these reasons a focus on architecture alone, or even the politics of its construction, will not get us very far. These technological arrangements need to also be seen in relation to social behaviours and shared sensibilities. Elias offers another example drawn from his own life. While a fellow at the Zentrum für interdisziplinäre Forschung at the University of Bielefeld in Germany, he lived in a nearby apartment that identified him as its inhabitant. While in principle contactable at any time, this almost never occurred. Before ringing his bell prospective visitors would phone ahead to arrange a mutually convenient time to visit. Elias' privacy was respected. Indeed, his apartment could only function as a private space because people regarded it as such. 'In other words, it really becomes a private space in conjunction with the development of a specific social canon of behaviour and feeling' (Elias, 2008a, p. 42). We need to remember the plane of practice; although Winner would doubtless retort that it will be more pertinent to some situations than others. A tall truck can never pass under a low bridge. Look what happened on Exit 28B.

We can clarify these points by revisiting some of our earlier discussions, and by recalling Pfaffenberger's note about the technical and the social being 'reciprocally and recursively constructed in interaction with

each other'. The architectures of control that Davis writes about could not secure segregated spatial relations in and of themselves. The destruction of democratic space was also made possible by a background infrastructure of federal grants and tax breaks, city government and municipal policy, their (dis)investment strategies, the banking and insurance industries, homeowners' associations, and the machinations of the Community Redevelopment Agency. These official policies were in turn enforced by private security operators that insulated the wealthy from perceived risk, the LAPD who contained the poor in particular enclaves, and the media which sensationalized street crime while ignoring the economic violence inflicted on the poor. Race and class conflict can take concrete form, but Davis (1990, p. 228) argues that a thorough comprehension of these conflicts requires attention to economics and politics in addition to technics. Moses' alleged racism could not prevail by brute artifact alone even if it was enacted; it also required personnel accompanied by a financial and administrative apparatus: flagging, parking fees and permits.

At this point it seems as if we have two extremes: technology as open text endlessly shaped by human practices and technology as a fixed and essential property forever defining human action. What is the theoretical way forward? Ian Hutchby (2001) advances the concept of affordance as a way to chart a path between them. This has the merit of removing either social or technological determinism from the theoretical agenda. Winner has been accused of the latter while critics of his like Joerges and Woolgar can be accused of the former. Both Joerges and Woolgar see power as a representational issue rather than an artifactual one. It is what the thing symbolizes rather than what the thing is that is decisive (Joerges, 1999, p. 424): the generation of meaning beats technological effects. Hutchby (2001, p. 466) runs against this, arguing that different technologies provide for different interpretive and practical possibilities, they have different affordances. Affordance is simply what a technology allows, the restrictions on meaning and use, the potential for action. An aeroplane allows you to fly through the skies, a kitchen sink does not. A high bridge will allow a bus or truck to pass under it, a low one will not. Affordance has functional and relational aspects. The functional aspects are empowering or disabling. They are relational in so far as the constraints and opportunities may be different for different users. Specific technologies do not determine the situation but they help to structure what is achievable. Bridges across the parkways to Jones Beach did not prevent the poor visiting, but they did make it much less likely.

Having spent two chapters emphasizing the technological shaping of sociality we now turn to the social shaping of technology.

Further Reading

Donald MacKenzie's 'How Do We Know the Property of Artifacts? Applying the Sociology of Knowledge to Technology' in Robert Fox (ed.) (1996) *Technological Change: Methods and Themes in the History of Technology* (Amsterdam: Harwood Academic), pp. 247–63, draws on empirical studies to argue that the sociology of knowledge can shed light on the technical properties of objects, not merely their social meaning.

Richard E. Sclove's (1995) *Democracy and Technology* (New York: The Guilford Press) advances a methodical argument in favour of 'strong democracy' in the fields of technological innovation and application. Sclove insists that we should see technologies as social structures, and that as such, they have collective input. Michel Callon et al.'s (2009) *Acting in an Uncertain World* (Cambridge, MA: The MIT Press) also tackles the theme of democratic control of today's technology.

Two excellent meditations on the politics of artifacts can be found in Reviel Netz's (2004) *Barbed Wire: An Ecology of Modernity* (Middletown: Wesleyan University Press) and Olivier Razac's (2002) *Barbed Wire: A Political History* (New York: New Press). My review of these works plus Alan Krell's *The Devil's Rope* has been published as 'Review Essay: Entanglements: Barbed Wire and Sociology', *Thesis Eleven*, 92(1): 108–21.

Achille Mbembe's (2003) 'Necropolitics' (*Public Culture*, 15(1): 11–40) looks at the Israel–Palestine conflict and the ways in which roads and bridges and so forth can be weaponized in order to wage 'infrastructural warfare'.

A special edition of *Distinktion*: *The Scandinavian Journal of Social Theory* (2008, issue 16) was devoted entirely to the technologies of politics. It includes empirically-informed contributions by John Law, Noortje Marres and Nigel Thrift among others.

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5

The Social Construction of Technology

In Chapter 2 we indulged in macro-theorizing, looking at the big machines in the world of industrial work. Chapters 3 and 4 considered the spaces of social interaction. In this chapter and the next we discuss the technical and the social as they come together to form a sociotechnical order. The material will be drawn from Science and Technology Studies (STS). Having earlier focussed on how machine and architectural technologies help to construct subjects, we now examine the Social Construction of Technology (SCOT) through the work of Wiebe Bijker and Trevor Pinch, which looks at the ways in which social groups construct technological objects.

Sociology Rediscovers Technology

SCOT signals sociology's rediscovery of technology. In tying technological content to social context, this approach rejects three of the assumptions of earlier studies: technological determinism, the lone genius inventor, and the separation of studies into the social, economic, political and technical components of technological creation (Bijker et al., 1987, p. 3). Why isolate in theory what is merged in practice? Problems do not parse themselves so clearly. We are always talking about more than merely technical matters, and technicians neither recognize nor respect these boundaries. Following Thomas P. Hughes (1983) they prefer to speak of the 'seamless web' of interactions. SCOT also rejects the philosophy of technology's emphasis on the essence of technology. Indeed, Pinch and Bijker (1989, p. 19) take a swipe at the philosophy of technology, declaring it to be lacking in realism and generally 'disappointing' (see also Latour, 2005, pp. 93, 217). Instead of being interested in what technology is, in the essence of technology, Bijker (2010, p. 63) says that SCOT concentrates on the making, use and study of technology. The name of their approach pays homage to the work

of Peter Berger and Thomas Luckmann whose publication *The Social Construction of Reality* (1967) analyzed the processes that create social reality. They concerned themselves, among other things, with the ways in which subjective meaning becomes objective fact, and how actions become things (Berger and Luckmann, 1967, p. 18). SCOT literally takes this on board, studying the processes by which actions and meanings turn into things in the course of social interaction.

Social construction aside, SCOT was influenced by three other intellectual strands: the science-technology-society (STS) movement, the sociology of scientific knowledge (SSK) and the history of technology (Bijker, 2010, p. 65). STS took institutional hold in the late 1970s, when courses on the social aspects of science and technology appeared on university curricula. The agenda had been pushed by politicians who saw advances in science and technology, and their mainstreaming into British society, as boosting the economy (Fuller, 2000, p. 318). Largely taught to scientists and engineers, these courses became increasingly popular in the arts, humanities and social sciences. They helped to legitimate technology as an area of sociological study.

SSK also emerged in the late 1970s. It combined the sociology and philosophy of science with the sociology of knowledge and its leading proponents were David Bloor (1976, pp. 4–5) and his colleagues at the University of Edinburgh. Their strong programme – with its insistence of symmetry, impartiality on questions of truth and falsity and a commitment to explain all sides in precisely the same terms – seemed to apply equally to the worlds of science and technology. Indeed, symmetry is regarded as 'the most important thesis which guides … "social constructivist" studies' (Pinch, 1986, p. 3). Steve Woolgar argues that the entire history of the sociology of science and technology can be read as an extension of this idea (cited in Bijker, 1993, p. 125). Bijker elaborates, noting that Robert K. Merton called for a symmetrical treatment of science and various social institutions, David Bloor called for the equal treatment of true and false knowledge claims in scientific content, Trevor Pinch and Wiebe Bijker advocated bringing the content of technology into the proceedings (considering both working and failing machines), actor-network theorists argued that the construction of science and technology should be studied in the same terms, and at the same time, as the construction of society.

Contemporaneously, the history of technology, particularly as practised in the USA (Hughes, 1983), was generating interesting new theoretical questions, resulting in a groundbreaking collection: *The Social Shaping of Technology* (MacKenzie and Wajcman, 1985). The first step in SCOT's formation involved taking Hughes' idea of the technological system as the foundational unit of analysis (Bijker, 2010, p. 66). This ensured that the analysis was not strictly technological but also institutional, social, economic and political. It also extended the scale from the micro world of the

artifact to the meso and macro worlds which produce, use and regulate it, although Bijker (1995a, p. 327) prefers the term 'sociotechnical ensembles' to capture these scalar shifts. Influence also came from Hughes' (1969) concept of technological momentum, which countered more typical explanations based on technological determinism. Much like path dependency, technological momentum describes the force of systems with large investments of capital, technology and personnel. Once embedded, they seem to take on a purpose and energy that is often difficult to resist. STS, SSK and the history of technology all stress thick description, and the need to open up the 'black box' of technology (Pinch and Bijker, 1989, p. 5). Black boxing is a term taken from cybernetics in which the content of a 'box' is rendered unproblematic. Only inputs and outputs count. Representatives of all three approaches were invited to an international workshop that was convened in Holland in 1984. The publication that resulted is seen as marking SCOT's birth (Bijker, Hughes and Pinch, 1987).

Contested Technology

In its infancy, SCOT could be read as a reaction against technological determinism. SCOT countered determinist takes by arguing that technological development is not preordained and linear but contingent and multidirectional. Since there is no internal logic to technology, technology cannot explain itself (Bijker and Law, 1992, p. 8). Various case studies led them to conclude that invention is the result of contestation and negotiation between the relevant social groups that shape technology (Bijker, 1987; Bijker, 1992). Innovation is much messier than traditional accounts in the history of technology would have us believe. SCOT therefore emphasized the need to begin analysis at the point of controversy in order to understand technological development. This also involves looking at the wrong turns and down the blind alleys since the winners' stories tend to become the official history of technology. Here SCOT took influence from Thomas Kuhn (1962, pp. 136–43) who argued that scientific textbooks rendered intellectual revolutions invisible. Instead of a history of science and invention these official histories offered an ideology of science in which incremental additions are made to our body of knowledge by way of unproblematic linear developments.

SCOT has no time for explanations that the best technology wins, or the most efficient, or the most rational. Instead it asserts that '[t]he success of an artifact is precisely what needs to be explained. For a sociological theory of technology it should be the *explanandum* not the *explanans*' (Pinch and Bijker, 1989, p. 24). To do this SCOT replaces notions of unproblematic development, technological purity and political neutrality with notions of contingency and conflict. The underlying message, then, is that things

could have been otherwise (Law and Bijker, 1992, p. 3). Technology does not have complete agency; social groups shape technological development. SCOT's aim was to create a theoretical model which would account for technological change and stability, for actors and structures.

The commitment to symmetry, which Bijker (2010, p. 73) calls 'methodological relativism', widens the analytic horizons. It eradicates the distinction between the social and the technical, failed technology and the successful, minor players and major ones. Because this extends the number of groups under analysis, an organizational unit is required to identify and categorize them. Bijker et al. use the concept of relevant social groups. They focus on how these groups make sense of the artifact and the particular problems they face with it (Pinch and Bijker, 1989, p. 37). The recognition of these groups is the first of SCOT's three research steps (Bijker, 2010, p. 68). By identifying them and describing the relevant social groups, questions of politics and power are raised (Pinch and Bijker, 1989, p. 34).

The technology is then described through the relevant social groups' statements: 'The meanings given by a relevant social group actually *constitute* the artefact' (Bijker, 1995a, p. 77, emphasis in original). Technology has no essence, only the meanings that groups give to it. Different groups will have different takes on the technology; in consequence it will have interpretive flexibility. Eventually, interpretive flexibility reduces, and the many readings will reduce to one. The second step ceases when the technology achieves stabilization and closure. These are both parts of the same process. Stabilization is an intragroup semiotic activity concerned with the fixing of meaning. Closure is an intergroup interactionist activity concerned with reducing interpretive flexibility.

Closure was used in SSK to mark the end of a scientific dispute and the emergence of agreement within the scientific community (Bijker, 1993, p. 121). Closure was also a key concept for Berger and Luckmann (1967). They took 'social' to mean any specifically human phenomenon. The activities of humans are culturally and historically variable. Humans display 'world-openness' toward their environment (Berger and Luckmann, 1967, p. 47). We make worlds, while animals merely inhabit one. Social order comes about through closing world-openness. For Bijker et al. closure brings technological order. At this point there is common agreement as to the artifact's meaning.

In the third step the process of stabilization is explained through the concept of the technological frame. Such a frame comes into existence when social interactions emerge. Bijker (1995a, p. 125) provides a tentative list of the technological frame's elements:

- Problems
- Strategies to solve them
- Requirements to do so

- Theories
- Tacit knowledge
- Testing procedures
- Design methods
- User practices
- Exemplary artifacts.

The technological frame anchors individual action to a relevant social group. Here we can identify a further influence from the sociology of science, Kuhn's concept of the paradigm. Kuhn (1962) studied the history of scientific thought. He argued that knowledge does not progress in linear incremental ways but through a series of revolutions which transform the field. He called these upheavals 'paradigm shifts'. A paradigm provides the framework for questions, the lines of enquiry, investigative methods, areas of significance and, ultimately, meaning. Bijker (1993, p. 123) amends Kuhn's work to argue that technical frames (unlike paradigms) do not exist solely in the cognitive realm but contain material artifacts too, and that participants may be committed to more than one such frame.

Bijker (1989, pp. 182–4) argues that a technology can be in three states at any point in time. First, there are situations in which no single group and no technological frame dominate. Actors will try to conscript others to their cause, often by redefining the problem so that it answers the questions of the non-committed. Given the lack of consensus there will be a high level of technical variation, with different designers putting forward their particular solutions. Second, two or more groups with well-developed technological frames vie for dominance. In these cases factors beyond technological frames, such as rhetorical force, may prove decisive. The protagonists will be more open to the possibilities of future failings and viable technical alternatives. In the third situation, there is a single group and its technological frame clearly dominates. In Kuhnian terms this could be seen as the 'normal technology' phase. Bijker suggests that under such conditions there will be actors with high and low levels of inclusion in the technological frame. Actors with high levels of inclusion will be very mindful of functional failure, but given their commitment to the technology their inventions will tend to be modest and conservative. Actors with low levels of inclusion will be less blinkered.

This brings us to the question of power. Bijker's (1995a, p. 262) definition of power is derived from Anthony Giddens. Power is the appropriation of the agency of others to achieve one's own ends. In the context of this discussion agency is harnessed to fix technological meaning. 'Power thus is the apparent order of taken-for-granted categories of existence, as they are fixed and represented in technological frames' (Bijker, 1995a, p. 263). This success should be seen as something structural. It will impact upon subsequent technological use. Through various processes the once-mutable

technology is now an 'exemplary artifact' (Bijker, 1995a, p. 282). In the example discussed below, the air-tyre made technical closure in the cycling industry possible: with heavy advertising and sponsorship on the part of its producers the pneumatic tyre became synonymous with comfort, safety and speed, thus meeting the requirements of very different relevant social groups. Such a fixing of meaning is referred to as 'semiotic power'. Meanwhile, the use of technological frames to reduce interpretive flexibility is referred to as the 'micropolitics of power' (Bijker, 1995a, p. 263). Let us look at how these theoretical concepts help to illuminate the case study.

Fixing Meaning: Black Boxing the Bicycle

For a time the 'Ordinary' bicycle referred to a model with a large front wheel and a very much smaller back wheel – although we now remember them as penny farthings. The large front wheel was simultaneously driven and steered. These high-wheelers were expensive, difficult to mount and dismount, unstable and tiring. It was also very easy to catch your feet in the spokes. Riding them could therefore be an anxiety-inducing and painful experience. Advertisers pitched these machines in terms of their resilience: they could withstand numerous crashes. Salesmen even developed a terminology to describe the commonest types of falls. In the 1870s they were largely seen as a vehicle for wealthy young men to show off on, and their natural habitat was the public park. Bicycles would not emerge as widely used technologies or modes of transportation until somewhat later. Financial barriers shut workers and the middle classes out from the technology. Safety concerns put off the mature rider. Moral standards barred women from using them, the combination of skirted rider and high saddle being too risqué a proposition. Young male riders offered another discourse. The high-wheelers were macho machines, sporting devices that took bravery and skill to master. These two readings of technology – the Macho Machine and the Unsafe Machine – constructed two different technologies. The story of the modern bicycle, which enthusiasts are wont to see as the emblem of modernity (Bijker, 1995a, p. 40), revolves around these two meanings, numerous manufacturers, users and non-users.

The earlier bicycles, which were often called velocipedes, used the skills of carriage-builders. The machines had wooden wheels with cast iron rims and bent steel frames. The later designs used tubular frames, wire spokes and other components which favoured the manufacturing industries. The Coventry Machinists Company emerged as a major player, but competition abounded. Engineers looked at each component with a view to improvement. Manufacturers also began to change their approach to broaden the market size. Older male riders and women cyclists would require a different pitch, and a different, altogether safer machine. Tricycles were regarded

as the solution to the safety problem. The three-wheelers were more stable, they enabled a more comfortable posture, and in theory crashes were much less likely. These contraptions were more appealing to older men and women; they were also seen to be a better class of machine by Europe's royalty and nobility (Queen Victoria included).

Efforts to make a risk-free machine continued. Various models were made the world over. The development of Safety Ordinaries increased the size of the rear wheel. This repositioned the rider. No longer perched above the front wheel the rider was now between the wheels. This eliminated many of the vibrations that riders had to endure. These changes were not without costs. The bicycle was somewhat heavier and also harder to handle. The new aesthetic also failed to find favour with the high-wheeling fraternity. The small back wheel had always emphasized the rider's superiority.

At this point the market had three competing models: the Ordinary bicycle, the Safety Ordinary and the tricycle. In practice the three-wheeler did not solve the safety problem. Tricycles created three tracks rather than one, making them much more susceptible to the significant road surface problems of the time. Brake mechanisms were also poor. Most cyclists relied on back-pedalling. When accidents did occur the rider tended to be thrust into the wheels. By 1883 more accidents were recorded for tricycles than for bicycles (Bijker, 1995a, p. 50). The tricycle's heyday came to an end in the 1890s. Significantly, though, as a more seemly pastime it opened the way for women cyclists (Bijker, 1995a, p. 59). Even with the tricycle out of the way, and ignoring the Safety Ordinary, there was still interpretive flexibility. The Ordinary high-wheeler was viewed as two technologies: the Unsafe Bicycle, which was seen as a non-working machine, and the Macho Bicycle, which was seen as a working machine (Bijker, 1995a, p. 74). These two different meanings derived from two relevant social groups: older men and women who wanted a safer bicycle, and young men of means who cherished speed above all else.

Eventually the macho machine lost out to the safety vehicle. Various technical improvements were made to the Safety Ordinary, such as moving the saddle back, fitting handlebars that would detach in the event of a crash, and switching the position of the large and small wheels. None of these proved decisive in terms of closure. Closure was achieved by the 'pneu' bicycle design which used air-filled tyres. This allowed for both the fixing of meaning (semiotic power) and the reduction of interpretive flexibility to a single artifact (the micropolitics of power). The air-filled tyres had two advantages over solid rubber ones: they reduced vibration and they increased speed. At first the new tyres provoked mockery. They looked ridiculous. But cyclists who used them consistently triumphed in sporting competition. Their victories were widely advertised to the general public. Soon no serious racer would be seen dead riding solid rubber tyres. The public no longer looked down on them as an inferior product. As

Bijker (1995a, p. 84) puts it, the general public and the sports cyclists had combined to create a new technology, the high-speed tyre. And this new technology had effectively redefined the safety problem. While redefinition is an important closure mechanism, Bijker (1995a, p. 86) also draws our attention to rhetorical closure, the arguments made against opposing viewpoints. Seen from the perspective of the safety advocates the high-wheelers were simply dangerous.

There had existed a range of velocipedes, bicycles and tricycles. Some had two wheels others had three, some had different size wheels others the same size, some had solid tyres some pneumatic ones, some had paddles and others had pedals. At one point you had to speak of individual machines like the Ariel, the Facile, and the Xtraordinary to describe the geometry and running gear. People had spoken of Guilmet's, Lawson's, or Macmillan's bicycle. By 1897 the bicycle as we know it – air tyres, two wheels of the same size, chain-driven on the rear wheel, with a diamond frame – was in existence. Closure was such that, after a process lasting several decades, the interpretive flexibility of the technology had been erased. One could finally speak of *the* bicycle (Bijker, 1993, p. 122).

Criticisms of SCOT

On the plus side SCOT has theoretical rigour, an eye for detail, an emphasis on concrete case studies and an appropriate skepticism towards the social/technical divide. However, SCOT also has its detractors. Nick Clayton (2002) questions the historical accuracy of Bijker's account of the modern bicycle. More than this, he also thinks that their concepts of interpretive flexibility, relevant social groups and closure are based on questionable data gleaned primarily from populist accounts. Dick Pels (1996, p. 279) salutes SCOT's democratic ethos of symmetry, but notes that it can be extended indefinitely. How many social groups are relevant? Where does the analysis stop? Michael Khoo (2005) questions the usefulness of stabilization and closure as concepts and practices because technologies appear to be in endless states of evolution. We said in Chapter 1 that mobile phones now take photographs, play music, store data and surf the web. Have they ever stabilized? Can we say that closure has been achieved? Do we ever get to the point of a single technological frame? Technologies may never be finalized. Instead they may be constantly constructed in social processes and social contexts, forever in a state of becoming.

Khoo (2005) is also concerned that SCOT's concepts, including that of relevant social groups, come to be reified. That is, they are seen less as theoretical guides and more as actually existing entities that are always in need of explanation. He argues that SCOT's use of closure and relevant social groups adds little to older arguments that rested upon notions of

invention and actor. Khoo's preference is to see technological development as an interactive and temporally emergent social process (which is precisely what posthumanist thinkers advocate – see Chapter 8). 'While SCOT theories often emphasise the complex interplay between social groups, social processes and technologies, over time, an emergent approach would avoid reducing analysis to a model of a *social* structure and a *technological* artifact locked in a dialectical embrace' (Khoo, 2005, p. 284, emphasis in original).

Given its adherents' antipathy towards philosophy, it is not surprising that strong criticisms of SCOT have come from philosophers of technology. Langdon Winner (1993b, p. 377) responds in kind: 'Pinch and Bijker … show little awareness of the literature in philosophy and technology, past and present. That does not prevent them from delivering a peremptory judgment on the matter'. In his article 'Upon Opening the Black Box and Finding It Empty' Winner (1993b) offers four criticisms of SCOT while conceding that its simplicity is such that even the most struggling graduate student will be able to follow it. Winner's first criticism is a question of focus. SCOT is interested in how technologies become, what about when they *are*, and where they go? The concern with origins and innovation are seen as negative influences from the sociology of science. SCOT is silent on the social consequences of stabilized technology. There is no discussion of what happens when a particular design prevails. (In Chapters 7 and 8 we discuss what various new technologies mean for people's self-identity and social relations.) This connects with Winner's second criticism. SCOT seems to offer a politically pluralist model of innovation in which a number of relevant social groups compete to shape the technology to their own ends. A better model of technological innovation would admit those groups that have been marginalized and silenced yet must live with the consequences of its triumph. What Winner (1993b, p. 369) is calling for here is a broader appreciation of social structures, ongoing patterns of systemic inequality, the workings of power. (For example, in Chapter 2 Noble's study of numerical control showed that the interests of workers were consistently overlooked. Had SCOT theorists done this study, the workers might have been deemed an irrelevant social group.) Because the powerless are ignored Winner believes that in their absence SCOT serves up an 'implicitly conservative' analysis 'that attends to the needs and the machinations of the powerful as if they were all that mattered' (Winner, 1993b, p. 369). Third, SCOT's focus on the immediate actors and their frames of meaning may leave larger unseen forces out of the picture. In Chapter 2 we noted Marx's insistence on class relations as the defining feature of modern society, for Max Weber it was the spread of instrumental reason, and for the Frankfurt theorists a combination of the two. This, again, is a plea to consider the bigger picture. Finally, Winner argues that SCOT's methodology trumps morality. There is no space for meditations

on technology and humanity. SCOT researchers' commitment to symmetry means that they remain agnostic. They never take a political stand on anything. Instead they stay resolutely on the fence. This returns us to Winner's earlier criticisms of political conservatism. Since SCOT offers no challenge to the powers that be it ultimately does nothing to change the status quo.

Conclusion

In SCOT's newer works the definition of technology is extended in a way which would find favour with Latour (1988a) who always advocated for 'the science of techniques' to become preferred definition of technology. Early studies defined technology in the sense that MacKenzie and Wajcman (1985, p. 3) did: as artefacts, activities and knowledge, later works also take such 'things' as cities, markets and people to be technologies too (Aibar and Bijker, 1997; Pinch and Swedberg, 2008; Thompson, 2005). Bijker feels that SCOT's revised framework also enables us to explain the politicized nature of technology and the technological construction of the socio-political. Technology is a social construction, society is a technical construction. As Bijker (1995b, p. 230) said of Holland's dikes, these sociotechnical ensembles allow 10 million people to live below sea level, and they have reclaimed 40 per cent of the land from the sea. 'Without this technology, there would have been no Netherlands' (Bijker, 1995b, p. 230). SCOT therefore takes on board normative and macro-political issues in its later incarnations. Bijker (2010, p. 73) surmises that Winner perhaps mistakes SCOT's methodological relativism for moral relativism.

SCOT's evolution can be explained in part by the application of its theories to new domains and the responses to criticisms levelled at it. The combined result has been that it has increasingly come to resemble ANT. To begin with SCOT focussed on single technologies. Now it makes pronouncements on the condition of society. Bijker (2010, p. 64) draws our attention to three significant changes: the type of analysis, its methods and claims, and the research questions asked. The first change in emphasis is from specific technologies to technoculture, the second from the social construction of technology to society and technology as co-productions, the third from the politics of particular artifacts to the politics of modern technoscientific society. Taken together, these transformations go some way towards countering Winner's (1993b) criticisms.

SCOT had adopted Hughes' notion of the seamless web as a basic analytical unit. This increased the scale of study to consider regulatory environments and infrastructure. The sociotechnical ensemble became the subsequent unit of analysis. The phrase was used as it is looser than 'system' and it also helps to capture the stuff under consideration which is always social and technical (or political and material). Bijker (2010, p. 67) cites the

example of the Challenger space shuttle disaster, which was also mentioned in Chapter 1: was it a failure of technology or organizational oversight or lack of funding? Could it be all three? This type of theorizing eventually broadened into thinking about culture and society as a whole, hence the shift towards technological culture. One such study was a cross-national comparison of water management technologies and their respective value systems and cultures of risk (Bijker, 2007). While Dutch dikes and American levees have the same function, they operate in entirely different contexts. Water management in Holland is dispersed and highly democratic. It is consensus-driven, its citizenry are well-informed about flooding issues, it privileges engineering practice and, with the terrible events of the 1953 storm surge which killed over 1800 people stamped indelibly in the collective memory, it tolerates no perceived risk. American management is more centralized and hierarchical, its citizenry are not well-informed about pertinent issues, it privileges scientific research, and it works on coastal defences that will keep out a 'hundred year flood' (Bijker, 2007, pp. 119–21).

At this point the intellectual debt to ANT becomes more apparent. Non-human agency begins to be taken seriously, the context and content of technology are important, and the technical and the social are no longer separated. In fact society and technology are now seen as co-produced. To gauge technological impacts emphasis is placed on obduracy instead of interpretive flexibility. This hardness manifests in two forms: closed-in and closed-out hardness. The former applies when users are strongly included in the technological frame. A pertinent example is college students and their mobile phones. The latter applies when one is literally shut out of the technology. Here Bijker mentions standardized electrical power supply. Most of us lack the skills to counter the national system: we either purchase the right device with the right voltage or we don't get to use it. Technologies, then, can be seen to have political force (Bijker, 2007). Such studies shift us away from the twin pitfalls of social and technological determinism. As with ANT (Latour, 1991, p. 129), the social and the technical are two aspects of the same phenomenon. These studies also bring a new explanatory mode into being, that of co-evolution or co-production (Bijker, 2010, p. 71).

In Chapter 6 we interrogate this source of influence.

Further Reading

The key work of the social construction of technology school is W.E. Bijker, T.P. Hughes and T. Pinch's (eds) (1987) *The Social Construction of Technological Systems* (Cambridge, MA: MIT Press; paperback edition 1989). It also formalizes the study of technology within STS. Law and Bijker's

(1992) collection *Shaping Technology/Building Society* (Cambridge, MA: MIT Press) is also worth consulting.

Bijker's best known work is *Of Bicycles, Bakelites and Bulbs: Toward a Theory of Socio-Technical Change* ((1995, Cambridge, MA: MIT Press).

Trevor Pinch provides a good introduction to SCOT in 'The Social Construction of Technology: A Review', in Robert Fox's (1996) *Technological Change: Methods and Themes in the History of Technology* (Amsterdam: Harwood Academic Publishers), pp. 17–36.

Technology and Culture, 43(2) (2002) contains an exchange between Nick Clayton, a critic of SCOT, and two of its defenders: Wiebe Bijker and Trevor Pinch. Bruce Epperson is given the final word.

The merits of the social construction of technology are also debated in a special edition of *Social Epistemology*, 19(2–3) (2005). This analyzes and updates earlier material.

SCOT owes an intellectual debt to work on the social shaping of technology. Donald MacKenzie and Judy Wajcman's (1985) edited collection *The Social Shaping of Technology* (Milton Keynes: Open University Press) is one of technology studies' classics. The book is prefaced by an introductory essay on the social shaping of technology, and it includes contributions from such luminaries as Ruth Schwartz Cowan, Thomas P. Hughes, Harry Braverman, David Noble, Cynthia Cockburn and Mary Kaldor.

Donald MacKenzie's (1996) later work, *Knowing Machines* (Cambridge, MA: MIT Press) collects together a number of his prize-winning essays on the sociology of technology.

SCOT is extended in Ronald Kline and Trevor Pinch's (1996) article 'Users as Agents of Technological Change: The Social Construction of the Automobile in the Rural United States', *Technology and Culture*, 37(4): 763–95. As the title notes, the users of technology are here considered as a relevant social group.

6

The Sociotechnical Construction of Society: Actor-Network Theory

ANT is an important social theory which foregrounds the role of technology in the construction of society. Indeed, it is particularly noted for its insistence on non-human agency. In rethinking the composition of the social it also provides a powerful rejoinder to traditional and critical sociology. Put simply, no technology, no society. The main figures in ANT are Michel Callon, Bruno Latour, and John Law. John Law (2003b, p. 381) summed up the core principles of ANT thus: a central concern with the operations of power, the social conceived as a heterogeneous network, with knowledge, action and power explained as network effects 'embodied in a variety of material forms'. This chapter teases out all of these points, as well as the source of this inspiration. It begins by discussing ANT's break with social construction and by extension its challenge to mainstream social theory.

The Break with Social Construction

ANT departs from early SCOT in significant ways, beginning with the question of social construction. Debates about the merits of social construction are not new to social theory. For a time, the orthodoxy within the sociology of deviance was that drug 'highs' were socially constructed. Howard Becker's seminal essays 'On Becoming a Marijuana User' and 'Marijuana Use and Social Control' cemented this position. He asserted that the cultural dominates the chemical. Learned behaviours through group interaction are important, not the pharmacological properties of the drug. That learning process was threefold. To become a proper user Becker argued that the

marijuana smoker must learn the correct way to take the drug, to perceive its effects and to enjoy it. Geoffrey Pearson and John Twohig took issue with the social construction of drug experiences. Being critical of meanings minus a material base they brought our attention back to the pharmacological properties of drugs. Their 1970s study of white middle-class British hippie drug users asked users to comment on Becker's articles, one of whom famously responded, 'that guy Becker should change his dealer!' (quoted in Pearson and Twohig, 1977, p. 122). That person noted that even when using for the first time he did not need to take cues from the company around him. The bodily effects were immediate and dramatic. Pearson and Twohig (1977, p. 122) call this 'heavy technology'. The materiality of the drug gets lost in the social constructionist account when it should be given primacy. That said, Pearson and Twohig (1977, pp. 122–3) admit that the drug can have different effects in different settings. As a 'party technology', which is to say taken at social gatherings often in conjunction with alcohol, its effects may be less pronounced. Still, culture, context and cohort seemed less important than 'technology' (which is Pearson and Twohig's term for method of ingestion).

Bruno Latour and Steve Woolgar dropped 'social construction' from the subtitle of the second edition of *Laboratory Life* (1986). It simply became *The Construction of Scientific Facts*. Since everything was now said to be social the term had become an empty signifier carrying no meaning. Latour's (1994b, p. 793) second, and more substantive, objection to social construction mirrors Pearson and Twohig; 'when you "socially" explain things you are not interested in things anymore'. ANT's charge is that SCOT is guilty of committing the standard error of social scientists. Ever since Émile Durkheim, critical sociologists have stressed social projections rather than material properties. Technologies are considered only as neutral intermediaries that do no work and exert no real agency. Objects are treated purely as symbolic, 'mere receptacles for human categories' (Latour, 1993b, p. 52). Early SCOT does not assume, or perhaps even acknowledge, technology's independent existence. As Bijker (2010, p. 66) writes, 'technical artifacts are analyzed by looking at statements uttered by humans, and no assumptions are being made about the existence of these artifacts independently of the statements about them'. If we think back to his case study in the last chapter, what role do bearings, brakes, cables, cranks, cotters, hubs, forks, frames, gears, inner tubes, pedals, pins, rims, saddles, seat posts, spokes and tyres really play in Bijker's study of the bicycle? With SCOT, notably early SCOT, the artifact is in danger of becoming so transparent as to be invisible. SCOT might oppose the notion of a pure technology (Bijker and Law, 1992b, p. 3), but their model of technology comes close to being purely social. Social interaction replaces materiality. They may have substituted one form of determinism (technological) for another (social).

SCOT's original stance seriously weakens objects and it downgrades the important roles that they play. Latour (2004a, p. 80) says that it 'scandalizes' them. Against such damage ANT grants technology 'ontological dignity' (Latour, 2002a, p. 254). Latour (2005, p. 92) argues that any successful construction relies on non-human as well as human objects, with the non-humans typically playing the leading role. Stability is not merely a matter of social consensus; it is achieved via a heterogeneous assemblage of human and non-human associations. As Michel Serres (1995c, p. 166) says, 'human relations go through things, our relations go through things to men'. For this reason 'we have to turn away from an exclusive concern with social relations and weave them into a fabric that includes non-human actants, actants that offer the possibility of holding society together as a durable whole' (Latour, 1991, p. 103). At times SCOT does at least seem to acknowledge this (Bijker, 1995a, pp. 262, 273). The difference between SCOT and ANT is that SCOT takes construction metaphorically while ANT treats it literally (Latour and Hermant, 2006, p. 74). In ANT's accounts society is indeed constructed but not simply *socially* constructed (Latour, 1994b, p. 793). For example, we are bound to our electricity provider by 'things' like loyalty and fear, but also by things like 'wires, meters, copper and filament lamps' (Latour, 1988a). Where SCOT talks about the meaning of technology, ANT talks about technology. The array of actors to be included *as actors* is therefore much larger. Matter matters.

Critics of SCOT suggest that technology does not necessarily *do* anything in its accounts. Technology has no agency (see Verbeek, 2005, p. 102). For ANT, if it makes a difference, if it has an effect, it is an actor. Latour argues that technologies fold time, space and agents, they stand in for others, intensify attributes and create new possibilities (Latour, 2002b). 'This is why the theme of the tool as an "extension of the organ"', discussed in the next chapter, 'makes such little sense' to him (Latour, 2002b, p. 250). Non-humans, then, can be 'full-fledged actors' (Latour, 1999b, p. 174). Latour (1999b) argues that technologies primarily permit mediation, in four senses. First, technologies create interference (Latour also talks about displacement). They create new programmes of action, new possibilities: 'You are a different person with a gun in your hand' (Latour, 1999b, p. 179). Second, technologies provide for new distributed practices, new compositions, and new associations. They afford the exchange of performances and competencies. Third, technologies fold time and space. What we think of as a black-boxed single thing is typically a complex of integrated parts whose composition is variable, sometimes stable and sometimes not. Suppose a part of the machine should fail. How far back in time and space do we need to go to trace its contribution? In a later article Latour (2002b, p. 249) used the simple example of a hammer. The minerals in its composition are as old as the world itself, the wood in the handle will be of a significantly lesser age, and the time since it left the factory still less. The hammer folds

together a German forest (the raw material for the shaft), a German mine (the raw material for the head), a German factory (the site of the hammer's production) and a French work van (the site of its sale). Thinking back to Marx we could also say something that Latour would not, that the factory additionally folds together capitalist relations (capital as alienated thing) and labour (as alienated action). Fourth, technologies delegate. They cross boundaries between symbols and things, and importantly they do the work that humans would otherwise have to do. This means that humans do not have to be present. The same principle applied in our panopticon discussion in Chapter 3. The prisoners police themselves. This 'heterogeneous engineering' (Law, 2003b, p. 381) changes the form and substance of our expressions. By way of illustration Latour (1999b) writes that authorities everywhere have recognized that speed bumps are more effective at slowing down speeding drivers than warning signs. Speed bumps shift goals and expressions. Meaning is displaced from signage to roading, the action of slowing down translated into another form of expression. This movement is from public morality ('reduce speed, you might hurt someone') to personal interest ('reduce speed, you might damage your vehicle'). As this example demonstrates, material and symbolic relations are tied together. The technical content of the speed bump includes engineers, town planners and law makers as well as concrete, paint and tarmac. Now the technology exerts a morality as indeed technologies always do whenever they '*oblige us to oblige them*' (Latour, 2002b, p. 258, emphasis in original).

There are further points of difference between SCOT and ANT. Some suggest differences in the types of study they conduct and the forms of explanation they utilize. Pickering (1995, p. 158) argues that SCOT's studies have emphasized technological innovation, while ANT has been more concerned with implementation. This appears to be a weak claim considering Callon's (1986b) work on the development of an electric car, Latour's (1996a) work on the attempt to make an automated commuter system and Law's (2000) work on the British military's efforts to build the TSR2 aircraft, to take but three examples.

Another point is worth noting. SCOT and ANT use different types of explanation. Bijker's (1995a, p. 12) studies of bicycles from 1860 to the 1890s, Bakelite from 1880 to 1929, and the fluorescent lamp from 1930 to 1945 are historic. ANT generally believes that studies should only be undertaken in the present, when science and technology are in the making, while the controversies are still raging. In *Science in Action* Latour (1987, p. 258) made this his first rule of method. He argued that finalized technologies cannot be studied as they are already black-boxed. Latour's injunction is to follow the actors. John Law (2003b, p. 387) agrees. ANT concerns empirical stories in the present. SCOT is archival while ANT is ethnographic. That said, ANT's theoretical rule is not always observed in research practice. Actor-network theorists have undertaken historical

studies: Latour (1988b) on Louis Pasteur, and Law (1986b) on Portuguese colonization.

A more compelling point pertains to the different forms of explanation that SCOT and ANT utilize. To explain their studies SCOT adherents gesture towards a solid social base. Meanings and the desires of actors and groups are all relatively stable. For ANT, social stability is not the cause of technological closure, it is the *consequence*. This results from the settlement of a controversy. Settlement is accomplished by the successful enrolment of humans and non-humans (Latour, 1987, p. 258). Social forces should therefore not be privileged (Law, 1987, p. 113). Identities, groups, meanings and desires are not unchanging. They are worked out, and transformed, in processes of translation (Callon, 1986a, pp. 227–8). Indeed, Law (2002, p. 9) argues that subjects, objects and bodies of knowledge are only ever 'fractionally coherent'. ANT therefore eschews fixed categories and foundations. To study technological projects it insists that we move from traditional or critical sociology which relies on fixed forms of reference to a relativistic sociology which has fluctuating referents (Latour, 1996a, p. 169). ANT practises 'radical relationality' (Law, 2003a). This leads to a difference that is more than methodological: becoming replaces being (Harris, 2005, p. 164).

Sociology: What is it Good For?

The criticisms that ANT makes of SCOT reflect ANT's objections to social science more generally. All is well with the social sciences, Latour (2000) quips, except for two words – 'social' and 'sciences'. Sociology seems to be founded on the identification of category error. Much of the sociologist's job is devoted to putting people right. 'You think that it is X', says the sociologist, 'but it is *really* Y'. Typically 'Y' will be some form of social function. Irrespective of what they study then, the *real thing* always turns out to be something else. So when sociologists claim 'to comprehend something they have left aside what the *thingness* of this thing actually is! Either they destroy what they study or ignore what it is' (Latour, 2000, p. 112).

For Latour (2000, p. 109) the paradigm case is religion. Sociologists of religion often argue that religious beliefs, rituals, even miracles performed purely social functions. Nothing was happening in heaven and the hereafter, no action could be attributed to a higher source, everything was happening here on Earth right now. They dismissed religious practices as mere fetishes, as false objects of belief. These were replaced with the true objects of society (because, irrespective of the object of attention, the real object always comes from there). Sociologists knew that the true function of religion was *really* to give society its cohesion, and mask its hierarchical structure. Durkheim explained (away) religion as a tool of social solidarity

and social control, while Karl Marx famously dismissed it as 'the opium of the people'.

Latour calls for a rethinking of customary social science explanation, urging us to seriously confront the thingness of things. In answering the question of when the social scientist comes on the scene, he says the following:

> If a cyclist falls off his bicycle because he hits a rock, social scientists confess, they have nothing to say. It is only if a policeman, a lover, an insurance agent or the Good Samaritan enter the scene that a social science becomes possible, because we are now faced … with a string of socially meaningful events. Not so for STS practitioners, who deem sociologically interesting and empirically analysable, the very mechanisms of the bicycle, the paving of roads, the geology of rocks, the physiology of wounds and so on, without taking the boundary between matter and society as a division of labour between the natural and the social sciences (Latour, 2000, p. 108).

The last sentence illuminates the entire article. Latour argues that society is an assemblage of people and things in combination, that the social has material as well as symbolic bases and that 'a general feature of *all* objects … is that they are so specific that they cannot be replaced by something else for which they are supposed to be a stand-in' (Latour, 2000, p. 112, emphasis in original). Everything has its 'unique adequacy'. This in turn causes us to rethink our standard notions of society. This is precisely what ANT does.

> 'Society' has to be composed, made up, constructed, established, maintained and assembled. It is no longer to be taken as a hidden source of causality which could be mobilized so as to account for the existence and stability of some other action or behaviour. (Latour, 2000, p. 113)

For ANT, objects are the point of difference between humans and other primates. Without all that is solid, the social melts into air. Structuring effects are not possible by social means alone. Indeed, ANT severely doubts that a purely social relation has ever been observed (Latour, 1991, p. 110). Social regulation is often relinquished to things. We have already used Latour's speed bump example. His writing about hotel keys reinforces the point. Before readily replaceable (and cancellable) swipe cards were invented, all hotel doors were opened with keys. This posed a security problem for each establishment. Every time a key was lost or kept, the door lock needed to be replaced. Needless to say, this could be a costly exercise, though hoteliers generally regarded this as less costly than repeat thefts from guests' rooms. Hoteliers drew upon several strategies to minimize key

loss. They could simply ask guests to hand their keys in to the concierge every time they left the hotel. Typically there would be low enrolment into this programme of action. To reinforce the message they could place signs by the exit. This would result in a greater enrolment into the desired programme of action, although most would still take their keys with them. A more costly, but also more effective, strategy would be to employ a doorperson to remind customers that they should hand their keys into reception prior to departure. This requires constant vigilance on the part of the doorperson, and what happens when they take a break? Hoteliers hit on the idea of attaching large weights to the keys. This made them awkward to carry around. It would now be far more convenient to hand in your keys to reception whenever you left the building. This not only seemed like a good idea, it seemed to be the guest's idea (Latour, 1991, pp. 104–10). Thus a material artifact, the weight, replaces an oral or written request to much greater effect.

ANT, then, looks at the social anew. The social is not a stable and homogeneous type of thing, a privileged domain of reality which is always already present, but a series of heterogeneous assemblages. These stabilized chains of association are often more durable, reliable (Latour, 1992b) or docile (Law, 1986a, p. 17) than human agents alone. What we think of as the social is the effect of these heterogeneously composed networks. Society, technology, and even agency, are network-effects. The social is not that which explains but, given the literal construction of social order, that which needs to be explained: 'to transform academic sociology into a sociology capable of following technology throughout its elaboration means recognizing that its proper object of study is neither society itself nor so-called social relationships but the very actor networks that simultaneously give rise to society and technology' (Callon, quoted in Pickering, 1995, pp. 372–3). The sociology of the social therefore needs to be replaced by the sociology of associations, and the notion of society needs to be replaced by that of the collective (Latour, 2005, pp. 5, 75).

The Sociology of Translation

The sociology of translation, or Actor-Network Theory as it is more commonly called, was developed in Science and Technology Studies. The old argument amongst scientists, but also amongst sociologists from Karl Marx through to Karl Mannheim (1936) was that external reality exists; it is fixed, and scientists get better and better at approximating it. Accepting this, sociologists of science like Robert Merton (1973) and Pierre Bourdieu (2004) studied other (trivial) aspects of scientific work such as career trajectories and legal wrangles. Following Thomas Kuhn (1962) scientific work was viewed as cognitive constructs understood by reference

to social interests. That these can be identified implies that social interests are relatively fixed. The social realm replaces the natural realm in explanations. Such is the approach of David Bloor (1976) and his colleagues in the Edinburgh School and Harry Collins (1985) and his colleagues in the Bath School. It is also the approach of SCOT. ANT asserts that when natural scientists are in dispute they negotiate what the physical world is like and what social relationships will be like to transform social reality as well. These two processes are wedded together. Thus scientific controversies are all about telling stories. People recruit allies to their social and material model of what the world is like (Latour, 2005, p. 95). These points hold for technologies too: 'By definition, a technological project is a fiction, since at the outset it does not exist' (Latour, 1996a, p. 23). Earlier we conceptualized this trajectory as the progressive extension of symmetry. Latour (2005, p. 76) has reservations about seeing it as such since it is open to misinterpretation. Some may think that it implies the maintenance of nature and society, whereas Latour seeks the dissolution of these terms.

ANT makes an important intervention in the world of social theory, the significance of which goes well beyond its thoughts on technology. As Law (2003b, p. 383) states, it is 'analytically radical'. ANT does not entertain the idea of fixed frames of reference or the notion of foundations: 'if differences exist it is because they are generated in the relations that produce them. Not because they exist, as it were, in the order of things' (Law, 2003a, p.3; see also Latour, 2005, p. 147). It also dispenses with most of the standard social science dualisms: ancient/modern, micro/macro, subject/object, society/technology and nature/society. While almost all sociologists make an ancient/modern distinction, ANT refuses to do so. There is no fundamental difference between the two societies. Differences, such as they are, can be explained by scale, complexity (the number of non-humans involved) and the length of chains of action. Modern society 'translates, crosses over, enrolls, mobilizes more elements which are more intimately connected, with a more finely woven social fabric, than the former does' (Latour, 1999b, p. 195). The micro/macro split makes no more sense to ANT. Scale relates to the actor's achievements (Latour, 2005, p. 185). Significance is to be found in chains of association, the size of networks, the number of elements tied into them. 'Napoleons are no different in kind to small-time hustlers, and IBM to whelk-stalls' (Law, 2003b, p. 380). Here Hughes' work was influential as it showed that the material that makes up the micro-structure of society is the same as the material that constitutes the macro-structure (Latour, 1991, p. 118). ANT eschews the subject/object dichotomy and their setting within something called society. In their place Latour (1999b) proposes associations of humans and non-humans within a collective. Whether an actor is human or not is of no concern. The society/technology dichotomy also collapses under empirical scrutiny because entities exchange competencies, and because humans and non-humans

alike can exert agency. The division between 'things-in-themselves' and 'humans-among-themselves' (Callon and Latour, 1992, p. 359) is therefore senseless. The two are always combined. When armies do battle we do not have naked bodies on one side and weaponry and uniforms on the other (Latour, 1988a). Instead of asking ourselves whether something is social or technological we should instead be enquiring 'is this association stronger or weaker than that one?' (Latour, 1988a). Bruno Latour (1991, p. 129) states: 'Society and technology are not two ontologically distinct entities but more like phases of the same essential action'. The same holds for nature and society, both of which are the consequences of network construction (Callon and Latour, 1992, p. 348).

In preference to thinking in terms of essential differences in binary opposition, ANT's explanatory framework stresses the stability and durability of actor-networks, the strength or weakness of associations. Its ultimate point is to explain what keeps society together (Latour, 1992a, p. 272). To answer this question ANT attends to two things that customarily escape the social theorist's attention: the role of non-humans, and the work done to make translations and associations possible. Things and people, nature and society have a shared ontology, for which ANT provides a shared vocabulary. Actant often replaces actor in their accounts as actor suggests a strictly human agency, actor-network replaces social relations, delegation replaces social roles and translation replaces interaction (Callon and Latour, 1992, p. 347).

Semiotics inspired much of ANT's vocabulary (actant, performance, representation, text, translation). Indeed, ANT is sometimes referred to as a material-semiotic approach. Material-semiotics at once captures 'the thingness of things' and the symbolic aspects of technology. It also signals relationality. Semiotics is the study of meaning and communication. Originating in linguistics, it holds that the significance of an entity is generated in relation to other entities, for example husband and wife. ANT broadens this from language to all phenomena (Akrich and Latour, 1991, p. 289). Nothing has meaning in itself. Things find significance through their relations to other things and humans, 'entities give each other being … they enact each other' (Law and Mol, 2008, p. 58).

Dissident Agents

SCOT highlights the role of relevant social groups in shaping a technological artifact through mechanisms of closure. It does little to explain the reasons for their actions. This is mostly linked to the quest to fix meaning. By contrast, particularly in its early incarnations, ANT regards power as the prime motivating force (later on power comes to be seen as something to

be explained). Callon (1986a, p. 196) introduces the sociology of translation as 'a new approach to the study of power'. Deliberately programmatic, Callon and Law (1992, p. 358) would later call 'Some Elements of a Sociology of Translation: Domestication of the Scallops and Fishermen of St Brieuc Bay' 'an ontological manifesto and a point about social theory'; the point being to present non-humans 'to social theory in a new way' (Latour, 2005, p. 10). The paper's core concerns are the roles that science and technology play in the construction and perpetuation of power relations.

Callon's (1986a) case study is informed by three principles and by four moments of translation. The principles are: agnosticism (neutrality between conflicting actors), generalized symmetry (the explanation of conflicting positions in the same way), and free association (the refusal to distinguish between the natural and the social). It is in this last respect that ANT is methodologically innovative. Indeed, there are some who would argue that ANT is best seen as a method rather than a theory (see Latour, 1999a, pp. 20–1). The four moments of translation are: problematization (know your actants, provide solutions to their problems), *interessement* (break new recruits from their former networks and align them to yours), enrolment (solidify the new network's identity through pressure, appeal or consent, and by allocating roles to others), and mobilization (ensuring that spokespersons represent their collectivities while avoiding betrayal). In *Science in Action* Latour (1987, p. 258) also outlined rules of method, including the injunctions to:

- Follow science and technology in the making,
- Ignore technology's intrinsic qualities and consider instead their subsequent transformations by other agents,
- Avoid the use of either nature or society to explain the settlement of scientific disputes as both are themselves the result of settled controversies,
- Think about the enrolment of humans and non-humans in the same way, and
- Suspend judgement on the make-up of science and technology, instead focus on what and who does the work.

Theirs is a relational approach that emphasizes processes and practices rather than substances and essences.

Translation controls behaviour by making it predictable. It connects disparate entities and makes common cause where there was difference. Simply put, the notion of translation was intended to cover the process whereby one thing represents another so well that the voice of the represented is effectively silenced. Thus understood, an actor is an entity that creates or fosters a certain level of dependency upon their being and projection. Actors change programmes of action. 'By translation we understand all the

negotiations, intrigues, calculations, acts of persuasion and violence thanks to which an actor or force takes, or causes to be conferred to itself, authority to speak or act on behalf of another actor or force' (Callon and Latour, 1981, p. 279). Latour (1987, pp. 108–21) offers elaboration on translation techniques: catering to the interests of others, providing options to the thwarted, offering a faster route to success, altering interests and goals, making yourself indispensable. Likewise, he enumerates various tactics including the creation of new problems, goals and groups, and concealing detours. Success, here, is measured by the ability to order a section of the world on the basis of your own formulations; this will normally be marked by an expansion of the size of the translating actor (the actors that are networked) and the redefinition of other actors and their interests (Callon and Law, 1982, p. 620). ANT studies, then, observe the making and breaking of worlds. Here Law (2003b, p. 387) again acknowledges the inspiration of Hughes' (1983) earlier system-building work.

In Callon's (1986a) bivalvular cautionary tale no one really knew how scallops reproduce. Scallop numbers had been declining at all major harvest sites (Normandy, Brest and St Brieuc Bay). Highly prized by consumers with a price tag to match, scientists began looking for ways to reverse this trend. Three researchers discovered a successful method of scallop cultivation in Japan. Larvae are fixed to undersea units that protect them from predators. When the scallops are big enough they are 'seeded' along the seabed, then left to grow for a further two to three years. The initial problem in transferring this method to France was the lack of scientific understanding about scallop biology. Fishermen were just as ignorant about the scallop's reproductive cycle. But prior commercial fishing had threatened the continuation of the scallop industry. The fishermen of St Brieuc Bay feared that their livelihood would collapse. In the early 1980s a group of scientific researchers and fishermen's representatives organized to study (and increase) scallop numbers. As Latour (1987, p. 202) put it:

> French gastronomes are fond of scallops, especially at Christmas. Fishermen like scallops too, especially corralled ones, that allow them to earn a living similar to that of a university professor (six months' work and good pay). Starfish like scallops with equal greed, which is not to the liking of others. Three little scientists sent to the St Brieuc Bay to create some knowledge about scallops love scallops, do not like starfish and have mixed feelings about fishermen.

The researchers visited the Far East. They saw Japanese methods of scallop cultivation. But would the French scallop species (*Pecten maximus*) successfully anchor to collectors? This question was framed with a network of relationships in mind: the successful resolution of this problem

would involve the researchers making themselves indispensable, by casting themselves as an obligatory passage point. Their questions involved three other actors: fishermen, scientific colleagues and scallops. Fishermen have an interest in maintaining scallop stocks. Scientific colleagues are largely ignorant about scallops, yet they have an interest in advancing knowledge. Scallops have only been seen in their adult form when dredged from the sea. They have an 'interest' in reproducing. However, it is not known whether the scallops will attach to artificial shelters in commercially significant numbers.

'At this point in our story,' Callon (1986a, p. 207) writes, 'the entities identified and the relationships envisaged have not yet been tested. The scene is set for a series of trials of strength whose outcome will determine the solidity of our researchers' problematization'. Some actors may not share the researchers' goals. Tentative links between allies must be strengthened. Their conflicting interests and agendas must be made to converge if stability is to be achieved. The researchers increase the frequency of meetings to impress upon the fishermen the causes of scallop extinction. They 'draw up and comment upon curves which "indisputably" show the severe decline of the stock of scallops in St Brieuc Bay; they also emphatically present the "spectacular" results of the Japanese' (Callon, 1986a, p. 210). Scientific associates are canvassed through conferences and publications. Various 'structures comprising both social and natural entities are shaped and consolidated' (Callon 1986a, p. 211). Yet *interessement* – the action of interesting and locking in other actors – is no guarantee of enrolment. Questions must be turned into statements: scallops *will* anchor, fishermen *need* to replenish shellfish stocks, and scientists *want* to know about scallop reproduction. To be enrolled, scallops must congregate on the collectors just as fishermen must act to rebuild stock and scientific colleagues support their work. Each actor must fulfil their delegated function.

Allies are mobilized. 'Will the masses (employers, workers, scallops) follow their representatives?' (Callon, 1986a, p. 214) Will the translation succeed? Will all of the actors submit to the scientific researchers' structure? In theory the scallops anchor, but nets removed from the sea show collectors that are obstinately empty. Experiments fail, repeatedly. Inefficiencies in *interessement* are blamed on predators, on variations in sea temperatures and on unusual currents. Breton larvae decline to attach, '[t]he scallops become dissidents' (Callon, 1986a, p. 220). Fishermen defy their spokesman, and one Christmas Eve the scallops are 'brutally dredged by fishermen who could not resist the temptation of sacking the reserve oceanographers had put aside' (Latour, 1987, p. 202). Scientists begin to wonder if larvae anchorage is an obligatory passage point. Colleagues call the broad research programme into question, and there are doubts about continued funding. The venture fails.

Foucault/ANT

So far we have examined ANT's differences from SCOT, we have looked at ANT's challenges to mainstream sociology and social theory, and we have discussed an exemplary case study. Until now ANT's genealogy has been traced exclusively within Science and Technology Studies, but Foucault remains an important presence in their work. ANT's intellectual debt to Foucault can be traced by examining the topics of power, materiality, the nature of the social, non-human agency and technological neutrality. These topics are selected because they form the core of what leading protagonists take ANT to be (Law, 2003b). As we shall see, these ideas all resonate with Foucault.

ANT shares Foucault's (1982) definition of power as the ability to affect the actions of others (Latour, 1986a, p. 265). Success is therefore measured in the same way. Disciplinary power results in the docility of potential opponents. Like Foucault (1979, p. 27) ANT treats power as effect rather than cause, and as strategy not property (Law, 1986a). The notion of power operating through a network is also already present in Foucault's thought. 'Power must be analysed as something which circulates, or rather as something which only functions in the form of a chain. It is never localised here or there, never in anybody's hands, never appropriated as a commodity or piece of wealth. Power is employed and exercised through a net-like organisation' (Foucault, 1980, p. 98). Compare Latour (1991, p. 110): 'Power is not a property of any one of those elements but of a chain' of human and non-human actors. For Foucault, as for ANT, this network is heterogeneously composed: '[p]ower relations are rooted in the whole network of the social', a 'multiple network of diverse elements' (Foucault, 1979, p. 307). People and things do not populate a void; rather they occupy 'heterogeneous space', with various sites defined by their relations (Foucault, 1986, p. 23). The network is invoked to describe social formations such as the family, 'a network of pleasures and powers linked together at multiple points and according to transformable relationships' (Foucault, 1990, p. 46). It is also used to describe our social situation more broadly: 'The present epoch will perhaps be above all the epoch of space … We are at a moment, I believe, when our experience of the world is less that of a long life developing through time than that of a network that connects points and intersects with its own skein' (Foucault, 1986, p. 22).

In *Discipline and Punish* (1979) and 'The Punitive Society' (2006) Foucault discusses the materiality of power and in *The History of Sexuality* (1990, p. 140) he reminds us that power is only made possible through *agencement concrets* (concrete arrangements). That is to say power is 'not a network of forces, but a multiple network of diverse elements – walls, space, institution, rules, discourse … a strategic distribution of elements of different natures and levels' (Foucault, 1979, p. 307). This is precisely

what ANT theorists take the social to be, '*nothing other than patterned networks of heterogeneous materials*' (Law, 2003b, p. 381, emphasis in original). ANT also fully subscribes to Foucault's notion of the materiality of power. Writes Latour (2004b, p. 225):

> Left to its own devices, a social tie made only of social ties would be limited to very short-lived, local, face-to-face, unequipped interactions… When power is exerted, it is because it is not made of social ties… It is when power is exercised through things that don't sleep and associations that don't break down that it can last longer and expand further – and for this, of course, links made of another stuff than social contracts are required.

Foucault's work is sensitive to the ways in which subjects become objects (of knowledge), and the ways in which (material) objects act upon subjects. Colin Gordon (1980, pp. 238–9) draws attention to the significance of this. Foucault does not affirm 'the radical autonomy of "human" from "physical" technologies'; moreover he jettisons the 'ethical polarisation of the subject-object relationship'. Domination, after all, is simultaneously subjectification and objectification. Gordon directs us to Foucault's discussion of Man-the-Machine, although Foucault's later observations on 'body-object articulation' are more apposite. Foucault argues that the early modern idea of man as machine had two sources of influence: an anatomico-metaphysical register inaugurated by Descartes and elaborated by subsequent philosophers and physicians, and a technico-political register beginning in the military but spreading to schools and hospitals. The former aimed at making the body intelligible, the latter useful. One was aimed at comprehension, the other control. Man could be treated as a machine, with bodily movements made to operate as if clockwork: 'The human body was entering a machinery of power that explores it, breaks it down and rearranges it' (Foucault, 1979, p. 138). Foucault continues in this vein, citing 'Ordonnance du 1er janvier 1766, pour régler l'exercise de l'infanterie' – a weapons drill for the correct holding, aiming, firing and reloading of rifles. Here the body relates to manipulated object in a precisely codified manner. Another example concerns the Prussian military regulations of 1743 which stipulated six stages for bringing the weapon to foot, four to extend it and thirteen to raise it to the shoulder. In the process soldier and rifle are fused, the two become one, bonded by a power that operates over all surfaces. Together they become 'a body-weapon, body-tool, body-machine complex' (Foucault, 1979, p. 153). Latour (1994a, p. 32) would also write of person and firearm in combination as more than the sum of their parts, describing the result as 'a gun-citizen'. Like Foucault, Latour's analysis eschews accounts which focus exclusively on users of technology ('people kill people') and materialist accounts focussing only upon the technology being

used ('guns kill people'). Neither of their analyses proceeds with essences, subjects or objects, but with a hybrid composite. What is foregrounded is the mediating role of techniques. They argue for what we might call a distributed agency ('people with guns kill people').

Foucault also identified a moral dimension to technology, as Latour (2002a) would do much later. Tellingly, Foucault (1979, p. 223) refers to morality as 'a set of physico-political techniques'. Here he adds his voice to all of the others that have opposed the naïve view of technological neutrality: technology as mere tool, as mere means to an end. Instead, technologies are positioned as political actors. The means are, in some way, imbricated with ends. Technologies like stethoscopes are designed to do specific things, and to allow certain actions. In other words there is a morality to artifacts – what Akrich and Latour (1991, p. 261) called 'prescription' – which affect decisive transformations. As noted earlier, institutional formations are included in this. Foucault (2007, p. 149) writes that '[t]he architecture of the hospital must be the agent and the instrument of cure'. Prison is discussed 'as an instrument and vector of power' (Foucault, 1979, p. 30). The cell acts as moral agent, discipline's fundamental structure, necessary for isolation, reflection and transformation. It is 'the instrument by which one may reconstitute both *homo oeconomicus* and the religious conscience', the means by which the body and soul are worked upon to reconstitute the deviant subject as model citizen (Foucault, 1979, p. 123). A case in point was the Pennsylvanian prison of Cherry Hill where 'the only operations of correction were the conscience and the silent architecture that confronted it' (Foucault 1979, p. 239). Warders do not need to exert force, 'this is assured by the materiality of things' (Foucault, 1979, p. 239). Walls do the punishing. *Stones can make people docile and knowable*. This was, of course, Jeremy Bentham's original point in writing about the panopticon. Foucault cites the opening lines of Bentham's preface:

> *Morals reformed – health preserved – industry invigorated – instruction diffused – public burthens lightened* – Economy seated, as it were, upon a rock – the Gordian knot of the Poor-Laws not cut, but untied – all by a simple idea in architecture! (Foucault, 1979, p. 207, emphasis in original)

On occasion ANT scholars have noted affinities with Foucault. Michel Callon (1986a, p. 196) introduced the sociology translation as a new sociology of power. In his concluding comments about translation – how power is realized and how the conduct of others is controlled – he directed his readers to a final footnote: 'this point links with the notion of the political economy of power proposed by Michel Foucault' (Callon, 1986a, p. 230). Latour's (1986a, p. 279) discussion of power draws the same conclusion: the result of ANT analysis is 'in effect the same result as that obtained by

Michel Foucault … when he dissolves the notion of a power held by the powerful in favor of micro-powers diffused through the many technologies to discipline and keep in line'. ANT, then, is 'simply an expansion of Foucault's notion to the many techniques employed in machines and the hard sciences'. Law (2003b, p. 388) offers a further point of connection when he notes that processes of translation 'like Foucauldian discourses, ramify through and reproduce themselves in a range of network instances or locations'.

What might be original to ANT? Law (2003b, p. 387) suggests that it is analytically novel because it makes no sharp distinction between subject and object. As demonstrated, *Discipline and Punish* had already taken this position. Law (2003b, p. 389) further suggests that ANT's relational materialism might be the point of difference, by which he means its insistence on viewing both people and things as part of the social scientist's story. But recalling Foucault's writings on heterogeneity, materiality and networks this claim is similarly spurious. Indeed, Law (1994, p. 11) would later write that relational materialism is not unique to ANT, rather it is a sensibility it shares with Foucault and various stars of STS like Donna Haraway, Madeleine Akrich, and Steve Woolgar. In more recent writings ANT is offered as a scaled-down version of Foucault's discussions of discourse and epistemes (Law, 2007, p. 6). The real point of departure is methodological not conceptual. Foucault's books excavate points in the past, ANT is focussed on empirical stories in the present (Law, 2003b, p. 387). For the most part – and this only seems to hold if we ignore his interviews and shorter works – Foucault was in the archive whereas ANT theorists are in the field. Perhaps the methodological differences, such as they are, are less significant than the political reasons that seem to drive them. Foucault's excavations show us that our social arrangements can be different *because they have been different*, while ANT shows us how power is achieved and how worlds are built. Both, in their own ways, offer the possibility of alternatives.

Before STS and ANT came into being Foucault had already made the point that neither agency nor morality are the exclusive preserve of humanity. Similarly, prior to Latour (1991) writing 'Technology is Society Made Durable', Foucault had already shown us the 'the decisive role of *technological procedures* and apparatuses in the organization of a society' (de Certau, 2000, p. 187, emphasis in original). Humans cannot be abstracted from the very technologies that help constitute them. Hence the proliferation of words like apparatus, instrumentations, machineries, mechanisms, techniques, technologies and techno-politics throughout *Discipline and Punish* capture 'the silent agents of his story' (de Certau, 2000, p. 185). 'By showing, in a single case, the heterogeneous and equivocal relations between apparatuses and ideologies', Michel de Certau (2000, p. 189) writes, 'Foucault has constituted a new object of historical study:

that zone in which technological procedures have specific effects of power, obey logical dynamisms which are specific to them, and produce fundamental turnings aside in the juridical and scientific institutions'. Deleuze (1988, p. 196) would doubtless agree: he had already praised Foucault for his excavations of 'the most peaceful regions of knowledge, all the procedures that are based on confession and productive of truth, in order to pinpoint the technology by means of which visibility transforms space into an operator of power. In fact, the visible becomes for him the arena of the new stakes of power and knowledge'. Foucault's notion of apparatus (*dispositif*) assumes central significance here. His fullest definition of the term is to be found in 'The Confession of the Flesh':

> What I'm trying to pick out with this term is, firstly, a thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral and philanthropic propositions–in short, the said as much as the unsaid. Such are the elements of the apparatus. The apparatus itself is the system of relations that can be established between these elements. (Foucault, 1980, p. 194)

Compare, once more, ANT theorists on the nature of the social: 'Agents, texts, devices, architectures are all generated in, form part of, and are essential to, the networks of the social' (Law, 2003b, p. 379).

Criticisms of ANT

Michel Callon, John Law and Arie Rip (1986, p. 3) begin *Mapping the Dynamics of Science and Technology* 'with a statement of the obvious' – science and technology are powerful things which generate interest in various sectors of society, including 'groups of concerned citizens and the general public which may be both excited by and feel powerless in the face of scientific advance'. Yet generally ANT pays no attention to these groups, they are residual categories. ANT only studies those actors wanting to do (or involved in) science and make technology. Susan Leigh Star (1991, p. 40) suggests that 'one of the features of [human and non-human] intermingling may well be that of exclusion (technology as barrier) or violence'. The important questions to be asked are: for whom do networks work, and what about those left outside of them? Here we have resonances with Chapter 5's discussion of relevant and irrelevant social groups.

Latour (1992b) seems content enough to ignore the few that might be discriminated against by any particular technology, such as, for example, those who may find themselves disadvantaged by automatic doors. To take a larger problem that we mentioned in Chapter 4: what of the fate of

the tens of thousands displaced by Robert Moses' public building programmes? Star (1991, p. 42) opposes Latour's stance. She argues that we should consider the marginalized and the oppressed, those that do not get to design technologies, those that cannot access them, and those that, nonetheless, are compelled to feel their effects. Being outside the privileged network does not mean that you will be free of the effects of the technologies. In Star's calculus the public strength of networks may come at the cost of private pain. This squares with Donna Haraway's (1992, pp. 331–2) objection. ANT mostly tells grand tales of men and their machines, while other non-scientist humans and non-human non-machines are left aside. Relatedly, Joan H. Fujimura attacks ANT's agnosticism. She argues that we should pay serious attention to the consequences of network building. Unlike ANT, Fujimura is 'still sociologically interested in understanding why and how some human perspectives win over others in the construction of technologies and truths, why and how some human actors will go along with the will of other actors, and why and how some human actors resist being enrolled' (quoted in Star, 1991, p. 29).

Even when ANT focuses on those who benefit from technological construction they still neglect the question of the wider resources that are central to the maintenance of successful networks. These structural determinants are strangely omitted: see Latour (1987, p. 142) for his wilful refusal to consider class, gender, and the role of big business and the wider machinations of capitalism on the disingenuous grounds that scientists and engineers do not mention them. Jan Harris (2005, p. 175) writes that there is 'an apparent disregard for the socio-economic systems that drive the innovations and lubricate the alliances actor network theory explores: capital is not a term in Latour's vocabulary'. Here ANT finds parallels with ethnomethodology, of which it approves on account of its refusal to bring society ready-made to its studies and its insistence on a fieldwork which follows the actors (Latour, 1986b; 2005, pp. 13, 41). Ethnomethodologists can tell you how two people conduct a conversation but they cannot tell you why they would be in a room together in the first place. Can it really be the case that the peasants of the world are simply poor network builders? Is there really no difference between the heads of multinational corporations and 'the wretched of the Earth'? Or is something being left out? It would seem that ANT is failing to illuminate something here. Rayvon Fouché (2008, p. xxiv) puts it succinctly when he writes that ANT 'is lacking in its ability to handle culturally embedded discrimination like racism'. As he notes, the success of slavery never rested on the free movement of people through obligatory passage points.

Fujimura's (1987) concept of 'doable' science acknowledges the criticisms regarding resource constraint. As such it acts as a brake on ANT's apparent voluntarism. Fujimara studied scientists working on cancer research. The scientists proposed, and ultimately conducted, work on an

antibody for a tumour-causing gene. From this study she concluded that '[a] problem is "doable" when scientists can align tasks to three levels of work organization – experiment, laboratory, and social world' (Fujimura, 1987, p. 257). The experiment refers to a set of tasks situated within the laboratory. The laboratory is the site of experiments and related tasks. The laboratory in turn is situated within the social world. The social world contains the wider scientific community, funders and other players like the general public. The alignment of tasks on all three levels is 'complex and dynamic,' varying 'by local and temporal conditions, by institutional and organizational location, and by discipline or profession' (Fujimura, 1987, p. 282). In this regard it is akin to the mobilization and enrolment of allies in ANT. However Fujimura's framework has the advantage of including society at large in the consolidation of links, rather than the narrow stratum that conducts scientific experiments. ANT has a retort here, in that their texts can only be so long and cover so much. Besides, ANT does not believe in such things as an explanation for all occasions. If an explanation is that portable it is effectively superfluous.

Other objections to ANT have been raised. Humanists are upset that ANT downgrades the importance of human beings and exaggerates the significance of non-humans. Frédéric Vandenberghe (2002, p. 52) defends traditional sociology: shared language and shared understandings of norms and social action bond us. There are essential differences between humans and non-humans. We can walk and talk. We have intentionality and we act. They cannot walk and talk, technologies have no intentionality. They do not act. Steve Fuller also thinks that ANT grants far too much power to technology. Additionally, he believes that ANT reinforces rather than rejects the heroic inventor/engineer. Their stories smack of 'flexible fascism', the triumph of technicians' wills, the ongoing attempts to impose visions of order on others via omnipotent technologies. 'Thus, the necessitarian myths that originally propped up Mussolini, Hitler, and Stalin have now yielded to contingent narratives centred on Pasteur, Edison, and Seymour Cray' (Fuller, 2000, pp. 376–7).

ANT has been mindful of this criticism. Responding to the type of complaint raised by Fujimura, Haraway and Star, Law (2003b, p. 390) accepts that there are differences in kind between the Napoleons of this world and peasants, the powerful and the dispossessed. Law (2003a) still sees the good in networks. They allow for relational analysis. However, he also sees the bad in networks. Three objections are raised:

1 The network metaphor is so prevalent in everyday discourse and social theory that it seems to be *the* way to represent the world (for one example, see Castells, 1996). This poses problems of noise. Most of this network talk is trivial, and not radically relational. Have actor-network theorists unwittingly replicated a hegemonic version of reality?

2 If ANT has reproduced present orderings of the world on their own terms, is it guilty of collusion? Law (2002) cites one of his own empirical studies on the development of a British military technology. This study looked at an aircraft's design, development and ultimate abandonment. The project took him into the offices of top brass, bureaucrats, engineers and politicians. In the course of his interviews Law felt increasingly coopted. Key informants clearly wanted two things: a document that identified the project's failings and a blueprint for future success. With such knowledge the next nuclear tactical strike and reconnaissance aircraft might get off the ground. Law's unease was compounded by the fact that 'they' used the same terms to talk about the project as he did. Was he merely describing a world or helping to legitimate one?

Combining points 1 and 2 creates the third:

3 In uniting the hegemony of the network with the idea that 'we help to perform networks into being' Law (2003a) says that we assume a functionalist version of networks and relationality. In Law's telling this remains rather cryptic. He does not elaborate on this, other than to say we become managerialist.

Conclusion

As with SCOT, ANT has strayed from its origins in STS. ANT has moved from single laboratory studies (Latour, 1988b), single scientific experiments (Callon, 1986a) and single technologies (Callon, 1986b) to areas like accounting (Robson, 1992) and central and local government studies (Tait, 2002) to yet broader meditations on social, ethical and policy analysis (Williams-Jones and Graham, 2003) and on education (Fenwick and Edwards, 2010). Sometimes these shifts are difficult to track. Latour (1998) admits to being a 'moving target', readily going between research sites and topics, academic styles and concepts. For example, Latour (2005) has claimed that intentionality is not the sole property of humans, but with Callon he has said that he does not want to extend intentionality to things (Callon and Latour, 1992, p. 353). Even within the same publication we can get contrasting definitions of key terminology. An actor is not a source of action, it is made to act and, conversely, actors make everything (Latour, 2005, pp. 46, 147). In *Actor-Network Theory and After* Latour (1999a, p. 15) recanted his faith in ANT claiming that there are four things wrong with it: the words actor, network and theory, and the hyphen. The Continental tradition has always allowed for the rhetorical flourish. The more staid Anglo-Saxon tradition is not always able to discern when tongue is firmly in cheek. In a later book Latour (2005, p. 9) returns to the fold,

writing that a term 'so awkward, so confusing, so meaningless … deserves to be kept'. In *Reassembling the Social* (2005) he resolves to defend all of ANT's elements, hyphen included. In an interview Latour (2003, p. 16) brought some clarification to his life's work. He described his enduring project as an analysis of contemporary civilization's truth-generation sites: science, religion, law, technology and techniques. All of this sounds remarkably Foucauldian.

Whatever the validity of these criticisms, ANT does draw our attention to the significance of technology and to the importance of non-human agency. This, in turn, shows us how power is exercised, how social order is built and what the social is composed of. Time and again ANT turns its attention to the ingredients of the social, highlighting the importance of robust material marked by its capacity to 'last longer than the interactions that formed them' (Callon and Latour, 1981, p. 284). Latour (1991) stated it most simply in one of his article titles: 'Technology is Society Made Durable'. From ANT's perspective social theory fails miserably at making sense of what it studies. ANT tells us that we should not think of social ties and moral bonds, but of translations and associations. Society is not a substance, as sociologists are wont to describe it, but a connection. 'By ignoring the practical means through which inertia, durability, asymmetry, extension, domination is produced, and by conflating all those different means with the powerless power of social ties, [sociologists] are the ones who have disguised the causes of social inequalities' (Latour, 2004b, p. 225).

It is possible to observe group organization that is socially and politically complex, minus tools or technology of any type (Latour, 1994b, p. 792). Under such conditions relations are friable; they are in need of constant maintenance and repair. Other group members need to be constantly placated or kept in place. But such observations are not made of humans (Serres, 1995a, p. 200; Latour, 2005). Does this mean that traditional sociology is useless? No. In Latour's opinion, it is perfectly good for baboons (Callon and Latour, 1981; Latour, 1994b).

Further Reading

Michel Callon (1986) provides another important early case study in 'The Sociology of an Actor-Network: The Case of the Electric Vehicle', in M. Callon, J. Law, and A. Rip (eds) *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World* (Basingstoke: Macmillan), pp. 19–34.

More than 50 of John Law's sole-authored and collaborative publications are accessible through The Open University's website, Open Research Online: http://oro.open.ac.uk/view/person/jl6987.html. An older site – The

Actor Network Resource – contains an annotated bibliography: http://www.lancs.ac.uk/fass/centres/css/ant/ant.htm.

The May 1994 issue of *The American Behavioral Scientist*, 37(6) is devoted to non-human agency.

Aramis, or, The Love of Technology (Cambridge, MA: Harvard University Press) is Bruno Latour's (1996) book-length study of the failed attempt to realize an automated commuter system for Paris. The story is told from several perspectives: an engineer and his professor, public officials, company executives, a sociologist and Aramis, the system itself.

John Law and John Hassard's edited collection (1999) *Actor-Network Theory and After* (Oxford: Blackwell) assesses the strengths and weaknesses of ANT, considering its achievements to date and its prospects for the future. The book features all of ANT's main protagonists.

Bruno Latour's (2005) *Reassembling the Social* (Oxford: Oxford University Press) is a more recent book-length introduction to actor-network theory.

Latour's homepage contains links to academic and popular articles, (virtual) books, exhibitions and presentations in English as well as in French: http://www.bruno-latour.fr/

A number of works bring Bruno Latour into critical dialogue with the philosophy of Martin Heidegger. Søren Riis' (2008) 'The Symmetry Between Bruno Latour and Martin Heidegger: The Technique of Turning a Police Officer into a Speed Bump', *Social Studies of Science*, 38(2): 285–301, notes similarities in their thought, while Jeff Kochan's (2010) 'Latour's Heidegger', *Social Studies of Science*, 40(4): 579–98, defends Heidegger from Latour's attacks while also criticizing Latour's concept of mediation. Graham Harman's (2010) book of essays and presentations, *Towards Speculative Realism: Essays and Lectures* (Ropley: Zero), discusses actor-network theory ('Bruno Latour, King of Networks'), Heidegger, and Harman's own 'Object-Oriented Ontology' (OOO) that is informed by both. The blog ANTHEM provides commentary on ANT, OOO and Heidegger and links to useful resources. See http://anthem-group.net/

Débordements (Paris: Presses de l'Ecole des mines) is a 2011 publication in Michel Callon's honour. Half of the book is in French and half is in English. Amongst the English language contributions are works by Andrew Barry, Sheila Jasanoff, John Law, Annemarie Mol, Arie Rip and Nigel Thrift.

7

Left to Our Own Devices: Subjective Machines

Having spent two chapters on STS we now enter new theoretical domains: psychology, cultural, sound and sensory studies. This chapter and the next both emphasize ethnographic studies of engaged technology users. In Chapter 2 we concentrated on technology and the public world of production. Here we are primarily concerned with technology in the private world of consumption. This takes us from questions of domination to ones of empowerment, from the sphere of work to that of leisure, and from the macro level to the micro. The focus on the collective that is class gives way to the solitary individual, just as steam has given way to electricity, and the large industrial machine to the small post-industrial gadget. We focus on three technological devices that have been seen as metaphors for modern life: the personal computer (Turkle, 2005, p. 66), the Sony Walkman (Du Gay et al., 1997, p. 11) and the Apple iPod (Bull, 2007, p. 4).

In Chapter 2 'objective' technology was largely seen as the extension of physical force. Here we concentrate on the identity work performed by 'subjective' technology. We position subjective technologies as extensions of mind and senses. They are not taken to be separate tools but parts of our being. We close with some thoughts on technology and intimacy. Technologies help to create intimate spaces. We think about what this means for shared public places.

Sensing Change

Different times call for different theories. From the 1970s onwards an increasing number of scholars began to argue that an entirely new social formation was taking shape in the Western world. Daniel Bell (1973) was one of the first to signal the underlying economic changes in *The Coming*

of Post-Industrial Society. As the title suggests, the new society was defined by shifts in production practices from traditional manufacturing towards the service sector and knowledge economy. These transformations in modern life were being driven by innovations in information technology. For Jean-François Lyotard (1979, p. 4), the technological transformation of knowledge via the 'hegemony of computers' signalled the emergence of a postmodern condition in which information surpasses territory, natural resources and labour as the prime commodity. Ernest Mandel's *Late Capitalism* (1975) offered another typology: a three-phase history of capitalism comprising market, monopoly and postindustrial. Each phase is typified by a particular type of technology. Steam-driven machine production dominated until the mid-1800s, then from the end of the 1800s electric and combustion motors held sway. Finally, from the mid-twentieth century, electronic and nuclear-driven motors have been paradigmatic. In reference to this, Fredric Jameson (1991, p. 36) calls the current period 'the Third Machine Age' in which computers are the 'technology of our moment'. Paul Virilio (2003b, p. 50) also suggests a changing 'topology' of technology. The big machines of the industrial era are giving way to the smaller machines of the postindustrial 'technosphere'. These include the various devices of the ongoing telecommunications revolution like Walkmans, mobile phones, portable computers and their successors. Jean Baudrillard (1999, p. 77) takes a similar line. For him, the machine is the symbol of industrial society, and the gadget is the symbol of postindustrial society.

In Chapter 2 we saw how Karl Marx considered technology as an extension of human forces. Marshall McLuhan (2005, pp. 48–9) agrees: technologies extend our bodies and physical forces into the world, and since the electronic age they have extended our senses too. Each new invention creates its own environment (McLuhan, 2005, p. 57). New technologies alter the ratio of the senses, our perceptual patterns; they change scales, social forces and conditions. This is their 'message'. In his 1964 work *Understanding Media* – dubbed 'the most important book ever written on communication' when re-released as a Routledge Classic in 2001 – McLuhan made the contentious statement that the medium is the message or, restated, that meaning is found in the means. For McLuhan, media content did not refer to particular texts but, as a rule, to other media. Thus the written word contains speech and telegraphy contains print (McLuhan, 2001, p. 8), just as blogs contain diaries and YouTube contains television. Different media have different effects which McLuhan (2001, p. 24) divided into hot and cool. Hot media extend a particular sense in high definition. Data are plentiful. He uses the photograph as his example of hot media because it is visually rich. With cool media the reverse holds and information levels are low. For McLuhan the cartoon is a good example of this, being low definition with poor visual information. Hot media – radio, film – invite low participation; being information-rich they leave little for the audience

to complete. Cool media – speech, telephone, television – are high participation; audiences must actively fill in the blanks.

In a follow-up work with his son Eric, McLuhan identified a tetrad of scientific laws that apply to any media, although they were extendable to any technology, indeed any human product. They called them media laws. Eric McLuhan (1988, pp. ix–x) said their finding 'constitutes the biggest intellectual discovery not only of our time, but at least of the last couple of centuries'. This statement has gone remarkably unchallenged in the world of social theory. McLuhan and McLuhan (1988, p. 7) suggest that, although we are not used to doing so, we interrogate our technologies by asking: what do they intensify, what do they displace, what do they recapture, and what eventuates when they are pushed to an extreme? That is to say, we should look to what a technology enhances, reverses into, retrieves or obsolesces (McLuhan and McLuhan, 1988, p. 129). Our discussion of the computer, the Walkman and the iPod will be informed by these considerations.

In 'Poetry and the Microphone' George Orwell (first published in 1945) had already picked up on technology's impact upon the senses and sensibilities. Orwell was part of a group charged with broadcasting radio programmes to India. This included a poetry programme in which the poets read his or her own work. From this experiment Orwell began to think about the radio as a vehicle for popularizing poetry. In his opinion poetry was generally the least valued of all of the arts. Orwell claimed that poets do not ordinarily consider their work as something to be read out loud. It is text-based, part of print rather than aural culture, something to be seen and not heard. By reading their poems into a microphone the poet 'has been led to think of this work *as sound* rather than as a pattern on paper' (Orwell, 1961, p. 318, emphasis in original). Orwell discovered that the broadcast affected the poet as well as the audience. The microphone created a new emphasis.

> It is a commonplace that in modern times – the last two hundred years, say – poetry has come to have less and less connection either with music or with the spoken word. It needs print in order to exist at all, and it is no more expected that a poet, as such, will know how to sing or even declaim than it is expected that an architect will know how to plaster a ceiling. (Orwell, 1961, p. 317)

Thanks to the microphone-radio hybrid the poet was brought into a new relationship with their work. New feelings are possible. While radio is a public broadcasting medium it possesses a certain intimacy. Radio feels like an individualizing technology. The poet's reading is broadcast to the solitary person or small domestic grouping, not to a mass. The reader can also presume a certain amount of goodwill. Should listeners not be engaged

they will do something else, most likely adjust the dial. Unlike public performances where the crowd determine the tenor, the power relations are levelled, the audience has nothing over the reader. Negative emotions are also banished. The radio broadcast eliminates nerves (stage-fright) and senses of shame (the embarrassment of reading in public). Poetry matters to the poet. The poet imagines that he or she is communicating through the radio to people who share that belief. The microphone-radio permits a virtuosity that is not possible with the live audience because they too would be part of the performance. Audience receptivity (or lack) would feed back into the poet's performance or, at any rate, the poet would be forced to be mindful of them. On radio he or she can concentrate exclusively on the poem itself. For Orwell this was art for its own sake.

Not all theorists have been in agreement with McLuhan and Orwell on the question of technological devices. Many regard gadgets as reducing, rather than extending and enhancing, human capacities. In *The Sociological Imagination* C. Wright Mills (1971, p. 194) argued that the accumulation of technological gadgetry has diminished the human mind. Cultural life suffers because users do not understand these proliferating technologies and designers understand little besides them. Technological abundance is therefore no measure of quality of life or of social progress. Gadgets exemplify the irrationality of rationality. Renaissance Man is replaced by The Cheerful Robot. Herbert Marcuse (1967, p. 6) agrees. The political economy of advanced capitalism is also a psychological economy; it manufactures the very needs it satisfies. People find themselves in their gadgets, but this is a false subjectivity. Marcuse continues with this line of thought in *Eros and Civilization*. We sell our labour and our free time to possess these things. They consume us and take our attention away from the real issue: that technology has reached the stage at which we could work less and define our own needs and wishes. Gadgets do nothing more than channel our desires and petrify our abilities (Marcuse, 2006, p. 100). Like Mills and Marcuse, Baudrillard (2002, p. 41) suggests that gadgets take a terrible toll on the social fabric. Again, the argument is that we effectively exchange our freedom for them. This denigrates both social existence and sociality. Baudrillard predicts that one consequence of this will be a future public space populated by 'zombies' plugged into various mobile devices. These new urban forms will not relate to their immediate environment nor will they connect with others in close proximity: 'Everyone will be simultaneously elsewhere' (Baudrillard, 2003, p. 24). Richard Sennett (2006, pp. 154, 172) also raises the theme of technological disengagement. In discussing the hyper-potent device that is the iPod he asserts that information overload induces passivity. With a storage capacity of 10 000-plus songs it offers users more than they will ever need, and more than they can ever know. More populist commentaries have it that we are producing smarter machines and dumber people. This chimes with Simmel (1971,

p. 234) who voiced fears that industrial society was producing ever-more elaborate objects while subjective human culture struggled, indeed failed, to keep pace with them.

Do people feel passive when using their technological devices? The gadget critics claim that they do, but this opinion seems to be based on little or no direct experience of the very things that critics oppose, and no attempt to systematically study them. For example, when Paul Virilio (2005) was questioned on his use of new media devices, which he had criticized as an emanation of the Cold War military complex and likened to the new Occupation, he said: 'I prefer to keep my distance and participate laterally'. Very different readings are offered by engaged users. This point is crucial as meanings are 'always *made in usage*' (Du Gay et al., 1997, p. 85, emphasis in original). Like McLuhan, users are inclined to see these technologies as prostheses, as extensions of the self. Let us now examine some case studies of technologies in use.

The Second Self: Personal Computers

Sherry Turkle's *Second Self* studies the spread of personal computing from university laboratories to early adopters in schools and homes in the early 1980s. It offers fascinating insights into how a new household technology gets domesticated. At that time computers were relatively open machines, with users expected to program them. In Turkle's case the openness was literal. Her Apple II was stripped of its casing, a new CP/M operating system had been installed, and its printed circuits were on show to the world. Many early enthusiasts went even further, assembling their own machines from kit sets. Consumers were also constructors. Twenty years on from her original study Turkle mourns the passing of the computer's transparency. Today a new political aesthetic reigns. Users are expected to play not program, theirs is a world of simulation rather than algorithms. In all likelihood they will occupy ready-built environments rather than construct their own. This takes away some of the intimacy early enthusiasts had with the exposed machine. Users are now directed away from the deep structures of computing languages and architectures. Instead they are 'learning to take the machine at (inter)face value' (Turkle, 2005, p. 9).

The Second Self was the result of thousands of hours of interviews and observations with hundreds of adults and children. Bernward Joerges (1990, p. 211) described it as 'hitherto the most ambitious empirical (ethnographic) study of the cultural implications of computer technology'. At the time of writing Google listed over 1500 citations of the book's twentieth anniversary edition. Against those who argued that gadgets lead to a 'petrification' (Marcuse) of the mind thus creating passive (Sennett) human robots (Mills) and zombies (Baudrillard), Turkle (2005, pp. 20,

50, 90) finds computer users engaged in intense, interactive and enhancing relationships with their machines. These findings do not sit comfortably with a technological effects model, in which technology dictates human action, and they qualify earlier ideas of technological domination. Instead the focus is on what people do with their technology (Turkle, 2005, p. 93). Rather than offering a one-dimensional explanation, Turkle (2005, p. 170) finds people's relationships with their computers to be 'overdetermined'.

Where Marx was inclined to see technology as an extension of (human) forces, and McLuhan as an extension of senses, Turkle sees the computer as an extension of the mind. *The Second Self* owes its title to a sixth-grade student called Deborah who told Turkle: 'When you program a computer, there is a little piece of your mind and now it's a little piece of the computer's mind' (Turkle, 2005, p. 1). Part II of the book is devoted to 'the mechanization of the mind' and an appendix offers a methodological discussion on a sociology of sciences of mind. Turkle (2005, p. 279) takes this approach because she regards the computer as a wholly new type of technology, 'the first psychological machine'.

Part of the computer's 'holding power' appears to be its role as an enabling device. Respondents repeatedly told Turkle that computer programming, use and game play gave them a degree of control that was lacking in other areas of their life. In *Space Invaders* Jimmy could attain a level of perfection that eluded his physical self. His 14-year-old body defied him. Neither speaking nor walking was effortless, but high scores came with ease. Sixth-grader Tanya had both a crippling perfectionism and a chronic shyness. Writing was difficult, as was relating to others. Word processing freed her. Mistakes could be erased without trace, and letters and poems passed on to communicate to those she could not personally face. Thirty-something lawyer David played arcade games to relax after a stressful day at work. After dealing with the problems of others all day he found these sessions cleansing, going home a better person. Endless hackers told Turkle that, while personal intimacy and 'physical things' were problematic, they could attain virtuoso status in programming. This gave them enormous pleasure and satisfaction, and it brought them great respect (Turkle, 2005, pp. 84–5, 86, 118–19, 201).

Seen thus, the 'subjective' computer is less a tool for some, and more a constitutive element of psycho-social existence. Attention is thus focussed on the ways in which computers, as machines that appear to think, help us to think of ourselves and others. Given the role of computers in child development and their contributions to cognitive and emotional growth they make perfect objects for theorizing. In doing so Turkle positions computers as marginal objects which transgress the physical/psychological, and animate/inanimate divides. They are 'evocative objects' of self-reflection, simultaneously part of us (mind) and part of the world (matter). These things of intimacy are companions to emotional life and stimuli for

thought, reflection and personal development. Younger users especially see computers, electronic toys and gadgets as imbued with forms of life, possessed of their own mind, morality and motive power. Elementary-school children frequently told Turkle (2005, p. 52) that computers were 'sort of' alive.

It is all too easy to write this off as naïve anthropomorphism. Latour suggests that this is the typical sociological response. Anthropomorphism 'for them is akin to zoophily but much worse' (Latour, 1992b). Latour contests this for the simple reason that technologies are always thoroughly anthropomorphic: they are made and used by humans, they do the work that humans would otherwise do, and they in turn shape what it means to be human. (These issues are revisited in the following chapter.) For these reasons Latour would be in full agreement with Turkle: it is entirely appropriate to speak of emotions and relations when discussing machines. She is not alone. Trevor Pinch and Frank Trocco's study of early electronic synthesisers has a chapter entitled 'In Love with a Machine' to capture the intense feelings users have for their devices (2002, pp. 155–70). Turning to sociologists, Latour (1992b) proclaims: 'You discriminate between the human and the inhuman. I do not hold this bias but see only actors – some human, some nonhuman, some skilled, some unskilled – that exchange their properties'. (For an expanded discussion of Bruno Latour refer back to Chapter 6.) Turkle's empirical findings seem to contradict the claims of earlier theorists of gadgets: we humanize them, they do not mechanize us. But this statement requires qualification. First, the 'human' in her studies is distributed. Second, Turkle was largely interested in personal uses of the home computer. It is doubtful that her findings would apply so strongly to data entry operators.

Pursuing the point about anthropomorphism Turkle asked children if machines can do what humans do. Can they cheat? Children of different ages and developmental stages gave very different answers. From her observations Turkle (2005, p. 53) identified three discrete stages with their own attendant forms of reasoning. Young children fall back on physical explanations. Do machines have the necessary anatomical parts to cheat? The general belief was that, in order to cheat, machines must have equipment like us (brains, eyes, hands). Slightly older children eschew physical equivalence and action as explanations. Turkle calls this second stage 'behaviourist'. Machines may have *different* ways of cheating. Our cheating is visible. Perhaps machines cheat on the inside. The third stage of reasoning is entirely psychological. It ignores body parts and the ability to act, focussing instead upon the issue of purpose. Here there was widespread assent to the notion of intent. In order to cheat you had to know that you were cheating.

These findings mesh with Turkle's (2005, pp. 23–4) broader study of how children make sense of their relations with these machines. The youngest children are at a metaphysical stage. Preoccupied with physical thinking,

the prime question appears to be: are machines alive? The mastery stage comes at around age 7 or 8. Here the question is: can the machine be controlled? During adolescence mastery is displaced by the question of identity and how machines might contribute to the production of the self. The question now becomes: what do machines say about me?

Interestingly, even when age and developmental stage are equivalent Turkle (2005, p. 99) was able to identify a range of programming approaches and styles. Through an intensive study of a school computer scheme that utilized the programming language Logo, Turkle discovered two dominant approaches (although she noticed hybrid styles too). She called these contrasting styles 'hard' and 'soft mastery'. They are introduced through the figures of Jeff and Kevin. Jeff revels in his mastery. He has had a lifetime of playing with machines. He oozes expertise, leading a subculture of programmers who depart from the official school-sanctioned program. For Jeff, the plan precedes the program. The overall program is conceptualized and then broken down into manageable portions. He seeks to control the computer by imposing his will upon it. He likes to control all facets of his existence. Precision takes precedence. He is hard on himself, unforgiving of his errors. In contrast, Kevin has had no previous history with machines. He is happy to fly under the radar. Kevin emphasizes interaction rather than premeditation, conversation as opposed to dictation. The program is emergent. Errors are part of the process. Sometimes they even lead to new discoveries. Kevin's programming style is more intuitive, and it is informed by things other than technical mastery. He talks about feelings and emotions, things Jeff has no time for. It is important to Kevin that his program has aesthetic appeal. As a hard master Jeff fits the stereotype of the scientist or technician. As a soft master Kevin is more obviously arty. Significantly, both approaches were equally successful. By the week's end Jeff and Kevin had both programmed a working space shuttle.

More often than not these styles of mastery mapped onto gender. Unsurprisingly, soft masters tend to be female, hard masters mostly male (Turkle 2005, p. 105). Turkle (2005, pp. 105, 114) explains this by way of traditional gender socializing, but she voices high hopes for women in computing as the computer 'provides an entry to formal systems that is more accessible to women. It can be negotiated with, it can be responded to, it can be psychologized'. Despite the long history of women in computing (Plant, 1997, p. 37), the dream has not been realized. Frances Allan personifies this struggle. She was the first woman in 40 years to win the prestigious A.M. Turing Award after a glittering 30-plus-year career at IBM. During her time there she received two company awards: a research prize in the form of cufflinks and tie clip, and a certificate honouring 'his' accomplishments (Pham, 2007).

Feminist theorist of technology Judy Wajcman (1991, p. 164) argues that all too frequently women must sacrifice their femininity if they are to

work with high technology. Technology is culturally-coded as men's business. Hard mastery, which is to say stereotypically male object relations, dominates. Wajcman (1991, p. 155) accepts Turkle's premise that computers had the potential to reconfigure gender relations, but what has eventuated conforms to the norm. Computers 'slotted into a pre-existing male subculture and took on its masculine face'. In the world of computing men accrue symbolic and material rewards. Women are heavily underrepresented in the IT industry (Bartol and Aspray, 2006; Zarrett et al., 2006), and they are concentrated in 'softer' service areas like administration, communication, customer relations and marketing. Men monopolize the technical hard core of programming (Whitehouse and Diamond, 2006).

The Meanings of the Walkman: The Biography of a Cultural Artifact

Whereas Turkle wanted to position the personal computer as a psychological machine and understand use in terms of personal development and emotional life, Paul Du Gay et al. (1997) want us to think of the Walkman as a popular culture machine, as one of the premier artifacts of popular culture. As such they use it to pronounce on collective life. Historically, the explanatory power of economics and politics has been privileged in the social sciences (see Marx in Chapter 2). As leading scholars of cultural studies, Du Gay et al. (1997) want to acknowledge the analytical purchase of culture for understanding social action. To be meaningful something must be cultural. Shared meanings enable communication, they provide the framework to interpret social actions; in short they help to make society possible. Given culture's constitutive role, its centrality to knowing and doing, it should not be relegated to a reflection of economic or political processes. Meaning provides the bridge between the material world (in this case the object world of wiring, plastics and metal) and the symbolic world of language, thought and communication. It also bridges the real world of possession and consumption and the imaginary world of fantasy and desire. It soon emerged that the Walkman had a significant symbolic role. '[S]leek, high-tech, functional in design, miniaturized – [it] has become a sort of metaphor which stands for … a distinctively late-modern, technological culture or way of life' (Du Gay et al., 1997, p. 11).

Du Gay et al.'s study proceeds on the understanding that the Walkman is not just a part of our culture but actually has its own culture (Du Gay et al., 1997, p. 10). This culture does not grow out of the gadget itself; rather it comes into being through a circuit of five connected processes – representation, identity, production, consumption and regulation. To understand a technical object, in this case the Walkman, we need to understand each part of the circuit of culture and the complex interplay between them. Form,

function, use and meaning are mutually imbricated. As they write, 'text and technology, hardware and software, production and use are dependent upon each other and are interrelated' (Du Gay et al., 1997, p. 80). To capture these interrelations their study provides an analysis that is at once personal, cultural and institutional. Alliteratively, we might say that the project centres on creation, comprehension and conduct. They therefore resist reading the story of the Walkman as the narrative of one individual or, in the final analysis, even one company.

Since meaning comes about by association Du Gay et al. cast their networks much farther. They direct us towards semantic networks and discursive formations, the various discourses which speak of and to the Walkman: entertainment, fashion, 'Japaneseness', modernity and youth. This is an encouragement to look at modes of representation and communication through language and other symbol systems. Their source material includes company documents, the autobiographies of Sony executives, advertisements, journalism, and academic articles. We are also encouraged to work through signifying practices, those behaviours which structure meanings (Du Gay et al., 1997, pp. 15, 18). Meanings are not only coded in oral, print and visual culture, but also in cultures of use. At the individual level the Walkman has what Baudrillard would call 'identity value' (Du Gay et al., 1997, p. 91). It speaks to particular social practices (like listening on the commute to work or while jogging) undertaken by particular people (youth, music fans) in particular places (the train, the park).

Several lessons can be drawn from Du Gay et al.'s (1997) *Doing Cultural Studies*. First, technology is a collective achievement. The Walkman has no single author; their study locates no lone genius inventor. Some commentaries have identified Akio Morita, one of Sony's founders, as the inventor. Others attribute it to Kozo Ohsone. Yet Ohsone said that it was a collaborative process within the company, while Du Gay et al. (1997) push the boundary even further to include various publics who gave feedback on the early prototypes. Du Gay et al. (1997, p. 49) are inclined to give much of the credit to Sony's organizational culture. Its organizational ethos departed from Japanese contemporaries in significant ways, its particular culture of production being a hybrid of Japanese and American business styles. While other companies frowned upon the 'Sony way', Sony was happy to head-hunt talent from rivals. They were also more flexible than the typical Japanese corporation, and their hiring practices were more open. Eccentrics and people willing to think outside the square were welcome. Unusually for a manufacturer, designers were accorded greater status than engineers. They were given direct access to senior management, and this path was also laid out as a possible career trajectory. Many managers had begun corporate life as designers. The Sony Design Centre kept in touch with the prevailing trends of target consumers, and designers were able to initiate and lead projects.

Shu Uyema, a company insider, suggests that the Walkman was a 'fortuitous accident' that arose from divisional politics (Du Gay et al., 1997, p. 131). In October 1978 the audio division was informed that production of radio-cassette recorders was being shifted to the radio division. This left the audio division underemployed and vulnerable, and it caused the drive to create a new device. It was agreed that a portable personal stereo was needed. As work progressed the project drew on the efforts of the engineering team and Sony's research laboratory who, at the suggestion of Sony co-founder Masaru Ibaka, worked on the development of lightweight components. The prototype was then project managed by Morita and a team of 10 drawn from several Sony divisions: production, planning, advertising, sales and exports. All parts were produced in-house to reduce costs. Once the form of the technology was agreed upon, its mass manufacture involved legions of female assembly line workers. Even so, at this stage it was only a 'potential' personal stereo, '[f]or it to be fully realized, for it to have any social meaning, production has to be connected to consumption' (Du Gay et al., 1997, p. 52). Consumer feedback was sought. There followed concerted public relations and publicity efforts. Leading musicians and media people were coopted. Focus groups were formed, and when the Walkman hit the shop shelves, retailer feedback proved valuable too. Who was buying it? How were they using it? The 'final' product that is the Walkman seemed to be the result of notable individuals, designers, engineers, factory workers, marketers, opinion leaders, and consumers. Against corporate expectation, the Walkman proved to be an attractive accompaniment to a range of physical activities. As a result Sony began producing numerous models to appeal to these various lifestyles (Du Gay et al., 1997, p. 66).

Du Gay et al.'s (1997, p. 58) second lesson concerns the finality of technology, suggesting that technology is better interpreted as a process. The Walkman, for example, underwent constant upgrades informed by customer use. In 1997 there were 700 models in existence (p. 67). Sony predicted Walkman uptake amongst the young, the urban and the cool, yet from the outset there was a significantly broader range of consumers than they had ever imagined. Different people were using them, and in ways that differed from what had been anticipated. Sony believed that people would not want to listen alone. This would break social conventions of politeness. Accordingly, they installed two headphone jacks in the original model and a mute button which would stop the music should anyone speak to the user. The planned sharing did not eventuate. People happily listened alone. The Mark II model eliminated the second headphone socket. Later on (1993) they were surprised to learn that British users liked large headphones. Sony thought that everyone preferred the less visible ear plugs (Bull, 2000, p. 6). These two lessons suggest two amendments to SCOT: relevant social groups might be more numerous than is commonly

supposed, and technological closure might never come. Stability may only ever be a temporary state.

Finally, Du Gay et al.'s (1997, pp. 3–4) circuit of culture provides us with a useful framework for understanding technological success. How a technology is represented, the identities which attach to it, the conditions of its production, the nature of its use and the various practices impacting upon distribution and consumption transform a material thing into a meaningful cultural artifact. In the process it usefully counters older culture industry arguments (introduced in Chapter 2) which insist that culture is produced for us by corporate concerns. Without doubt Sony is a significant player in the culture industry, a position consolidated by the synergies between hardware and software (including music and film rights). But it is not omnipotent. The Walkman found listening publics that Sony's designers never envisaged and listening practices that they never thought possible. Culture, it would seem, is also made by us.

The Walkman was a revolutionary technology. Gramophone and radio had uncoupled music from time and space. Prior to their invention, if you wanted to hear music you had to attend a live performance or play an instrument yourself (Spice, cited in Du Gay et al., 1997, p. 20). The Walkman extended these possibilities, making music portable and more accessible. For Michael Bull (2000, p. 1) it was 'the first truly mobile consumer technology', and for Rey Chow (quoted in Du Gay et al., 1997, p. 139) it 'ushers in the history of miniaturized music'. It also assisted in the privatization of what was once a public experience. The Walkman, with its capability of producing a form of privacy in public – as the iPod and mobile phone would later also do – resonated with sociological themes regarding the metropolitan experience: the isolated individual adrift in the crowd (recall the discussion of the flâneur in Chapter 3), increasing autonomy, choice, media engagement as a foil for boredom, and mobility.

If the computer extended the human mind, the Walkman gave it its own soundscape (Du Gay et al., 1997, p. 20). Turkle's second self gets to occupy a second world. Thus the Walkman marks a very significant reprogramming of sensory life, offsetting a general feature of city life: the primacy of vision. Small town life offers exchanges and interactions. We mingle with those we know. This does not hold in the city, where in the company of anonymous others we only see. Sights and signs predominate in city settings. This, at least, is Simmel's (1969, p. 358) argument, with the further opinion that 'the mutual gaze represents the most perfect reciprocity in the entire field of human relationships'. The eyes are the window to the soul. They reveal something of the gazer as well as the person who is gazed upon (Simmel, 1969, p. 358). Simmel suggested that self-assertion, self-denial, social proximity and social distance would all be changed in unknown ways were the gaze to be avoided. For it is only in the mutual gaze that people

are truly present to each other. Simmel (1969, p. 357) was also well aware that our object relations have affective aspects, that we have emotional and aesthetic responses to them. The Walkman also confirms McLuhan's observation: the ratio of sense perceptions is indeed changed. The reciprocity of the mutual glance is replaced by what Bull (2000, p. 191) calls the non-reciprocal 'non-reflective' gaze of 'auditory looking'. Two Walkman users told Bull (2000, pp. 73, 74) how their device helps them manage the gaze, how they can be socially absent while being physically present:

> When you start commuting it's very unsettling not to know where to put your eyes. The Walkman makes you one step removed from the situation. Also the music is quite comforting, or is something familiar superimposed on everything else… It's a way of passively acknowledging that they're not going to talk to anyone, and that what's around them is not relevant to them. It blocks out and it certainly alters reality. You're not fully there… It emphasises the step of removal from where you are. (Chris, interview #11)

> It's easier to have eye contact with people, because you can look but you're listening to something else. You don't feel you're intruding on people, because you're in your own little world. (Stephanie, interview #42)

Thanks to the device, interior life is privileged over external connection. Many respondents even said that they felt invisible while wearing their personal stereo (Bull, 2000, p. 71). The role of sight diminishes as the auditory capacity increases. Simmel regarded hearing as the most democratic of senses, always a supra-individual phenomenon. We had no control over what we heard; no ability to discriminate. Everyone heard the same thing at the same time. The Walkman ended this. Now hearing can be entirely individualized. The iPod continues this trend. As Bull (2007, p. 12) writes, auditory culture is no longer passive and democratic. Other technological artifacts achieve the same effect. Turkle (2006, p. 4) discusses the mobile phone's ability to create social invisibility. People speak freely in public places on the 'presumption that those around them treat them not only as anonymous, but as close to disembodied'.

Du Gay et al. (1997, p. 108) criticize Iain Chambers' piece 'A Miniature History of the Walkman' for making assertions unsupported by empirical evidence of use. Arguably they are open to the same accusation. The voices of Walkman users are a notable absence in their book. The engaged user is a residual category. Instead, they offer secondary research on existing literatures. They offer no empirical dimension of their own. In contrast, Shing-Ling S. Chen (1998) illuminates the experiences of these hidden users. She studied the journals of 40 college students who had been asked to record their Walkman experiences across a two-week period. Chen identified a number of common themes: the personal stereo's ability to privatize

and intensify experience, to gratify emotional needs, to construct experiences and to assert control over them. In short it seemed like a device for self-absorption. Pat wrote, '[a]s I sit here listening to my Walkman, I really don't notice things going on around me. I am in my own world' (Chen, 1998, p. 262). One of Blaine's journal entries read: 'With the Walkman headphone on I am alone. I control the entire situation and can't be bothered' (Chen, 1998, p. 269).

A more ambitious study was attempted by Michael Bull (2000). He conducted qualitative research in the form of in-depth interviews of individuals and groups across a two-year period in London (1994–96). Bull interviewed over 60 personal stereo users representing a range of ages, ethnicities, genders and incomes. Diaries were also drawn upon. In addition, Bull also met Sony executives and representatives of their advertising agency. Bull's (2000, p. 2) study was motivated by the fact that 'there is no contemporary account of the auditory nature of everyday experience in the daily lives of people'. *Sounding Out the City* corrects this. His analysis of technologized experience focusses on the many meanings of privatized listening.

Bull (2000, p. 147) reflects on the ability of personalized soundscapes to create asymmetries in sight, social engagement and place. The wearer can effectively occupy the same space on different perceptual terms from those around them. Personal stereos affect how we look at (and to) others, how we interact with them and what we think of our environment. The Walkman enables different ways of hearing, looking and being. Stressing an 'auditory epistemology' Bull's (2000, pp. 116–33) empirical study allows him to construct an 11-point typology of personal stereo use:

1 *Environmental control:* Walkman users control what they hear and when they hear it. They make a world.
2 *Social control, I:* the Walkman serves as a boundary marker between self and other. Use can act as a 'do not disturb' sign.
3 *Social control, II:* women respondents in particular noted that they frequently receive unwanted (verbal) attention in public. Walkmans screened this out. Listeners were left to their own devices. This in turn increased the wearer's contentment and confidence.
4 *Inner control:* Walkmans are often used to block out negative thoughts and feelings. They are used to create the correct 'head space'.
5 *Hedonism:* Walkmans assist in the pursuit of pleasure, principally the indulgence of 'me time'.
6 *Aestheticism:* users match music to moods and landscapes to create 'filmic' experiences. The Walkman meshes sights, sounds and imagination.
7 *Narratives:* personal stereos fill life's gaps. Particular music also links to nostalgia and personal memories.

8 *Companionship:* the Walkman counters loneliness and isolation. Users never feel alone when they have one with them.
9 *Routine enhancer:* many of us live mundane lives of routine; the same commutes to the same job week in week out. Personal stereos help the time pass, and they make the quotidian more bearable.
10 *Purpose:* personal stereos often give people more drive, energy and direction. People use them as motivators and they sometimes (as with exercise) synchronize their bodily activities with them.
11 *Sharing:* the Walkman is not only an isolating device. Users will share music with significant others to create an intimate world of two.

Bull's findings suggest that we see personal stereos as technologies of empowerment as well as isolation, enhancing our bodies and our perceptual abilities. They permit us to be something else, something more. Other theorists discussed in this chapter agree, although they are split on the notion of technology as prostheses: does it extend outwards from the human body or into it? Turkle (2005) calls the personal computer 'the Second Self', Chen (1998, p. 257) used the title 'Walkman as Extension of Self' within her study, while Karin told Bull (2000, p. 115) that her personal stereo is 'part of my body'. Hosokawa (1984, p. 176) thinks of the Walkman as a prosthetic intrusion *into* the body rather than an elongation of the body. Roland Barthes says that with a Walkman music seems to emanate from within the human body (cited in Chen, 1998, p. 258). All of these devices allow for identity work, contributing to the production of the self by becoming part of one's style, self-image and social actions (Du Gay et al., 1997, pp. 23, 140).

Connecting to Your Self: The Private World of the iPod

The personal computer was the first psychological machine. The Walkman was the first to privatize and mobilize listening. The iPod and other MP3 players continue the 'Walkman effect'. 'For the first time in history the majority of citizens in Western culture possess the technology to create their own private mobile auditory world wherever they go' (Bull, 2007, p. 4). Bull (2007, p. 4) noted that, at the time of writing, half of all Australians owned an MP3 player, while Chinese and Korean ownership levels were at the 70 per cent mark. The popularity of the iPod has made it 'the first cultural icon of the twenty-first century, representing a sublime marriage between mobility, aesthetics and functionality of sound and touch – enabling users to possess their auditory world in the palm of their hand' (Bull, 2007, p. 1).

The iPod represents a significant upgrade of the Walkman. The Walkman has no collective use. The iPod can at least be shared. Respondents

like Frank told Bull (2007, p. 119) that their device functioned as the workplace sound system. The iPod's storage capacity massively increases choice. Planning ceases to be an issue. Walkman users would often prefer the sound of silence to the wrong song. To get it right Walkman users had to devote a lot of conscious thought to tape selection. Said Catriona, 'I spend quite a while thinking what tape to take with me and it really gets me annoyed because if I'm in a rush I think: "Take anything. You like them all! They're all your tapes!" I can't. It has to be something I really want to listen to. I wouldn't like to take something that would change my mood. I just take something that would fit my mood' (quoted in Bull, 2000, p. 18). In contrast Susan tells Bull (2007, p. 127): 'I can now carry all my CDs with me and listen to whatever I want whenever I want. I don't even have to think about it any more – what should I bring, how do I feel today, I wish I had that one … There's no need to plan any more, because I'm bringing all my music with me all the time'. Because of this capacity, and because it connects to home stereo, car audio, docking stations, home and work computer, it effectively plugs into every aspect of the user's day. For this reason the 'in-between' narrative of the Walkman is replaced by the 'ever-present' iPod narrative (Bull, 2007, p. 128). iPod users are able to attain what was only ever a dream for those with Walkmans: continuous control. 'A central tenet of iPod culture is the micromanagement of mood, sound, and time' (Bull, 2007, p. 148).

Michael Bull (2007, p. 161) set out to map the experiences of iPod users by way of a 34-question survey posted in various print and online media, including the *New York Times*, the *Guardian* and *Mac World*. Over 1000 people, concentrated in Anglo-American countries, responded. They tended to be reasonably wealthy, employed in media and advertising, their median age was 34, and their gender balance was roughly equal. Bull asked participants about their use of other communication technologies, their iPod use across a week, and what they listened to. Follow-up questions were asked of 205 of the total respondents. A smaller UK sample was also interviewed.

Bull's typology of personal stereo use listed above also applies to iPods. The following respondent – Joey – notes how it gives environmental control, and social control in both of the senses outlined in the section above:

> I see them [people] as an obstacle. I have to deal with crowded streets and subways all the time, and the iPod helps me cope with this … I listen to my iPod while running errands around the city. You have men making comments at you like "Yo, Baby" and then you have people trying to hand you religious flyers, or tourists trying to get directions, and all I want to do is grocery-shop and go to the bank. If I have my headphones on I am invisible and I do not have to get intimidated by jerky men or disrupted by lost tourists. (Bull, 2007, p. 31)

The social invisibility of the iPod user is also familiar to us. As a foil for sexism we can say that the technology is socially progressive, but this hinges on the question of use. The same device can be seen to reinforce racism and xenophobia when employed as a social filter against particular ethnic groups. Tracy told Bull (2007, p. 31):

> In America people are often loud and rude, and it's sometimes hard to concentrate effectively. In Phoenix we have a lot of Mexican immigrants. They don't learn English and they have no control over their children. I believe in mutual respect when in public places. It was becoming increasingly difficult for me to shop without encountering a bombardment of Spanish or screaming kids. The iPod lets me filter them all out. I'm much calmer now when I shop. The iPod lets me overlook the lack of courtesy. Using the iPod helps control my concentration. Since I'm familiar with the music, I can let it float to the back of my consciousness.

Some users reported that they could be rude without appearing rude: 'The iPod makes me feel like I can edit what I'm doing. If I want to talk to someone I can take the headphones off and talk, but if I don't want to talk I can keep on walking. The person will just think I didn't hear them because I'm distracted by my music instead of ignoring them on purpose' (Amanda, quoted in Bull, 2007, p. 58). Others privatized their listening for precisely the opposite reason: 'It's … more polite to wear my iPod while doing yard work instead of blasting my home stereo' (Ben, quoted in Bull, 2007, p. 64).

At any one time something like one in seven city dwellers will be using a mobile device (Katz, cited in Bull, 2007, p. 84). This has profound implications for the metropolitan experience. Bull (2007, p. 52) is also sensitive to the ways in which the iPod specifically contributes to the 'architecture of isolation'. Said one user, the iPod 'removes an external layer. I see people and things as inanimate or not fully connected. It seems that I have an external connection they lack. It's quite odd, actually … When I look at the people around me they appear to be two-dimensional and without significance' (Jonathan, quoted in Bull, 2007, p. 53). One reason why others are insignificant is that we are able to do what we need to with machines. Technologies replace people: we can use ATMs, websites and phones to do our banking. With a credit card we get practically anything we want online. 'It also happens, more and more frequently, that a so-called person represents a thing as far as a second thing is concerned. For example, as far as an ATM machine is concerned, a consumer is nothing more than a credit card; as far as a decoder is concerned, a TV viewer means a remote control, and so on' (Droit, 2005, p. 124). The iPod therefore joins a long line of other technologies – the car, the Walkman, the mobile phone, the laptop, the pda – to have mediatized public space (Bull, 2007, p. 54). Some

of the unintended consequences of iPod technology are minor social irritations: the part it plays in making young people deaf, its contribution to the dent in corporate music industry profits through illegal downloading, sound pollution through ear pod leakage and tuneless sing-a-longs (Dixon, 2010, p. 17). Of more concern are the threatened large-scale social transformations.

Sonic gating strategies contribute to 'urban chill'; distance, exclusivity and disconnection. Warmth, in contrast, speaks to closeness, inclusivity and connection. Bull notes an inverse relation between the two (although he calls it dialectical): the warmer our personal space the chillier our urban space. With mobile technologies we connect to others not in our presence. We ignore those that are. With a cell phone there is at least someone else. With an iPod you are connecting to yourself (Bull, 2007, p. 85). As one person put it: 'When I plug in and turn on, my iPod does a "ctrl + alt + delete" on my surroundings and allows me to "be" somewhere else' (quoted in Bull, 2007, p. 9).

From Our Space to My Space: The Privatization of Public Life

In Chapter 1 we introduced Wolfgang Schivelbusch's work in relation to technology and mediation, the ability of technology to change our sense perception. This discussion concerned railways and the rise of the panoramic sensibility. The new mobility of vision is paralleled in the Walkman and the iPod which provided for the new mobility of sound. The speeding train broke up the world outside. The view through the window was not the only alteration to sensory life. As Georg Simmel (quoted in Schivelbusch, 1986, p. 75) noted:

> Before the development of buses, trains and streetcars in the nineteenth century, people were quite unable to look at each other for minutes or hours at a time, or to be forced to do so, without talking to each other. Modern traffic increasingly reduces the majority of sensory relations between human beings to mere sight, and this must create entirely new premises for their general sociological feelings.

Inside train compartments travellers took to reading. This eased social discomfort. It also allowed commuters to occupy a coherent imaginary world. Read as technologies of disengagement, both Walkman and iPod find an historical precursor in the activity of reading aboard trains, which soon became the norm for travellers. This practice occurred to the detriment of communication with fellow passengers. Conversation and sociality

declined. Schivelbusch (1986, p. 67) called it a 'dissolution, dispersal, and trivialization of perception and communication'.

The new practice of public reading began at the very outset of rail travel. Stalls, bookshops and complex lending systems sprang up in railway stations to service customer demand. More accurately, this became the practice amongst a certain social strata of traveler. Reading on the train was a solid middle-class activity. The working classes had neither the means nor the desire to do so. Again we find parallels with Walkmans and iPods. Du Gay et al. (1997, p. 99) noted that British statistics show significant differences in the Walkman's consumption according to social class, generation, gender and geography. The typical user was a young middle-class male in the South East of England. Similarly Bull (2007, p. 161) showed that iPod users were most likely to be middle-class urban professionals. Yet another parallel is the existence of quasi-medical discourses enquiring into the safety of the technologically mediated practice (Schivelbusch, 1986, p. 68). Is iPod use really good for our health (Dixon, 2010; Wilson, 2009)? A final connection concerns the nature of modern urban life: we are overwhelmed by stimuli. Books, computers, Walkmans and iPods help to filter the world and make it more manageable.

Awareness of such screening practices has spawned a new wave of gadget critics. They accept that we relate to things, but they argue that we do so to the detriment of relating to each other. Technology substitutes for human company. In consequence, public life is diminished. The problem is posed as both the decline of community and the rise of unfettered individualism. Technology is creating a new sociality of connectivity. It is blamed for the loosening of social bonds and their replacement by the more fragile networks of association (Bauman, 2003), marked by their disposable 'until-further-notice character' (Bauman, 2002, p. 153). Termination of a social relation, in the extreme, is but a mouse click away.

The idea that technology allows us to be apart together is not new. Back in the 1940s Horkheimer and Adorno (2002) addressed this issue in relation to new office construction. The open plan workplace put employees under scrutiny from managers and customers (see also Foucault, Chapter 3). As they put it, one must always behave as if one was being watched: 'Progress keeps people literally apart … [they] are isolated in their collective'(Horkheimer and Adorno, 2002, p. 183). Horkheimer and Adorno also pointed out the atomizing development of motor vehicles and the mass media. The railway provided for the possibility of new acquaintances. Now we travel in cars with intimates. There is no opportunity to meet someone new. The radio speaks to us. We do not speak to others.

Similarly, Guy Debord (1994) recognizes car and radio as technologies of isolation. Jean-François Lyotard (1979, p. xxiv) asserts in the preface to his discussion of the computerization of society that we all live in 'clouds of sociality'. With advances in information technology we no longer have

to leave the house in order to be social. We can participate in civic life from the comfort of our own home. Henry Giroux (2007, p. 36) argues that a hollowed out 'ghost sociability' prevails. Other theorists agree. Peter Sloterdijk (2008, p. 47) claims that these days 'each man is an island' and Nigel Thrift (2005, p. 131) talks about 'the tendency to mass individualisation'. All of the gadgets under discussion here enable such things. Shuhei Hosokawa (1984, p. 170), for example, writes: 'The Walkman obviously corresponds to a "singular" position of the self. It is not necessary to inquire into the causal relation between the birth of this consciousness and that of the Walkman. What we must confirm here is the positional correspondence between them'. Similarly, Michael Bull (2007), while charting the many meanings of the iPod, concedes that one of its messages is the 'denial of shared space'. 'The one and the many' is recast as 'the i and the Wii'. Users occupy another sonic territory (Bull, 2007, p. 21). Once more, we find ourselves in 'non-space' (Augé, 2008).

In terms of McLuhan and McLuhan's media laws we could say that personal electronic gadgets intensify individual experience, displace interpersonal contact, recapture levels of autonomy and control and, pushed to their limits, they obsolesce public life. Yet the very technology that allows for the privatization of public life can also be seen to lead to the publicization of private life. Arguably social networking sites, blogs and the like mark the end of inner-directed existence. Now every passing feeling can be Tweeted, every passing thought posted. These internet technologies enable us to extend ourselves in time and space. This, coupled with the fact that users often mistake their public nature for something more private, can lead to negative unintended consequences.

Paul Chambers, a British man upset that poor weather had closed his local airport (and as a result scuppered a blind date), Tweeted to his 600 followers from his mobile: 'Crap! Robin Hood airport is closed. You've got a week and a bit to get your shit together, otherwise I'm blowing the airport sky high!' (quoted in Mitchell, 2010). He was arrested under the Terrorism Act, interrogated for 7 hours and eventually fined £1000. His employers sacked him. Chambers later Tweeted his 'thanks' to the Crown Prosecution Service for ruining the life of an ordinary citizen.

Given the prevalence of these technical gadgets, you never do know who is watching. Moreover, cheaper digitization, global access and more powerful software have combined to create the conditions for permanent digital memory. Every thought and deed, no matter how rash, is, once posted, there for all time. Stacey Snyder was a 25-year-old single mother looking forward to a career in teaching. Despite passing all of the relevant university coursework, gaining all of the necessary credits and completing the practical component, it was not to be. What she had failed to do was behave appropriately. She had posted a photograph of herself on MySpace with the caption 'Drunken Pirate'. This had been spotted by a teacher at the

school where Snyder was interning. They duly reported it to university officials. It was agreed that students could see this and that images of teachers drinking are unprofessional. Ms Synder was denied her certification. She sued, unsuccessfully. What was intended for a particular audience was also accessible to others who had different interpretations of the same image. In today's networked world you are always accompanied by an historical self, your data trail to date (Mayer-Schönberger, 2009, pp. 1–2).

Conclusion

Technologies, as Turkle (2005, pp. 18–19) tells us, change thoughts and deeds, our sense of self and others, and our orientation to the world. All of the devices under discussion here have qualities that speak to such changes. Turkle (2005, p. 15) describes the personal computer as a marginal or liminal object, betwixt and between the inanimate world and the world of the living. One of the key things it appears to alter is the public/private divide. Shing-Ling Chen (1998, p. 256) calls the Walkman an 'ambiguous technology' which, for Iain Chambers has an 'uncanny quality' (quoted in Du Gay et al., 1997, p. 142). Stephen Bayley is even blunter. It is a 'sod-you machine' (quoted in Morley, 2006, p. 39).

We began this chapter with the words of various grand theorists of gadgets. They saw gadgets as emblems for our times, and wholly harmful ones at that. Technologies have negative effects. Orwell (1961, p. 321) has opposed this position, stating that we should never confuse what a technology can do with what it is actually used to do. This takes us to what is arguably the most important and least studied aspect of technology: what people do with it (Pinch and Trocco, 2002, p. 309). This Turkle (2006, p. 10) regards as technology's inner history. André Nusselder (2009, p. 22) calls it 'technology as volition', which he considers the 'most difficult and "hidden" aspect of technology'. Producers can never completely code technological meaning. Only empirical studies of use can reveal technology's hidden aspects. This takes us from products to practices.

An immediate insight that such studies yield is that instrumental approaches to technology based on good/bad binaries are woefully inadequate. Technology does not just do things to people, nor do people just do things to it. We have emotional relationships with technology. As Jade told Bull (2000, p. 35): 'It's a little like another person. You can relate to it. You get something from it. They share the same things as you do. You relate to it as if it's another person'. Eleven year old Fara was of the same opinion of Cog, a robot at MIT's Artificial Intelligence Laboratory: 'It's not like a toy because you can't teach a toy; it's like something that's part of you, you know, something you love, kind of like another person, like a baby' (Turkle, 2005, p. 293). Other empirically-informed studies of

technoscience show that the same holds for all of our various gadgets, that the people we are emerge through interactions with the things that we have (Michael, 2006, p. 152). For such reasons Turkle (2003) suggests that we think of our gadgets as companions rather than tools. We need to learn 'to see ourselves not as separate but as at one with our devices' (Turkle, 2006, p. 16). After all they mediate our experience of, and in, the world. They affect actions and activities, behaviours and interactions, moods, perceptions and propensities and, contrary to the gadget critics' opinions, often positively (Du Gay et al., 1997, p. 93).

Studies of personal computing, Walkman and iPod use all note their empowering nature (Bull, 2000, pp. 76–81; Bull, 2007, p. 21; Du Gay et al., 1997, p. 93; Hosokawa, 1984, p. 166; Turkle, 2005, pp. 84–6). This comes from the new levels of control that they permit. With them we are no longer occupants of a shared world, but authors of our own world, albeit in limited ways. We need to be mindful of issues relating to social class and cultural capital. To be empowered by them we need to be able to afford them and know how to use them. Turkle (2005, pp. 143, 174) identified the personal computer as a world at the user's command. The Walkman was noted for its ability to help manage moods (Du Gay et al., 1997, p. 21), experiences (Chen, 1998, pp. 259, 269), social relations and social setting (Bull, 2000, pp. 180–1). It was effectively used as a mode of resistance to the material organization of the city. As one woman told *The New Yorker* magazine: 'When I am listening to the Walkman I'm not just tuning out. I'm also tuning in a soundtrack for the scenery around me' (quoted in Du Gay et al., 1997, p. 93). This concurs with Hosokawa's (1984, p. 166) designation of the Walkman as 'urban strategy'. Bull (2007, p. 129) wrote of iPod use: 'it permits unparalleled micro-management of mood, environment and sound, permitting the successful management of the self through the contingencies of the user's day'.

Popular accounts suggest that new technologies are even more empowering, although the points about capital (economic and cultural) still hold. The wonders of Web 2.0 with software like Facebook, Linux, MySpace, Second Life, Wikipedia and YouTube are providing endless new possibilities for making and expressing: blogs, camcorders and raw feeds, home movies, mash-ups, podcasts. These are globalizing community and collaboration. We are peer-to-peer not corporate-to-consumer, part of a brave new world of creation in which to digitize is to democratize. For these reasons *you* were *Time* magazine's person of the year 2006 (Grossman, 2006).

We also need to further discuss the valence of technology. Technologies do not only relate to empowerment and control, they also concern feelings. Chen's (1998, pp. 263, 272) study of the Walkman revealed it to be an 'emotional energizer'. Users withdrew emotional energy from the external world, and released emotions within the self. The journals of college student users also showed that the Walkman helped to amplify feelings,

and mediate and maintain moods. Boring moments were made interesting, the lonely were provided with companionship. In other words the device was used to help construct experiences. Similarly Bull's (2000, p. 43) study showed that Walkmans 'are used as strategic devices in managing and changing the relationship between thought, emotion and volition'. These emotions were anchored in the technology (Chow in Du Gay et al., 1997, p. 138). In Turkle's (2005, p. 36) terms, personal computers, Walkmans and iPods are all 'evocative objects'.

Several theorists have identified an emotional problem of modernity that connects with questions concerning technology: our disconnection from those around us. Such individualizing tendencies are seen to threaten the social fabric. All of the technological gadgets under discussion here have been implicated as privatizing devices. They all provide users with their own bubble of being. Turkle (2005, pp. 92, 126) observed the personal computer's potential to create worlds apart. She conceded that 'the satisfactions that the computer offers are essentially private' (Turkle, 2005, p. 164). Chen (1998, p. 263) referred to Walkman use as 'electronic narcissism', Du Gay et al. (1997, p. 20) said that users escape into a 'second world', a world which Hosokawa (1984, p. 177) designated 'secret theatre'. The prevailing feeling that Walkman users reported, and indeed wanted, was 'social invisibility' (Bull, 2000, pp. 78–81). Bull (2007, p. 23) likewise saw the iPod as a 'technology of separation'. These issues present with other mobile devices. Empirical studies of cell phones, for example, show them to be emotional objects (Vincent, 2005) that trouble standard thinking about the public and the private (Höflich, 2005).

Sherry Turkle has continued to trace the evolution of our communication gadgets from early home computers, email and the first virtual communities to the mobile technologies, instant messaging and social networking sites that followed. Connectivity is the norm. This technology is always on, and it is always on us. While the first computers could be said to be projections, a second self, later technologies created a new 'tethered' self. This is perhaps put best by a BlackBerry user who told Turkle (2006, p. 13) 'I glance at my watch to sense the time; I glance at my BlackBerry to get a sense of my life'. In effect, we extend ourselves into these communication devices. Brian Rotman (2008, p. 81) agrees. He argues that 'the technological upheaval transforming the landscape of Western culture makes itself felt deep within our heads, within our subjectivities, our personas, our psyches'.

New forms of mediation and new networks of communication are creating nothing less than a 'networked self'. Technologies allow us to do things differently. Perhaps, then, it is more appropriate to talk about an altered sociality as opposed to a diminished one. Iain Chambers captures this when he writes that the Walkman gives us a different conception of the polis (cited in Du Gay et al., 1997, p. 142). This alternative can be

described as the transformation of communal places into spaces of social collection in which connection is uncoupled from co-presence. Relations between proximate people are not as prized as mediated experience (Bull, 2007, p. 54). Rather than this being 'a one-dimensional collapse of subjectivity' (Bull, 2007, p. 23) as the gadget critics would have it, '[w]e are witnessing a new form of sociality in which the isolation of our physical bodies does not indicate a lack of connectedness but may be its precondition' (Turkle, 2006, p. 3).

Further Reading

Douglas Coupland's (2010) *Marshall McLuhan: You Know Nothing of My Work!* (New York: Atlas & Co.) provides a quirky new introduction to McLuhan's thought. It also makes sense to supplement this with McLuhan's (2005) *Understanding Me: Lectures and Interviews* (Cambridge, MA: MIT Press) which contains numerous pieces on technology, including 'The Future of Man in the Electric Age' and 'Predicting Communication via the Internet'. McLuhan inspired a large body of work on media ecologies, which is to say work considering technology as environment. Neil Postman's scholarship is important in this regard. See his 1985 work *Amusing Ourselves to Death: Public Discourse in the Age of Show Business* (New York: Penguin) and his 1993 publication *Technopoly: the Surrender of Culture to Technology* (New York: Vintage Books). Matthew Fuller's (2005) *Media Ecologies* (Cambridge, MA: MIT Press) offers a more up-to-date take on the topic.

For an anthology on the underside of the information society amongst early computer users in the workplace see the Processed World website: http://www.processedworld.com/.

To upgrade our discussion of technological theory and to bring it into the networked world the following are recommended: Alexander Galloway and Eugene Thacker's (2007) *The Exploit: A Theory of Networks* (Minneapolis: University of Minnesota Press) and Christian Fuchs' (2008) *Internet and Society: Social Theory in the Information Age* (New York: Routledge). *The Exploit* is volume 21 in the University of Minnesota Press Electronic Mediations series. Other works in the series are also worth consulting.

Tim Wu's (2010) *The Master Switch: The Rise and Fall of Information Empires* (New York: Alfred Knopf) traces the fate of information technologies in the long run. He argues that ITs tend to go from private hobby to public industry, from amateur contraptions to well-oiled machines, and from open systems to ones under tight corporate control. He observes this pattern with telephones, radio, TV, film and, perhaps, now the internet.

D.E. Wittkower's (2008) *iPod and Philosophy: iCon of an ePoch* (Peru, IL: Carus) collects a range of authors with expertise in philosophy, communications and cultural studies. Remarkably, Michael Bull is not mentioned once. Chapters include: 'iPod Therefore iAm', 'The Unbeatable Whiteness of the iPod' and 'Mobile Clubbing: iPod, Solitude and Community'.

Mike Michael (2009) offers a recent sociological study of mobile phone use in '"The-Mobile-Phone-In-The-Countryside": On Some Ironic Spatialities of Technonature'. This features in D. White and C. Wilbert's (eds) *Technonatures* (Waterloo: Wilfred Laurier University Press), pp. 85–104.

Sherry Turkle's (2011) *Alone Together: Why We Expect More From Technology and Less from Each Other* (New York: Basic) trades the earlier optimism she had towards new technologies for something altogether more pessimistic. In this book she suggests that the very 'social' media that promise connection tend to produce loneliness instead.

David Kirkpatrick's (2010) *The Facebook Effect* (New York: Simon & Schuster) is an attempt to offer, as his subtitle puts it, 'the inside story of the company that is connecting the world'. Nicole S. Cohen produced a political economy of Facebook in the Spring 2008 issue of *Democratic Communiqué*, vol. 22, no 1.

The *Journal of Computer-Mediated Communication* is a good source for current articles concerning topics such as blogs, emails, SMS and social networking sites.

8

Objective Life: Things and Social Theory

Once we wrote of the linguistic turn in early twentieth century philosophy. Jonathan Sterne (2003, p. 367) believes that we 'may now be undergoing an even larger "technological turn" in the human sciences'. Steven Connor (2008) has identified a 'thingly turn' in philosophy and cultural studies, while Judy Wajcman (2002, p. 361) has noted the increased salience of material culture within social anthropology, including the foundation of a dedicated journal. Doubtless SCOT and ANT did much to put technology back on the theoretical agenda. Latour (1996b, p. 242) specifically credits two intellectual currents: the sociology of techniques (Bijker and Law, 1992a) and the 'reobjectification' of economics (Appadurai, 1986). At any rate, with numerous scholars devoted to things (Brown, 2004; Daston, 2004), objects (Turkle, 2007; Candlin and Guins, 2009) and material culture (Buchli, 2002; Miller, 2005) Latour's 'missing masses' argument is now difficult to sustain.

Latour's work is hugely influential in these new interdisciplinary domains but, given his coverage in Chapter 6, we will have a different focus here. We do this to think about that which Latour does not, to bring yet more residual categories into the spotlight of social theory. To Scott Lash (2002, p. 55), there is something cold and calculating in Latour's accounts of technology which smack of the rational utility maximizer: 'His theory, while attributing to the object admirable powers, remains too one-dimensional. Objects are much more than instruments. They are repositories of memory, of traces, of tradition'. This chapter is devoted to these issues that 'appear to run counter to the requirements of functional calculation, and answer to other kinds of demands such as witness, memory, nostalgia or escapism' (Baudrillard, 2005, p. 77). This helps to flesh out, quite literally in the end, our discussion of the three material artifacts in the last chapter into a broader consideration of materiality itself, of the life, death and rebirth of

things. In so doing we engage with two of the newer theoretical strands to emerge post-ANT: Thing Studies and posthumanism.

The Things of Social Life

In *The Division of Labour in Society* Émile Durkheim (1997a, p. 72) announced that: 'Things in fact are a part of society, just as persons are, and play a specific part in it. Thus their relationship to the body social needs to be determined'. Durkheim has a place in the prehistory of Thing Studies for his work on the totem which seeks to determine the role of things in group cohesion. From his discussion on how things help to build solidarity within a group, we turn to Marcel Mauss who shows us how things help to build relations between groups. Finally we draw on Daniel Miller who demonstrates how things build individual harmony, how they can help make people whole.

Durkheim took religion to be society's original organizing impulse. Shared religious belief, he argued, was the basis of social cohesion. While regarded as an emanation of the social, religion also created, described and made society meaningful. Durkheim looked to 'archaic' aboriginal society to extract the first principles of religion: its role in social order and social control. In *The Elementary Forms of Religious Life* he argued that Australian tribal life was based on the clan, with the clan identified in two ways: by kinship bonds and by its name which it shares with a set of material things to which it claims a special relationship. Durkheim (1965, p. 123) calls the species of things which defines the clan its 'totem'. The totem can be read as a materialized and externalized social fact. He interprets it as an impersonal religious force made visible, as the *object* of religion. 'This is what the totem really consists in: it is only the material form under which the imagination represents this immaterial substance, this energy diffused through all sorts of heterogeneous things, which alone is the real object of the cult' (Durkheim, 1965, p. 217). The totem has a twofold symbolism; it represents god and the clan. However, for Durkheim this is tantamount to saying the same thing. For him god and society are both emanations of the collective consciousness.

People and their totemic objects in combination form a unified clan system. Things in this sense play a crucial, if only symbolic, role: 'they have a determined place in the general scheme of organization of the society', representing 'social unity in a material form' (Durkheim, 1965, pp. 166, 262). Clan members find their humanity and tie themselves to the collective through material artifacts. Durkheim suggests that in order to share beliefs we need things to represent value systems or to mark symbolic orders. The totem, then, acts as a focus of moral life. Identification with the totem binds individuals to their religion, their ancestors and their contemporaries.

Collective representations, those things which act upon the minds of people, are only possible through artifactual mediation (Durkheim, 1965, p. 263). It is only when fixed upon material artifacts that sentiments come to be shared (Durkheim, 1965, p. 269). In *Suicide: A Study in Sociology* Durkheim (1997b, pp. 313–14) made passing reference to technologies of modernity like architectures, mass communication and transportation as crystallized social phenomena, as materialized social facts that act upon us. These fabrications of times past inform and shape our present.

Marcel Mauss, Durkheim's nephew and sometime collaborator, moved on from his uncle's intragroup analysis. His work considered the stabilization of social relations between clans and groups. Completed a decade after Durkheim's *Elementary Forms*, Mauss' (1954) study of the gift similarly examined other 'archaic' societies. Mauss surveyed practices in Melanesian, Polynesian and Native American cultures, as well as those recorded in Roman, Hindu and Germanic literature. At the outset of his study Mauss (1954, p. 2) talks about the law of things merging with the law of people. Granted, part of the power of gifts is that the presence of the giver is projected onto the object given, but gifting commingles the moral, the physical and the spiritual. Against the common perception of things as inert objects, Mauss (1954, p. 48) even entertains the notion of things as actors, asserting that they have 'a personality and a virtue of their own'. Elsewhere he writes of gifts as 'a part of the family' noting the power *within* things (Mauss, 1954, pp. 61, 63). Mauss' well-known conclusion was that the gift, while appearing disinterested and voluntary, is in fact self-interested and obligatory. Such practices tie groups into relations of reciprocity: people give, they receive, and they repay. Once a gift is received the recipient is effectively 'bought'. The giver binds the receiver, obliging them to gift in return. In this way gifts go to the heart of material and moral life, they cement social bonds, forming an 'irrevocable link' between collectivities, indeed 'the communion and alliance they establish are well-nigh indisoluble' (Mauss, 1954, pp. 58, 31).

Subsequent social theorists have discussed the gift, usually in the manner of Mauss as something which is anathema to capitalist modernity where markets replace morality as the primary means of exchange (see Bataille, 1988; Baudrillard, 1993; Bourdieu, 1990; Derrida, 1992). Simmel breaks the mould. Like Mauss, he sees gifting as a way of projecting ourselves into our objects. However, for him all exchange entails the objectification of human relations, and 'in the fully developed economy, personal interaction recedes altogether into the background, while goods gain a life of their own' (Simmel, 1964, p. 388). Marx (1972, p. 165) is another obvious point of reference for the objectification of relations. Under capitalism money functions as 'almighty being'. Because it can buy everything it is *the* object. 'Money is the pimp between man's need and the object, between his life and his means of life. But that which mediates my life for me, also

mediates the existence of other people for me. For me it is the other person' (Marx, 1972, pp. 165–6). Does gifting die in this money economy? Against Bataille and other French theorists, other scholars argue that gifting is even flourishing. Literatures in the sociology of computing devoted to gaming, hacking, file sharing and the open source movement frequently refer to them as gift cultures (Barbrook, 1998; Currah, 2007; Rehn, 2004).

We can further update our discussion of the anthropology of objects with reference to two ethnographies: Miller's (2008) *The Comfort of Things* detailed in this section, and Olga Sezneva's (2007) 'We Have Never Been German' covered in the next. This also marks a transition from 'armchair anthropology' to engaged study. Miller conducts an investigation of a typical London street – 'Stuart Street' –a place that is architecturally, ethnically, sexually and financially diverse. Across the best part of a year-and-a-half he and his co-researcher Fiona Parrott investigated what matters most to its residents. The book condenses these experiences into thirty individual portraits. The final publication can be read as an extended analysis of what our possessions say about us. From the outset Miller (2008, p. 1) wants to bring two findings to our attention:

1 Despite the proliferation of consumer goods things retain a profundity for us, and
2 Deeper object relations are matched by deeper interpersonal relationships, neither negates the other.

Indeed, Miller (2008, p. 285) finds empirical confirmation of Serres' (1995c, p. 45) assertion that 'human relations go through things, our relations go through things to men'. He also confirms another of Serres' (1995a, p. 66) statements, that '[h]umanity begins with things'. As Miller puts is, our relationship to objects confirms our cosmologies. This continuous confirmation socializes us, it 'creates people' (Miller 2008, p. 287). The point about *relationships* is central. Miller does not want his analysis to proceed from either society or the individual but from relationships with people and with things. Miller refers to the material systems in which people are embedded as an aesthetic. This speaks to patterns and organizing principles within particular settings. Each aesthetic is responsible for a particular localized order. This local cosmology is composed of the very same stuff as broader social cosmologies. Durkheim and Mauss thought that they were studying simple societies; Miller says his study 'could be regarded as the study of societies, but just of very, very small societies' (Miller, 2008, p. 294).

Miller (2008, pp. 162–71) found that objects frequently functioned as modern totems, in the sense of symbolizing the person they are, were or would like to be. Take Dave, an illiterate working class man from the city's South. Large patches of his life had been nothing short of nightmarish, involving episodes of depression, drug and alcohol abuse, as well as brushes

with the law. These days he spends much of his time trying to help others, while simultaneously trying to help himself. His life story is well rehearsed. Dave has delivered his narrative numerous times. It scarcely touches on the world of objects, but when his interlocutors bring it up things are seen to play very important roles.

Dave proved more than capable of uncovering the role things play in his life. He could see that his collections of black and white photographs and CDs aid with the archiving of his existence; assist with the story of who he is. Together the songs and images help steer him away from the twin lures of drink and drugs. They do memory work, providing an anchor to different times and places. They locate him, and they remind him about the better periods. Dave was an insider in the music business. His tastes more fringe than mainstream. He had acknowledged expertise. For him, individual songs on CDs invoke specific memories. Despite the substance abuse his recall is excellent. Dave can remember where he had first encountered particular songs, and when he subsequently acquired them. Many proved elusive, but he always acquired them in the end.

Dave's trophies are another collection of importance. They are too precious to be kept in his house. Instead they are trusted to his mother's custody. The old photographs and CDs are of no value to anyone else. They cannot be exchanged for a drink or a fix. Anything else that could be exchanged had been. His home had no carpet or furnishings. Everything had gone; everything except the trophies. The trophies marked Dave's sporting and musical triumphs. They were an important source of value and self-worth, from a time when things were different:

> they reflected his worth back to him; and they mattered most when he needed such mirrors. Mirrors that would tell him the truth about what he had been and therefore still was, or perhaps could be again. Mirrors that were not shattered like those deceitful truths, the silvered glass mirrors which only sent back to him the image of a shattered man. (Miller, 2008, p. 166)

Of course, people could and did perform the same sorts of functions, but gripped by powerful addictions Dave's domestic space was not one that could be safely shared. His children and partner were now elsewhere. Fleeting family visits were the best he could hope for. In their absence, his only significant others were his collections. They were his sources of balance and stability. It is difficult to overstate their significance. Miller (2008, p. 290) thinks that they have made a life-and-death difference.

Like others before him (Baudrillard, 2005; Serres, 1991), Miller concludes that we find ourselves in our objects. The point of difference between Miller and Durkheim and Mauss is that Miller came to this conclusion empirically, through fieldwork. Durkheim, Mauss and Miller discuss

how unity is made in material form, and how we orient to self and others through things. This said, Miller wants to separate himself from social science in the Durkheimian mould, and not only methodologically. Durkheim's work is faithful to the ethos of secular Enlightenment thought. He argued that we created God to create order. Loss of religious belief would need to be compensated by belief in some other transcendent object. For Durkheim this object was society. Growing individualism and consumerism have led to fears that society might fragment and fail. Miller found that big objects like community and society meant little to the Londoners of his inquiry. Neither religion nor society featured as major preoccupations, nor were they seen as prerequisites for living an ordered life. Miller (2008, p. 285) believes that 'this amounts to a repudiation of much of Durkheim and of the initial premise of social science'.

The Social Life of Things, I: Technological Lifecycles

The overriding point in the previous section was that technologies give us stability, but how stable are our technologies? Bill Brown (2004, p. 9) has pointed out the rather obvious, 'however materially stable objects may seem, they are … different things in different scenes'. Indeed, we said as much in our opening chapter, and we demonstrated it with the baby bottle example. Having looked at the place of things in social life we now consider the social life of things.

Bruce Sterling (1994) looks at the technological life cycle in relation to the telephone. He says that technologies go through four stages, from initial 'question mark' through to eventual death. The first phase of technology is called the 'Golden Vaporware' stage. Here technology is merely notional. It is nothing more than an idea, a dream or desire, a figment of the inventor's imagination. Sterling considers the archetypical inventor to be Alexander Graham Bell. Bell invented numerous fantastic devices including the phonautograph which made use of an ear taken from a corpse. The human-machine hybrid could draw sound-wave images on smoked glass. Few of us have heard of the phonautograph. Its life, like that of most technologies, was cut short. Most technologies begin and end in Golden Vaporware.

If they do manage to progress to the second stage they become Rising Stars. Sterling calls this the 'Goofy Prototype' stage. Bell's greatest gadget, the telephone, achieved this status on 10 March 1876. Bell made history on this date, being the first person to transmit human speech electronically. At this stage technologies are still fluid and unreliable, their true potential yet to be realized, their meanings yet to be fixed. No one is sure of their real worth. Positive publicity and financial investment are required if the technology is to move from Goofy Prototype to something more stable.

This is what makes additional research and development possible. In Bell's case the telephone was touted around trade shows and it featured heavily in the popular press. Bell's assistant would play music in another room and eventually in another city. Audiences could clearly hear the tunes, although the impact was not always positive. Disembodied mechanical sounds could be creepy.

Bell envisaged the telephone as a mass medium. Music, sermons and speeches would be disseminated to those on the network. This seemed to make sense to potential customers, although the only place where this practice was realized was in Budapest. Their Hirmondó system ran for decades, broadcasting news, novels, plays and concerts. From our vantage point the Hirmondó looks less like the precursor of the telephone and more like the progenitor of today's computer bulletin boards.

For Bell's system to triumph it had to successfully tackle the established, and perfectly adequate, telegraph system. In many respects the telegraph industry had the competitive edge: telegram messages left a permanent trace and they could be answered at the receiver's leisure, it covered greater distances than the telephone was capable of, and the entire system was already well-established. In 1858 a cable connected the USA to Europe and by 1861 telegraph wires traversed America (McLuhan, 2001, p. 272). Sterling (1994, p. 7) notes that in 1876 the US had 214 000 miles of telegraph wire coverage and 8500 telegraph offices. Compared with this, Bell's device looked like a toy, a mildly amusing novelty of only passing interest.

Sterling calls the third stage the Cash Cow. At this stage the technology comes of age, the novelty finds utilities, it embeds itself into the world. Bell's triumph came from a successful rebrand. The telephone would be an intimate technology, a tool for person-to-person communication. The machine would not be in charge, sending the same message out to the masses; rather its users would be in control. They would decide how the technology got used. Marketing it along these lines was crucial to its success. With increasing numbers of users, greater areas of coverage and the aggressive use of lawsuits to keep competitors at bay (600 in all with a 100 per cent success rate) the telephone achieved maturity (Sterling, 1994, p. 9).

Beyond maturity lies death, technology's final stage. This has not been the telephone's fate to date. In many parts of the planet land lines may now be losing out to mobiles, but '[t]he global telephone system is the largest and most complex machine in the world' (Sterling, 1994, p. 15). Still, any number of media have gone that way, including Budapest's Telefon Hirmondó, phenakistocscopes, stereopticons, zoetropes, 8-track tapes and floppy disks. So many, in fact, that Sterling (1995) issued a Dead Media Manifesto. In a later interview he explained that his Dead Media Project was designed to offset our distorted picture of technology which focusses on the present and the successful. Newer technologies are not necessarily better, the only certainty is that you have paid money to upgrade (and you

are likely to stay on the upgrade treadmill). Alas, this project also appears to be terminal, the links to it all dead too. Sterling finds a fellow traveller in Benjamin (2004, pp. 460, 475, 540) who was a firm believer in the necessity of sifting through the material detritus of our culture in order to comprehend it. As Scott Lash (2002, p. 61) phrased it, 'Benjamin begins in his later work to understand modernity as a world of dead objects' (see Chapter 3).

What happens to technologies that die? Sterling thinks that they simply fade from our memory. However, this is not the only possibility. Marginal objects can return to life as antiques. Here they have an important role in the sociology of interior design, invoking a particular cultural atmosphere – part of the play of materials, form and space. No longer functional in any direct instrumental sense, they nonetheless do valuable symbolic work: bearing witness, anchoring memory, mediating moods (Baudrillard, 2005, p. 77). For Baudrillard the antique signifies time above all else. Within the system of objects the antique is psychologically privileged. People seek out artifacts from earlier eras, and, therefore, from beyond their own cultural contexts. This is tied to the quest for authenticity. (Tourism, which is also a kind of time travel, works similarly.) 'The demand to which antiques respond is the demand for definitive or fully realized being' (Baudrillard, 2005, p. 79). In acquiring antiques the possessor seeks to endure through time or even beyond it. Antiques anchor us to myths of origins, they mediate the past. Antiques possess a dual function, linked to a longing for origins and a fixation with authenticity. What do antiques bring us back to? Tradition, primitive wisdom, God… And authenticity? This is connected to the need for certainty. Did the antique belong to someone rich, famous or powerful? If so, additional value will accrue to it. Here we have two contrasting tendencies. Coming from the past, the antique signifies the emptiness of time. Anchoring ourselves to it, and thereby backwards in time, signifies the emptiness of being (Baudrillard, 2005, p. 80). There is a certain amount of escapism at work here. Being always also 'elsewhere', the antique permits a limited escape from our times, from the everyday. This is part and parcel of their mythical quality.

Baudrillard finds parallels between Westerners' quest for the artifacts of times past and the clamour for the technological products of Western modernity in the underdeveloped world. Cargo cults may amuse Westerners, but Baudrillard finds the love of antiques to be a related phenomenon. In both cases we are talking about technologies that have minimal function and maximal meaning. 'In both cases what is being acquired under the form of the object is a "virtue": the "savage" acquires modern technology, the "civilized" person acquires ancestral significance' (Baudrillard, 2005, p. 87). Both display fetishism, the former for power, the latter for objects. What we are not is projected into the artifact. Object fetishism is often used as a tool of advancement. Here things serve as indicators of our social

standing. This is increasingly the case in modern society where older markers of status like birth, blood and family are diminishing, although things can be used to cement the links. Bourdieu (1984, pp. 76–7) writes:

> Every material inheritance is, strictly speaking, also a cultural inheritance. Family heirlooms not only bear material witness to the age and continuity of the lineage and so consecrate its social identity, which is inseparable from permanence over time; they also contribute in a practical way to its spiritual reproduction, that is, to transmitting the values, virtues and competences which are the basis of legitimate membership in bourgeois dynasties. What is acquired in daily contact with ancient objects, by regular visits to antique dealers and galleries, or, more simply, by moving in a universe of familiar, intimate objects 'which are there', as Rilke says, 'guileless, good, simple, certain', is of course a certain 'taste', which is nothing other than a relation of immediate familiarity with the things of taste … it is an immediate adherence, at the deepest level of the habitus, to the tastes and the distastes, sympathies and aversions, fantasies and phobias which, more than declared opinions, forge the unconscious unity of a class.

Baudrillard (2005, p. 89) is inclined to agree, writing that 'the task of signifying transcendence has fallen to material signs – to pieces of furniture, objects, jewelry and works of art of every time and every place'. Such is our demand that supply cannot satiate it. This explains the profusion of fakes and forgeries. In social theory the loss of the real and the proliferation of simulation have been tackled by a number of scholars (see Baudrillard (1994), Umberto Eco (1987) and Guy Debord (1994).

The Social Life of Things, II: Technological Lifecycles and Ontological Exchanges

Even seemingly banal objects can perform important identity work as Miller demonstrated. Olga Sezneva's (2007) study of the history, politics and culture of Kaliningrad comes to the same conclusion. Her ethnographic research was on a larger scale than Miller's street. It involved site visits to flea markets, conversations with dealers, discussions with treasure hunters and those that commission them, and formal interviews with city residents. Kaliningrad had formerly been part of East Prussia, where it was known as Königsberg. It was annexed by the Soviet Union at the end of the Second World War, and all of its German inhabitants were expelled. Today the population is overwhelmingly Russian; most of the remainder are Belarusian and Ukranian. Hardly any of its citizens are ethnically German. Since the collapse of the Soviet empire the Kaliningrad Oblast region

which borders the Baltic has become geographically separate from the rest of Russia, to which it belongs.

Sezneva shares Baudrillard's interest in marginal objects. She is similarly interested in the overriding concerns of Durkheim, Mauss and Miller: the manner in which things help to construct social worlds, the way in which objects help to produce subjects. Complications abound in this specific case study. Items of the pre-socialist past are integrated into the development of a post-socialist present. Kaliningrad combines with Königsberg. This is a reorientation to Europe and all things European. The intriguing point is that Kaliningraders are connecting with a history which is not their own. They inhabit a location that was *terra nova* for most of their parents. Sezneva is not talking about anything grand; Kaliningrad's inhabitants are investing worth in the accoutrements of everyday existence – found bowls, plates, cutlery, keys. Some of these artifacts, like bottles, can be reused. The rest find their value as part of the possessor's collection.

A green beer bottle bearing the name "Koenigsberg" can fetch the equivalent of a month's telephone rental. This is in marked contrast to its original value. As Seznova (2007, p. 19) notes, the bottle was originally a secondary commodity, the prime commodity was the beer contained within. Once the beer was consumed the bottle would have been disposed of. The initial consumer would have envisaged the bottle's life ending there and then. The bottle would have had no, or even negative, value. It would have been waste. German bottles such as this would later be discovered. The 1960s are seen as the take-off point for this 'discovery' process, a period during which there was a construction boom. During the Soviet era collecting was a strictly private activity. Finds would only be shared amongst trusted intimates as the Soviets officially denied Kaliningrad's German past.

Demand for such objects created a new cycle of consumption. This in turn stimulated supply. Diggers, treasure hunters, traders and collectors began to search for sites and excavate them. In the process the value of discarded artifacts was transformed. They became a 'class of durable extraordinary commodities' (Sezneva, 2007, p. 19). The market for these commodities is geographically bound. Outside of the Kaliningrad region there is no demand for them. Tourists show no interest. They do not work as souvenirs. In fact, they are not allowed to. Both buyers and sellers share the same cultural code. There are clear understandings between relevant actors as to the appropriate recipients. Muscovites and other foreigners are likely to be refused (although they are equally likely to mistake these objects for refuse). Legitimate buyers are Königsbergers or former ones now resident in Germany. Resonating once more with Baudrillard, Sezneva (2007, p. 21) sees the 'production and exchange of bric-à-brac in Kaliningrad as spheres of production of historical continuity', with an '"ontological exchange" between objects and people … underl[ying] its consumption'.

Through her research Sezneva (2007, p. 19) is able to construct a four-phase lifecycle of Königsberg's objects. In the initial phase of production during the interwar period the objects have little economic value and probably less symbolic worth. Phase two comes about when the object is thrown away. Since it is rubbish it has no value because, as Latour (1994, p. 46) notes, '[o]bjects that exist simply as objects, finished, not part of collective life, are unknown, buried under soil. Real objects are always parts of institutions, trembling in their mixed status as mediators, mobilizing faraway lands and people'. In phase three, which Sezneva dates as the decades between 1960 and 1990, the objects undergo a 'second production' thanks to excavation. It is during this time that the collectibles market develops. The objects have low economic value but reasonably high symbolic appeal. In phase four, which runs from the 1990s to the present, excavation projects are ongoing rather than piecemeal, and the market for finds is well-established. The cultural products are now 'durable', their monetary value is climbing and their symbolic worth is similarly high.

Secondary production begins with digging. Decisions about when and how to dig are determined by experience and cultural memory. During the Soviet regime maps were classified documents. To access them required connections. The knowledge gleaned from them was the decisive factor. When that regime crumbled the diggers' field of activity was radically reorganized. The democratization of knowledge opened the practice up to broad competition. To be a successful digger these days one needs to be a fast operator and a shrewd one. Officially all finds within the city limits are state property. Diggers need to be discreet. They need to have reliable helpers and they need to cultivate a trusted client base. It is through these networks that value is created, because value relies on the creation of social connections, a network of diggers and buyers, and the acknowledgement of shared codes.

The question of explaining the changes in signification across time still needs answering. Why are people so interested in what looks to the rest of the world like rubbish? What do these German artifacts reclaimed from the soil mean to their non-German collectors? Why be nostalgic for a past that never was theirs? Sezneva asked this question many times of many people, and they provided many reasons. Modern mass manufactured items are not the same, the older artifacts feel different, they are cheaper, rarer and original, they are of a better quality, and (echoing Baudrillard once more) they connect their owners to the past, to eternity. In sum, the act of possession anchors a person to a place. It helps to provide an identity. We might say that it concretizes 'Europeanness'. This provides a certain stability in the domestic realm of the present when both the current situation and the future seem so uncertain. Part of the nostalgic impulse seemed to be a longing for a past that they would have liked to have been part of. It also

signals dissatisfaction with the Soviet past that they actually had and the present that they are currently enduring. In this sense, possession substitutes for experience. 'The value of bric-à-brac is that it has implications for the construction of subjectivity, relating the ontology of things to the ontology of individuals and collectivities' (Sezneva, 2007, p. 28).

The Greening of Things: Never-ending Spirals

Seen in isolation, a physical object extends our reach in the world: glasses help us to see farther, and shovels help us to move more dirt. But we are never without technologies in the plural, and in their totality they do something much more profound. In *The Human Condition* Hannah Arendt (1958, p. 13) noted that the human world rests on the presence and memory of other people and the persistence of things, material artifacts that outlast the activities that produce them. Miller and Sezneva showed that they help make our existence what it is. A point of difference between all previous civilizations and our own consumer society, however, is that we 'live at the pace of objects, live to the rhythm of their ceaseless succession. Today, it is we who watch them as they are born, grow to maturity and die' (Baudrillard, 2003, p. 25). Thus we can add another element to Du Gay et al.'s circuit of culture that featured in the previous chapter: disposal. This leads to another very modern problem, that of waste.

Sometimes Sterling's technological lifecycle does not end in death, as things enjoy a second life. Sezneva's work exemplified this. However, this seems to be the exception rather than the rule. Barry Smart (2010, pp. 162–3) says that there are five ways in which consumerism creates waste:

1 Waste is a necessary end result of consumption, things are eaten, worn and so on. (Consumption derives from the Latin *consumere*, which means 'to use, destroy'.) Droit (2005, p. 65) considers the absurd ends to which this process goes with reference to food packaging:

> Graphic designers designed it, printers proof-read it, hygienists controlled it, machines glued it together, storekeepers inventoried it, employees displayed it; from where it was checked out, deposited in my bag, placed in my refrigerator, and the following morning, in the space of two seconds, torn apart for the extraction of a yoghurt, and then tossed away.

2 Some objects fail as desirable commodities or are outmoded before they reach the market. As unwanted or unsellable products they are often discarded.

3 Consumers will often move on from a product before it has been entirely consumed. This is as true of any technology as it is, for instance, of food. Verbeek (2005, p. 221) cites a Dutch study which showed that over 60 per cent of hifis, telephones and stoves, and close to 90 per cent of PCs found in landfills were still fully functioning.
4 This urge to replace is encouraged by the culture industries which cajole consumers into constant upgrades and the endless acquisition of evermore fashionable items. (Recall the insights of Adorno, Horkheimer and Marcuse in Chapter 2.)
5 The globalized nature of production and consumption, frequently involving the intense exploitation of workers and environments, has created new forms of waste tracked by such things as food miles and carbon footprints. This has led to calls for zero waste.

The move from waste management to zero waste constitutes a paradigm shift, with some heralding it as a new industrial revolution, a 'materials revolution' to match the labour productivity revolution of the first (Lovins, cited in Murray, 2002, p. 16). Waste management sees waste as useless, as something to be disposed of. Yet there is no technological fix for the waste problem. Neither landfill nor incineration practices successfully manage pollution. And disposal takes materials out of circulation. This downgrades 'natural capital'. Natural capital is a 3.8-billion-year store of systems needed to sustain planetary life. Such are our current practices that natural capital may be depleted before the century's end (Hawken et al., cited in Murray, 2002, p. 14).

Waste, Robin Murray (2002, p.18) writes,

> has been the untouchable in the caste system of commodities. The idea that waste could be useful, that it should come in from the cold and take its place at the table of the living, is one that goes far beyond the technical question of what possible use we could make of this or that. It challenges the whole way we think of things and their uses, about how we define ourselves and our status through commodities, by what we cast out as much as what we keep in.

Zero waste proponents reject the notion of waste as the necessary endpoint of production. In their view waste is material wealth by virtue of the energy embodied in it. It is ripe for recycling and reuse.

Commitment to zero waste entails commitment to non-polluting production processes (zero discharges and zero environmental damage). It also means aiming for zero defects during manufacture, and only using those materials that can be recycled. Two material cycles are identified: a biological cycle relating to objects composed of biodegradable elements that can be returned to nature at the end of the object's social life, and a technical

cycle made of completely reusable materials (referred to as 'technical nutrients' in the literature). Under such conditions technological objects and materials have never-ending spirals of existence rather than limited life-cycles. This constitutes a greening of technological thinking.

Quasi-Objects: Posthumanism and Companion Species

The chapter's closing thoughts detail more recent theorizing which further troubles subject/object distinctions. It can all be said to fall broadly within a theoretical paradigm called 'posthumanism'. Posthumanism opens up the world to its contents. It recognizes that our technologies are always in attendance, and that they are far from the only party to our human being. '[R]ice, bees, tulips, and intestinal flora', for example, 'all … make life for humans what it is – and vice versa' (Haraway, 2003, p. 15). Pickering (1995, p. 26) defines posthumanism as an analytic approach which removes humans from centre stage, which is where the humanists had positioned them. Instead, posthumanists acknowledge other forms of (material) agency and they stress the significance of changes across time. An illustration of this concerns a case we discussed in Chapters 2 and 4: David Noble's study of N/C machine tools. If we allow for temporal emergence and agency in the widest sense – of all human groups, not just management, and of all relevant materials – a very different story emerges. Just as Pfaffenberger (1992, p. 304) and Anne-Jorunn Berg and Merete Lie (1995, p. 338) contend that Noble's story does not hold when the technology crosses countries and regulatory contexts, Pickering suggests that even in the USA Noble's interpretation can be questioned if we look at how N/C changes across time. Pickering argues that prior to the introduction of a new technology it is impossible to know what resistances will arise or how they will be placated. To demonstrate he uses Noble's own case study of General Electric's Aero Engine Group factory in Lynn, Massachusetts. Granted, management did have clear hopes for the technology, but their desires can be seen to shift across time. These shifts are accommodations to resistances offered by the workers (who refused to do everything management wanted them to) and the technology (that could not do everything that management wanted it to). What resulted at Lynn was an assemblage, a 'sociocyborg' composed of multiple people and machines. In fact, despite their best intentions, managerial dominance declined across time. N/C could not manufacture consent. The original pay rate was restored, and there was worker participation in some managerial decisions (1995, pp. 161–2). For these reasons Pickering suggests (1995, p. 172, emphasis in original) that rather than management interests being all-powerful and all-determining they are situated '*within the plane of practice*'.

C.P. Snow (1960) argued that two cultures divide modern society: sciences and humanities. The sciences focus on a material world devoid of humans, and the humanities on a human world without materiality (Franklin, 2007). This helps to explain social theory's reluctance to engage with objects. Posthumanists find neither approach desirable; they seek to theorize 'matter and humans within the same intellectual framework' (Rose, 2001, p. 46). As indicated, this involves decentring humans from their privileged status of *primum mobile*. An early example of such work was Latour's (1988b) *The Pasteurization of France* which featured microbes as social actors. He headed one section, 'There Are More of Us Than We Thought'. This seems to be a fitting motto for posthumanism, which ushers in a host of non-human others like Latour's microbes, speed bumps and hotel keys (see Chapter 6), Haraway's (1989; 2008) primates and dogs, and Adrian Franklin's (2006) eucalypts. Clearly, then, posthumanists reject an intellectual division of labour that cedes natures, creatures and things to the natural sciences. For them humanity cannot be isolated from the non-human world. Serious attention must be given to questions of materiality. As Franklin (2007) notes, this is accompanied by approaches that 'look less for what things mean (to humans) than what things *do*'. As such it signals a break with the sociological tradition that follows from Max Weber (phenomenological approaches, social constuctivism, the Chicago school, ethnomethodology) to one that looks at what things mean to humans. Intentionality is the issue. And in a major challenge to standard social theory Latour (2005) and others claim that it is not the exclusive province of human beings.

Posthumanists are inclined to argue that all objects have agency in as much as they materially affect other materials. Objects contain other active objects. Perhaps, says Dan Rose (2001, p. 50), we should abandon the idea of essences. Perhaps essences do not exist. It is preferable to think of variable ontologies (Latour, 1993b) and multiple agencies. Karen Barad (2003, p. 807) agrees: 'matter is substance in its intra-active becoming – not a thing but a … congealing of agency'. Posthumanists, then, refuse to honour the standard binary of culture versus matter. They emphatically reject the assertion that culture is active and historical while matter is passive and unchanging. It makes no sense to oppose humans to matter because humans are composed of matter, and they live their lives fully embedded in it (Rose, 2001, p. 57). (For an earlier 'pre-post' expression of this, see Merlau-Ponty, 1968, p. 138.) Paris is more than its people, be they Parisians, visitors or tourists. Latour and Hermant (2006, p. 64), quote from the *Commission municipale du mobilier urbain* which lists the city's street furniture. They insist that the city's inhabitants also include: '770 Morris columns, 400 newsstands, two theatre stands, 700 billboards, 2000 information stands, 400 public toilets, 1800 bus shelters, 9000 parking meters,

10 000 traffic lights, 2300 post boxes, 2500 telephone booths, 20 000 bins, and 9000 benches'. They are included not simply because they occupy the same space as Paris' human co-habitants but because they anticipate and help shape their behaviours: 'Each of these humble objects … brings a particular order, a distinct attribution, an authorization or prohibition, a promise or permission' (Latour and Hermant, 2006, p. 64).

Barad (2003, p. 802) also explains posthumanism as the attempt to move from representational to performative understandings of the world, from how reality is described to how reality is achieved. This is sometimes captured in another phrase that emanates from technology studies: ontological politics, which is 'a politics about what there is in the world' (Law, 2002, p. 198). Ontological politics was introduced into the theoretical lexicon by Annemarie Mol (1999). It owes its intellectual origins to ANT, which inspired such work by demonstrating the literal construction of society, how reality is performed into being. Politics and reality, then, are co-shaped. Each is enacted by the other. The lesson to be drawn from these revelations is that reality exists in the multiple (see also Law, 2002, p. 143). This means that we have choices. Which one should be performed? Where might it be performed? Who chooses? As with technological development, there are options, things can change, it can be otherwise. Ontological politics is both a call to recognize diversity and to respect it.

Reality has to be temporally, culturally and materially made in practice. In STS the laboratory was seen as the primary site for doing so. From there the reality of the peptide TRF(H) (Latour and Woolgar, 1979), the computer, the telephone or the OncoMouse™ (Haraway, 1997) was, or was not, released into the world. These objects transport new realities and new ontologies. The stress on plurality also explains why old words like 'construction' lose their purchase. In constructionist accounts plurality is always a thing of the past. Singularities reign in the present thanks to mechanisms of closure brought about by relevant social groups. Against this, proponents of ontological politics argue that reality undergoes constant manipulation by tools of various types. 'Here it is being cut into with a scalpel; there it is being bombarded with ultrasound; and somewhere else, a little further along the way, it is being put on a scale in order to be weighed' (Mol, 1999, p. 77).

Mol expands upon these points with reference to anaemia. She notes that the medical condition is performed in at least three ways. A classical performance of the type that would take place in a doctor's surgery takes note of visible symptoms, like dizziness, and bodily effects, like eyelid and skin colour. Diagnosis is via conversation. In a hospital setting laboratories would determine the reality of anaemia via blood tests which determine haemoglobin levels. Individual results are measured against a statistical standard of normality. The doctor-patient interaction is now one of doctor-patient-lab technician-testing machine. A third performance is

pathophysiological. This determines, for each individual, the line between healthy haemoglobin levels which will properly transport oxygen throughout the body and abnormal levels which will not. Textbooks tend to reduce all of these to three aspects of the same story, to a singularity (Mol, 1999, p. 78). Low haemoglobin levels mean that insufficient oxygen is carried from the lungs to other organs (pathophysiological), that they are beyond the normal range as determined by population data (statistical), and they cause symptoms that motivate the afflicted to get medical assistance (clinical). Yet in practice a patient may not display the proper symptoms, even though their haemoglobin levels are low. Organs may lack oxygen despite readings being in the normal statistical range. Mol (1999, p. 78) believes that the three ways of diagnosing anaemia address quite different things. Each diagnostic technique has its own object, its own reality. There are multiple anaemias (see also Mol, 2002).

This stress on performativity signals a move from words alone to words, things, animals, nature, indeed to materiality writ large. It also signals dissatisfaction with states and a preference for processes, discursive practices and temporal emergence. Posthumanist language privileges verbs over nouns, with 'doing' and 'becoming' top of the list (Haraway, 2006, p. 143). Matter, then, matters less than materialization. In this mangling (Pickering, 1995) there is a tendency to conflate what had formerly been separated by dashes and slashes, the socio-technical becomes the sociotechnical, nature/culture becomes 'naturecultures' (Franklin, 2006, p. 555), the natural and the social 'naturalsocial' (Haraway, 2008, p. 66). This is yet another way of signalling disdain for the ontological divides of old. In this respect Haraway's (1991) 'Cyborg Manifesto' was particularly significant, calling into question the division between humans and animals, humans and machines, and the physical and non-physical. As with cyborgs, those cybernetic organisms first dreamed of by the Cold Warriors of the military-scientific-industrial complex, companion species gather culture and nature, humans and non-humans, the organic and the technological in new and unpredictable ways.

Haraway has a long-standing interest in classification, how categories are constructed and come into being and how they help perform us. She has zero interest in reifying these boundaries or policing them. In many ways her career has been defined by her interest in things that cross the nature/culture divide: cyborgs (1991), coyotes (2004), the OncoMouse™ (1997), and the FemaleMan (1997). Dogs are interesting because they cross numerous schemas: pets, friends, food sources, herders, hunters, pests, carriers of disease, research subjects, weapons, protectors, rescuers, trackers. In other words they 'are very many kinds of entities [with] ... various kinds of relationalities' (Haraway, 2004, p. 330). The point about relationality is a crucial one. As Haraway (2003, p. 7) puts it, '[s]ubjects, objects, kinds, races, species, and genders are the products of their relating'.

One constant in the dog world appears to be their relations with humans (see also Miller, 2008, pp. 100–7). Haraway dispels the popular saying that dogs have owners and cats have staff. She argues that dogs also train us and that their domestication was a co-production, rather than a human effort alone. In very literal senses humans help bring dogs into being. Conversely 'dogs figure back very important kinds of human investments' (Haraway, 2004, p. 331). Dogs are reputed to be the first animals to be domesticated. Here Haraway (2003, p. 27) offers a different take from the usual because her domestication smacks of the fantasies of male humanist technophiles, which is to say dog as product of male will made flesh, a tool of his creation. Thanks to this masculine project of domination wild wolf is remade as tame dog. Haraway suggests that the agency may have been reversed. In all likelihood dogs made the first move (see below), and dogs and humans have acted with (and on) each other ever since. Current science makes several claims. Dogs may have developed from wolves as far back as 150 000 years ago, at around the time that Homo sapiens sapiens was emerging. Most prefer to date the beginning of the dog's becoming to some time between 50 000 and 15 000 years ago, placing its development in East Asia (Haraway, 2003, pp. 28–9).

As with the rest of technology, unintended consequences play a significant part in the development of human-dog relations. One of the most plausible paths from wolf to dog seems to arise from opportunism. We have already discussed humans as waste-makers, and this seems to be something the wolf-to-be-dog seized upon, the food scraps of human settlements. It is thought that across time, as these animals adapted to humans living in close proximity, they became less prone to flight. Humans' control of dog reproduction – killing some puppies, refusing to feed others – could also have contributed to the early shaping of dogs, although the dog-human relationship remains one of continuing co-evolution. Haraway (2003, p. 30) believes that this story makes less sense as a tale of nature and culture than it does as a narrative of technoculture, given that we are talking about natural and artificial selection. Here she cites Ed Russell who thinks of dogs as examples of 'engineered technologies' (Haraway, 2003, p. 30).

Haraway (2008) discusses training by prisoners to make the animals into pets or therapy dogs. This transforms the human and the animal subject. If successful, both are co-shaped into performing the correct behaviours. In Foucauldian fashion this involves technologies of training, various disciplinary regimes, forms of coercion and positive reinforcement. Necessary qualities for both include obedience, respect for authority, calmness and the avoidance of violence. Mastery of these attributes guarantees life outside the cell. Even those inmates still inside can leave the prison in so far as their dogs gift something of the convict to the new owner. Part of them is imprinted in the animal. Prisoners also show themselves to be reformed characters, worthy of freedom. This is reinforced

by the prisoner's relinquishment of 'their' dog. In so doing they forsake the only officially sanctioned physically proximate intimate relationship that they have. And they do so to benefit a complete stranger. Such actions are but one example of 'biotechnologies in circulation' (Haraway, 2008, p. 65). In thinking about our relationships, Haraway breathes life into object studies. Marx emphasized the concepts of use and exchange value. Haraway (2008, pp. 46, 65) suggests that companion species also have encounter value, and as commodified organisms, they are instances of 'lively capital'.

This type of dog training is positioned as a thinking technology, an 'ontological choreography', a type of 'material-semiosis'. It is a thinking technology for both dog and human. Each must be attentive to the other in order to do something together that neither could do apart. The participants in dog training are remade, changed. This is the case for all technology. 'Technologies rearrange the world for purposes, but go beyond function and purpose to something open, something not yet' (Haraway, 2006, p. 154). Compare this with Latour (2002a, p. 250): 'all technologies incite around them that whirlwind of new worlds'. Technology therefore operates to train, to think and to transform: 'In their personal bodies themselves, the dogs and people are freedom-making technologies for each other. They are each other's machine tools for making other selves. Face-to-face encounter is how those machines grind souls with new tolerance limits' (Haraway, 2008, p. 64).

Michel Serres offers another way of thinking about technology. He suggests that we should treat technologies as quasi-objects, neither object nor subject (Serres, 1995b). Quasi-objects act as bonds or ties. They are made in, influenced by and influence these relations. Meanings come through connections. Quasi-objects exist between nature and culture. They are more social and more constructed than 'hard' nature, and they are more than blank tablets awaiting the impress of the social. They are real and non-human (and for Serres (1991) sometimes human too). Latour (1996a, p. 213) agrees. He says of technology: 'It offers a continuous passage, a commerce, an *interchange*, between what humans inscribe in it and what it inscribes in humans… What should it be called? Neither object nor subject. An instituted object, quasi-object, quasi-subject, a thing that possesses body and soul indissolubly'. Could we not say the same of dogs, which as Haraway (2004, p. 331) notes, 'are neither nature, nor culture, not both/and, not neither/nor, but something else'.

Conclusion

In surveying the exchange and consumption of objects, things and their various phases and stages, our ethnographic works have given substance

to John Frow's (2004, p. 359) statement: 'Things are naturally shifty'. They pass in and out of certain forms; they are discarded and recovered, reclaimed and recycled. They go through different regimes of valuation. They are both heterogeneous and fluid (Frow, 2004, pp. 359–61), and just like people they have social lives (Appadurai, 1986, p. 3). We have seen subjects invade objects and objects invade subjects. We are forever involved in ontological exchanges. Perhaps, then, Latour's line about the exchange of competencies does not go far enough. Perhaps we need to think about 'compoundings'; not exchanges between but embedded within. Haraway elaborates. She takes on board Don Ihde's (1990) point that we use, and are used by, technologies. We inhabit them. This takes the meaning of technology away from mediation, from things that intervene between us and the world and from McLuhan's idea of technology as extensions of organs and senses, to Maurice Merlau-Ponty's proposal that 'technologies are organs, full partners … "infoldings of the flesh"' (Haraway, 2008, p. 249). Haraway (2008, p. 50) defines technologies as compounds; they contain other things and in their combination they increase their power, precipitate action and connect with the world. They are mediators and they are mediated. They can be human, part-human, organic non-human, mechanical non-human or any sort of concatenation. For Haraway (2000) they are all still technology.

We have covered a lot of ground between social theory's first material turn in the nineteenth century, examined in Chapter 2, and the more recent material turn of Thing Studies. Yet we have also come full circle. In the *Economic and Philosophic Manuscripts of 1844* Marx (1972, pp. 139, 165) wrote that objects orient us to the world, they confirm and even realize our individuality, and allow us to take up with reality: 'man is affirmed in the objective world' (Marx, 1972, p. 140).

Further Reading

While 'Thing Studies' in all its guises has yielded interesting and important insights it is remarkable how many of them are already contained in the work of Georg Simmel. To get a sense of this see his discussion of things, having and being in the chapter on individual freedom in (1990) *The Philosophy of Money*, 2nd edn, trans. T. Bottomore and D. Frisby (London: Routledge), pp. 303–34.

The December 2002 edition of *Theory, Culture & Society*, 19(5–6) is a special issue on materiality and sociality. *Organization*'s May 2005 issue – volume 12, number 3 – looks at the rise of objects in the study of organizations.

Harvey Molotch (2003) *Where Stuff Comes From* (New York: Routledge) is an excellent sociological study of the origins of objects, and of the actors,

forces and factors that shape them. Particular emphasis is placed on the design, manufacture and marketing of objects.

Where stuff goes is the subject of several interesting studies, including Heather Roger's (2005) *Gone Tomorrow: The Hidden Life of Garbage* (New York: New Press).

Joseph Murphy's (2007) edited collection *Governing Technology for Sustainability* (London : Earthscan) and Alf Hornborg's (2001) *The Power of the Machine: Global Inequalities of Economy, Technology, and Environment*(Lanham, MD: AltaMira Press) are both useful sources for material on technology and the environment.

The posthumanist literature is diverse and plentiful. The 2004 *Haraway Reader* (New York: Routledge) provides a good overview of Haraway's work. Katherine Hayles' (1999) *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press) is a classic in the field. Joel A. Tarr and Clay McShane's (2008) 'The Horse as an Urban Technology', *Journal of Urban Technology*, 15(1), pp. 5–17, speaks to this chapter's theme of interpreting organic beings as technologies, while Reviel Netz's (2004) study, *Barbed Wire* (Middletown: Wesleyan University Press), combines people, animals and environments with a technological artifact to produce what he calls 'an ecology of modernity'. The University of Minnesota Press Posthumanities Series is now in double figures. It is worth consulting, having published books by Michel Serres, Donna Haraway and Isabelle Stengers, and interesting new works are planned.

Langdon Winner (2004) gives his critical take on it all in 'Resistance is Futile: The Posthuman Condition and Its Advocates' in Harold Bailie and Timothy Casey's *Is Human Nature Obsolete?* (Cambridge, MA: MIT Press), pp. 385–411.

Neil Baddington's (2003) 'Theorizing Posthumanism', *Cultural Critique*, 53, pp. 10–27, makes the case that the posthumanist position is far from self-evident and as such it requires a more systematic theoretical approach to prove its worth.

Finally, it would be remiss not to acknowledge the significant anthropological literature on Thing Studies. The renewed interest in materiality is largely due to them. There are a number of edited collections and readers worth consulting, including: Arjun Appadurai's (1986) *The Social Life of Things: Commodities in Cultural Perspective* (Cambridge: Cambridge University Press), Patricia Spyer's (1998) *Border Fetishisms: Material Objects in Unstable Places* (New York: Routledge), Victor Buchli's (2002) *The Material Culture Reader* (Oxford: Berg), and Chris Tilley et al.'s (2006) *Handbook of Material Culture* (London: Sage). Fiona Candlin and Raiford Guins' edited collection (2009) *The Object Reader* (London: Routledge) is very much worth a look and the interested reader is also directed to the *Journal of Material Culture*.

Conclusion: We Have Always Been Posthuman

'All our technologies in the Western world', McLuhan (1968, p. 335) argued, 'are built on the assumption that they have complete immunity from inspection'. McLuhan was making a general observation. Latour (1992b) and Law (1991) think that this point applies to social theory and sociology: they too have been reluctant to engage with technology. Latour (1992b) was moved to call technologies the 'missing masses' of social theory, while Law (1991) referred to technologies as 'monsters' that startle sociological sensibilities, leading to reactive strategies of avoidance. For them, the failure to address technology is a failure to address that which makes society possible. This avoidance of technology has a long history. If we think of technologies as material artifacts (which is what we have largely done in this book), the argument can be made that for large periods of time social theory has appeared to be without object. Daniel Miller (1987, p. 217) expressed his exasperation that material culture constitutes 'the least understood of all the central phenomena of the modern age' because it is systematically ignored. Why was this so?

Bjørnar Olsen (2003, p. 94) provides one answer: the negative emphasis that critical theorists have placed on the material. He includes many of the heavyweights of modern philosophy in this category, including Martin Heidegger, the Frankfurt School, Karl Popper and Jean-Paul Sartre. Machines and instrumentation have been interpreted as sources of domination, and as the embodiment of calculating reason – the *zweckrational* with bolts on. Positioning technology as the manufacturer of alienation and inauthentic experience relates closely to Marx's concerns with technology as the vehicle for fetishism and reification. Turning a person or social relation into a thing has been seen as the worst of all possible outcomes (Olsen, 2003, p. 94).

Scholars beyond critical theory have also shown little regard for objects. This is because close identification with the world of things is commonly identified as a human failing. We are supposed to relate to other humans, not to lifeless objects (Miller, 1987, p. 11). As Turkle (2007, p. 5) puts it, we have taken a long time to admit the (emotional) influence of things on us for three reasons: fetishism is equated with perversion, collecting with hobbyism and materialism with excess. This avoidance of things was also

reinforced by the 'linguistic turn' in social theory which privileged the symbolic and the representational over the material (see Butler, 1993, p. 27). In the words of Karen Barad (2003, p. 801): 'Language matters. Discourse matters. Culture matters. There is an important sense in which the only thing that does not seem to matter anymore is matter.'

Finally, there are more banal reasons for overlooking technologies in the widest sense of the word. We do not notice the obvious. Ubiquity creates invisibility (Miller and Woodward, 2007, p. 337). McLuhan (1969, p. 22) famously compared us to fish that fail to see our water. Under such circumstances, as Heidegger said, we are only likely to notice our technologies when they stop working as anticipated (Brown, 2004, p. 4).

The result of all of this has been that social theory's 'proper' domain has tended to be the purely social relation, unequipped person-to-person encounters. Yet technologies always intrude even in supposedly unmediated face-to-face conversation. Artifacts, activities, knowledge and modes of organization are ever-present. Yes, we converse with another individual,

> but the clothing that we are wearing comes from elsewhere and was manufactured a long time ago; the words we use were not formed for this occasion; the walls we have been leaning on were designed by an architect for a client, and constructed by workers – people who are absent today, although their action continues to make itself felt. (Latour, 1996b, p. 231)

In sum, '[t]he very person we are addressing is a product of a history that goes far beyond the framework of our relationship' (Latour, 1996b, p. 231).

Clearly when we are engaged in interpersonal communication we are also involved with a whole host of others. Few of our activities are done alone. Technologies always intrude. The trend is for ever-more technologies to intervene between people or even to replace them. Think of email, voicemail, mobiles, social networking sites, ATMs, automated telephone technologies, and the slew of online services. This has led theorists to argue that contemporary society is best defined as one marked by mediated action (Bauman, 1991, p. 210). This impresses upon us the need to take technology seriously.

In opening up the black box of technology this book has been mindful of issues like access, control, ownership and use. We have paid attention to technological content and the social context of use, noting their complex connections. Technologies were initially considered as activities, things, knowledge and modes of organization. But we have also thought of technology as applied science, discourse, legislative act, ongoing encounter and experiment, ritual and social relation. We have looked at objective and subjective technologies in the domains of work and leisure. We moved

from tools and gadgets to machines, buildings and companion species. We also went from technology 'as a male activity and arena' (Berg and Lie, 1995, p. 333) to one which encompassed all genders, species and their environments. This took technology from the realm of technocratic experts and positioned it as something that concerns us all.

Technology's obduracy – its closed, fixed and essential properties – was noted, as was its interpretive flexibility as fluid and open-ended text. In the process we moved from deterministic arguments which saw technology as 'autonomous and internally unproblematic' (Wynne, 1988, p. 149) to ones stressing the contingency of technology. Technologies, it was noted, *could have been otherwise*. This shift was also presented as a move from arguments of technological neutrality towards an analysis of the politics of artifacts and their various 'enfoldings, detours, drifts, openings and translations' (Latour, 2002a, p. 255).

Our discussion saw us progress from subjects and objects, essences and substances to distributed agency, actor-networks, assemblages, configurations, quasi-objects, hybrid composites, ontological exchanges and compoundings. In place of distinct zones of ontological purity such as society and technology, then, there emerged a mangling (Pickering, 1995). The 'us' and 'them' dualisms were traded for talk of imbrication, interpellation and co-production. The older separate modes of address for people and technologies were therefore replaced by 'a single grammar for things and for people, and a single semantics' (Latour, 1995, p. 280). This is necessary for a simple reason, as Latour (2002a, p. 256) explains: the human being is never 'for itself or by itself, but always *by other things* and *for other things*'.

Latour's observation is well illustrated by a blog posted shortly after the King of Pop's death in June 2009. In 'The Michael Jackson Assemblage' P. E. (2009) brought attention to the range of heterogeneous actors and the networks of diverse and distributed practices needed to create the star's farewell concerts. Major players in this venture included: private doctors (one also acting as a spokesperson), a personal trainer, the concert promoters AEG Live, in addition to a slew of monetary advisers, managers and other hangers-on. That Jackson was a talented individual is beyond dispute, but to achieve the status of stardom the combined efforts of the culture industry were necessary. Most of us only came to know him through his mediated presence in newspapers and magazines, on the television and the internet, and through the records, tapes, CDs, videos, DVDs and MP3s that delivered him and his music. At various times this has been mediated in turn by the machinations of various cultural brokers including PR advisers, image consultants and lawyers. Even the live concerts that were to take place at London's O2 Arena in July 2009 would not be unmediated events between singer and audience alone. Various technologies like microphones, mixers, amplifiers and speakers would intrude. Similarly the set and the

lighting would be very much part of the performance. The singer would also have been supplemented by backing singers, musicians and dancers, who would themselves require the services of voice coaches, sound technicians, choreographers, stage managers and roadies. No one acts alone. It takes a network. Multiple agencies are necessary to produce a major pop star (or even a minor one). As much was known by Jackson himself who told AEG Live's CEO: 'Look, this whole business revolves around me. I'm a machine and we have to keep the machine well oiled' (quoted in P. E., 2009).

The problematization of the clearly demarcated subject/object distinction is also a way of signalling the reciprocity of technology and society, their mutual constitution in interaction. 'Instead of humans and non-humans we are beginning to think about flows, movements, arrangements, relations. It is through such dynamics that the human (and the non-human) emerges' (Michael, 2000, p. 1). We structure our worlds with technology; we perform our reality with it. Technologies, in turn, perform us. They are agents of social change and of social stability, helping to produce self and society. As such they are forms of order and forms of life. In the later chapters of this book this led to an emphasis on radical relationality, on how people and things, animals and environments help to enact each other. In other words the social is seen in all its fullness as a world of (non)human relations and interchanges. Thus came about the collapse of another divide: the mechanical and the organic. Society was not ultimately constituted by culture but by technoculture, by a collective, a series of heterogeneous networks, a sociotechnical ensemble.

Recent technological theorizing suggests that the possibility of fixed and stable states is a temporary achievement at best. In their stead, relational temporally emergent processes are noted. This, in conjunction with the recognition of the work undertaken by technology, shifts the emphasis from what things mean to what they do. It entails a shift in registers from symbolic and representational understandings of the world to performative ones. The metaphors of construction are dropped in favour of a literal interpretation. We began to speak of materialization. We also suggested that current technological lifecycles might potentially transform into never-ending spirals.

It was acknowledged that technologies do many things. They save time and effort. They help to shape the environment. They solve problems and they create new ones. They have unintended consequences and revenge effects. They are accidents waiting to happen. We have seen that technologies possess politics and ambivalence; they are capable of discrimination and domination. We have seen them function as instruments of class war, and as tools of racism and sexism. As such they have been the subjects of dramas and morality tales. The issue of technology and subjectivity was also explored. This was a recognition of Félix Guattari's (1992, p. 6) point that

'the contents of subjectivity have become increasingly dependent on a multitude of machinic systems'. This issue was also approached under a rubric of the morality of things, with the insight that morality is often delegated from humans to nonhumans (and vice versa).

We also considered the positive and empowering aspects of technology, looking at technologies as stimuli for thought, reflection and personal development. They can help with our activities, interactions, moods, perceptions and propensities. They can give us social status, mediate past and present, and assist with identity and memory work. Technologies speak to tradition, group cohesion, escapism and nostalgia. Technologies also function as prostheses, as extensions of forces, senses and mind. They also gather us; folding time, space and agents. Technologies permit new programmes of action, affordances, distributed practices, forms of association, delegations and, as a result, entirely new possibilities.

Social theory is concerned with a specific domain, what C. Wright Mills (1956, p. 20) and Michel Foucault (1979, p. 31) called 'the history of the present'. If social theorists neglect technology they fail to comprehend their object. They lose the opportunity to explain what makes us human, how action comes about, how power is exercised, and how society is constructed, maintained and transformed. It therefore needs to be centre stage in any history of the present, recognized by theorists for all its worth as 'that which makes us be' (Latour and Stark, 1999, p. 22). As Brian Rotman (2008, p. xiii) puts it: 'From the first "human singularity" to our present incarnation, human being has been shaped through a complicated co-evolutionary entanglement with language, technics, and communicational media', and, Haraway would add, co-evolutionary entanglement with other creatures. We need to pay heed to 'the temporalities, scales, materialities, relationalities between people and our constitutive partners, which always include other people and other critters, animal and not, in doing worlds, in worlding' (Haraway, 2006, p. 143). We have been co-evolving with our technologies for millions of years. We should not be separated from them by theory when we are not in practice. They are part and parcel of what it is to be human, perhaps our most human element (McLuhan, 2005, p. 289). To say that we have always been posthuman is to say nothing more than this. We are never prior to or independent of the very technologies, companion species and environments that help to constitute us. Our spotlights need to illuminate these areas.

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