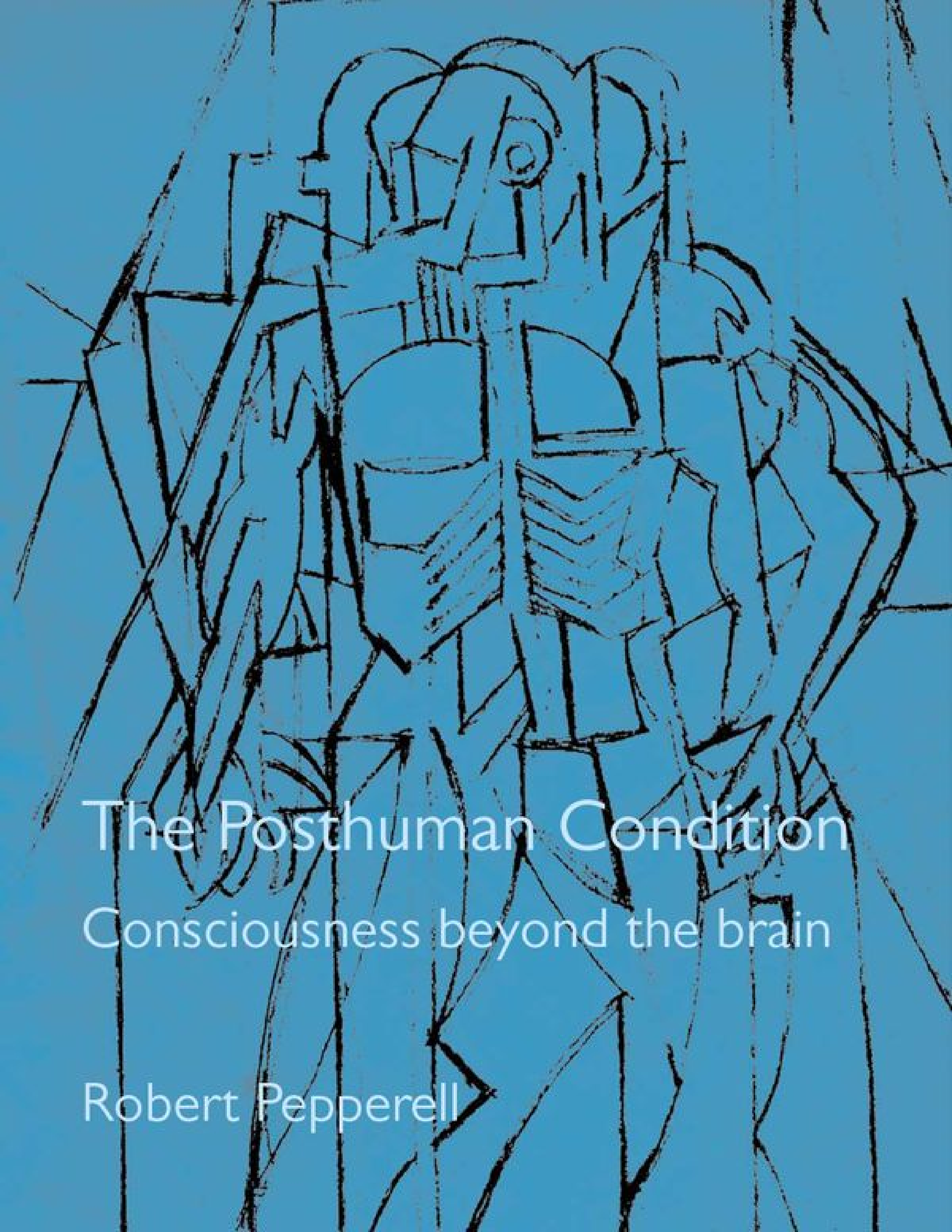

The Posthuman Condition

Consciousness beyond the brain

Robert Pepperell

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ALL Bibles or sacred codes have been the causes of the following Errors:

1. That Man has two real existing principles: Viz. a Body & a Soul.
2. That Energy, call'd Evil, is alone from the Body; & that Reason, call'd Good, is alone from the Soul.
3. That God will torment Man in Eternity for following his Energies.

But the following Contraries to these are True:

1. Man has no Body distinct from his Soul; for that call'd Body is a portion of Soul discern'd by the five Senses, the chief inlets of Soul in this age.
2. Energy is the only life, and is from the Body; and Reason is the bound or outward circumference of Energy.
3. Energy is Eternal Delight.

William Blake, *The Marriage of Heaven and Hell*, 1793

Humanists saw themselves as distinct beings, in an antagonistic relationship with their surroundings. Posthumans, on the other hand, regard their own being as embodied in an extended technological world.

The Posthuman Manifesto

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Preface to the new edition

Without wishing to claim any credit, I have detected a subtle shift in favour of the ideas offered in *The Post-Human Condition* since it was first published. In the mid- 1990s, when I asked an audience the question “Is consciousness something confined to the human brain?” the almost universal response was “yes”. Now I ask undergraduates the same question and a significant proportion say “no”, or at least look uncertain. I have also noted a shift in the positions adopted by some high- profile brain scientists and philosophers who are starting to accept that, perhaps, the body has a significant role in the production of higher mental functions. Meanwhile, the increasing respect given to what is broadly called eastern philosophy has made the continuity between object and subject more readily acceptable, along with the idea of consciousness as a phenomenon that pervades all reality. At the same time a large number of technical developments, especially in genetics and cloning, have further confused the distinctions between ‘natural’ and ‘artificial’. As I write, controversy is growing about the Italian researcher, Severino Antinori, who claims the first successful human clone is imminent; it may well have already been born (*Sunday Times*, October 20th, 2002).

Elsewhere the subjects of cultural and literary studies and social science are starting to pay attention to the emerging field of ‘posthuman studies’, with several recently published books and articles staking their claims to the rapidly expanding ground. Books such as *How We Became Posthuman* (Hayles 1999) have attempted to negotiate the synthesis of science fiction, cybernetics and artificial intelligence from within the tradition of literary criticism. Others, like *Our Posthuman Future* (Fukuyama 2002), attend to increasing uncertainty about human nature in the age of genetic manipulation and pharmaceutical engineering, and give consideration to the political and ethical implications of these technologies.

But perhaps the most significant change to have occurred in the intellectual landscape since the mid-1990s is the growth of interest in consciousness studies, and particularly the consolidation of multi-disciplinary approaches to the question of human existence, drawing on areas such as philosophy, neurology, quantum physics, art theory and spiritual traditions. In this new version I have added a subtitle, 'Consciousness beyond the brain', which I hope conveys the essential thesis of the book and positions it within this wider field of consciousness studies.I have also replaced the rather speculative term 'Post-Human' with the now more widely accepted compound 'posthuman'. This change in itself is the most obvious indication of the shift that has occurred since the first version was first published.

This book touches on many complex intellectual and philosophical issues from a broad range of areas, and is firmly aimed at the general student rather than any specific academic discipline. This cross-disciplinary approach is both a weakness and a strength. I imagine the ideal reader to be well-informed, curious and open- minded; someone more interested in the synthesis of many diverse ideas than detailed analysis of any particular one. Of necessity, therefore, the book includes a certain amount of generalisation, some unsupported assertions and even some imaginative speculation: things I usually advise my students to avoid. However, I have adopted this approach in the hope that the overall value of the synthesis will outweigh the deficiencies of any particular analysis.

I have also tried to use, where possible, bibliographical references that are widely available and accessible, even if they are not in all cases the most recent work in the field. Further information can be found at the Web site 'www.post-human.net', where comments will be warmly received.

Finally, I must thank all those whose stimulating conversation, criticism and support has, in one way or another, contributed to what is written here. This book is dedicated to "Billie", whose future is probably beyond our imagination.

Robert Pepperell, October 2002

Foreword

There seems to be an inherent compulsion in the human condition to try and understand our own existence. From diverse epochs of human history comes evidence of attempts to make sense of what we are, and how we relate to the world. We understand how earlier humans saw forces of nature, controlled by Gods, as determining human existence and subjecting us to their whim. By enhancing our technical capabilities, the story goes, we gained increasing confidence in our ability to exert control over those forces and impose our own will on nature. In the humanist period of western development, where science advanced and deities held less sway, it even became possible to think of our selves, with our intelligence and skills, as coming to dominate a fickle and violent nature. Indeed, some thinkers came to believe the universe is precisely tuned to the production of human existence — a theory latterly known as the 'Strong Anthropic Principle' (Barrow and Tipler 1988).

Today the possibilities suggested by synthetic intelligence, organic computers and genetic modification are deeply challenging to that sense of human predominance. These developments awaken deep-rooted anxieties about the threat to human existence from technology we cannot control or understand. We know we are capable of creating entities that may equal and even surpass us, and we must seriously face up to the possibility that attributes like human thought may be created in non-human forms. While this is one of our deepest fears it is also the holy grail of the computer sciences. Despite the enormous problems involved, the development of an artificially conscious entity may happen within our lifetimes. Would such an entity have human-like emotions; would it have a sense of its own being?

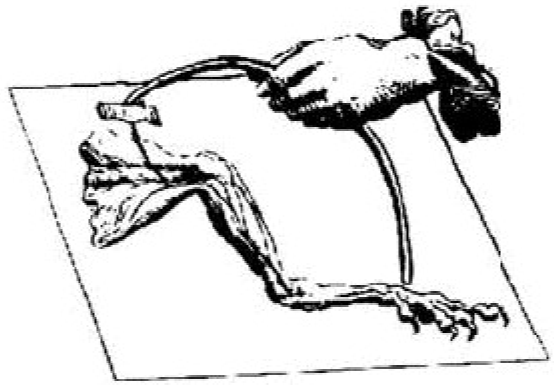
This book argues that such questions are difficult to answer given the redundant concepts of human existence that we have inherited from the humanist era, since many widely accepted humanist ideas about consciousness can no longer be sustained. In addition, new theories about nature and the operation of the universe arising from computer modelling are starting to demonstrate the profound interconnections between all things in nature where previously we had seen separations. This has implications for traditional views of the human condition and for some of the oldest problems in philosophy.

A note on the term 'posthuman'

In this book the word 'posthuman' is employed to describe a number of things at once. First, it is used to mark the end of that period of social development known as humanism, and so in this sense it means 'after humanism'. Second, it refers to the fact that our traditional view of what constitutes a human being is now undergoing a profound transformation. It is argued that we can no longer think about being human in the same way we used to. Third, the term refers to the general convergence of biology and technology to the point where they are increasingly becoming indistinguishable. In this sense the term posthuman is preferable to 'post-biological' (the two terms are sometimes interchanged) insofar as the decaying category of 'human' can be seen merely a subset of an increasingly virulent 'techno-biology' of which we might be but a transient phase. The term 'transhuman' is also widely used and carries some interesting implications not fully explored here, such as extended life and extra-terrestrial intelligence.

The 'posthuman condition' cannot be so easily defined. In simple terms we could say it is the condition of existence in which we find ourselves once the posthuman era begins. But that does not tell us very much and I believe a fuller sense can only emerge by working through the ideas presented in this book. Even here I can't claim to have given a complete picture of the posthuman condition; inevitably there are many topics and ideas that have been left out of this account. In fact, as the reader will probably come to appreciate, there is very little that is irrelevant to what I am trying to describe. Therefore, one of the major challenges in writing this book is to condense a wide range of ideas into a digestible form without treating any of them superficially. My hope is that this has been, at least partially, achieved.

If I had to summarise my own feelings about the posthuman condition, I would say we are nearing an awareness of the energy of existence — there is the tangible crackle of a storm in the air.



Introduction to the technological climate of posthumanism

The background to this book is the climate of increasingly sophisticated technology that seems to be having an ever greater impact on our daily lives. In medicine, at work, in leisure, in politics we are noticing more and more the encroaching influence of computers, telecommunications and miniaturisation. Our phone systems, which remained relatively static for 60 years, are now the means by which we can send and receive words, moving pictures and sound internationally. Television, which also developed at a fairly slow rate between the 1950s and the 1980s, has exploded in complexity within a few years such that we now have access to hundreds of services, with stereo sound and interactivity. The number of platforms on which we can listen to pre-recorded music has risen from two or three in the 1960s to around a dozen at the last count. Few people in the 1970s might have thought that they would ever own their own computer. Then computers were huge boxes that took up whole floors of buildings and were attended to by operators with degrees in mathematics. Now computers are almost as common in homes as refrigerators and, since the arrival of computer games, word-processors and spreadsheets, people see them as sources of pleasure, convenience and utility. We can get money out of walls, pay for goods with plastic cards, carry phones in our pockets, eat genetically modified tomatoes, hold computers in our palms, and navigate our cars with satellites. These are the technologies of which many people are aware in their daily lives.

Yet there is another stratum of technology that is less visible, in that it has not fed through into general consciousness, but which may have a long-term impact no less dramatic than the developments we currently see: technologies like robotics, prosthetics, machine intelligence, nanotechnology, and genetic manipulation, which will shortly be discussed. This book is not about the technologies in themselves, nor necessarily about the direct impact collectively they will have on our sense of human existence. Rather, I wish to examine a distinct kind of self- awareness of the human condition that owes something to our anxiety about, and our enthusiasm for, technological change, but is not entirely determined by it. It is a kind of self-awareness that in some ways pre-dates us by decades, even perhaps by centuries, but also seems strangely new. I have labelled this the ‘posthuman condition’, and I hope it will become clear why.

Posthuman technologies

Humans have imagined for a long time that the ability to develop and control technology was one of the defining characteristics of our condition, something that assured us of our superiority over other animals and our unique status in the world. Ironically, this sense of superiority and uniqueness is being challenged by the very technologies we are now seeking to create, and it seems the balance of dominance between human and machine is slowly shifting. It is a common fact of life that many manual and clerical workers’ jobs are being automated on the grounds of efficiency; one might wonder when, or if, this process will stop or decelerate.

While there are no machines or system that can yet be said to be capable of outright global domination, I will argue that the distinction between humans and machines is becoming less clear at the same time as it becomes increasingly hard to imagine how we would now survive without mechanical aids. The following is a summary of some contemporary developments that point to our growing integration with, and reliance upon, a technological environment.

Robotics

The science of robotics, which draws on other disciplines such as artificial intelligence and micro-engineering, is generally understood to concern the design of autonomous or semi-autonomous machines, often modelled directly on human attributes and skills. The military have shown a particular interest in automated weaponry and mechanically intelligent surveillance devices, for obvious reasons, and it is certainly the case that a large proportion of current research projects are funded directly or indirectly by the US agency DARPA (Defence Advanced Research Projects Agency). Manuel De Landa (1991) has effectively portrayed the historical precedents and potentially disturbing consequences of automated war in *War in the Age of Intelligent Machines*. He argues the twentieth century saw a shift in the relation between humans and machines that may lead eventually to the emergence of a truly independent robotic life-form, a “machinic phylum” to use a phrase he borrows from Gilles Deleuze.

Meanwhile, advances in computer control through parallel processing and learning systems that produce semi-intelligent robots, or ‘knowbots’ have accelerated the integration of machines into mass production. Here productivity is increased and labour costs reduced by the automation of many processes leading to a situation where manufacturing lines are often human-free zones as many tasks that previously required great human skill and dexterity are mechanised. And while industrial robots are now relatively static and cumbersome, the aim of much current robotic research is to achieve autonomy for the machine, to free it from static sources of power and human intervention. Mobile robots, or ‘mobots’, are intended for applications in space exploration, warfare and nuclear installations but may eventually find their way into the home in domestic applications. Most robots in use today are blindly pre-programmed to do repetitive tasks, but research into machine vision, sound sensing and touch sensitivity will allow them to sense their environment and take ‘real-time’ decisions about their operation.

At the same time as investments are made in large-scale robotic projects, alternative methods are explored that distribute resources rather than concentrating them. Rodney Brooks (Brooks and Flynn 1989) at the Massachusetts Institute of Technology (MIT) has proposed robots that are “Fast, Cheap and Out of Control”, consisting of millions of tiny units, each programmed to do a simple task, but not subject to any centralised control. In this sense they are like an ant colony that can build large structures through the co-operation of lots of tiny workers. Brooks suggests that such creatures could be dropped on a planet surface and work together to clear an area of rocks for a landing pad. It would not matter that many of the minibots might die or stop working, because they can easily be replaced. This is an example of human engineering trying to model technology from nature to improve efficiency. Equally interesting is the seemingly awesome power of Mark Tilden’s ‘Unibug’ made from cast-off electrical parts assembled for a couple of hundred dollars and described in *Robosapiens* (Menzel and D’Aluisio 2000). The Unibug, almost uniquely amongst current robots, dispenses with digital processing and uses analogue feedback circuits which allow this little ‘creature’ to move about and learn. These units are highly efficient, very cheap and more reliable than many more expensive systems.

At the other end of the complexity spectrum, Rodney Brooks has recently suggested that humans and machines will shortly reach a level of equivalent intelligence and worldly behaviour, and that we will increasingly come to see robots as companions and guides (Brooks and Frank 2002). The dream of creatingintelligent mechanical objects has historically been bound up with the strong AI (artificial intelligence) goal of modelling the human brain in order to replicate the mind. However, as will be discussed later, traditionally this has tended to towards a rather 'disembodied' understanding of the mind as a 'brain-determined' phenomenon. Taking their cue from the 'situatedness' of the embodied human brain, a new generation of researchers are building systems that more closely mimic the real behaviour of brains and bodies in the world by combining AI and robotic systems. This kind of work is being conducted using a $1 million 'Dynamic Brain' robot at the Japanese ATR Centre just outside Tokyo under the direction of Stephan Shaal and Mitsuo Kawato (Menzel and D'Aluisio ibid.).

But despite all the excitement and the high expectations of robotics it should also be recognised that we are still coming to terms with the huge degree of complexity involved in replicating anything approaching human-like behaviour (or 'humanoid' as the terminology has it). Even given the remarkable balance and agility of the Honda Corporation's hugely expensive 'Humanoid Robot' (http://world.honda.com/robot/) and its ability to walk down stairs and kick a ball, you probably wouldn't trust it to wash your best wine glasses. There is a danger that high-end robotic research comes to be seen as a public-relations exercise for large businesses, with few practical applications. In response, funding- hungry research is setting its sights on smaller, more achievable, areas of investigation such as 'search and rescue' and surgical assistance where practical benefit can more readily accrue by extending human abilities rather than replicating them. So while theorists and designers like Rodney Brooks, Ray Kurzweil (Kurzweil 1999) and Hans Moravec (Moravec 1999) are confidently predicting humanoid beings within the century, it is clear the compelling vision for those leading the field is of a world co-inhabited by human-like machines.

Communications

The use of optical fibres, satellite and microwave distribution systems is accelerating the rate at which data can be transmitted. In the digital world virtually any information can be encoded into a stream of ‘bits’ which can then be transmitted and stored in very high volume. In general, digital communications are preferred to analogue since digital encoding is much less prone to noise and interference, so the potential amount of data that one can pass through any conduit with integrity is much greater. In recent times we have witnessed a massive expansion of global telecommunications in the home and at work. We now take for granted long distance phone calls bounced off satellites, videophones, e-mail, cellular phones, domestic optical cabling with two–way information flow, as well as the Internet. The Internet changed from an obscure networking system to a global marketing phenomenon within a few years. Originally developed for military communications and academic research, it was initially limited to carrying text messages and small files, but provided the original inspiration for the influential notion of ‘cyberspace’, a dimension of reality where human experience consists in the pure flow of data (Hayles 1999).

The ‘point-and-click’ environment of the Web, giving simple access to inconceivable volumes of data, allows Web sites to become natural extensions to the multimedia desktop, giving the impression of an ‘info-world’ devoid of the restrictions of time or space. And as virtual representations are combined with digital communications, we start to see ‘meetings’ of thousands of people who are physically remote, and the building up of on-line communities distributed across the world. It seems that in this electronic world one’s physical attributes will be less significant that one’s ‘virtual presence’ or 'telepresence'. From all this derives the notion that we can increasingly socialise, work and communicate in a way that, strangely, diminishes human contact, while simultaneously extending it. In telepresent environments it will be difficult to determine where a person 'is', or what distinguishes them from the technological form they take.

Prosthetics

An area where rapid progress is being made in integrating humans and machines is in bio-engineered prosthetics; that is, artificial body parts or extensions. Although prosthetic aids have been used since ancient times and devices like spectacles since medieval times, we have only recently started to intervene in the internal workings of the body by introducing pacemakers and artificial heart valves. The replacement or enhancement of damaged organs with electromechanical devices has recently been able to boast some spectacular breakthroughs, particularly with eyes and limbs. US medical researcher Dr William Dobelle was able to offer a blind manpartial vision using a miniature video camera, a portable computer and a set of electrodes implanted in his brain (Dobelle 2000). Although the subject was able to see little more than a constellation of dots representing object outlines, according to Dr Dobelle, he was able to usefully distinguish objects in his view. In a procedure that somewhat inverts the aforementioned technique, and one with a dubious ethical dimension, signals have been retrieved from the eyes of cats and electronically reconstructed so that an external observer can see what the cat sees (Stanley et al. 1999). The resultant images are reasonably recognisable and the process, when combined with transmitting apparatus, has remarkable implications for remote sensing, not only in cats but also in humans.

Scientists, doctors and many others have long held the ambition of controlling not only mechanical limbs directly from brain activity but also remote devices. This ambition has come closer to being realised through the efforts of researchers at the MIT Touch Lab in the US, and no doubt also through the considerable discomforts of several owl monkeys (Wessberg 2000). The brains of these creatures were wired to remote scanning systems that 'learned' to interpret brain activity related to motor tasks such as reaching for food. The system was then able to correctly interpret the brain activity and use it to control remote devices through the Internet. One outcome of such research may be the control of artificial limbs by thought impulse. Another, more fantastically, may be direct brain-to-brain communication across electronic space.

An area that has attracted considerable interest, especially amongst fiction writers, is brain or body implants that embed silicon chips in the nervous system to repair or enhance the physiological processes. It is anticipated that such chips would be able to send or receive electronic impulses to or from parts of the nervous system to trigger thoughts, memories or to 'download' new information. Never shy of generating publicity, Professor Kevin Warwick of Reading University in the UK conducted a high-profile experiment in 2002 that involved having an array of electrodes implanted near his wrist that, he hoped, would allow data from his nervous system to be recorded and interpreted. Whether or not such experiments bring us closer to an understanding of our physical constitution, they certainly confirm the lengths to which some people will go to integrate themselves with machines. Given increasing miniaturisation and computer processing speeds, we can almost certainly look forward to much greater levels of interaction between machines and organic tissue, although as with robotics we should acknowledge the limitations of our current knowledge and avoid speculative futurology. In the longer term, however, with such developments it is apparent that the practical distinction between machine and organism is receding.

Intelligent machines

By arranging individual electronic 'neurons' in complex networks, computer scientists are able to construct systems that have the ability to learn from experience. Such techniques are supposed to emulate, in a modest way, the operation of the human brain, which is currently viewed as a huge matrix of interconnected neural cells. These 'neural networks' consist of virtual 'neuron' arrays set up inside the memory of a computer, each of which is linked to another; some are given the job of receiving input data, some perform calculations and others display the output of the calculation. Initially the arrays are given random values, but with regular input data the system starts to stabilise and display regular output that correlates in some way to the input; in effect, the system has learned something. It is hoped by some cognitive scientists that through this approach it will eventually be possible to develop intelligent computers that can think, feel, reason and learn from experience. Such is the view, for example, of people like Marvin Minsky (1986) at MIT and Igor Aleksander (2001) at Imperial College, London (for a discussion of the posthuman implications of some of Igor Aleksander's ideas see www.postdigital.org).

Whilst this research is in its infancy, it does indicate the trajectory of future developments. For example, it is likely that trained machines will soon do tasks now undertaken by skilled humans. Stephen J. Meltzer, M.D., professor of medicine at the University of Maryland School of Medicine employs neural net systems that have been taught to diagnose certain forms of inflammatory bowel disease which can lead to cancer. More widely, intelligent nets have been used in market research where huge volumes of customer data are analysed for trends, in the stock markets where programs learn about economic data and suggest investment routes, in handwriting recognition which has allowed the automation of form processing and postal work, and in industrial quality control where production lines can be monitored and modified if necessary. Possible futureapplications have been suggested, such as face and voice recognition for security access, automatic transport systems, on-line intelligence databases, virtual teachers, and even artificial consciousness itself. Neural networks of today do have severe limitations if they are to be seen as models of the human brain (they are usually digital serial rather than analogue parallel, as the brain is) but they do show how machines can have the ability to adapt and learn; qualities that are so fundamental to human nature.

Nanotechnology

Nanotechnology represents the technique of designing or evolving tiny machines that can be programmed to operate in environments such as the human body. Such machines might fight diseases, increase physical performance or prevent ageing. In his important book *Engines of Creation*, Eric Drexler (1990) describes some of the means by which little machines could be created and what they could be used for. One branch of nanotechnology consists in arranging molecules in certain configurations that will perform given tasks in certain environments. For example, it may be possible to create artificial proteins, the building blocks of organic matter and thus special types of organic machine. According to Drexler, nanomachines will be able to design and assemble other nanomachines. Such 'universal assemblers' will operate at an atomic level building molecular compounds to order.

Because assemblers will let us place atoms in almost any reasonable arrangement, they will be able to build almost anything that the laws of nature will permit — including more assemblers — and thus may open a completely unimagined world of new technologies. Some of the applications of nanotechnology seem fantastical, yet according to Drexler, are based on proven scientific principles. He writes of space-suits constructed like living skin, as strong as steel, that are programmed to adapt to your body as you move around so that you hardly feel them. The skin, whilst protecting you, also passes on the sensory data you need to feel your way around with your hands and feet. Molecular engines could be inserted into the blood to seek out and kill malignant cells and viruses, or mend damaged DNA so that dying cells could be revitalised and lost tissue re-grown. Large machines, such as rocket engines, could be built by billions of tiny molecular workers 'growing' complete structures from programmed 'seeds'. Whilst many of these remain highly speculative, the notion of molecular machines has attracted considerable interest. There seems no essential reason why this approach could not be adopted as the relevant technology advances. Yet again, such organic machines would blur the distinction between organic and mechanical.

Genetic manipulation

The DNA molecule inside living things contains information about how organisms develop, how they behave and, to some extent how they die. As the biologist Steve Jones explains in *The Language of Genes*, human DNA today holds traces of heredity that date back to the beginning of life (Jones 1993). Shortly after DNA was isolated the hope arose that the destiny of life itself could be controlled through its manipulation. In fact, it turns out that DNA is an extraordinarily complex molecule that controls extraordinarily complex biological events. It has by no means been easy to decipher the way it reacts with other chemicals, or to determine what each part of the DNA chain does. However, since the 1980s genetic synthesis has become highly advanced and various techniques have been developed that allow the structure of DNA to be modified for various purposes. Gene therapy attempts to treat certain diseases that are caused by faults in DNA by replacing the faulty strand with a working one. Genetically engineered livestock and produce have been marketed that display beneficial features but also some disturbing potential dangers, as the recently reported defects in cloned mammals have demonstrated (for a study of the dangers of genetics see Fukuyama 2002).

As a result of the Human Genome Project, which is responsible for decoding the entire genetic structure of humans (http://www.ornl.gov/hgmis/), it is apparent that there is great potential for genetic manipulation of the human species. The obvious implication is that once the human has been reduced to a series of codes, such codes can be 're-mixed' in a number of ways to produce mutant offspring with varying physical, cosmetic and cognitive characteristics. It is almost certain that genetic codes, being huge in data volume, will be stored and manipulated with computer systems, further implying that computers will be able to help design new organisms from databases of genetic codes.

Some geneticists, notably Richard Dawkins, have claimed that DNA is actually a machine for making life (Dawkins 1995). What's more, this machine is 'digital' in the same way that computers are digital, and its sole purpose is to ensure its own reproduction. As he uncompromisingly states in *River Out of Eden*, "We — and that means all living things — are survival machines programmed to propagate the digital database that did the programming." Whether one agrees with Dawkins' hard-line on mechanism, viewed in this way there is no distinction between the mechanical and the organic when it comes to considering DNA.

Artificial life

Artificial life, the study of man-made systems that exhibit behavioural characteristics of natural living systems, is a relatively new field of study that has emerged from the investigation of complex dynamics made possible by fast computers (Levy 1992). A typical A-life project would consist in creating a virtual space in the computer in which digital organisms, sometimes called 'critters', can live, breed, feed, fight and die. These creatures might not look like much more than strings of numbers, or specks on a screen, but they can 'live' out intricate, interdependent existences that have much in common with real colonies of cells, or, as we shall see later, flocks of birds. The behaviour displayed by artificial communities is often called 'complex' or 'emergent' in that the programmer is unable to determine in advance what the colony will do, instead merely creating suitable conditions in which complex behaviour can emerge. This is true even though each individual critter has very limited and predictable functions. Such computer models are used to suggest both ways in which actual life may have begun and ways in which life might be simulated in future.

In some ways computer viruses, as their name suggests, can be considered a form of artificial life insofar as they are self-replicating and parasitically reliant on being passed from host machine to host machine. Some biologists, such as Noriyuki Kasahara, member of the Institute for

Genetic Medicine, consider organic viruses to be self-replicating machines, and not a form of animate life at all (Kasahara 1995).

In computing terms, artificial life forms are often able to breed and in doing so can pass beneficial characteristics to their offspring just as real viruses and organisms can. If the A-Life critters are set some task, for example to be good at getting through small holes, then those offspring that can get through holes better are rewarded with survival. This behaviour can be expressed in a 'genetic algorithm' — a piece of computer code that creates random mutation that allow the possibility of novel solutions to problems. The very name 'genetic algorithm' firmly implies the integration of organic and mechanical processes.

The real and the artificial

This is by no means an exhaustive survey of, what are termed here, posthuman technologies. But from this sample it seems evident that many living functions will be machine replicable and many machines will acquire life-like qualities. The net effect of these developments, and many others, is the background to what I call here posthumanism, and it leads us to ask — how will we distinguish between the real and the artificial, the original and the simulated, the organic and the mechanical? I would suggest that very soon, for practical purposes in certain circumstances, these will become little more than semantic distinctions.

CHAPTER ONE
CONSCIOUSNESS, HUMANS AND COMPLEXITY

Does consciousness reside in the brain? Are human beings confined to the boundaries of their skin? These questions, which for so long might have had straightforward answers, are now becoming deeply problematic, partly as a consequence of developments in technology and partly because of shifts in our understanding of nature and the cosmos. This chapter will look again at these questions to see how our views about human nature may be changing, and why new philosophical ideas are needed to help us describe them.

Belief in brain determinism

In his book *Minds, Brains and Science* the philosopher John Searle declares "Mental phenomena, all mental phenomena whether conscious or unconscious, visual or auditory, pains, tickles, itches, thoughts, indeed all our mental life, are caused by processes going on in the brain." (Searle 1984 p.18). It is a commonly held belief that the brain determines or causes mental phenomena, in particular the phenomena of consciousness, with the consequence that in much philosophical discussion of consciousness the body and the world beyond are largely neglected. I wish to argue this neglect can no longer be sustained if we are to make any progress in understanding the role of consciousness in our existence.

What is meant by consciousness?

Any discussion about 'consciousness' first requires some clarification of the term. As specialists in the field will quickly point out, the exact nature of consciousness is open to various interpretations, some more controversial than others. As used here the term consciousness refers to all those attributes we usually associate with a sentient human such as thought, emotion, memory, awareness, intelligence, self- knowledge, a sense of being, and so on. It turns out that within this range of attributes there are varying layers and densities of consciousness that can be more or less successfully distinguished. But for the purposes of this discussion we will consider these variations as homogeneous, while tacitly acknowledging the greater complexities of the subject.

The supreme organ

Roland Barthes, in his book *Mythologies*, speaks of ‘The Brain of Einstein’, which had been bequeathed by the great physicist to two hospitals upon his death.

> A photograph shows him lying down, his head bristling with electric wires: the waves of his brain are being recorded, while he is requested to “think of relativity”. (But for that matter, what does “to think of ” mean exactly?) What this is meant to convey is probably that the seismograms will be all the more violent since “relativity” is an arduous subject. (Barthes 1972 p. 68)

Surely it would be absurd, grossly counter-intuitive, to place similar electrodes on the palms or feet and expect to get a “violent” reading? The brain is after all spectacularly described by Jonathan Cohen (2001) of the Center for the Study of Brain, Mind, and Behavior at Princeton as the “most complex device in the Universe” (this seems to imply a dubiously privileged knowledge of everything else in the universe). At the same time we are told that there are “more synapses in the brain than there are stars in the galaxy.” Whatever the accuracy of these compelling facts, it seems we are to be left in no doubt as to the supremacy of this organ over all other objects.

Dead heads

Joseph-Ignace Guillotin (1738-1814), who is often credited with inventing the comparatively rational and humane execution machine, is sometimes also accused of collecting severed heads in order to revive them and communicate with the after-life. Although both claims are erroneous, the latter story does accord with a widespread belief in the idea that the person, or their personality, is contained in the vessel of the head. During the French Revolution and its bloody aftermath Guillotin was actually a prominent advocate for, rather than inventor of, this well- established form of execution for the reason that it was less barbarous than other methods of execution being used. So progressive was it seen to be that it was utilised publicly in France up to the mid-twentieth century. There does exist, however, an account by a French physician, Dr Beaurieux, who in 1905 conducted a gruesome experiment with the decapitated head of a guillotined prisoner. As the prisoner, Languille, was executed at 5.30 on a summer morning, Dr Beaurieux shouted at the severed head. “I saw the eyelids slowly lift up, without any spasmodic contractions, I insist advisedly on this peculiarity, but with an even movement, quite distinct and normal, such as happens in everyday life with people awakened or torn from their thoughts", runs the doctor's commentary (Kershaw 1958). This testimony might be taken as apparently convincing proof that conscious reactions can persist, albeit briefly, without the presence of the body.

Counter interpretations

Rather than providing evidence of an autonomously conscious brain, an experiment such as the one just described could equally well be used as evidence to confirm the contrary view — that the brain has no chance of being conscious without complementary physical apparatus and some external stimuli. First, it is possible that the reflexes noted by Dr Beaurieux are automatic and involuntary. Cases of muscular movement after decapitation are seen in chickens and even, reportedly, in marching soldiers killed as they advance into the fire of their enemy. Second, the apparent response to the shouting is not absolute evidence of consciousness but merely the deduction of its presence. The presence or otherwise of consciousness can only be deduced from observable behaviour and not internally verified by any empirical or technical methods. So, in this case appearance and actuality may not necessarily accord. Third, without the ancillary apparatus of ears, eyes and facial muscles to convey sensation, no conscious response would be affected or detected, which re-asserts the necessity of sensory organs other than the brain, such as ears and eyes, in producing a conscious response (if that's what it is in this case). And finally, this case serves to confirm what we already know without having to do the experiment: that severing the brain from the spinal cord (the official cause of death in guillotining) terminates conscious activity, so far as we can tell from observation.

What am I?

If I were deeply concerned about my own mortality I might consider having myself cryogenically suspended. Foundations like Alcor (www.alcor.org) will perform the service on my whole body for about $120,000 at today's prices. If I believed that what essentially constituted 'me' was the brain in my head, however, then I might save money and opt for 'neurosuspension', a euphemism for having just my head or brain frozen, at the much lower cost of around $50,000. The reasoning goes that my body is dispensable, interchangeable and may well be diseased. Therefore, I (my brain) could be replanted in another body, or in one re-grown from my own DNA. In this way 'I' could be reconstituted, which presumably means having some sense of continuity with my pre-frozen self when I am revived.

Such reduction of individual humans to the specific organ of the brain seems economical until one considers how such a replanted brain might struggle to cope with an alien or inexperienced torso. We know from anatomy the deep extent to which the brain is closely bound to the autonomic nervous system of the body and certain highly responsive organs and glands (Thompson 1993). Will the implanted brain be able to simply restore those intimate conduits immediately, without itself first failing? How will the body, in whatever state, regain the slowly acquired motor skills the living person takes for granted and which are, to some extent, inherent in the muscles, nerves and organs of the body rather than just the brain itself?

These objections might rightly be regarded as medical problems to be overcome in the course of time. Yet a deeper philosophical problem remains — am 'I' no more than a specific arrangement of cerebral neural tissue, a compound of synaptic probabilities that can be inserted into any suitable carcass? Some would think this valid. Or am 'I' something of much greater complexity, which includes those synaptic probabilities, but many other things as well?

Physical intelligence

There seems to be little doubt in the minds of many cognitive scientists that modelling human intelligence means modelling the human brain. The study of neural nets is predicated on engineering techniques inspired by the brain's neuronal structure (Aleksander 2001). One would not wish to deny this assumption entirely; there can be little serious resistance to the belief that the incalculable intricacy of the brain, with its massively parallel interconnections of neurons, supports much of our intellectual activity. However, this belief does not preclude or negate the possibility that a similar capacity for intelligence might exist beyond the brain; for example, elsewhere in the nervous system or even across the body as a whole.

Consider our occasionally startlingly rapid reactions to dangerous or unexpected events, such as flinching from heat, catching a falling child, or the manual dexterity of an accomplished musician. Such reactions, of course, would rely to some extent on the processing capacity of the brain. But given the range of sensors, conductors and motors that enable the response to occur at all, as well as the relative 'slowness' of internal nervous signals (as was established by Hermann Helmholtz as far back as the 1850s), it does not seem sensible to ascribe our immediate reactions to brain activity alone. In other words, intelligence may be a quality recognisable in the overall behaviour of a person but normally attributed to only a single component of the body. A pertinent question might be, to what extent is intelligence possible in the human brain without the intervention and co-operation of the rest of the body? Without a precise answer, where can we say intelligence 'is'?

How to build a mind

Some years ago, when the first edition of *The Post-Human Condition* was published, I was invited to speak to students studying artificial intelligence at a well-known UK University. On arrival I was warmly received by a group of staff and taken to lunch where the conversation started amiably enough, until the subject of my lecture came up. With a certain confidence born of naïvety, I proceeded to set out my claim that the brain was not solely responsible for consciousness (and, by extension, intelligence) and that attempts to generate artificial thought by modelling brain structure alone were flawed. While the faces around me had initially shown polite interest they soon turned to polite derision and I realised I was intellectually isolated. I was, of course, aware at the time that the views I held were unorthodox but I wasn't prepared for the hostility they would induce in all the staff and in all but a couple of the students I spoke to. Today, of course, the situation is very different. The notion of 'embedded' or 'embodied' intelligence is certainly now a powerful, if not the dominant, paradigm in artificial intelligence research and human-machine interaction (Clark 1997, Dourish 2001) and recent research tends to support the idea that intelligence is as much a function of an organism's interaction with the environment as its brain processing capacity. Joseph Wakeling and Per Bak have conducted experiments with neural network 'minibrains' that are tasked with choosing simple options in competition with each other (Wakeling 2001). The minibrains perform poorly when endowed only with knowledge of their own behaviour, but perform much better when they are able to take into account information about other minibrains around them and the status of their environment. They conclude that intelligent behaviour requires more than just brain processing power: the bodily vehicle and awareness of activity in the surroundings are crucial to good overall performance. This seems to imply some deep unity between the active world and the active, functioning mind.

Sensory deprivation and the mind/body problem

Since the original research was done in the 1950s at McGill University, much has become known about the damaging effect upon human consciousness of sensory deprivation; that is, when the brain is left entirely to itself in the absence of bodily stimulation. In cases where the person is denied sensory stimuli for long periods of time the normal functioning of the mind breaks down, with an onset of hallucination and eventual severe trauma. Without the continuous flow of varied information it is used to receiving from the body and the world the mind cannot operate properly. In *Out of Control* Kevin Kelly cites examples of the detrimental effect of denying visual stimulation to sighted patients, and has this suggestion:

> 'Black patch psychosis' is something ophthalmologists watch for on the wards. I think the universities should keep an eye out for it too. Every philosophy department should hang a pair of black eye patches in a red fire alarm-like box that says "In case of argument about mind/body, break glass, put on." (Kelly 1994 p. 68)

Quantum holism and the mind/world problem

Support for the deep unity of mind and world, and by extension the unity of brain and body, comes from perhaps the 'hardest' science of all — physics. In the Copenhagen interpretation of quantum reality the conventional boundary between the observer and the observed is brought into question, as is the boundary between mind and reality. The Copenhagen interpretation is a way of reading the results of sub-atomic research that holistically binds the observer and the observed in such a way as to make the outcome of an event dependent on the researcher. As David Peat reports in *Einstein's Moon*:

> This holistic nature of the atomic world was the key to Bohr's Copehagen interpretation. It was something totally new to physics, although similar ideas had long been taught in the East. For more than two thousand years, Eastern philosophers had talked about the unity between the observer and that which is observed. They had

> pointed to the illusion of breaking apart a thought from the mind that thinks the thought. Now a similar holism was entering physics. (Peat 1990 p. 62)

My own feelings of consciousness

But need we rely on academics and scientists to advise us on the location of consciousness and the relationship between mind, body and world? Is the fact that are bodies are conscious not obvious? If by consciousness we mean a compound of feelings, emotions, and memories that are exhibited by the living being and not by the dead, then arguably these are as much a function of the whole body as of the brain: when I feel unhappiness it is in my chest and arms; when I am frightened it is in my bowels and legs that the sensation is strongest; if I am amused it is my mouth and cheeks that are significantly altered; when I am alert it is my muscles that are tense; when I am moved by music it is my whole body which tingles or dances; if I am bored my body starts to fidget. All these apparently 'mental' states seem more easily identified by their 'physical' attributes. It seems the distinction between mental and physical states might be increasingly dubious.

What is the matter?

If it is the case that the long-held separation between brain and body, or between the mental and the physical, is being eroded as the tide of contemporary ideas runs against it, then we might be gradually drawn to the conclusion that our minds, our bodies and the world are continuous. But this is a conclusion that for many runs counter to our habitual understanding of human existence. Furthermore, it is one thing to say the mind, the body and the world are continuous (and posthumans are not the first to say it) but another matter altogether to appreciate what practical implications this might have. We shall return to these later in the book.

What is a human?

Like the separation between mind and body already discussed, the separation between the body and the world is deeply embedded into our habitual conception of our own existence. Further to what has already been suggested, I wish to reinforce the claim that the apparent separation between the human and the environment is invalid in the posthuman era and, therefore, needs revision.

Fuzzy humans

Our bodies consist in a complex matrix of senses that perpetually respond to the stimuli and demands of the environment. Even when asleep we are still partially sensitive to light, heat, movement and sound. And as our waking body responds to fluctuations in the world, so to some extent it affects the world reciprocally with its excretions and actions. Since a human cannot be separated from its supportive environment for any length of time without coming to harm (for example, by being put under water, or into space), it seems the human is a 'fuzzy edged' entity that is profoundly dependent into its surroundings, much as the brain is dependent on the body. We only have to consider the perpetual exchange of liquids, chemicals and energies in the form of urine, faeces, menstrual fluid, hair, air, sperm, food, water, skin, sound, light, and heat to recognise how deeply integrated into our environment we are. Because of this perpetual exchange between the living human organism and its surroundings, there can be no fixed state of a living human. Ultimately, we may never know the human as anything more than approximation —a contingent nexus of substances and events that mutates from egg to decaying corpse, neither bounded by our skin nor isolated from the environment we are woven into, and woven of.

Animal sense

As a practical illustration of how humans might extend beyond their skin I can recount an apparently remarkable faculty displayed by Spider, my old cat, who knew that my wife was more likely to feed her than I was. Despite this, Spider used to like sleeping on my lap in the late afternoon when I had finished work in my studio at home. From the position where I sat with the cat in my lap it was just possible, through our own door and corridor, to hear the sound of a key being inserted into the main front door, which the flat upstairs also shared. It was not possible, however, to see who was at the door. Several people lived in the upstairs flat and even though they used the front door many times in a day, Spider never stirred unless it was my wife who put her key in the door. As soon as the key turned Spider jumped up and ran towards the door in anticipation of being fed. I noted this on many occasions, and only very rarely did Spider miss her cue.

Short of endowing her with some inexplicable sense, the most obvious explanation is that Spider was responding to the scent of the person whom she associated with food. The remarkable thing is the speed and distance at which this recognition occurred — almost instantaneously and through two doors and two corridors. It's also worth mentioning that the people upstairs had a dog that would yap when one of them turned a key in the door.

Whatever this scent that triggered the behaviour in the animals, it is certainly something that extends beyond the skin boundary of its owner. It would be reasonable to assert that the scent is part of that person, a part of what constitutes them uniquely, at least as far as the animals are concerned. Those who use tracker dogs depend on the fact that animals can identify humans from their scent. Likewise the game hunter must be wary of detection by a quarry. A visit to one of the many suppliers of hunting equipment on the Web will reveal a host of products that claim to eliminate human scent, including sprays, suits and boots. The manufacturers claim that prey can detect humans at distances over half a kilometre (www.bucksndoes.com/facts/facts.html), which means, for the purposes of hunting at least, one's dimensions exceed a diameter of one kilometre.

The posthuman conception of human existence

If we accept that the mind and body cannot be absolutely distinguished and that the body and the environment cannot be absolutely distinguished, then we are left with an apparently absurd, yet logically consistent conclusion: that consciousness and the environment cannot be absolutely distinguished. If so, then an integrated continuum exists throughout consciousness, body and environment such that any distinction in that continuum, for example between the skin and the scent it emits, or between an object perceived and the object itself, is necessarily contingent and arbitrary. The general implication is that we can never determine the absolute boundary of the human, either physically or mentally. In this sense, *nothing can be external to a human because the extent of a human can't be fixed*. The consequences as far as the posthuman condition is concerned are profound. It means that human beings do not exist in the sense in which we ordinarily think of them, that is as separate entities in perpetual antagonism with a nature that is external to them.

(One might argue that if I was shot with a bullet I would promptly re-assess this opinion about the non-existence of an independent world. In this case the impact of material reality would seem to prove the existence of a distinct, antagonistic externality beyond doubt. However, whilst a bullet might cause severe problems to my continued viability as a conscious being, it would not negate the fact that my body has no fixed boundaries. It would simply mean those indefinite boundaries had undergone a transformation, probably increasing the surface area over which I am distributed, making the job of fixing my boundaries even less precise.)

Reductionist thought

On the other hand, it is understandable that many philosophers and scientists will continue to insist that conscious thought only occurs in the brain and assume the body is distinct from its environment. This is because much philosophy, and most science, proceeds in an essentially reductive, linear way; that is, philosophers and scientists tend to break down complex processes into a series of definable steps that they then try to rebuild as a logically consistent sequence, a process that is sometimes called the 'analytic method' or 'reductionism'. It is commonplace in reductionist methodologies to seek to isolate a property displayed by a whole system to a specific part of the system. The attempt made by neuroscientists to locate consciousness in a particular region of the brain is a good example.

But when something as complex as the body and the mind are dealt with in this reductionist way one is forced by practicalities to limit the number of variables under consideration, with the consequence that certain factors in the overall behaviour of the system to get side-lined, or ignored altogether. For example, the only usual evidence we have for how a person feels comes from outward physical actions such as gesture, speech and expression. There is no scanner that can see ‘happiness’ or ‘surprise’ inside a brain. Given that these expressions are present in a conscious person we are observing, where then would we specify that ‘feeling’ is actually happening? Is it happening centrally in the brain with the consequential reactions filtering outwards to the limbs and lips? This is certainly a respectable scientific view in which activity in the body is seen as either contributing to or responding to the processes of the brain, but not in itself part of the central mental experience. It is a view that is essentially linear and reductive in the terms described above and endorsed by many computational psychologists who tend to think of human cognition in terms of ‘input’, ‘output’ and ‘processing’, hence regarding human minds as somewhat analogous to serial computers (Draaisma 2000 p. 151).

The linear approach to modelling minds

Classical artificial intelligence theorists try to break down cognitive processes into a series of logical statements that can be run in sequence much like a piece of computer code. This approach has been endorsed by those who support the ‘strong’ form of artificial intelligence (Hofstadter 1980, Minsky 1986, Moravec 1989) and who draw an analogy between the brain as hardware and the mind as software. In this linear model, a central controlling device is assumed, and it is natural to follow the computer analogy and regard the brain as the central processing unit (CPU). If the brain is like a giant computer (albeit a very convoluted one) then the body is relegated to the status of a peripheral device supplying input data and energy and responding to output data and commands. The outward expressions of thought, or the bodily sensations that accompany thought, are seen as products of rather than constituents of the thought itself, in the same way that a computer monitor displays the output of the CPU but is seen as distinct from the information processing centre (for a related thought experiment see Appendix I). This is what I have called here the ‘linear model of thought’ (although the term ‘linear is not used here in its strict mathematical sense), which is arguably a product of rational, humanist science, and for many recent decades seemed to promise rich rewards for those seeking to replicate human qualities in machines.

But how much longer can this linear analysis remain useful? Even the most enthusiastic proponents of the computational model acknowledge the huge difficulties involved in replicating actual human thought processes. Perhaps attempts to understand conscious activity by dividing the thinking system into component parts and then trying to piece together the parts in a logical and linear way will flounder in the face of overwhelming complexity? From some of the evidence presented here, we may have to accept the possibility that the human mind is just too circuitous to be modelled using a linear paradigm.

A note on non-linear systems

Objects and systems with indeterminate boundaries are often described as 'non- linear'. In simple terms, non-linear systems are those which cannot be described by linear equations. Such systems are often called 'complex dynamical' or 'turbulent' in that they represent activity that is chaotic and unpredictable. Examples of non- linear systems would include a cloud of gas, a splash of paint, or a turbulent river. In recent times the concept of non-linearity has been used to describe many phenomena from the weather to the price of oil. Linear equations are seen to be useful in describing 'ideal' situations with few variables, whereas non-linear equations are often used to try and describe 'real' situations — things that are messy and complex. One of the major features of non-linear systems is that their behaviour is seen to be sensitive to many simultaneous influences. As will be discussed later, to describe such a system fully we cannot rule out the effect of even very small perturbations as they may become magnified and cause global changes in the system — the so-called 'butterfly effect'. For what is still an entertaining and useful introduction to non-linearity, see *Chaos* by James Gleick (1988).

The non-linear approach

A non-linear model of the mind and body might be easier to reconcile with our own experience, in which we understand ourselves to be constituted of dynamic, interrelated events involving multiple stimuli and responses occurring simultaneously throughout our being. In which case, rather than following a sequential model in which inputs and outputs are peripheral to a central processor, could we not think of a schema in which inputs and outputs are *part of* the central processor — to the extent that there is no 'central' processor but instead a matrix of dispersed but interconnected processes? Then the activities we are discussing (thought, consciousness and a sense of being) could be distributed throughout the system that gives rise to them rather than being confined to any one part. After all, we have already said that the only way we can determine whether or not someone else is thinking is from their physical expressions. Why should such physical expressions, or their associated sensations, be any less a constituent of a thought than that part that occurs in the brain?

Consciousness and system sensitivity

If we can accept that thought may be distributed throughout the body (and the body distributed through the environment) then we must assume that any factor that affects the body might have a bearing on thought. Thought, then, becomes a highly sensitive process influenced by a huge range of interacting factors, many of which arise from our existence in the world. A non-linear model of consciousness and human being would regard the complex activities of the living person as a constellation of interdependent processes, to the extent that no one event can be isolated as a cause or origin of conscious experience. Such a model demands that we acknowledge all the potential forces that might act upon a person to influence their state of consciousness, things like the weather, memories, chemical changes in the body, age, sex, social conditioning, personality, skills, reflexes, general health, and so on. A more detailed discussion of this model is offered in chapter four.

In the context of the posthuman condition, the non-linear model is preferable to the linear since a dynamic conception of thought allows us to account for the widely dispersed factors that collectively generate conscious sensation.

A note on complexity

Complexity theory holds that the overall behaviour of a complex system cannot be explained by reference to any of its individual components. This means that even though we may be able to break up a system into its constituent parts, we will not be able to learn about the global behaviour of the system by studying them individually. The global behaviour is something that emerges when all the constituent parts are exerting their influence on each other. Without the mutual effect of the constituents on each other the critical state of complexity is not reached and the global behaviour does not appear. The phenomenon is clearly described by Steven Levy in *Artificial Life*:

> A complex system is one whose component parts interact with sufficient intricacy that they cannot be predicted by standard linear equations; so many variables are at work in the system that its overall behaviour can only be understood as an emergent consequence of the holistic sum of all the myriad behaviours embedded within. Reductionism does not work with complex systems, and it is now clear that a purely reductionist approach cannot be applied when studying life: in living systems, the whole is more than the sum of its parts. . . this is the result not of a mysterious dram of vital life-giving fluid but rather the benefits of complexity, which allows certain behaviours and characteristics to emerge unbidden. The mechanics of this may have been hammered out by evolution, but the engine of evolution cannot begin to fire until a certain degree of complexity is present. Living systems epitomise complexity, so much so that some scientists now see complexity as the defining characteristic of life. (Levy 1992 p. 7)

An example that is often given to illustrate complexity theory is the behaviour of flocks of birds. Taken collectively, the behaviour of a flock seems well choreographed and purposeful. It can avoid obstacles, circle over food and prey, and travel halfway around the world while performing all sorts of loops and whorls in the sky, yet there is no apparent central controller. Complexity theory offers an explanation of this behaviour based on the assertion that the global activity we see exhibited by the flock emerges from simple interaction among the individual birds. Steven Levy goes on to quote the person who first modelled bird flocks on a computer system, Craig Reynolds:

> The motion of a flock of birds is . . . simple in concept yet is so visually complex it seems randomly arrayed and yet is magnificently synchronous. Perhaps most puzzling is the strong impression of intentional centralised control. Yet all evidence suggests that flock motion must be merely the aggregate result of the actions of individual animals, each acting solely on the basis of its local perception of the world. (Levy ibid. p. 76)

Complexity theory has been incredibly useful in modelling behaviour on computers that is analogous to that seen in nature (Waldrop 1992). What is striking about such simulations, and what is most useful to our account of consciousness, is the purposeful, almost ‘mystical’ properties that even fairly simple systems exhibit. Cellular Automata (CA), little cell-like creatures that live, grow and mate in a computer’s memory, quickly seem to take on those attributes of ‘animism’ we normally associate with other living things. They are born and they die, struggle, reproduce, try and fail. This is not because any such animistic properties have been programmed in by a clever coder or animator; such a programming task would be awesomely difficult. It is simply that these properties emerge when relatively simple things are allowed to interact with each other in a suitably supportive system. There are many examples of CA programs on the Internet, particularly a variety called “Life”, or “The Game of Life” (for some fascinating examples see http://cell-auto.com/).

Biologists and philosophers such as Hans Driesch and Henri Bergson (1911) have postulated that the phenomenon we know as life rests on some essential ‘spark’, the élan vital, which distinguishes animate and inanimate matter. The case of Driesch is interesting in this regard, in that for much of his early biological career he was an avowed reductionist, pursuing a mechanistic view of embryonic development. Later, he became an equally enthusiastic vitalist “postulating Aristotle’s ‘entelechy’ as the purposive intelligence which governs development.” (Bullock 1983). Putting aside the dispute about the merits of vitalism, we do know that the exact location of a ‘spark of life’ has never been scientifically determined. Yet, as Steven Levy points out, complexity theory apparently provides us with just such a spark: the appearance of animation and purpose that arises in a complex system. It is not ‘located’ in any one part of the system and it does not emerge until the system is up and running. The ‘immaterial spark of life’ may be nothing but the appearance of complexity.

Mechanically reproduced pictures can be seen as a type of complex system in which a recognisable image emerges from a number of smaller, distributed events. In this case, the printed dots that make up the ink screen on the page are the individual components which, collectively, give rise to the appearance of a face. The appearance of a face does not consist in any of the parts, or dots, but we are able to recognise it as we simultaneously perceive their unified effect; here, the emergent property is a coherent picture. Such a description can be true of any material (silver-based film emulsion, video screens, laser printers, faxes) that has an informational content that is greater that the sum of its parts. To take the case of a graphic on a computer screen: the mere addition of all the pixel's RGB values would produce a number, but that number would have very little informational content. However, the spatial arrangement of pixel values on a screen gives rise to an image (informational content) which the numerical values of the pixels alone do not convey.

The unlocated mind

In the same way that a 'spark of life' was postulated but never isolated, an 'immaterial mind' has been proposed as a way of accounting for the sensation of consciousness and self-knowledge — a tactic known as 'dualism' and often attributed to René Descartes. The source of this immaterial mind, which is sometimes synonymous with the 'spirit' or 'soul', has never been successfully located, but is assumed to have something to do with the brain, or part(s) of the brain. But given sufficient and suitable complexity, it becomes easier to see how something as animated and purposeful as human consciousness could emerge in an organic system without recourse to the dualistic conception of a mind that is separate from the body, or a specific 'seat' of consciousness. In an emergent account, some parts of the system, such as the brain, may be more significant than others in the production of thought, and indeed these may be the areas in which the search for a 'seat' has been historically concentrated. But unless the brain, or parts of the brain, can be shown to produce the mind *on their own*, without the need for any other tissue or activity, then it is mistaken to assume that the brain alone contains the 'hardware' or 'software' of the mind.

In summary (and at the risk of over-stating the case): to say that conscious thought is not exclusively a function of the brain, does not deny that the brain has a significant part to play. It is merely to state that the brain contributes to consciousness, but does not determine it.

Consciousness as a complex process

But despite this, philosophers continue to postulate the existence of a 'seat of consciousness' or some physical centre in the brain that co-ordinates all other mental activity. For Descartes (1912) this was the pineal gland or epiphysis, but more contemporary researchers have suggested other areas of the brain that may be responsible. Roger Penrose summarises several such suggestions in *The Emperor's New Mind* (1990), whilst elsewhere offering 'microtubules' as a possible mechanism (Hameroff and Penrose 1995). But while the idea persists that there must be some cells or structures within the brain that could ultimately be said to be the 'conscious' centre of the mind, the fact that, after intensive work, no such centre has yet been conclusively found gives support to the view that it may not exist, at least in the form expected. This highlights the difference between the reductive approach characteristic of classical humanist science and the complex or emergent approach adopted here.

In posthuman terms, both consciousness and human existence can be considered as emergent properties arising from the coincidence of a number of complex events. In this sense they are like boiling: given sufficient heat, gravity and air pressure the water in a kettle will start to boil; we can see what boiling is; we can recognise it as something to which we give a name; we do not consider it mysterious, yet we can't isolate it from the conditions that produce it.

The determinants of consciousness

We have seen that as far as the posthuman condition is concerned, it is beneficial to consider thought and consciousness as functions of the whole being; or put another way, it is less useful (or realistic) to treat thought processes as 'brain- determined' than to consider them as determined to differing degrees by the brain, the body and the world. This might be called, as it sometimes is, an 'embedded', 'enworlded' or 'embodied' conception of human existence, an approach that has huge implications for areas of study such as cognitive psychology, social psychology and neurology as well as artificial intelligence and neural networking. When we come later to look at the possibilities of synthesising creativity and mental activity with computers in chapters six and seven it will be useful to adopt a model of the conscious mind that is embedded in a body and a world that continually generate unpredictable stimuli, which in turn demand unpredictable responses from the mind.

Philosophy, or how we think about ourselves

All philosophy is inevitably a product of the times in which it is conceived rather than a depository of eternal, ageless truths. Throughout the pre-humanist and humanist eras, philosophers struggled with problems concerning the relationship between gods, nature and the human being. Whilst these struggles have been infinitely complex, it is fair for the purposes of this argument to say that there have been two broadly opposing views about the human condition that have divided philosophers since the early Greek times. Essentially there have been those who hold an idealistic view of the world and those who hold a materialistic view of the world. These two views come into particular conflict when the problem of the relationship between mind and reality is debated. To briefly (and necessarily crudely) summarise the conflicting views:

Idealism

The idealist holds that the only things that exist are ideas. In idealism the whole structure of reality is to be understood through consciousness. All attempts to know the world in itself are futile since all data about the world must inevitably be supplied by the body's senses (which are selective) and passed to the mind for interpretation. Therefore, there is no value-free or truly objective knowledge of reality, other than what one knows about one's own thoughts. In essence, the existence of reality is subject to the existence of a conscious being. It is easy to reconcile idealism with the existence of a God since while there might not be much hard evidence of God in the real world, he can justifiably be said to exist in the form of an idea in which people believe. Most religious belief systems are idealistic in the sense that they accept a reality or existence that is outside of, and separate from, earthly reality. Idealism has gained a reputation for developing absurd propositions such as the claim that nothing existed before human consciousness, and that the thinker is the only thing that actually exists, since nothing else can satisfactorily be proved to exist — a black hole known as solipsism.

Materialism

The materialist view (sometimes known today as physicalism) denies that the mind obeys different laws from physical reality. For the materialist nothing exists except matter, or reality as defined by the 'hard' laws of physics. Thought is a product of matter, being merely a special example of material organisation. Far from the mind determining how the world is viewed, the mind is a product of real events in the world: the world determines the mind. The mind is just as much of an objective reality as the world and matter has an objective existence, independent of thought. For nineteenth century thinkers materialism was very influential as it seemed to conform with the new discoveries of science that promised an ever more precise grasp of natural phenomena. Dinosaur bones were collected and studied, giving credence to the idea that the world existed long before humans and at the same time alarming the creationists. Diseases like cholera were starting to be controlled by the application of scientific principles such as hygienic waste disposal, and better observational equipment exposed humans to previously invisible micro and macroscopic worlds. In a political sense, materialism seemed to prove what was obvious to many: that humans were responsible for their own conduct and conditions without reference to a mysterious outside agency such as God.

The end of the affair

What is absorbing about the debate between idealists and materialists is that it has endured for so long without ever having been resolved. Perhaps the reason that it has not, and may never be resolved is that both idealism and materialism make the same mistaken assumption. They both assume a division between the mind and reality, between the internal human experience and an external world, when in fact there is none. In idealism the conscious mind (the thing that thinks) can only have partial knowledge of reality (the thing that is thought about). It can never be proved that the sensory data received gives an accurate representation of what it purports to describe since we have no independent means of verification. In materialism, the mind (the thing that thinks) is made of the same stuff as the real world (the thing that is thought about) yet is unique in that it is conscious of its existence in a way that most other matter is not.

In the posthuman schema, it is a mistake to separate the thing that thinks and the thing that is thought about. However, we should not be too conceited about this position, since it is only with the benefit of the technical and scientific advances described herein that we can conceive of a universe in which humans and nature are not separated. For most of western history this distinction has been taken as given by many thinkers. I have already described above why I believe the distinction to be invalid and I shall show why, in later chapters, it is necessary that we hold this view in order to help our understanding of our present condition.

Loss of separation

If one removes the concept of the separation between human and nature then many traditional philosophical disputes are cast in a new light. Developments in scientific thought have dispelled many of the assumptions on which idealist and materialist philosophy was based. Idealists can no longer claim that nothing existed prior to human consciousness without denying the whole weight of empirical evidence that shows the existence of a pre-human universe. Nor can they make a very convincing case that reality only exists in the mind; that reality is an 'illusion'. To say something is an illusion is to imply that there must be some 'truer' state that is being masked. Yet the possibility of knowing this 'truer' state is ruled out by idealists on the grounds that it cannot be independently verified. Therefore, the 'illusion' might as well accord with the 'truth'.

And not only is materialism mistaken in assuming a division between mind and reality, it is also flawed on the question of whether there is actually any matter ‘out there’ which can be thought of as constituting reality. We will see later that the advent of relativity theory and quantum theory in the early part of the twentieth century effectively dissolved our view of a solid, material universe. A more contemporary scientific view of what we used to think of as the ‘fact of matter’ can be found in the provocatively titled book *The Matter Myth,* in which physicists Paul Davies and John Gribbin argue “matter as such has been demoted from its central role, to be replaced by concepts such as organisation, complexity and information.” (Davies and Gribbin 1992 p. 9). They proceed to quote the physicist Werner Heisenberg:

> In the experiments about atomic events we have to do with things and facts, with phenomena which are just as real as any phenomena in daily life. But the atoms or the elementary particles themselves are not real; they form a world of potentialities or possibilities rather than one of things or facts. (in Davies and Gribbin ibid. p. 21)

Resolution

In summary, the posthuman view admits no inherent dichotomy between mind and matter; the opposition between them is only a problem in the minds of those who maintain it. In fact, as will be suggested later, one can deny the existence of any distinctions in the world other than those that arise in the mind, whilst accepting that the mind exists in the world. Hence, distinctions in general can no longer be thought of as existing independently of our conceiving them.

But before this argument can be made in full we need to examine some common scientific assumptions about how the universe is understood, and explore an alternative way of thinking about the nature of reality.

CHAPTER TWO
SCIENCE, KNOWLEDGE AND ENERGY

As we gain more knowledge about how the universe operates, are we proceeding, however slowly, toward some final resolution of the scientific problems we face? There are certainly those who think we are; but should we believe them? This chapter looks at some of the fundamental assumptions of the scientific world- view in the context of the grand humanist project to see how they compare to posthuman ideas. As part of the process of acclimatising us to the posthuman condition, the concept of an energetic universe is introduced along with its implications for our understanding what we mean by order and disorder.

Computer knowledge

Over the past half century the advent of computational technology has profoundly changed our view of science and how we look at the universe. Certain types of calculations involving high levels of recursion, impossible to carry out with pencil and paper, are ideally suited to the large number-crunching machines available to scientists and mathematicians since the 1950s. Experiments investigating the behaviour of the natural world conducted on these machines have given rise to new ways of thinking about phenomena that had previously defied computational analysis. For example, chaos theory has shown many phenomena which had seemed unstable and incalculable, such as turbulent liquids and the weather, can be considered chaotic; that is, their qualitative behaviour can be modelled with non- linear algorithms and their overall state depends on tiny disturbances and initial conditions (Kellert 1993). Catastrophe theory has demonstrated that complex systems, such as stock-markets and biological forms, give rise to discontinuous features that evade analysis in terms of smooth, continuous formulae (Woodcock and Davis 1980). Complexity theory has shown that locally predictable events in a computer when influenced by any other such events produce unpredictable global behaviour that can't be attributed to any single component (Levy 1992). In his book *Complexity: The emerging science at the edge of order and chaos* Mitchell Waldrop describes how computational technology ushered in a new world of simulated experimentation that permitted previously inconceivable kinds of systems modelling:

> Properly programmed, computers could become entire, self-contained worlds, which scientists could explore in ways that vastly enriched their understanding of the real world. In fact, computer simulation had become so powerful by the 1980s that some people were beginning to talk about it as a “third form of science”, standing halfway between theory and experiment. A computer simulation of a thunderstorm, for example, would be like a theory because nothing would exist inside the computer but the equations describing sunlight, wind, and water vapour. But the simulation would also be like an experiment, because those equations are far too complicated to solve by hand. So the scientists watching the simulated thunderstorm on their computer screens would see their equations unfold in patterns they might never have predicted. (Waldrop 1992 p. 63)

We are coming to rely on the computer as a means of modelling more complex natural phenomena, including thought itself. On the surface all this seems like yet another advance for reductionist science. But these technical developments have, ironically, also thrown into question some of the very principles upon which traditionally mechanist scientific methods are based, and have helped to undermine some long-held beliefs about the nature of the universe and our capacity to fully understand the workings of the natural world. For as I hope to show, the overall consequence of advances in mathematical modelling is that we now have to recognise the limitations of mechanical scientific reductionism—or for that matter any kind of reductionism. It is vital to understanding the posthuman condition that we appreciate this shift that is now occurring.

Philosophy and science

Philosophy and science both seek, to some extent and in different ways, to formally understand the fundamental nature of the universe and human existence. The foundational philosophic and scientific question that is so often asked, but so far not convincingly answered, is something like “Why are we here?” In posing this question several assumptions are made, including:

• there will be an answer,

• it will be satisfactory because it provides a final cause for human existence,

• this final cause would not be open to any further analysis of the kind that might ask, ‘What is the cause of the final cause of human existence?’ and so on.

But if some or all of these assumptions are invalid (and each is certainly questionable in its own right), the question of why we are here becomes even more curious. Might we have to accept as humans that there are certain things about our condition that we will never know, in the formal scientific or philosophical sense? This would surely be something of a humiliation, or admission of defeat, for a species that has such confidence in its own capacity for resolving questions about the world. It is perhaps not surprising that one rarely hears philosophers or scientists arguing the case for inevitable ignorance. One exception comes from those few philosophers of mind, like Colin McGinn, who claim human consciousness is a phenomenon of such overwhelming complexity it will most likely always remain beyond the grasp of our understanding, a view that is sometimes labelled 'mysterianism' (McGinn 1991).

What is the resolution of reality?

In trying to answer questions of such deep consequence we come up against what might be called 'the problem of resolution', which is one of how far we are able to resolve the question through answers. For example, are we here because God put us here? If so, why? Are we here because we evolved from space bugs? If so, why did space bugs evolve? . .. the questions would continue ad infinitum. We soon realise we can only resolve such questions insofar as our knowledge about the universe extends, and the extent to which we know about the universe is determined by the resolution at which we are able to analyse it.

In everyday life we operate at a human scale based on the size of our bodies relative to the objects and forces around them; doors are usually just over head height, text characters are of a size that makes them readable, we don't choke on oxygen molecules — all conditions of existence we tend to think of as the fabric of everyday common-sense reality. But when we start to investigate phenomena that are invisible or unavailable at the normal human scale of existence, whether by using microscopes, telescopes, particle accelerators, X-rays, or computer models, then we have effectively changed or enhanced the resolution of our viewing position with the consequence that we extend our knowledge of the universe. Having gained the ability to alter the level of resolution with which we observe the world, the question must arise as to how far one can go in magnifying, particle accelerating, deep-space probing before no more levels of resolution can be found. In other words, what are the limits of our knowledge about the universe?

Scale and knowledge

Since everyday human existence is conducted at a scale to which certain physical laws apply, it might seem natural to assume that similar laws would extend to all scales that are now, or ever will be, observable. This was very much the assumption of those early scientists like Isaac Newton (or at least his followers) who extended laws governing motion on earth to cosmic motion on the assumption that the laws of motion must be universal. Early in the twentieth century it was shown that whilst laws of motion may be accurate and useful at the human scale they are not so on a cosmic scale, or indeed on a quantum scale. Einstein showed that minute variations in gravitational pull have significant impact on the trajectory of large masses, and that the cosmos is by no means a reliable machine that obeys regular, fixed laws (Pais 1982). Using improved measuring equipment and theoretical concepts not available in Newton's time, Einstein took advantage of new data and developed ideas to accommodate it. The result, now widely known as 'relativity theory', immediately seemed at odds with human intuition and common experience. The theory was full of peculiar ideas like 'time is shaped like a banana', 'people can travel in spaceships and come back to earth years younger than their twin' or 'my watch is slower on a moving train than the clock on the platform'.

With advances in sub-atomic research at the outset of the twentieth century things got even stranger: it was shown that one particle could be in several places simultaneously, experiments seem to know what outcome the experimenter expected, along with many other instances of incomprehensible sub-atomic behaviour (Polkinghorne 1986). This quantum-scale world quickly came to expose the limitations of human-scale knowledge. It was found necessary, for example, to institute a maxim, Heisenberg's uncertainty principle, in recognition of the fact that it is experimentally impossible to measure both the position of a sub-atomic particle and its momentum. And as will be discussed later, sub-atomic events came to be regarded as probabilities rather than the certainties implied by classical Newtonian mechanics. In other words, the quantum world seemed to be telling us something quite paradoxical; that the closer we looked into the Alice in Wonderland world of sub-atomic events the less certain we would be about what we saw. Whether we look outwards into space or deep into the core of matter, from astro-physics to particle physics, we remain unable to grasp the ultimate nature of reality. In fact, with increased knowledge we discover the universe is less consistent with common-sense, and more complex and mysterious than previously imagined.

Ultimate theories

Perhaps the scientific mode of enquiry will never allow us to comprehend the ultimate nature of reality. To seek such comprehension may be ultimately a futile quest given the possibility that the universe will always be more complex than our capacity for understanding. Few contemporary scientists, however, would acknowledge this openly. For whilst it is true that not all participants in scientific activity would necessarily hold that science is the search for the ultimate nature of reality, there is an undeniable trajectory towards the goal of conclusive comprehension. The cosmologist Stephen Hawking writes almost poetically in *A Brief History of Time* about the prospects for ultimate universal knowledge divined through scientific discovery:

> However, if we do discover a complete theory, it should in time be understandable in broad principle by everyone, not just a few scientists. Then we shall all, philosophers, scientists, and just ordinary people, be able to take part in the discussion of the question of why it is that we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason — for then we would know the mind of God. (Hawking 1988 p. 175)

It seems the hope persists, however vaguely in the mind of any cosmologist or physicist, that there is an ultimate explanation of all nature. The problem is more than purely philosophical, it has practical financial ramifications for us all. The justification sometimes offered for huge investments in massive particle accelerators, telescopes and deep-space probes is that the knowledge gained will lead us closer to understanding the origins of the universe, what some have called the “Secret of the Universe” (Barrow 1988). One senses that science sees itself driven by a compelling ‘dream’: that the materialist scientific project has within its methodology the capacity to understand all aspects of natural phenomena and that given enough time and enough resources the very fabric of reality will succumb to the scientific way of understanding. The dream is encapsulated by physicist Steven Weinberg in the following way:

> The dream of a final theory inspires much of today's work in high energy physics, and though we do not know what the final laws might be or how many years will pass before they are discovered, already in today's theories we think we are beginning to catch glimpses of the outlines of a final theory. (Weinberg 1993 p. ix)

Humanist context

The dream of closure is not new. In *Theories of Everything* John Barrow describes one of the early modern attempts at a unified physical theory by the little known but highly influential Roger Boscovich in the 1750s. Something similar was attempted by Bernhard Reimann who, in the nineteenth century, envisaged a "total theory of physics" derived from a "completely self-contained mathematical theory" (Reimann quoted in Barrow 1988).

From the hopes expressed by these figures, and many others, the case could be made that the idea of a theory of everything is deeply rooted in the wider humanist project, and accords with an almost unlimited self-confidence in human abilities. The optimistic belief that humans will be able to rationalise the totality of natural phenomena through the tool of science is an inevitable corollary to the belief that humans are the most important things on the planet, if not in the universe (see chapter eight). Humanists, therefore, see no ultimate reason why human knowledge should be limited, and although this belief has been subject to many challenges in its long history, it persists today in the minds of many scientists.

The fallacy of ultimate knowledge

Given what is at stake it is worth pressing the notion of ultimate knowledge, or explanation, to its logical conclusion. To put it brutally: knowing the ultimate nature of the universe (or, if you prefer, the 'Theory of Everything' or the 'Final Theory') would actually imply knowing everything about the universe, everything that has happened and everything that will happen. One cannot restrict a theory of everything to an arbitrarily disjointed branch of study, e.g. physics, even if it produces a startlingly elegant unifying formula for the behaviour of all known forces. For on top of this one would be required to attend to the outstanding question of, for example, how we know what we know about the forces; in other words, how we are conscious of the universe at all. How would such a theory of unified forces help us to understand the nature of war, or global poverty, or jokes? One cannot propose a theory of everything that is only a theory of some things, for as long as just one thing remains unknown our knowledge of the universe remains partial, incomplete and, therefore, not ultimately explained. Which further points to a paradox: science itself proceeds on the very assumption that there is more to be known about the world, that in fact we are grossly ignorant of many aspects of natural phenomena and, indeed, it is this very state of affairs that scientists often highlight when pressing for funds. So it would seem to be a requirement of any theory of everything that it is able to tell us that there is nothing else we don't know. But how would we know what we don't know?

The limits of measurement

Some eminent thinkers have argued it is impossible even accurately to measure the coastline of Britain because there is no defined point where the coast stops and the sea starts:

> All measurement methods ultimately lead to the conclusion that the typical coastline's length is very large and so ill determined that it is best considered infinite. Hence, if one wishes to compare different coastlines from the viewpoint of "extent", length is an inadequate concept. (Mandelbrot 1983 p. 25)

How can we then be confident in any of the measurements we make about any entity in the universe? Could it be that in fact all such measurement must be contingent and "ill determined"? Perhaps not in the ideal world of pure mathematics in which values are defined in relation to each other. But maybe when it comes to quantifying the complex, gritty and continually shifting real world around us we might have to accept that all knowledge must be partial. In which case we can know more, or less, but not everything.

Posthumanism is not anti-science

It is important to stress that the argument being made here is not one against the scientific method per say, and in favour of some pre- or anti-scientific utopia. Nor is it a rehearsal of the well-established relativistic critique of science as a social construction initiated by Thomas Kuhn in *The Structure of Scientific Revolutions* (Kuhn 1970) and extended by theorists such as Bruno Latour and Steve Woolgar (Latour and Woolgar 1979). Instead it is to claim that while scientists are not alone in questioning the nature of the universe, many of them have presumed responsibility for providing the answers, and indeed for defending the position that there are answers to be provided. For whilst it would be naïve to suggest that there are no further discoveries to be made about the universe through the application of the scientific method (broad and flexible as that is), it is perhaps equally presumptuous to suggest that all discoveries lead to some final resolution — a presumption that might be classified as a kind of 'scientific fundamentalism'.

In practical terms I believe we should be wary of the allocation of limited resources, both intellectual and financial, to a project that has no hope of being fulfilled. To hold out the hope of some ultimate explanation in return for securing huge funding for super-colliders and telescopes can only be done in ignorance or with some self-delusion. I would simply argue that such resources would be better targeted at other problems where a solution would have a wider and more immediate benefit, for example environmental pollution, the crumbling former- Soviet nuclear reactors and weapons systems, and global resource management. In other words, tidying up some of the mess humans and our science have made.

The illusion of cause and effect

Many fundamentalist beliefs of science, such as the assumption of a final theory and the belief that all things must have causes, are linked to the problem of resolution we described earlier. As we have said, part of the difficulty posed by certain questions lies in the fact that we assume the laws that govern causality on a human scale will extend to all scales. This assumption lay at the root of the famous objection Einstein took to Bohr's Copenhagen interpretation of quantum theory when he declared "God does not play dice with the universe" (Peat 1990).

Perhaps this assumption of causality stems from the fact that many mundane questions we ask about the world have apparently straightforward answers. For example, if the question 'Why have you brought an umbrella?' is answered with the statement 'Because it's going to rain', enough information has been provided to satisfy the demands of the question. However, the conversation could equally continue along the lines ‘How do you know it's going to rain?’, ‘Because the sky is full of black clouds’, ‘Why is the sky full of black clouds?’, ‘Because there's a trough of low pressure over the area’, ‘Why is there a trough of low pressure over the area?’ and so on, until we travel through the bounds of chance, chaos, known science and into cosmic speculation. Consequently, no question starting with ‘why’ can ever receive a complete and deterministic answer because no phenomenon has any original cause or single determinate beginning; we can only make relatively precise judgements as to the causes or origins of an event. To take another example, chaos theory or the ‘theory of sensitive initial states’ is often illustrated with reference to the ‘butterfly effect’. Briefly, this states that the relatively insignificant flap of a butterfly wing in, say, Africa can ultimately cause a storm in Canada since the insect’s movement will be magnified from a tiny gust, to a breeze, to a wind and finally to a storm (Gleick 1988 p. 20). Initially this is seductive, and yet we must ask what caused the butterfly to flap its wings — a gust of wind perhaps? One could argue that the search for determinate origins is as futile as the search for the ultimate explanation of the universe since, finally, they amount to the same.

Ordering the universe

> Whatever is the ultimate nature of reality (assuming that this expression has meaning), it is indisputable that our universe is not chaos. We perceive beings, objects, things to which we give names. These beings or things are forms or structures endowed with a degree of stability; they take up some part of space and last for some period of time. (Thom 1975 p. 1)

If we can accept that the universe has no origins and no ultimate explanation (and many won't) then we must at least be able to say that it does display some patterns and follow some rules — there are forms and structures. If this were not the case, everything would be totally incoherent and nothing at all would be predictable. We are used to a world in which the sun always rises, things always fall downwards and computers always crash just before you've saved your work. These facts would imply that the universe is intrinsically ordered in some way, even if we do not understand all the ways in which this might be so. We will shortly come to the question of why we perceive order in the universe, but first we should consider the scientific attitude toward its counterpart — disorder. It is understandable enough that science should privilege order over disorder, pattern over incoherence, on the basis that science is engaged in establishing the laws and mechanisms determining natural phenomena. Until recently the whole thrust of the classical scientific method held that understanding arose through establishing what was predictable, certain and repeatable in any system under investigation. On the other hand, James Gleick quotes mathematician James Yo rke in *Chaos*:

> The first message is that there is disorder. Physicists and mathematicians want to discover regularities. People say, what use is disorder? But people have to know about disorder if they are going to deal with it . . . They're running a physical experiment, and the experiment behaves in an erratic manner. They try to fix it or give up. They explain the erratic behaviour by saying there's noise, or just that the experiment is bad. (Gleick ibid. p. 68)

But even holistically minded scientists find it hard to give up on the primacy of order in understanding. Speculation stimulated by the surreal results of particle accelerator research led the physicists David Bohm and David Peat in *Science, Order and Creativity* to question whether there is such a thing as an intrinsically ordered universe or whether the notion of order merely exists in our minds and is imposed upon the universe. "Is order simply within the mind? or does it have an objective reality of its own?" (Bohm and

Peat 1987 p. 120). As well as perpetuating the mind/reality separation we tried to remove in the last chapter, this comment still has at its heart the implication that true understanding only arises when we can identify the order in a system, thereby dispelling the disorder that is synonymous with non-understanding. According to such an approach, whether order is in the mind or in reality, the fact that a final order for everything is being sought is the predominant concern.

> This book, however, proposes that the notion that everything that happens takes place in some order (which, however, depends on broader contexts for its meaning). Therefore, while there is ambiguity within particular contexts, the notion of an ultimate limit to the meaning of order that holds in all possible contexts is not admitted. (Bohm ibid. p. 135)

The search for order and regularity at the expense of disorder and irregularity is, in the posthuman terms being set out here, a fundamental error. Rather, I will try to show that nature is neither essentially ordered nor disordered, but what we perceive as regular, patterned information we classify as order; what we perceive as irregular, un-patterned information we classify as disorder.

The humanist contempt for disorder

> The myth of science as a purely logical process, constantly reaffirmed in every textbook, article and lecture, has an overwhelming influence on scientists' perceptions of what they do. Even though scientists are aware of the non-logical elements of their work, they tend to suppress or at least dismiss them as being of little consequence. A major element of the scientific process is thus denied existence or significance. (Broad and Wade 1983 p. 126)

Without necessarily subscribing to a generally antagonistic view of science, it may be possible to claim that what Broad and Wade say about logic might be equally true of disorder. But despite the antagonism shown by Bohm and Peat to disorder in the quote above, we may actually be impoverishing our understanding of the world unless we lay equal emphasis on the notion of disorder that is otherwise displaced in general by our culture, and in particular by humanist science.

It is often the case that the less one knows the more one can believe

Belief and partial models

Speculation and research into the nature of life and the universe is often justified as a search for truth, as though the universe was concealing the truth about itself. What is clear is that all theories and explanations of all phenomena are simply models or descriptions that are more or less accurate, more or less useful. The model of the universe that was accurate, insofar as it was useful, to some earlier societies was that the sun orbited the earth. Later this truth was replaced by another claiming planetary motion could be defined according to fixed and universal laws. Such beliefs depended on partial models that in turn were based on partial information, even though claims were sometimes made that the models were complete. In this respect such discredited models were no different from the truths, beliefs or models we use in contemporary science, which are also based on partial information. The problem of course with claiming any model is complete, or any absolute truth is knowable, is that to know anything absolutely requires that all factors that affect it can be accounted for. This means that all dimensions of a system being investigated must be considered:

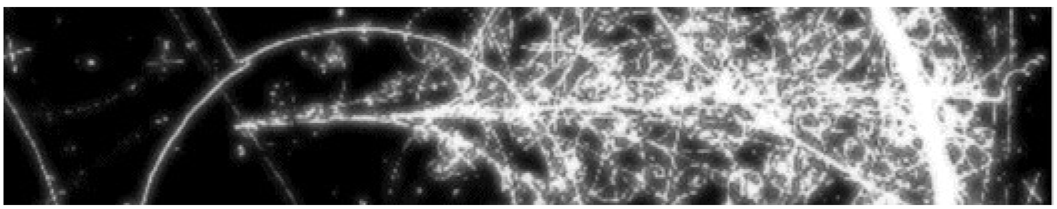
> The fundamental reasons for the stability of matter are still unknown and the stability of the proton remains unexplained . . . Furthermore, even when a system is controlled by explicit laws of evolution, it often happens that its qualitative behaviour is still not computable and predictable; as soon as the numbers of parameters of the system increase, the possibility of close calculation decreases — what Bellman has called the curse of dimensionality. (Thom ibid. p. 322)

In the sense employed here by biologist René Thom, dimensions are attributes of a system or object used to describe it. For example, if we consider a snooker ball with a view to knowing everything about it — all its dimensions — we could use the spatial dimensions x, y and z to plot its position relative to some arbitrary point, v to plot its velocity relative to some other speed and t to indicate the time in which it exists relative to some other time. We would need to know its mass which is relative to its surrounding gravitational field, its volume which is relative to the sensitivity of our calibration device, its colour which is dependent on the lighting conditions and our viewing apparatus. In addition, we would have to account for its reflectivity, its smell, it greasiness, the number and dimension of dents and chips in its surface, its age, history, level of radioactivity, chemical composition, sentimental or financial value, social and economic conditions that brought about its manufacture and so on. Just because we choose not to consider most of these factors when we discuss an object does not mean that they are any less part of the object's real existence. All these dimensions contribute in some way to the phenomena of the snooker ball, but it would be impossible and impractical to take them all into account in everyday, or even formal scientific discourse. We are forced to accept that any model or description of any thing must of necessity exclude some information about it, if only because nothing can be isolated from the context that allows it to exist in the first place. Thus whilst all models, or descriptions are partial this does not mean they are not useful.

> .. . the dimension of the space and the number of degrees of freedom of a local system are quite arbitrary — in fact, the universal model of a process is embedded in an infinite-dimensional space. This is obviously necessary: there is no doubt that the closer the study approaches the infinitesimal, the more degrees of freedom are needed, so that all qualitative representation of microscopic phenomena will require the use of an infinite-dimensional function space. (Thom ibid. p. 6)

The scientific search for truth, therefore, may be the process of building better models of processes in the universe, but never complete ones.

Certainly, models improve as we increase the resolution at which we are able to view things, and as we are able to account for more dimensions simultaneously. This is arguably something computer technology has made possible in a number of cases, as was suggested in chapter one, including simulating complex, turbulent and dynamical systems. But if no models can be complete, as Thom claims above, without requiring a "function space" as big as the universe itself, then what we deduce or learn from the models must also remain incomplete. Beliefs, like the models they are based on, have a contingent and somewhat arbitrary status.



There is nothing intrinsically wrong with producing models; there is little else we can do. The problem arises when we equate the model to the reality that is being modelled

Ultimate limits

> To each partial system, relatively independent of the environment, we assign a local model that accounts qualitatively and, in the best cases, quantitatively for its behaviour. But we cannot hope, a priori, to integrate all these local models into a global system. If it were possible to make such a synthesis, man could justifiably say that he knew the ultimate nature of reality, for there could exist no better global model. (Thom ibid. p. 7)

It has been argued here that there are no determinate origins, ends, complete answers or final reasons for the existence of anything; it's not that we can't find them, but just that they're not there. We may have to accept our models of natural phenomena are always going to be partial and incomplete, so we will never be able to produce a comprehensive model of how everything in the universe works. Of course none of this means that science, and indeed all other forms of human inquiry, will not continue to flourish. But we should be very wary of assuming that we are in any way nearing some final goal or end. We may in fact be going round in ever expanding circles.

Energism

We will now consider another important aspect of the overall thesis proposed in this book. One of the claims of the theory of posthumanism as presented here is that there are no absolute separations or divisions between any ‘things’, as between our selves and the environment. In fact, the self and the environment are more accurately conceived as one continuous whole rather than as being divorced or disconnected. However, this continuous view of the world does not seem to accord with our everyday experience in which things do seem separate and self-contained. Why is it that the world seems to be made up of lots of separate things interacting with each other and causing things to happen if everything is a unified whole, if there are no absolute divisions between things? To help with an understanding of this problem, what might be called an ‘energistic’ conception of reality is proposed wherein all reality is conceived as energetic activity in perpetual transformation.

Energy and matter

For thousands of years scientists and thinkers have thought that the universe must be made of some fundamental substance that would account for the solid matter we see all around us. Some ancient Greeks like Leucippus and Democritus held that atoms were the irreducible particles from which all other matter was formed. The common wisdom amongst nineteenth century scientists and philosophers was that ether was the most pervasive substance in the universe and the medium through which electromagnetic waves propagated. This view was largely discredited in the early twentieth century when Einstein published his first papers and called into question the distinctions between matter and energy, space and time. In fact Einstein didn’t entirely give up on the idea of ether, but came to understand it differently from the way it had previously been posited:

> We may say that according to the general theory of relativity, space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable; for in such space there would not only be no propagation of light, but also no possibility of existence for standards of space and time (measuring rods and clocks), nor therefore any space-time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristics of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it. (Einstein 1923 p. 23)

As the atomic nucleus was shattered into its tinier sub-particles of electrons, protons, neutrons, quarks, gluons and positrons amongst others, and the investigation turned to quantum field theory, the notion of a substantive material support for matter was dealt a further blow. In *The Matter Myth* Paul Davies and John Gribbin describe the changed view of matter:

> An extension of quantum theory, known as quantum field theory . . . paints a picture in which solid matter dissolves away, to be replaced by weird excitation and vibrations of invisible field energy. In this theory, little distinction remains between material substance and apparently empty space, which itself seethes with ephemeral quantum activity. The culmination of these ideas is so-called super-string theory, which seeks to unite space, time and matter, and to build all of them from the vibrations of submicroscopic loops of invisible string inhabiting a ten-dimensional imaginary universe. (Davies and Gribbin 1991 p. 8)

So what appears as solid matter at the human level of resolution turns into a web of volatile energy packets when investigated at a quantum level. A star may appear as a large solid mass in the sky, but on closer inspection may turn out to be a ball of vapour, each particle of which will in turn consist of tiny packets of energy. Perhaps anticipating this, Greek thinkers such as Heraclitus advanced a kind of divine fire as the eternal substance from which all else is derived. His enigmatic epigram "The thunderbolt pilots all things" was taken by other Greek scholars to mean "the eternal fire pilots all things" (Kahn 1979), but could equally be interpreted as "energy pilots all things". In a similarly poetic vein, the visionary poet William Blake expressed an analogous idea in *The Marriage of Heaven and Hell*: "Energy is the only life, and is from the Body; and Reason is the bound or outward circumference of Energy. Energy is Eternal Delight."

What is energy?

Those trained in orthodox physics may find it hard to swallow the idea that 'everything is energy', despite other physicists leading us toward that conclusion. The traditional definition of energy is the "capacity to do useful work", and as such is not a 'thing' or substance at all, but a potential force bound up in a particular arrangement of matter, e.g. a lump of coal or a wound spring, much like value is bound up in money. Some have argued that this transactional notion of energy is an inheritance of the stream-driven engines of nineteenth century industrial expansion, being "partly due to new concepts in accountancy accompanying the rise of industrialisation" (Brown 1999 p. 60). The economic allusion is reiterated by Anson Rabinbach in *The Human Motor*, a survey of the Victorian industrialisation of human labour. Speaking of studies undertaken by the physiologist Jules Amar into the efficiency of labour he says "As a result of his . . . experiments, Amar concluded that a science of work could in fact calculate the amount of energy output necessary to fulfil optimally and economically a given task: 'The estimate of the work done should be made according to the expenditure of energy', that is on a scientific basis." (Rabinbach 1992 p. 186).

But despite intensive research and speculation since the nineteenth century, and great advances in the generation and manipulation of energy, we are no nearer a clear grasp of what 'energy' actually is. As the physicist Richard Feynman admitted "It is important to realise that in physics today, we have no knowledge of what energy is .. . It is an abstract thing in that it does not tell us mechanisms or reasons for the various formulas." (Feynman 1995). Yet at the same time all contemporary models of physical reality are based on the activity of energy, whether through the propagation of waves, bouncing particles or low-level material interactions. In this respect, nothing is more iconic of the primacy of energy in the universe than Einstein's statement that matter and energy are continuous and relative: the $E= mc_2$ formula itself. We are apparently left with little choice but to concur with biochemist Guy Brown when he says in *The Energy of Life* "energy is the ultimate substance and fabric of the world, from which all else evolves and into which all else ultimately dissolves." (Brown ibid. p. 67).

What isn't energy?

If we can accept that everything is energy, in the absence of any other final 'stuff ' or substance, it profoundly affects the way we consider the universe and everything in it, including ourselves. It means that all we can really talk about or describe at any level of inquiry is the formation and transformation of energy, albeit as it is expressed in some tangible material form. In one way this greatly simplifies our investigations of the universe since it means that all scientific and philosophical endeavours have a common purpose; that is, to describe the way in which energy is formed and transformed. However, merely stating that all matter has an energetic foundation does not reduce the universe to an undifferentiated whole. What makes the universe complex is the myriad ways in which energy, as matter and force, is manifested, and the diversity of the transformations it undergoes. Clearly the energy content of a fire is not the same as that in a block of ice. But this does not negate the fact that both forms of matter are expressions of energy in varying states.

It is very difficult to refer to objects or processes in the world without implicating their energetic constitution. The material objects about us are usually defined and categorised by what are ultimately energetic properties, such as colour, mass, smell, luminosity, reflectivity, temperature, velocity and texture. Likewise, humans are masses of energetic activity operating in societies that represent incalculably complex electrical, chemical, and kinetic energy flows of production and consumption. The galaxies are vast, uncharted fields of energy manifest as light, radiation, gravity and mass, and even time itself cannot be measured or comprehended in any terms other than changes in energy states: a clock hand moving, a candle burning, or an atom oscillating.

While we have many theories and much knowledge about all the different forms energy takes, ultimately all we can say about it is that it changes from one form to another in ways that we can sometimes detect with reciprocal changes in our own limited sensory apparatus.

Energy as life

Some physicists have recently started to support the idea that life is a thermodynamic process of energy flows. As will be discussed later, in his book *Cosmic Evolution* Eric Chaisson offers the concept of “free energy rate density” as a quantifiable measure of the amount of energy flowing through a system in relation to its mass (Chaisson 2001 p. 132). The higher the rate of energy and the smaller the mass, then the greater the free energy rate density and, for Chaisson, the greater the complexity of the system. What this means, in specific terms, is that although the sun turns over a huge amount of energy compared to a bird, in proportion to the sun’s much larger mass the bird actually has a greater level of energy flow and, hence, a higher level of complexity.

Using this formula Chaisson charts a historical time-line, starting just after the big bang and ending today, of a universe travelling along a ‘time-arrow’ in the direction of generally increasing complexity in which islands of ‘order’ emerge at the expense of an overall increase in cosmic disorder, or ‘entropy’. Since it is so crucial to an understanding of the posthuman condition, we will look more closely at ideas of ‘order’, ‘disorder’, ‘complexity’ and ‘entropy’ in the next chapter.

CHAPTER THREE

ORDER AND DISORDER, CONTINUITY AND DISCONTINUITY

RECENT SCIENTIFIC IDEAS HAVE FORCED US TO RE-ASSESS HOW WE UNDERSTAND NOTIONS OF 'ORDER' AND 'DISORDER'. THEORIES OF CHAOS, CATASTROPHE AND COMPLEXITY CHALLENGE OLDER HUMANIST PREOCCUPATIONS WITH MECHANISM, REDUCTIONISM AND DETERMINISM AND, AS SUCH, CAN BE CONSIDERED POSTHUMAN THEORIES, OR AT LEAST AS HAVING POSTHUMAN IMPLICATIONS. IN THE CONTEXT OF AN 'ENERGISTIC' DESCRIPTION OF REALITY, ORDER AND DISORDER ARE NOT IRRECONCILABLE OPPOSITES BUT PROPERTIES THAT ARISE FROM THE WAY IN WHICH THE UNIVERSE BEHAVES AND HOW WE VIEW IT. LIKEWISE, CONTINUITY AND DISCONTINUITY ARE RELATIVE ATTRIBUTES OF ENERGETIC PROCESSES THAT ALLOW US TO DRAW DISTINCTIONS AND RECOGNISE PATTERNS IN THE WORLD.

Entropy and disorder

The First Law of Thermodynamics states that the total amount of energy is always conserved. Its supplement, the Second Law of Thermodynamics, states that in any conversion of energy from one form to another some is lost to the system, usually as heat. The Second Law describes the tendency of ordered systems to gradually decay into disorder through the dissipation of energy, and explains why for example gases distribute themselves pretty much evenly through a fixed space, and why perpetual motion machines are impossible. It is also used to explain why events in the world move in the direction of the "arrow of time", and indeed how we gain the impression time proceeding at all (Penrose 1990 p. 391).

The Second Law was originally developed to account for fact that in steam engines the conversion of heat to mechanical energy is only efficient to a degree of 50 to 80 per cent. The rest of the energy is lost through noise and friction, and escapes in the environment. More energy, therefore, is put into the system in the form of heat than is reclaimed as mechanical energy put to useful work, however efficiently the machine is constructed. To be able to maintain a particular state of order or work, such as pumping or beating, requires constant input of new useful energy, normally from burning fuel. The measurement of the loss of energy to the system, the part that escapes useful work, is known as 'entropy', and high levels of entropy are associated with greater loss of useful energy as more dissipates into the environment. Scientifically speaking, this escaping energy is seen as ‘disorder’.

Entropy and order

The consequence of entropy is that any structured, orderly or useful system can only exist by virtue of the energy that is consumed in creating and maintaining it — or to be more precise, by the ‘order’ (or ‘negative entropy’) that it ‘feeds off ’. The physicist Erwin Schrödinger referred to this negative entropy as ‘negentropy’, a term not without its critics (Schrödinger 1967, also see Arnheim 1971 p.15). Without such orderly input the system would eventually decay into a ‘disordered’ state; it would lose its tension, form and structure and become a shapeless noise. Humans are a good example; unless we continually import order into our bodies in the form of food and heat, we starve or freeze and eventually decay, thus losing our form and the capacity for action that characterises our living existence.

The nineteenth century terror of the ‘heat death of the universe’ was founded on the premise that all universal energetic processes proceed gradually from an orderly, useful state to a disordered one. Hence, in time all the forms we see in the cosmos (including our selves) will inevitably decay into an undifferentiated and lifeless dust. This will happen because forms in the universe represent a state of non-equilibrium, or non-dispersal, which are only held together and away from equilibrium by an energetically sustained imbalance. But owing to the dispersing effects of entropy, in ‘heat death’ everything will be finally resolved into a state of equilibrium. In simple terms, ‘everything goes downhill’ towards a state of rest and all tensions are ultimately resolved. Something of this effect is seen when ink is dropped into a glass of water. That which starts as a graceful cloud ends up dispersed in the more or less evenly coloured water. In physical terms, the cloud- state is more ordered than the dispersed-state since the cloud-state is further from equilibrium — further from ‘death’.

Form in the universe

One of the most puzzling aspects of physical law is how any form emerged in a universe which, according to the Second Law of Thermodynamics, is gradually dissipating into formless noise in accordance with the demands of entropy. For not only does order, in the form of galaxies, planets, life and societies, emerge but seems to increase in complexity over time — certainly if the evolution of life on earth is any guide. According to *Cosmic Evolution* (Chaisson 2001 pp. 101-120) the solution to the puzzle turns out to be relatively straightforward. Put briefly and simply, the early period of cosmic time saw a universe consisting of essentially shapeless radiation that was fairly evenly distributed everywhere. But as the universe expanded and cooled it gave rise to gradient shifts, or imbalances, in energy levels between different points in space, and this caused energy to flow from one place to another. In particular, the exertion of the gravitational force became increasingly decisive and eventually allowed the condensation of radiation into clumps of matter (galaxies, stars and planets). Each such shift, or concentration of energy, whilst generating form, simultaneously discharged some 'noise' into the surrounding universe, in accordance with the Second Law. Thus the universe gives rise to form as it expands due to irregularities in space, but at the expense of an overall increase in entropy.

Energy and order

In general then, when we think of 'order' we mean something that displays a perceptible form or structure, and when we think of 'disorder' we mean something that displays little or no perceptible form. At least this is the implication of the physical theories so far discussed. It also seems that any perceptible form or structure is one that embodies energy in a state of non-equilibrium, or non- dispersal. The creation of form requires the expending of energy such that the form embodies the energy expended in its creation. And to maintain its form the object must constantly resist the tendency of the energy it embodies to decay into a state of equilibrium. Creation, therefore, involves the transformation of energy from a relatively disordered state to one of greater order. But it does not matter that in the process some energy may be lost to noise since there is plenty available energy in the universe to create all the forms we know and more. In this respect life on earth is particularly indebted to the sun (but not entirely — 'extremophiles' on the ocean bed take their energy from other sources). Life on earth is sustained not just by the importing of energy from the sun, but by the importing of energy of a lower entropy state than that which is radiated back out into space as energy in a higher entropy state (Penrose 1990 p. 413).

The principle of form and life sustained by ‘borrowed’ energy, however, remains the same:

> A living organism could be defined as a system that maintains and even expands its ordered structures by constantly taking up external energy. This does not contradict the second law. A steam engine also runs for a very long time if it is continually stoked. The supply of energy is thus employed for maintaining and expanding structures. On earth, this energy comes mostly from the sun . . . The survival of life is understandable in principle, then, as long as the necessary transformations and material flows are financed by a large energy supply. In this sense life is very expensive. (Cramer 1993 p. 16)

Friedrich Cramer makes the case in *Chaos and Order* that order (more perceptible form) emerges spontaneously in certain media given the appropriate influx of energy (ibid. p. 18). He cites the case of ‘Bérnard instability’, a phenomenon whereby visual patterns emerge in a heated liquid when there is a critical temperature difference below and above it; hence “the consumption of energy spontaneously gives rise to order.” One can see this phenomenon quite readily as a pan of water starts to boil and an orderly array of bubbles appears at the base of the pan. For Cramer this demonstrates the fundamental role energy plays in the formation of structure in the universe. In many ways, such orderly structures are but expressions of energetic activity and its effect upon certain suitable media.

Problems of order

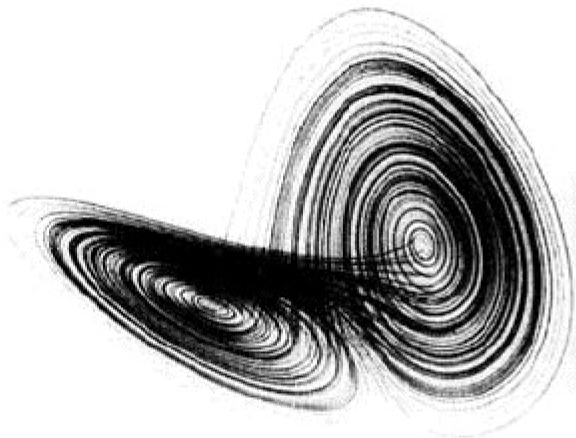
We are starting to establish, I hope, more clearly what is meant by terms like order, disorder and entropy, and how they relate to each other in physical processes. But while the physics is fairly straightforward and quite well understood, the philosophical implications of these ideas are more problematic. For example, there is a tendency in science, philosophy and everyday life to think of terms like ‘order’ and ‘disorder’ as opposites, even as mutually exclusive absolutes. Moreover they tend to be regarded as what philosophers call ‘mind-independent’ properties; that is, properties which exist whether humans are there to witness them or not. For posthuman thought, such mind-independent properties are highly awkward insofar as they perpetuate the split between ‘external’ reality and human perception we tried to resist in chapter one. In order to remove the order-disorder opposition and the external-internal reality opposition it is necessary to think more in terms of relations than distinctions.

The emergence of chaos

The story of the emergence of chaos theory is entertainingly told in James Gleick's *Chaos: Making a New Science*. He starts the story in the 1960s when meteorologist Edward Lorenz was carrying out work on weather prediction using a computer to help with the large amount of calculations involved. He found that during the long process of recursive calculation a tiny difference between two input numbers would, over time, produce a huge difference in outcome. This phenomenon, known as 'sensitivity to initial conditions' is at the heart of what came later to be known as chaos theory and seemed to explain why complex systems like weather are so hard to predict. Lorenz went on to model other complex systems like water wheels driven by a constant supply of water. Using three non-linear equations to model the system, he plotted the resulting output in graphic form as maps. Deterministic science, and indeed human intuition, would suggest that any system given a constant input of energy should settle into a regular, orderly pattern of behaviour:

> Instead, the map displayed a kind of infinite complexity. It always stayed within certain bounds, never running off the page but never repeating itself either. It traced a strange, distinctive shape, a kind of double spiral in three dimensions, like a butterfly with two wings. The shape signalled pure disorder, since no point or pattern of points ever recurred. Yet it also signalled a new kind of order. (Gleick 1988 p. 30)

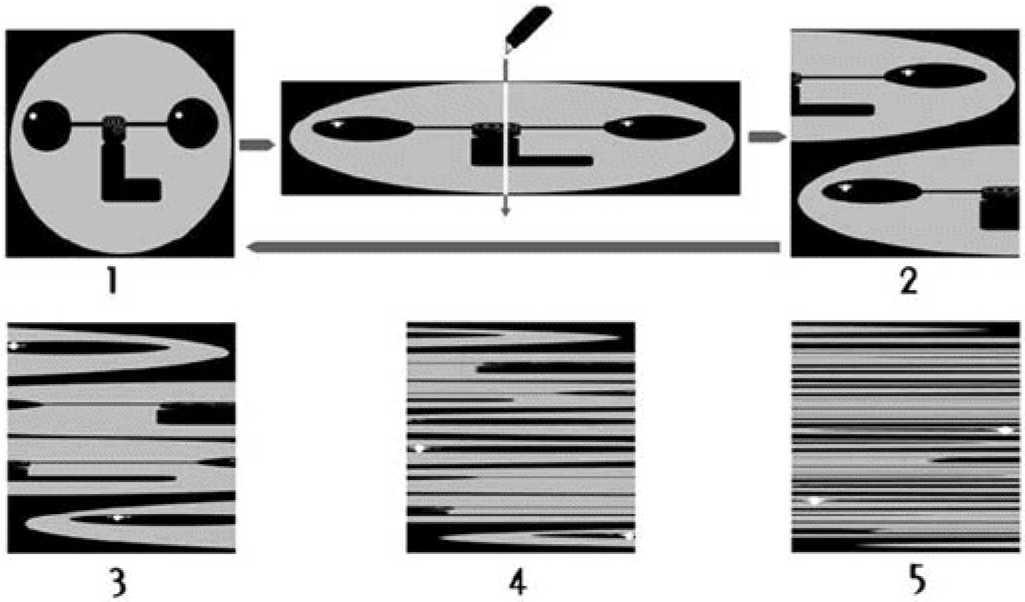
The behaviour Lorenz had observed was an example of what was later to become known as a 'strange attractor'. This butterfly-like spiral now quite familiar to us from images of chaos was one product of the advances made in mathematical research since the introduction of computers. It represents a system that is both ordered and disordered, stable and aperiodic. But how can a system be both ordered and disordered at the same time?



A Lorenz attractor

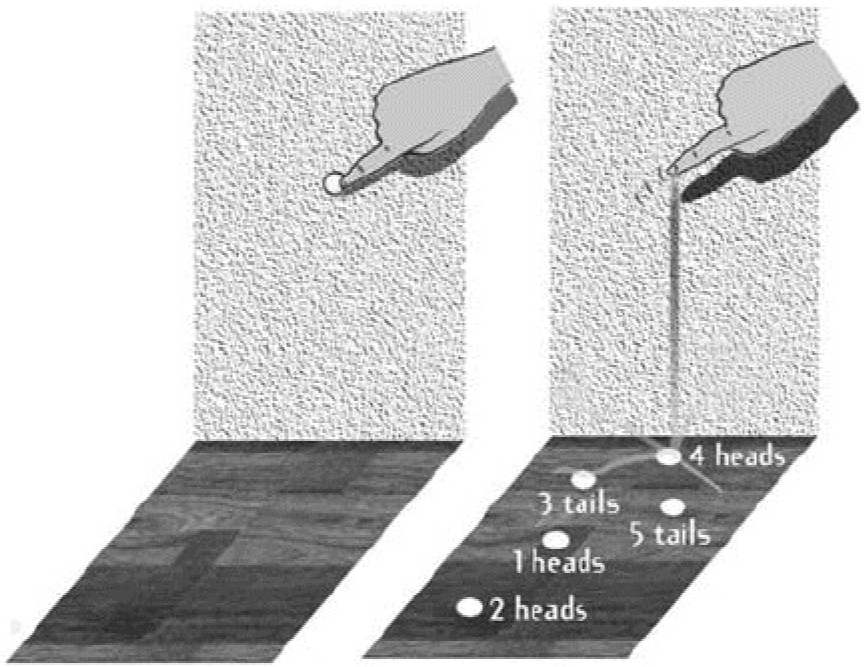
The continuity between order and disorder

There are many examples in mathematics, topology and the study of dynamical systems that illustrate the surprising continuity between order and disorder. For instance, in the study of bifurcations, fractals and non-linear systems it has become apparent that seemingly ordered procedures can give rise to seemingly disordered results. Ivar Ekeland describes the oft-cited example of the 'Bernoulli shift' in his book *Mathematics and the Unexpected* (Ekeland 1988 p. 50). The Bernoulli shift (also known as the 'baker's transformation') consists in taking a regular object, such as a square shaped piece of dough, and applying a simple transformation. The dough is stretched to twice its width and half its height, then it is cut in half and one half put on top of the other. The transformation is repeated many times in a process known as 'iteration'. Although this seems on the surface a very deterministic, orderly procedure it soon leads to the appearance of chaos. If two close points in the dough are followed around through the iterations it is soon apparent they start to diverge from each other in a dramatic way. In fact, after a critical number of iterations the position of the points becomes unpredictable.



The effect of the baker's transformations (Bernoulli shift). For the first five regular transformations the two white dots occur in stable positions relative to their starting position. However, after the tenth the position of the dots is no longer predictable despite the transformation being entirely regular.

As Ekeland says ". . . this process leads quickly to chaos — apparently to total disorder. Any small piece of the square is spread more and more evenly throughout the whole . . . until there is an equal likelihood of meeting it anywhere in the square." At a certain critical point in the iteration a discontinuity occurs and the smooth, continuous graph that plots the point's position up to a certain number of transformations suddenly jumps and splits, or bifurcates, in a way that leads the process in two possible directions. Each branch can then split itself in the same way leading, within a short time, to a hugely complex and chaotic state. For Ekeland the implications are clear: "Order and chaos, regularity and unpredictability, are woven together like land and sea on the beach when the tide is drawing out, leaving behind a maze of puddles and wet sand, so that it is impossible to tell where the water ends and where the dry land begins." Such statements undermine the belief that ordered systems are intrinsically distinct from disordered ones. Instead, order and disorder are better understood as being defined in relation to one another.



To illustrate how randomness can arise in an apparently deterministic system try the following experiment. Take a coin and place it on a vertical surface about 30 centimetres from the floor. Draw a circle around the coin. Now try letting the coin drop a number of times. Each time you should try to position the coin in the circle in the same way. No matter how many times you let it drop, or how accurately you try to position the coin, its resting position will always vary. The initial positioning of the coin is apparently fixed and determined yet it falls in a chaotic way.

The scientific definition of order and disorder

As I mentioned, some scientists will assert that there are 'objective' ways of defining order and disorder, and related qualities like complexity, that are both free of relativism and independent of human subjectivity. I argue something different: that what we perceive as order and disorder are less intrinsic conditions of external matter than subjective judgements about energy states, determined by sensory perception and cultural influence (which is not to forget, of course, that scientific authority is a strong factor in determining cultural beliefs). Whilst objective scientific definitions may be useful in certain applications and valid within their own terms, I will argue they remain open to relativistic interpretation.

Penrose's argument

For an authoritative and accessible scientific account of order I have turned to the renowned scientist Roger Penrose and his book *The Emperor's New*

Mind (Penrose 1990 pp. 394-406). Whilst this book is mainly concerned with refuting the claims made by some in the artificial intelligence community, it also offers a valuable overview of the current thinking in many areas of contemporary scientific opinion. Because of its relative complexity I won't relay his objective definition of order here in full, and instead urge the interested reader to consult it directly. Speaking of a glass of water that has fallen from a table, only to be shattered on the floor he raises the question directly: is order a subjective quality imposed by an observer or is it a quantifiable attribute that can be objectively measured in scientific terms? Penrose, being of a scientific persuasion, argues the latter although, as I will claim, he leaves ample latitude for entertaining the former.

The shattered glass is a common image in discussions of disorder and the irreversibility of natural processes, as is the scrambled egg, from whence comes the epigrammatic definition of entropy — "You can't unscramble an egg". First Penrose concedes that the shattered glass of water might be viewed as a "special" kind of orderly object if only it were practical to keep precise track of the motion of all the particles thrown into a "higher entropy state" by the crash. "For, in a more subtle sense, the higher entropy state in these situations is just as 'specially ordered' as the lower entropy state owing to the very precise co-ordination of motions of the individual particles." However, this concession is only made after the introduction of a qualifier; that such "specially ordered" states have "manifest specialness."

For Penrose "Entropy refers to manifest disorder" and it is this qualifier that apparently allows him to retain his "entropy state" distinction between the 'orderly' glass on the table and its 'disorderly' state on the floor. But unfortunately, 'manifest' in this context seems to mean nothing more than whatever we might subjectively think is disorderly. Penrose realises that this qualifier needs qualification: ". . . but it would appear, by my use of such imprecise terms as 'manifest' and 'disorder', that the entropy concept could not really be a very clear-cut scientific quantity." To give Penrose credit, he does at least acknowledge the possibility that not all people may agree on what order is. "It seems, also, that the various observers' aesthetic judgements might well get involved in what they deem to be 'order' rather than 'disorder'. We could imagine some artist taking the view that the collection of shattered glass fragments was far more beautifully ordered than was the hideously ugly glass that once stood on the edge of the table!" But Penrose is teasing us, and he soon re-asserts his original line ". .. the artist's or the scientist's judgement as to whether it is the assembled or the shattered glass which is the more orderly arrangement is of almost no consequence whatever, with regard to its entropy measure." One is left wondering what purpose 'almost' serves here.

What follows over the next few pages is an entirely reasonable, and no doubt accurate, summary of how entropy values are calculated logarithmically in relation to a phase-space. What is noticeably absent in this summary, however, is any further reference to order or disorder. One could be forgiven for concluding that, whilst entropy may be a reliable statistical way of calculating the probable behaviour of classical physical systems, it is less adequate as a guide to the essentially subjective properties of order and disorder. Entropy is less a 'measure of disorder' (and by implication order) than a statistical measure of the unpredictability of complex system. In other words, it is a measure of the limits of the human capacity for measurement.

Measuring disorder with probability

As a further example of the way in which he argues disorder is measured is by determining the amount of entropy in a system, Penrose discusses a box of gas molecules. This again is a common image in descriptions of entropy. In an ideal closed system it is theoretically possible for the gas molecules to be distributed within the box in an effectively infinite number of ways. For instance, it is possible that all the molecules may decide to move into one corner of the box or another, although it is much more probable that they will be distributed roughly evenly throughout. This is made much more likely by the energetic action of the randomly jiggling gas molecules. The notion of probability is crucial here, for the most probable states of a system tend to have highest measurements of entropy, while the least probable have the lowest. Hence, the improbable state in which the molecules are all collected in one corner of the box is described as exhibiting low entropy, and the most probable state where they are distributed evenly exhibits high entropy. Guy Brown offers a clear analogy in *The Energy of Life*:

> The same principle can be illustrated .. . with a pack of cards. If we start with the cards in order, arranged in suits from ace to deuce and then shuffle them extensively (that's the random jiggling) we end up with a disordered layout of cards. But the opposite does not happen; it would be extremely rare to see a disordered pack being shuffled into an ordered one. This is because there are only a few different arrangements that are considered ordered, whereas there are millions of different arrangements that are thought of as disordered . . . If there is one ordered arrangement and a million disordered, then a randomly selected one (as produced by shuffling) has a one in a million chance of turning up the ordered one, but a near certainty of producing a disordered arrangement. (Brown 1999 p. 71)

Note that in this example the use of the words 'considered' and 'thought of ' imply a certain degree of subjectivity in what is supposedly an objective description. For whilst it is indeed the case that the 'orderly' arrangement first described is highly unlikely to emerge from a random shuffling, the same would be true of any other particular sequence, however 'disorderly' it seemed to us. In other words, any one sequence is just as likely to come up as any other, but certain sequences will be considered or thought of by us as more orderly than others. Rudolf Arnheim presses the point in his famous essay *Entropy and Art* when discussing the analogy between entropy and card shuffling:

> The usual interpretation of this operation is that by shuffling, say, a deck of cards one converts an initial order into a reasonably perfect disorder. This, however, can be maintained only if any particular initial sequence of cards in the deck is considered an order and if the purpose of the shuffling operation is ignored. Actually, of course, the deck is shuffled because all players are to have the chance of receiving a comparable assortment of cards. To this end, shuffling, by aiming at a random sequence, is meant to create a homogeneous distribution of the various kinds of cards throughout the deck. This homogeneity is the order demanded by the purpose of the operation. (Arnheim 1971 p. 13)

The artist's view

When the prudish nineteenth century art critic John Ruskin accused the rather flamboyant American painter James Whistler of "flinging a pot of paint in the public's face" by exhibiting his impressionistic firework scene *Nocturne in Black and Gold* (1877) there followed a celebrated libel case initiated by Whistler. Ruskin had spent much of his illustrious career nurturing a highly structured aesthetic outlook that exalted the precise and orderly rendering of nature in art; an order that for Ruskin had profound religious connotations and which found its fullest expression in the work of the Pre-Raphaelite Brotherhood. Whistler, on the other hand, represented a new tension in western painting that incensed Ruskin. This was the much looser and more rapid response to natural scenes that was to become known, mainly in France, as ‘Impressionism’, but which was arguably directly traceable to the influence of J MW Turner, whom Ruskin greatly admired.

While the court case itself ultimately hinged on the amount of time necessary for the production of a work of art, the clear line of Ruskin’s attack was that the *Nocturne*, which consists of various splats and streaks of loosely applied colour, violated the fundamental orderliness of the artistic procedure. For Ruskin this orderliness amounted to the precise (or as precise as was thought possible) correlation between monocular vision and the rendered image, a correlation that necessitated great labour and skill. Instead, according to Ruskin, in Whistler’s painting too much was being left to randomness and not enough to the determined skill of the artist. The art historian Ernst Gombrich cites an amusing cartoon in *The Sense of Order* (Gombrich 1979 p. 109) which shows a bearded artist (surely already a signifier of abandon?) hurling a handful of paint at a blank canvas. Somewhat to the artist’s dismay the ‘randomly’ distributed paint forms the improbable image of that most famous of Whistler’s images — his painting of his mother, dubbed more formalistically by Whistler *Arrangement in Grey and Black: Portrait of the Painter's Mother* (1871). Gombrich goes on to warn of the dangers of equating the probable with the formless:

> The painter [in the cartoon] certainly had reason to be surprised, for we must agree that it would be infinitely improbable for this disaster to befall him. But in what sense is this event surprising or improbable? It is here that we must watch our step, for strange as it may sound at first, any other blot would also have been infinitely improbable. Imagine for instance that it had turned out that the artist had unintentionally made a replica of a Jackson Pollock . . . the shock would have been the same . . . Why? Simply because among the innumerable possibilities of configurations only a very few would fall in to some category we could name and recognize in any terms. (Gombrich ibid.)

Indeed, the case of Jackson Pollock, the archetypal (although beardless) reckless distributor of paint, is highly relevant here because it divides opinion in a way that exposes the vary danger Gombrich warns of. For not only is Pollock’s later work seen by many as the apotheosis of cynical, bohemian ‘skill-less’ confusion, it is regarded by others as the exaltation of balance and fragile self-expression. In other words, to some it is an unholy mess but to others a profoundly moving harmony of form and colour. One can probably guess at what Ruskin's view of Pollock would have been, although Turner, who was caricatured in his own time mopping paint onto a canvas from a bucket, may have been more sympathetic.

The objective definition of complexity

The same subjectivity that encroaches whenever one tries to be precise in establishing what is, or isn't, orderly also comes into play when precise definitions of complexity are attempted, despite attempts to deny it. Ervin Laszlo produced a book called *The Creative Cosmos* wherein the sleeve notes declare he is 'considered the world's foremost exponent of systems philosophy and general evolution theory'. In the book he states:

> Complexity in the universe is an objective element, not a subjective chimera. A bacterium is objectively more complex than an atom, just as a mouse is objectively more complex than a bacterium. (Laszlo 1993 p. 48)

On a common-sense level this seems perfectly reasonable — things that have more parts are more complex. However, the truth is that no one really knows how complex an atom is. The results of sub-atomic research suggest that the atom may be infinitely complex in itself whilst also being subject to influences from other atoms at infinitely large distances, the so-called 'non-locality effect' (Peat 1990 p. 126). There is certainly no sense in which it can be claimed that we are close to a total understanding of the complexity of an atom nor what non-local forces may influence its properties. Nor do we know how complex a mouse is. To say that a mouse is more complex than an atom is merely to state that Δ_{10} is a greater sum than Δ_2; in other words, that one indefinitely complex thing is more complex than another one. To avoid this confusion Laszlo directs the reader to an appendix in his book designed to remove any doubt we might have as to the objectivity of complexity (Laszlo 1993 p. 233). Opening confidently by saying "There are ways of measuring complexity in real world phenomena that are independent of the subjective complexity experienced by observers", he goes on to offer three levels of proof, which I shall summarise.

Firstly, we are told of a method of defining complexity that relies on the number of 'yes/no' choices needed to construct a system from its elements. Without explaining very clearly the operation of this method he immediately dismisses it as only being useful in "comparatively simple" cases. Secondly, we are offered the "Seth-Pagels" method that, we are told, is a "more sophisticated measure of complexity." Seth-Pagels' "thermodynamic depth" method states that complexity is greatest when a state is farthest away from total order and total randomness, as exemplified by atoms in a crystal lattice on the one hand and the molecules in a cloud of gas on the other. As has been made clear elsewhere, notions of total order and disorder are, at best, contingent. A crystal may be highly regular when viewed at one level but it is not totally ordered. At a quantum level it is unpredictable and the simple act of observing it introduces some perturbations, however slight. A cloud of gas may seem very irregular when viewed at a certain level but it is not totally random in that each molecule affects the behaviour of another and all are affected by gravity. The whole thing is just very complex and unpredictable. It is likely apparently random phenomena can have deterministic (that is, 'orderly') features if viewed with sufficient precision. So, in sum, randomness and order remain partially subjective properties despite the assumptions of the "thermodynamic depth" method.

The final proof offered by Ervin Laszlo is the "still more sophisticated measure of complexity" known as the Kolmogorov-Chaitin-Solomonoff definition, which actually turns out to be the weakest. After being offered a description of this precise algorithmic method we are immediately informed that "This program has been subsequently shown to be impossible to compute: the very concept of a general algorithm for finding the shortest program for computing a given entity involves a logical contradiction." Surely this limits the usefulness of this method? Possibly realising the fragility of his case, Laszlo then has to concede that "no fully satisfactory measure of complexity has yet been devised" and goes on to generalise about complexity being somewhere in between order and chaos. It seems that complexity, then, is as difficult to define objectively as order and disorder.

Confusion of meanings

The idea that order, disorder, complexity, randomness and chaos might be subjective categories that are ultimately impervious to precise and objective definition seems to be gaining some scientific validity. Eric Chaisson, who we have already met, is about as distinguished a representative of the scientific community one could wish to meet. His sleeve notes cite his numerous professorships in physics, astronomy and education and his prolific publishing record. And so it is with some interest that we read in *Cosmic Evolution*:

> By "complexity," we refer to the term intuitively as used in ordinary discourse, a definition culled from many sources: "a state of intricacy, complication, variety, or involvement, as in the interconnected parts of a structure — a quality of having many interacting, different components." . . . No attempt is made here to be rigorous with the words "order," "organisation," "complexity," and the like; this is not a work of classical philology or linguistic gymnastics. Indeed, no two researchers seem to be able to agree on a precise, technical definition of such a specious word as complexity, which may be context-dependent in any case. (Chaisson 2001 p. 13)

So Chaisson prepares us for the confusion of meanings these terms can have, but then unfortunately seems to compound them. Throughout *Cosmic Evolution* he makes the distinction on the one hand between the concepts of low-entropy, order, non-equilibrium, predictability and complexity, and on the other hand their apparent opposites of high-entropy, disorder, equilibrium, randomness and simplicity. Yet all such distinctions, as we have seen, are ultimately tempered by the fact that order and disorder are relative, qualitative values invested in the world by human perception, not intrinsic absolute states of things beyond us. As the law of entropy shows, at best they can be defined probabilistically or statistically.

If we follow Chaisson's line that complexity and disorder are exclusive, or that order and non-equilibrium are similar, then we find ourselves in a potential logical minefield. For if this were true then presumably we could not have such a thing as 'complex disorder' (as, for example, in the case of war or riot), or 'ordered equilibrium' (as in the ranks formed by marbles as they come to rest in a tray) or 'predictable randomness' (which seems to be the very essence of entropy). Chaisson's standard scientific presentation of thermodynamic laws early in his book is later undermined by a more relativistic definition of order as "an absence of disorder", whilst even later he acknowledges the deficiencies of some of the most common methods used to define order — 'information' and 'negentropy'(ibid. p. 133). This sets the ground for the introduction of his own definition (the "free density rate") which, as described at the end of the last chapter, uses energy through-put in relation to mass as an objective measure of complexity. Whilst this approach yields some impressive and persuasive results, it also leads to the rather unconvincing conclusion that a Pentium II chip is more complex than the human brain. Strangely, this is justified on the dubious grounds that the chip can do calculations faster than a brain, thus ignoring the magnitude of complexity variance between a linear digital processor and a hyper-parallel organic structure. This, I believe, exposes the limits of this latest attempt to objectively quantify order and complexity, powerful though the energy flow argument is in general.

The limits of objectivity and quantification

Whilst it might be in the interests of the humanist scientific method to propose we can objectively measure disorder and complexity, it is certainly a task fraught with subjective assumptions and severe limitations. Humanist science (as opposed to sciences with posthuman implications such as chaos, catastrophe and complexity) has traditionally sought to objectify and quantify, to reduce the subjective and qualitative nature of human experience. This is a tendency noted by sociologists of science:

> Newton based his theoretical work on the belief that the project of natural philosophy was to explain all there was in heaven and earth through the fundamental measurables, the quantifiable qualities of matter and motion — size, shape, distance and hardness. This metaphysical commitment to sticking numbers on things and then explaining their behaviour by reducing the numbers to abstract law-forms written in algebra, has become a dominant aesthetic in modern science — an ethic, even — and a dominant process in the management of social affairs. (Hales 1982 p. 122)

Pointing this out does not deny the validity of the use of algebraic methods in scientific modelling of the universe. After all it is just such methods that, through their use in computer simulations, have expanded our understanding of what is ‘measurable’ by allowing the exploration of more dynamic and qualitative phenomena in chaos and complexity theories. But the law of entropy reminds us that “nothing’s for free”, and there is a price to be paid for our increased capacity to model reality with computers, which is that we are brought up sharply by the impregnable limits of measurement discussed in chapter one. Which is to say reality is so complex, so sensitive to initial conditions that no computation, however refined, will be able to account for all the phenomena we see around us. Speaking of the early Lorenz experiments with computer-based weather forecasting and their unpredictable results, James Gleick writes:

> It was only a wobble from a clumsy computer. Lorenz could have assumed something was wrong with his particular machine or his particular model — probably should have assumed. It was not as though he had mixed sodium and chlorine and got gold. But for reasons of mathematical intuition that his colleagues would begin to understand only later, Lorenz felt a jolt: something was philosophically out of joint. The practical import could be staggering. Although his equations were gross parodies of the earth's weather, he had faith that they captured the essence of the real atmosphere. That first day, he decided long-range weather forecasting must be doomed. (Gleick 1988 p. 17)

So we are faced with the prospect that real, highly intricate and inter-related cosmic events will always be essentially 'non-computable'. This doesn't mean that we cannot produce sophisticated models of systems with a limited number of parameters, and there is no doubt computers allow us to produce such models to a degree of sophistication never before possible. What we should be wary of, however, is confusing the model of reality with reality itself. Ironically, while those sciences with posthuman implications may be seeking to achieve the same ends as humanist science, namely to complete modelling of the universe by computational means, the resulting computer-based calculations that ought to have made the job easier have pointed to the very impossibility of achieving this end.

Nothing is isolated

The attempts outlined above to quantify notions of order and disorder in anything other than an abstract sense are flawed on the grounds that absolute quantification is only valid for an idealised, isolated system. Since there are no actual isolated systems in nature, we are forced to deal with the qualitative aspects of real phenomena, and qualitative properties are by definition subjective; the best we can do is analyse them statistically. The discussion of consciousness in chapter one is a case in point. Neurologists have tried to quantify consciousness by treating it as an isolated system, something that is restricted to the brain. This is in accord with the materialist view that consciousness is an objective property of a certain type of matter. But as has been stated, consciousness is a quality that emerges from the co- presence of a number of complex factors, of which the brain is only one. Since the number of factors is so enormous (the billions of active neurons being only a part) the complexity involved is of such a high order that we are excluded from quantifying, or isolating, the process. Therefore, we are forced to accept that our knowledge of human consciousness will remain imprecise, although this does not rule out the possibility that we might be able to produce an analogous form of consciousness in a non-human medium, just as we can build analogous models of weather patterns.

Telling the difference

I have argued that order and disorder, like complexity and simplicity, cannot be quantified in an objective sense, but must remain open to some subjective, relativistic interpretation, despite what some in the scientific community assert. This is not to say that qualities of order and complexity have no meaning; we will often refer to them in subsequent chapters. Rather, it means that certain things will appear more complex or behave in a more orderly way than others when viewed subjectively by a human. But given that humans do subjectively perceive order and disorder, why do such perceptions arise?

Perception and energy

As previously discussed, the universe can be considered as a flux of energy states in continual transformation wherein there is no finite substance to which all matter will finally be reducible other than the 'medium' of energy itself, at least as far as we can tell from contemporary physics. So the fact that reality can be described energistically seems to suggest an underlying coherence and unity in natural phenomena. Although this might seem theoretically acceptable at the sub-atomic scale, it seems less applicable at the normal human level of perception where there does seem to be difference, contrast and conflict between solid, separate things. Consequently, as we perceive things on a daily basis we accept that forms and structures around us display more or less difference, order and stability in themselves; that is, we tend see these qualities as a function of the objects and not our perception of them. When looking in a garden at leaves, flowers and branches they all look more or less stable and distinct. How is it then that we can claim in this garden there is no intrinsic order distinct from our perception, and that none of the many things we see are actually separate from each other?

Following the arguments already made, the response is as follows: the apparent qualities of order and disorder and the perceived distinctions between 'things' are not products of any intrinsic, objective order that is external to us, nor are they the results of innate divisions within the structure of the universe. Instead, they are a consequence of both the numerous ways in which energy is manifested in the universe, and the operation of sensual processes in living entities.

Continuous change and a sense of order

Contemporary physics recognises that energy in the universe, in the form of forces and matter, exists in an infinite variety of ways, and that reality is continually changing: nothing in the cosmos remains still. In fact, it could be argued that no two occurrences of any event are exactly the same. The Greek philosopher Heraclitus poeticised the continually changing nature of the cosmos with the analogy “One cannot step twice into the same river, nor can one grasp any mortal substance in a stable condition, but it scatters and again gathers; it forms and dissolves, and approaches and departs.” (Fragment LI, Kahn 1979). This powerful statement of the Heraclitian universe in perpetual flux conforms to the principle of the ‘irreversibility of time’ underlying the Second Law of Thermodynamics which describes the inevitable increase in overall entropy as energy changes from lower to higher entropy states (“You can’t unscramble an egg”). But what is important to recognise here is that this continual state of flux in the world is reflected by the sensual responses of living things, which are sensitive to certain degrees of energetic change and intensity. For example, a sudden drop in atmospheric temperature might lead to goose-bumps and shivering, or a flash of light might cause the eyes to close. In simple terms, the organism will sense that some change has happened and respond as best suits it. And if such stimuli are perceived to occur with regularity, then the organism might build up a sense of rhythmical expectation and acquire knowledge of regularity — even a sense of order.

> We could not function if we were not attuned to certain regularities. This tuning, moreover, could never have come about by learning; on the contrary, we could never have gathered any experience of the world if we lacked that sense of order which allows us to categorize our surroundings according to degrees of regularity, and its obverse. (Gombrich ibid. p. 113)

Continuity and discontinuity

It is interesting to note, as Gombrich does, that a sense of order can only emerge through apprehension of two opposite conditions — regularity and its obverse (presumably irregularity). But even prior to a sense of regularity must come the capacity to sense change, and by implication its obverse — non-change. While the ways in which energy might mutate and transform are infinite and often unpredictable, the ways in which energy manifestations are perceived by an observer must exhibit one of three qualities before any other deductions can be made: energy states are either continuous, discontinuous, or both. In essence, continuity is non-interruption of space-time and discontinuity is interruption in space-time; both qualities can be discerned in all perceptual events depending upon how they are viewed. For example, a blank sheet of white paper can be said to display a certain amount of continuity when viewed at arm's length, but on magnification will reveal a surface of irregular, discontinuous fibres.

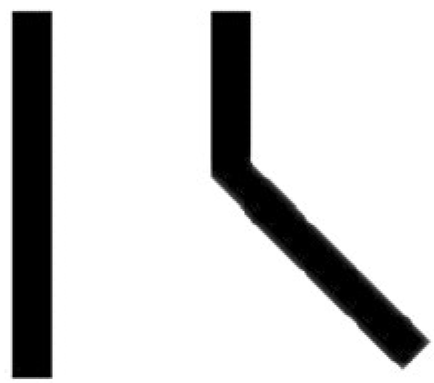
Qualities as perceived by an observer

It is crucial is to note that energy manifestations should not be thought of as intrinsically continuous or discontinuous; that is, neither condition is absolute since each can only be judged in relation to the other. To take an apparently simple example, look at the arrangement of dots in this diagram

To an observer there are several expressions of continuity and discontinuity here:

1. The dots are the same size and shape as each other (continuity)
2. The edges of the dots are distinct from the paper, which is white (discontinuity)
3. The dots form a row (continuity)
4. One dot deviates from the row (discontinuity)
5. The space between the dots is even (continuity)
6. The white paper has been disrupted by the dots (discontinuity)
7. The ink of the black dots is solid within their boundaries (continuity)
8. The dots are stable and do not move in relation to the page (continuity)

These qualities only apply when you are holding this book a few feet away from your eyes (assuming it is being read on paper). Decreasing the level of resolution (moving far away) might see the dots almost merge into a single line as with newspaper photographs which, when magnified, are made of discrete dots that merge to give the impression of a continuous image when viewed from a short distance, as seen in the last chapter. Increasing the level of resolution shows that the dots in the sequence above are a broken and irregular stain on a web of paper fibres. A detailed comparison would reveal that each dot is unique in terms of the paper fibres that support it and the particular way ink is distributed. Therefore, what can be considered either continuous or discontinuous is not intrinsic to the dots themselves, but subject to the resolution of the viewing position. Another kind of continuity and discontinuity can be seen in the following figure:



While the line on the left displays discontinuity inasmuch as the black ink is separate from the white paper, the shape itself is a continuous line. The line on the right has the distinction of having a further discontinuity by way of a bend. But the qualities of continuity and discontinuity are not confined to visual representations. Consider some phrases common in the English language: ‘bent as a ten bob note’, ‘bent as a banana’, ‘straight and narrow’, ‘crook’ (as in villain), ‘I put them straight’, ‘a straight person’, ‘bent cop’, ‘kinky’ and ‘straight sex’. Implicit in these phrases is the notion that continuity (straightness) is synonymous with order, the rule of law and honesty whereas discontinuity (bentness) represents disorder, dishonesty and deviation (as in dodgy, twisted, warped, etc.).

More generally, the extent to which continuity and discontinuity are fundamental to our ability to perceive order and disorder cannot be overstressed. In the sense described here, all difference and order in the universe appear as a result of our ability to discern continuous and discontinuous properties. One might go so far as to say there is nothing we do, feel, hear, say or think that is not perceived as either a continuous or discontinuous expression of energetic states. In fact, it seems impossible to sense one kind of state without the other — in each occurrence they define one another simultaneously. This capacity to sense at the same time, and without contradiction, apparently opposing qualities is a remarkable feature of our perceptual and conscious life.

States of (dis)continuity

What follows are some general comments about continuities and discontinuities intended to help clarify how the terms are used here. The notion of the 'thing' is employed —a deliberately indeterminate word referring to a perceptible object or event — which is discussed more fully below.

• *Discontinuities are things: things are discontinuities*. Nothing can be a 'thing' if it is not differentiated from some other 'thing' by displaying discontinuity, by having a boundary. For example, when describing the human body names are given to the areas that display discontinuity, change and difference; the face is densely mapped by names in proportion to the amount of surface area relative to the sparsely named torso, which covers a larger surface area with less discontinuities.

• *Nothings are continuities.* Continuities are 'no-things'. If one says "I felt nothing" or "Nothing happened", what's meant is that a certain continuous state was not punctuated by a discontinuity or perceived change.

• *Regular (dis)continuities are order.* Any (dis)continuity that is perceived to occur with, or display regularity might be construed as ordered, stable and determined; for example menstruation, night and day, periodic cycles, musical rhythm, stripy patterns and other regular differences in space and time.

• *Irregular (dis)continuities are disorder*. Any (dis)continuity perceived to occur with, or display irregularity might be construed as disordered, e.g. splashing water, cloud formations, scribbles — things often labelled unpredictable or complex.

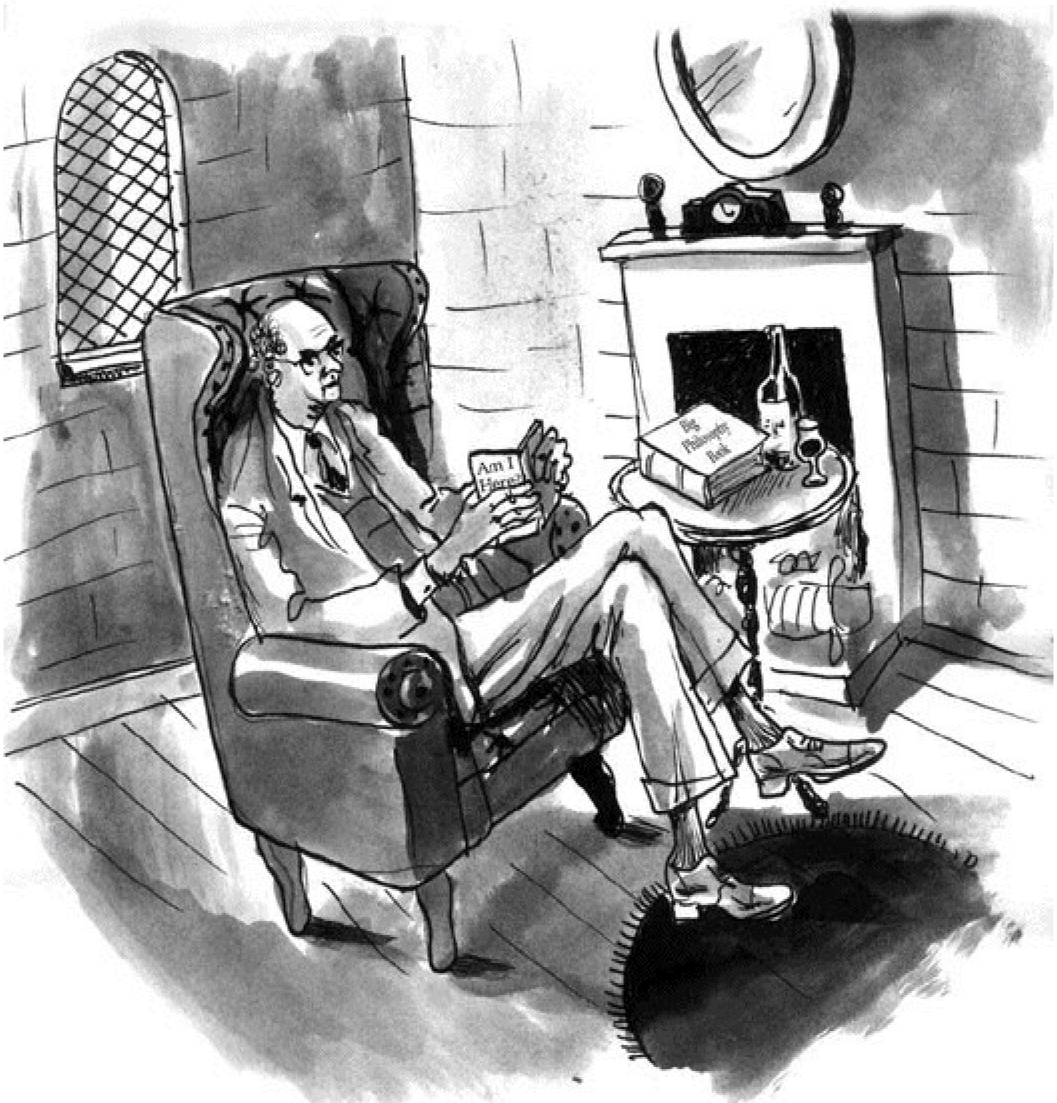
• *Continuity is an absence of discontinuity*. Continuity should not necessarily be confused with orderliness. For example the continuance of ink within a printed character, or area of space or time that is not perceptibly punctuated by any discontinuity is continuous but not always regular. Also, in language one might think of the continuation of associations between words or ideas, or the absence of breaks or stops in the flow of ideas which also may be disorderly.

• *Discontinuity is change.* Change is understood as the transformation of 'something' relative to 'something' else, either another thing or state. Some difference must be perceptible for change to be noticed; that is, some discontinuity must be present. Such change may be either orderly or disorderly, depending on how it is viewed.

Things

What distinguishes 'things' from each other is the perceived discontinuities they display to an observer. As the biologist René Thom put it "The characteristic of all form, all morphogenesis, is to display itself through discontinuities of the environment." (Thom 1975 p. 9). The different manifestations of energy between a philosopher and a chair, for example, allows them to appear distinguished. The distinguished philosopher might debate whether he or the chair 'actually' exists. While such debates are best left to philosophers, what cannot be disputed is that prior to doubting the existence of the chair he is only able to refer to it as a 'thing' by virtue of the discontinuities it displays which distinguish it from the fireplace, the sherry glass and the large philosophy book on the table. The chair itself may be of that comfortable kind in which the leather upholstery is restrained by buttons. Taking the chair as a whole, the buttons now form a discontinuity that punctuates the surface of the leather. Yet, since they are probably arranged in a regular, diamond shaped manner, their relation to each other forms a level of continuity — one could continue indefinitely.

To summarise, we can see that whilst there may be no intrinsic divisions among things (since all things are expressions of energy) an organism perceives differences because energy is manifested in different ways and an organism is sensitive to different manifestations of energy. Varying manifestations of energy can be perceived as either continuous or discontinuous, or both; these qualities being entirely relative to each other. The existence of order or disorder, therefore, is a function of both the perceptual apparatus and the energetic expression of that which is perceived.



The 'chair of philosophy'


A METAPHOR FOR SCIENTIFIC INVESTIGATION
MY SON...."SOB" I THINK I'VE BECOME SEPARATED FROM HIM
REMEMBER, IT'S ONLY LANGUAGE THAT MAKES THINGS SEEM SEPARATE
THAT LIGHT DIFFERENTIATION IN THE ENVIRONMENT HAS CAUSED A NEUROLOGICAL SHIFT IN OUR SENSORY MATRICES
SEE SON, EVERYTHING'S MADE OF ENERGY IN SOME FORM
LIKE, IT'S ALL THE SAME STUFF BUT WE ONLY SEE DIFFERENCES BECAUSE THINGS APPEAR SO VARIED?
SO, THE UNIVERSE IS TOTALLY HOLISTIC?
IT'S USEFUL TO VIEW IT IN THAT WAY
IN THE FUTURE THE UNIVERSE WILL BE THOUGHT OF AS AN UNBROKEN WHOLE WHICH CAN ONLY BE DIVIDED TEMPORARILY FOR THE PURPOSES OF STUDY OR DESCRIPTION

CHAPTER FOUR
BEING, LANGUAGE AND THOUGHT

In posthuman terms, reality is an energetic continuum in which humans are essentially indistinguishable from their environment. This is in contrast to the humanist view, which sees humans as essentially distinct from, in opposition to, and predominant within nature. The continuous view of human existence not only rejects the idea that humans are in opposition to nature, it also rejects the long-cherished belief that human thought is a unique case amongst natural phenomena—something that can never be replicated in any other medium. This chapter outlines a posthuman conception of language and thought as 'embedded' in other energetic processes in the world.

The acquisition of language and difference

> Noam Chomsky said that animals and small children live in a world of "states" and not in a world of "objects", in a world, that is, without order or coherence. Language alone allows the order of the world to be instituted, and then allows acts of reflexion and of consciousness upon the world and upon sense impressions to be carried out. Language serves above all as an organ of thought, consciousness and reflection. It thus provides the mind with an autonomy from the lived experience, allowing it to maintain a distance between itself and the lived experience. (Lemaire 1977 p. 51)

It has been argued by child psychologists and psychoanalysts that while newly born babies are unaware of divisions, children acquire self-consciousness as they become aware of differences. To a baby the world and itself are a continuous, existential reality. Later, however, when the nervous system is more fully developed and more experience is gained in the world, the child is able to differentiate more clearly. For instance, it can become distressed on realising the mother has left and is comforted when she returns, implying that the child can distinguish between itself and its mother, an experience discussed in detail by Sigmund Freud in *Beyond the Pleasure Principle* (Freud 1984).

The notion of separateness is later reinforced when the process of language acquisition starts; the difference between things is continually pointed out (literally, didactically, deictically) and marked by oral signals such as 'mama', 'dada', then later 'horse', 'table', 'house', and even later ‘semiology’, ‘gluon’, and so on. This process, sometimes called ‘splitting of subject, acquisition of language’ in psychoanalytic jargon, leads to an experience of the world in which things appear to become separated from each other and from oneself, a process made more vivid by the institution of naming (Lemaire 1977 p. 70, Lacan 1977 p. 2). And, as mentioned earlier, while things will appear to be separate owing to the response of the nervous system to variations in stimuli, these separations are reinforced by language in humans to an extent that is not true of other species; no other earthly creature uses verbal language to differentiate things in the world as we do.

In humans, therefore, the emergence of full consciousness coincides with the full acquisition of language; for though it may be argued that a small, pre-linguistic baby is still conscious, or at least aware, it is obviously not sentient in the reflexive, self-conscious sense that normally applies to fully developed adults. This is not to say, necessarily, that language ‘makes us’ conscious, but that human consciousness and language are somehow implicit in each other.

In the remainder of this chapter I will introduce some ideas concerning the nature of human being, language and thought which in many ways are rather speculative in that they are supported by little empirical data, but are based instead on the arguments presented so far and a degree of introspective analysis. However, it is consistent with what has preceded, and vital to our understanding of what follows, that we consider a non-linear, energistic model of human mental activity.

Becoming a being

If one broadly accepts the theory just outlined, that linguistically reinforcing the appearance of divisions among things contributes to something we know as human consciousness, then it could follow that the acclimatisation to a differentiated world over time also enables a sense of being. That is to say, if one has learned to distinguish between a thing and its environment and that distinction is sustained for a minute, or a day, or a year then a certain stability has been established in one’s mind about the world and in respect to one’s sense of self-permanence.

The peculiar sense of being that humans enjoy must be linked to the recognition that different things have a certain amount of stability and recurrence. Of course, nothing is entirely stable at all times and one will soon learn that even apparently stable things can change (the mother can disappear, for instance). So as one learns to depend on stability, whilst remaining aware that apparently stable things can change, the human becomes locked into an ongoing dichotomy: on the one hand we are reliant on global coherence to reassure us of our continued existence, but on the other we are continually aware of its potential loss. As will be discussed further on, only later in life when stability can be all too tediously persistent will we disturb it, perhaps with chemicals, art or dangerous sports.

We find ourselves in a classic human predicament: being attracted to stability because it confirms our presence in the world, but intrigued by instability, variation and novelty as it colours our lives. We will look more closely at why this might be.

Structural language

Language is understood, certainly by structural linguists such as Ferdinand de Saussure, as a self-referential system in which no identifiable elements (phonemes, nouns, utterances, etc.) have absolute or pre-given authority in themselves. Instead there exists an arbitrary arrangement of signals, forged by consensus over time, whose mutual opposition within a structure ensures that we are able to refer to distinctive concepts with some predictability. For example, a ‘branch’ is a branch because it is neither a ‘leaf ’ nor a ‘trunk’. The words or sounds may be interchangeable but they must remain distinguishable from each other in order to be able to refer to different concepts (with some exceptions). According to structural linguistics, there is no natural or pre-given relationship between the word ‘branch’ and the concept of branch. These units of linguistic discourse are commonly called ‘signs’. For the classic text on the structuralist description of language see Saussure’s *Course in General Linguistics* (Saussure 1990).

Semiology is the ‘science of signs’ and was developed mainly in French Universities in the 1950s and 1960s to formalise the study of social meaning. One of its more useful consequences has been to extend the notion of language from being merely that which is spoken to include all the images, symbols, conventions and gestures that are ‘meaningful’, from road signs to hem-lines. This extension is justified on the basis that meaning is articulated through non-spoken information (such as shapes of furniture, car designs) just as much as it is articulated through the spoken or written word.

(For an introduction to semiological theory, see Barthes 1967). Despite the fact that semiology has been discredited in a number of ways, I believe this enlarged description of language is useful. In this discussion I shall use the word language mainly to mean what is spoken or written, but without precluding the whole structure of articulated meaning that pervades our culture — the general semantic discourse of society.

Repetition and habituation

In reply to the question raised in chapter two as to whether order exists in the real world or in the brain, I argued that it really exists in both in that it is a product of a world-embedded mind. For in any discussion about our perception of the world we should never forget that the mind is not an external instrument introduced into nature in order to observe it, but an integral product of nature itself. Despite what we might wish sometimes, we cannot stand outside of the world (nor outside our brains for that matter) so as to analyse it in an objective, impartial way.

To illustrate how fundamental this integrated condition of order is to our existence we might ask how would human beings function if we did not perceive order, if we did not construct a view of the world as being at least partially certain? On the most basic biological level we would be highly ineffective, as stimuli would seem utterly chaotic and nothing would be learned or anticipated. In other respects a sense of order is equally important in what it allows us to ignore. We tend to become desensitised to familiar or repetitive stimuli that might otherwise keep us in an uncomfortable state of alertness, or perpetual confusion and shock:

> Animals respond to a novel stimulus or event. If the stimulus or event occurs repeatedly and has no interesting consequences, the animal stops responding to it. In this sense habituation is a very adaptive aspect of behaviour. Without it, animals would spend most of their time responding to all kinds of irrelevant stimuli. (Thompson 1993 p. 350)

This habituation to repetitious stimuli helps to reinforce our appreciation of order, even though we might be ignoring the stimuli. This also lends support to the view that a sense of order does not arise spontaneously and independently in the brain, but in response to, and in parallel with those regular environmental stimuli to which we become habituated.

Order and death

One might say that a sense of certainty contributes to the affirmation of being, or to adapt the Cartesian aphorism ‘I order, therefore I am’. But if this holds then so does the opposite: since the process of ordering is continually threatened by its potential loss in the face of uncertainty or instability, one’s sense of being is likewise threatened with a loss of being or, in effect, death. Hence the ever-present threat of insecurity and uncertainty, the state of not knowing, the fear of disorientation and the potential drift into meaninglessness compels us to grope for order and belief, wherever it can be found. Here at least is one motive for seeking the ordered and rejecting the random, something many of us are prone to do in our quest to extend our own sense of universal certainty.

> We and other mammals appear to be driven by nature towards certainty. This may in fact be the basis for the existence of various belief systems. A person firmly committed to a belief system does in fact “understand” the world and the nature of the controls that operate, even though this understanding may be quite wrong. (Thompson ibid. p. 202)

The rhythm of life

To make the imperatives for certainty more concrete we should note all the unavoidable influences that contribute to the formation of regularity within our sense of existence. For example, our own bodily functions establish a familiar rhythm and regularity in that the heart beats periodically, we get hungry and tired regularly and we are conscious of the cycle of breathing. We are bound to some extent by the periodic changes in the environment around us, or the desire to elicit a predictable response from the world and other creatures. To varying degrees these circumstances determine our actions, at the same time as promoting certainty and, by contrast, revealing unpredictability.

Order in language

The certainty that confirms our sense of being also contributes to the impression that processes in the world around us are intrinsically orderly or disorderly, which, as was argued earlier, is not the case. But as we come to recognise patterns in global events, so we come to believe those patterns exist independently of our recognising them. This is further reinforced in language whereby the mental distinctions upon which our language depends seem to be intrinsically consistent in a way that correlates with the apparent consistency of the world. For example, we divide a branch from a leaf, and give each a name, but branches and leaves are obviously associated by proximity, as are their names. Yet each name, and the object it refers to, can only be arbitrarily isolated as an integral entity —a fact which the process of naming tends to obscure.

Linguistic proximity

Language is a system which is to a large extent self-consistent, for if it is to be useful it must manifest coherence and orderliness. Moreover, the consistency of language reflects the degree to which the world is coherent to us. As we perceive trees and houses in the environment that display relative stability, so the words 'tree' and 'house' are relatively stable referents to those objects we perceive. But it must be remembered that we can only attribute consistency and orderliness in a contingent sense. As we saw earlier, things that seem ordered on one level can seem chaotic on another; order arises from both the behaviour of the world and the way we look at it, and language is just as prone to chaos as the world it reflects.

Language and continuity

Within our experience of language we can discern differing amounts of continuity and discontinuity. Consider a relatively continuous flow of linguistic signs:

… watch > look > see > vision > sight > view > vista > scene > spectacle …

This sequence, or any like it, can be regarded as a relative continuum since it does not require much conceptual diversion to pass from one word concept to the next. In general discourse, we might think of language moving in a continuum from one concept to another — almost through the path of least resistance — insofar as we make sense of the linguistic flow. Just as a high state of entropy in physical phenomena can't move spontaneously to a low state (things do not jump up hills of their own accord), given the choice between two alternatives language will take the easiest 'path'. Conceptually, therefore, one normally assumes the most obvious meaning in any communication to be the one that follows a prior utterance with least resistance or effort. This assumption is the basis of much comedy, which requires that an audience infers the most obvious meaning first, only to be surprised when a non-obvious meaning is revealed, resulting is a conceptual discontinuity. For example, the great comic Spike Milligan would quote the old Music Hall joke:

> 'Is anything worn under the kilt?'
> 'Nae, it's all in perfect working order.'

Such linguistic continua and discontinua form the fabric of cognition, reason and meaning and contribute to the coherence of our verbal experience. Faced with an infinity of possible meanings and associations we instinctively reach for the bobbing floats of coherence strung out in chains on the dark waters of meaninglessness. Consider a relatively discontinuous flow of linguistic signs:

… bite > chunk > vest > sample > scrounge > mope > shed > gentle > picnic …

This sequence, or any like it, can be seen as relatively discontinuous since it requires a greater conceptual diversion to link one word concept to the next. You will notice, however, that in the process of reading the list you start to assert conceptual links between the words that I did not intend to be present — especially if it is read several times over. The fact that we try to assemble links in the face of apparent incoherence points to our involuntary desire to construct meaning where there may be none. Even in the case of an overtly nonsensical sequence we still attempt to draw out some thread of conceptual continuity, such as in the opening line from Lewis Carroll's *Jabberwocky*:

'Twas brillig, and the slithy toves Did gyre and gimble in the wabe.

Despite the abstruse intent of the author I see little choice but to assert the following meaning: 'It was a brilliant, cold day and slippery frog-like creatures danced and frolicked in the fast flowing river.' Others would have their own interpretation.

Language, philosophy and the logic of definition

What is the relationship between the perception of a thing and the naming of it? Can one perceive things that don't have names, or does something's name alter our perception of it? The answer in both cases, I would argue, is 'sometimes'. It appears that many philosophical problems lie in that fact that because we name something in order to distinguish it, we therefore assume that it is actually distinct. Because we have named something called the ‘brain’, for example, it allows us to forget that the ‘brain’ is actually part of the heart! In fact most philosophical problems are really debates about language that arise because of three mistaken assumptions: *a*. that language is consistent, *b*. that because a word exists there must exist a ‘thing’ that it represents and *c*. that the things which are represented should in themselves be integral. I am sure a debate could be constructed around, for example, the difference between ‘consciousness’ and ‘thought’ which would demand considerable academic resources, or even a full-scale conference. However, this would be not much more than a debate about the difference between a ‘motor car’ and an ‘automobile’ since both disputes would be based on the mistaken assumption that because two words exist it must necessarily follow that two distinct things exist.

Words and things

We must remember that when we use a word to refer to an object we do not refer to an isolated entity — nothing can be isolated from the rest of the universe, except in an idealised or abstracted way. In this respect language has an interesting property which points to the fact that nothing can be defined in an absolute sense: nouns operate in a way that is both exclusive and inclusive simultaneously. In other words, nouns refer to something exclusively in order to differentiate it from all other things, but at the same time imply the inclusion of the functional context which gives rise to and motivates the normal usage of the concept. When I refer to my heart it is not to an isolated piece of meat floating in a Perspex box, but a functioning organ that is part of a dynamic organic system. My heart is relatively separate from my lungs, but to absolutely separate it would mean I would die and my heart would longer be a heart in the same sense as it is, but a lump of meat.

The inclusive operation of words is revealed when we used them metaphorically, as in ‘the heart of the matter’, or ‘the heart of the city’, where the functional ‘use- value’ takes priority over the nominal differentiating value. This inclusive effect of words reinforces the fact that they do not have absolute, finite definitions; even a dictionary or an expert can only be relatively precise, as was apparent in the discussions on ‘order’ and complexity’ in the last chapter. To think about language in terms that are more inclusive than definitive could be regarded as a type of ‘holistic linguistics' in which the inclusive function of language is given equal weight, or even privileged, over its exclusive (structural) operation.

Slippery language

As has been indicated, many philosophical problems arise from the conflict between the imprecise nature of language on the one hand, and the desire to impose a logical structure on the world through language on the other. Logic, by definition, is the precise analysis of definite terms that relate in a rational way. Logic deals with boundaries, limits and fixed quantities whereas words, sentences and meanings do not really have boundaries, limits or fixed quantities; in short, language is 'slippery'. In his *Philosophical Investigations*, the philosopher Ludwig Wittgenstein considers the requirement that investigation of language should proceed logically:

> The more narrowly we examine actual language, the sharper becomes the conflict between it and our requirement. (For the crystalline purity of logic was, of course, not a result of investigation: it was a requirement.) The conflict becomes intolerable; the requirement is now in danger of becoming empty. We have got on to slippery ice where there is no friction and so in a certain sense the conditions are ideal, but also, just because of that, we are unable to walk. We want to walk: so we need friction. Back to the rough ground! (Wittgenstein 1953 remark 107)

If it can be accepted that the meaning generated by a word is relatively and not absolutely stable then it will greatly relieve the pressure on philosophers of language to try and quantify what is meant by 'meaning'. Wittgenstein, as an eminent logician, struggles with the barrier that logic imposes on an understanding of real, as opposed to ideal, language:

> The ideal, as we think of it, is unshakable. You can never get outside it; you must always turn back. There is no outside; outside you cannot breathe. - Where does this idea come from? It is like a pair of glasses on your nose through which we see whatever we look at. It never occurs to us to take them off. (Wittgenstein ibid. remark 103)

If there is something to be learned from all the linguists and linguistic philosophers who have 'pre-seeded' us it is that language is exasperatingly complex. Perhaps we should take heed of this and accept that language will always be more grotesque than the sum of any logic we may construct to describe it.

Deconstructing language

There is a philosophy of language that has been extremely influential in European and American academies since the 1970s. 'Deconstructionism' arose from the French schools of structuralism and post-structuralism and has been important in showing how meaning is socially 'constructed' rather than being natural or pre- given. It operates around the principle of linguistic signs developed by Ferdinand de Saussure outlined above. In stressing the socially constructed nature of language deconstructionism attempts to reveal how words and ideas are not neutral, impartial symbols that we freely choose to express ideas. Rather, it exposes how words and the meanings they embody have a rich ecology of interconnections and evolutionary history that defies linear interpretation — what is sometimes called 'intertextuality'. The methodology it adopts is the literal deconstruction of texts, usually passages of writings of other philosophers, in order to show that the text does not represent an independent truth. All texts are open to interpretation and no single meaning can be assumed: all texts are to some extent volatile.

A key figure in deconstructionism is Jacques Derrida, whose ideas are highly controversial, in the academic community at least. Some critics have taken the upshot of his work to imply that there can be no meaning in a text, that everyone can read something different, that interpretation can go too far. Whatever view one takes on this, Derrida is pointing to something long denied by those who see language as more fixed and linear. When one is reading (or for that matter listening) one is not solely concerned with that which is being read; the possible meaning to be derived from a text is greater than the sum of the words on the page:

> Derrida entertains the curious hypothesis of a 'programming machine', one that would at least set certain limits to the play of aberrant interpretations. It is a notion related to his metaphor of "multiple reading heads", intended to suggest (by analogy to the record, playback and erasing heads in a tape machine) the way we read simultaneously what is there in front of us and also, in the process, a potentially infinite range of intertextual meanings and allusions, some of which may very well obscure or efface the immediate sense of "the words on the page". (Norris 1987 p. 201)

To say that the meaning of a text is not fixed is not to say that it is meaningless. It is merely to state that no two readings of a text can be identical, just like the Heraclitian river. The result of two people reading the same text might be that they both have almost identical interpretations. Yet the possibility must exist that the same text could be interpreted in vastly different ways. The case of Friedrich Nietzsche and the posthumous appropriation and distortion of some of his ideas by the Nazis ideologues is often cited in this regard. Texts themselves may not vary but the contexts in which they are read, or spoken, may vary drastically. The context can contribute as much to the meaning as the actual printed, or spoken, words so that two occurrences of the same person reading the same text in different contexts do not produce identical results. A love poem read when you're in love does not have the same meaning as one read when you're not.

This view of language operation is sympathetic with the view of other complex phenomena we have discussed in previous chapters — that all non-linear, complex systems (and the operation of human language is certainly a complex system) are highly sensitive to small perturbations and external influences, i.e. they are context sensitive and their boundaries cannot be fixed with precision. With language, as with other systems, total predictability and stability are ruled out.

The danger of deconstruction

Given that a text may be a social construction riddled with ideological assumptions and prone to aberrant interpretations, the task deconstruction seems to have set itself is, literally, to 'de-construct' that which is constructed, thus revealing some other truth in the text that was concealed in its construction. The process of deconstruction is often taken to mean 'pulling apart' by exegesis of a text, film, or speech and in practice this can often mean examining the frames of a film in minute detail or scrutinising a text through etymology, or microscopic 'textual analysis'. But the term 'deconstruction' and its associated procedures seem to imply that something specific, and perhaps quite dubious, is being attempted. For to hope that such methods will lead to a revelation of truth may be just as misguided as thinking we might understand the behaviour of a flock of birds by examining each bird individually. There is a danger deconstruction becomes merely another form of reductionism, another re-construction from fragmented elements.

If we try to isolate a sign or a unit of meaning in an effort to 'deconstruct' it we inevitably remove it from the context that supported its meaning and thus distort that which we wish to analyse. At the very least we create a completely new context from which meanings can be generated. Deconstruction itself carries us into an analytic mode of discourse that is specifically different from apprehending in situ the system of signs we originally intended to deconstruct. Logically, then, it is impossible to isolate a sign in order to analyse it objectively, because the act of observation interferes with what is being observed. There is an analogy here with Heisenberg's 'uncertainty principle' of particle physics that excludes us from knowing both the location and momentum of a particle (see chapter eight).

Language as a non-linear process

In the same way that (as we will see later) some cognitive scientists have sought to describe consciousness in terms of ordered, linear functions, some linguists and philosophers have sought to apply the same logic to human language, particularly in respect of artificial intelligence research. This is understandable in light of the fact that linguistics sees itself as a science and the traditional methodology of science is to investigate subjects in a linear way — to prise out what is orderly and consistent, and to disregard what is disorderly or incalculable and, therefore, by definition impervious to quantitative analysis. Linguists, and philosophers of language, tend to idealise language in order to make it quantifiable. But real language can be likened to a turbulent fluid, the catastrophic ruptures between continuous flows of words, the flips and reversals of meaning, are instantaneous and unpredictable; while there is much stability the fluid is never the same twice, it has recognisable form but is not fixed. Seen in this way, no element of language can be autonomous, isolated or reliable, just as a turbulent fluid contains no autonomous, fixed components.

This non-linear conception of language demands that we reject the more orthodox conception, which is one of an abstracted linear operation of signs. Real, active language should be regarded instead as a matrix of infinite-dimensional events, any apparent order being dependent on the context in which meaning is articulated. This kind of non-linear model of language would be much harder to program into a digital serial computer, which helps to explain some of the difficulties faced by AI researchers in trying to rationally codify human intelligence.

The proximity of concepts

If we ordinarily strive to maintain certainty in our understanding of the world to preserve our sense of being, then the flow of language is one thing among many that we are likely to interpret in an orderly way. Language, insofar as it is stable, contributes to our sense of a world that is consistent and regular. Words and signs are conventions that gain their stability through repeated use, and in any human group a consensus will form about the significance of certain discernible signs. This being so, language develops a consistency that is no different to the consistency of any stable stimuli to which we are exposed. When we think we recognise meaning (whether it is the 'correct' meaning or not) we are benefiting from our investment in the stability of a common language bond.

Having precipitated the activation of one concept, further concepts may be activated, to the extent that someone may not wish to be reminded of an idea, but the appearance of a particular cue may precipitate the unwanted idea in spite of a conscious wish to forget it. From such instances we can deduce that the degree to which we can control our own thoughts is limited; we are at the mercy of the probability of one idea leading to another, and the procession of thoughts is partially independent of any separate sense of free will we might think we have. This is something that advertisers take great advantage of by creating associations in our minds between ideas and products. When we see a particular chocolate bar we think of a tropical island, when we see a brand of cigarettes we think of rugged men, when we see a brand of soft drink we start humming a jingle — whether we want to or not! It would be hard to account for quantitatively for what determines the activation of such associations, but it would most likely include factors such as personal experience, cultural convention, the immediate context of the stimulus, the physiological state of the individual, or the inflection of expression.

The energistic conception of meaning

In accordance with the energistic conception of reality outlined earlier, I would argue that the degree of semantic continuity in any sequence of utterances is determined, at least in significant part, by the amount of energy required to pass from one concept to another through a 'chain' of association. Using this energistic approach, one might say that ideas proceeding from one to another with relatively little effort (energy) can be considered continuous. Ideas that require great effort (energy) to connect can be considered discontinuous. In this sense, involuntary thoughts of the kind described above are highly continuous.

Incomprehensibility

An energistic model of human thought allows us to speculate about the structural and biological basis of various semantic processes. For example, difficulty in establishing meaning arises in trying to reconcile concepts that are semantically distant; that is, when there is not a well-established connection between them, in which case greater effort is required to close the gap. However, the link between concepts that have little or no connection may be too difficult, or impossible, to resolve. For example the phrase ‘Crow yesterday up refractive pale’, whilst not meaningless, is certainly awkward to assemble by the standard of most phrases. Even if one tries, it requires a great deal of mental energy to assemble into some comprehensible expression, as with any difficult text.

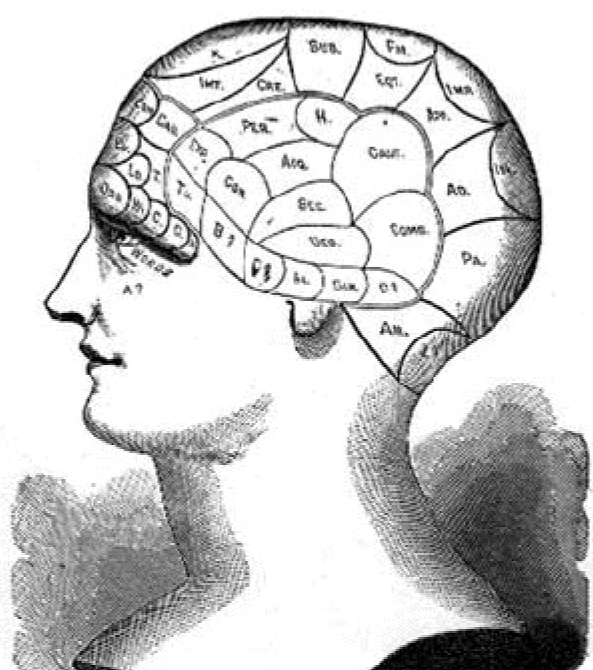
Memory and energy

As an example of the link between thought and energy, imagine having to learn two correlating columns of numbers, such as the stopping distances of cars specified in the Highway Code one is required to know to pass a UK driving test:

20 mph>12 metres
30 mph>23 metres
40 mph>36 metres
50 mph>53 metres
60 mph>73 metres
70 mph>96 metres

It is your task to learn 20 goes with 12, 30 with 23 and so on. The usual way to achieve this is through repetitive chanting in the manner that multiplication tables are sometimes learned at school. Having chanted the list only two or three times, it would take a great deal of mental effort (energy) for most people to recollect the pairs of numbers correctly, especially after some time has elapsed. Having chanted the numbers 20 or 30 times, the amount of effort required in recollecting a pair of numbers would then be significantly less. It seems that when we have learned something thoroughly, because we have invested a lot of effort in bonding certain concepts, we are able to recollect it at a later time with very little energetic expenditure. This is especially so if we 're-stoke' memories by frequently recalling them (which is generally not the case with stopping distances).

It is debated in the study of memory as to whether humans retain all memories throughout their lives, or whether some memories are lost, distorted or misplaced. While this would be hard to answer in an absolute sense, it is clear that some things are more memorable than others and that we certainly give priority to particular recollections, perhaps on some energetic basis. We know from our own experience that a memory brought into existence at a great physical or emotional cost can take longer to fade than its weaker counterpart. For instance, a memory created through particularly traumatic circumstances, such as a crash or an assault, may stay with us all our lives, even if we would wish to discard it. So although the sheer physical impact of an experience will not be the only, or necessarily the main, criteria determining how memories are laid down, it seems fair to say that memories may have some energetic correlation with their source.

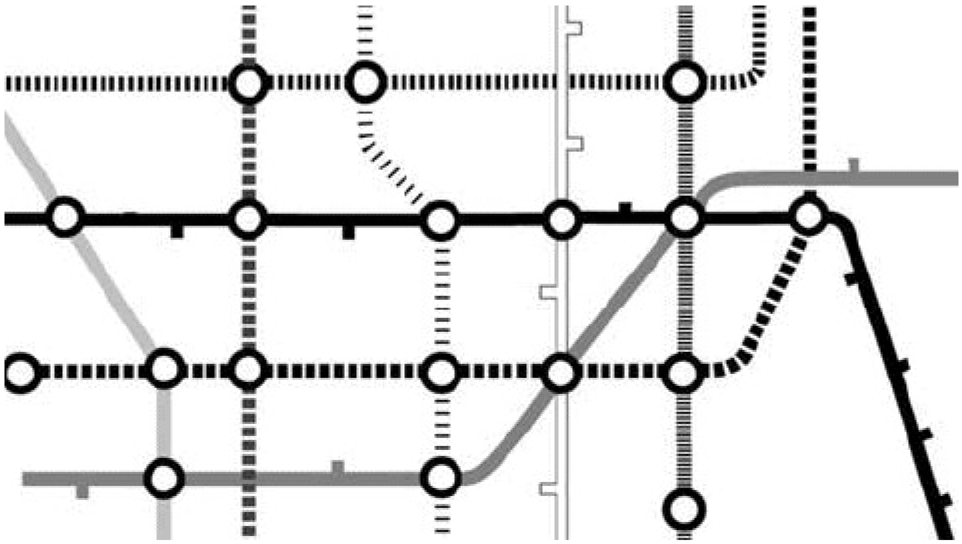


The discredited theory of Phrenology tried to map specific mental functions to local regions of the brain, a compartmental view of the mind which, to some extent, still persists in today's computational metaphors.

Memory models

As yet we have very little precise knowledge about how our memories might be stored or retrieved. The historian of psychology, Douwe Draaisma, has produced a fascinating study of the various ways in which memory has been understood since the time of the Greeks (Draaisma 2000). He argues that the nature of memory is so complex and elusive that we are constantly forced to turn to metaphor and analogy in the absence of explanation, and so recounts how memory has been variously compared to abbeys and cathedrals, the aeolian harp, aviaries, theatres with stages and wings, storehouses and warehouses, phosphorescent substances, clockwork mechanisms, the telephone exchange, railway networks, the camera obscura and photography, the phonograph and cinematograph, and the more recently familiar computer systems and holographs. In fact, a clear historical pattern emerges in which memory is compared to whatever happens to be the most advanced technology of the time, and in our own age, this is most often the digital computer. Interestingly, Draaisma makes no mention of the notion of an energetic conception of mind of the kind being discussed here.

Those who follow the linear computational model of the brain, mind and memory tend to regard memories as compartmentalised blocks of data stored on some huge biological hard disk. As such they will be stored in specific locations that are accessed by the 'program' of our mind (Draaisma ibid. p. 158). This particulate view of memory follows from the belief that the brain is made up of distinct units, each being, to a degree, responsible for different mental functions. It is a view that arguably has been inherited from phrenology but, as we shall see, is rarely understood in such crude terms by contemporary neurologists. But bearing in mind that the computer metaphor still dominates many branches of cognitive research, let us consider the following alternative: Memories should not be thought of as 'blocks of data' or discrete units of information that are 'filed' away in the brain and turned on or off. Rather, we might think of a memory as an activated potentiality that includes the sum of all events that contribute to it, even though they may occur in widely differing areas of the nervous system. In this sense, we might regard memories (and indeed thoughts) as *distributed* attractors rather than localised units; a distinction we will now try to make clearer.



Are thoughts discrete units connected by lines or distributed over the whole network?

Models of thought

In order to draw a very general distinction between the localised view of thought and the distributed one, I'll propose an analogy. Imagine a mental version of the London Underground map. In a localised model of mind the stations represent the ideas, thoughts and memories and the tracks represent the pathways or links between them. Cockfosters could be the memory of my first day at school, Elephant & Castle my knowledge of where I live, Shepherd's Bush my memory of where I used to live, etc. Using this map I can get to any memory by taking the appropriate route, and contiguous stations could be contiguous memories or thoughts. The overall 'brain' contains clumps of data (the stations) that are connected via links (the tracks) to form a network of memories, thoughts and ideas. (To an extent 'memories', 'thoughts' and 'ideas' are being treated here as interchangeable, although the possibility they could usefully be distinguished is tacitly acknowledged). Multiplied in complexity many billions of times, one could build up a working model of the mind from this analogy, and it would be one that fits well with the idea of the brain being made up of different parts that handle different functions. Its most extreme particulate form is exemplified by the "Grandmother cell" hypothesis. Briefly stated, theorists have suggested that a particular perception may be represented in the tissue of the brain by a cell. In *The Brain*, neurologist Richard Thompson quotes Nobel prize winning neurologists Hubel and Weisel:

> What happens beyond the primary visual area, and how is the information on orientation exploited at later stages? Is one to imagine ultimately finding a cell that responds specifically to some very particular item? (Usually one's grandmother is selected as the particular item, for reasons that escape us.) Our answer is to doubt there is such a cell, but we have no good alternative to offer. (in Thompson ibid. p. 243)

But consider another scientific opinion of the same problem by Erich Harth:

> No neuron is just a receiver or ultimate destination of information. It only serves to pass it on. Therefore we should not consider individual neurons as knowing or understanding anything … Similarly, we must assume that even those neurons whose activity has been shown to represent the detection of specific sensory pattern … cannot be said to have anything like a knowledge that the feature is present. They function merely as links in the chain that leads to cognition. (Harth 1993 p. 48)

Not neurons alone

From this it seems that individual neurons alone cannot be responsible for specific thoughts and memories. For even though neurons are the cells in which thought is generally supposed to 'happen', they do not act independently; each neuron is embedded in a rich culture of blood vessels, neuro-transmitters, peptides, hormones and other neurons. Although it is not clearly understood how the chemical agents in the brain function, no one who studies the brain denies that these 'extra-neuronal' substances may have a decisive influence on the activity of each neuron (Greenfield 1998 p. 103). Given that we must also take the effect of the body into account when studying mental activity (as argued previously), we are left trying to comprehend a system of immense complexity that cannot be consistent with the reductive study of individual components. It would seem more accurate, and potentially profitable, to understand the neuron as a mechanism contributing to mental activity, but further implying a matrix of chemo-electrical processes that collectively constitute the neurological fabric that supports the mind.

A non-linear moving model

Referring back to our analogy, imagine that a thought, memory or idea is a *route* rather than a station; in other words, the station is not the depository of a whole idea but part of a journey through which the idea is effected. Here an idea does not consist of any one part of the network but is only actuated when travelled: the idea is the journey rather than the destination. What's more, it's a journey made in many directions at once.

To explain this by expanding the analogy: on the Underground, stations are often also junctions that permit travel in many opposing directions, and connections between different locations are actuated as routes. If routes are analogous to ideas, then when I commit something to memory, a new idea or piece of information, in effect I define a new route. This new route may contain branches of previous routes, as would be the case if I learned more about a pre- existing idea, or it may be that I unite disparate routes that have until now been separate, as would be the case if I suddenly realised the connection between two ideas that had previously escaped me. One can go through different junctions to get to the same destination just as one can arrive at the same conclusion or idea for different reasons. Most importantly, travelling a route is a dynamic process which is distributed across the journey rather than being located in any fixed place, and thereby implies a temporal dimension — thought is always experienced in time.

Multi-linear thought

In order to extend the usefulness of the general analogy we would have to stress that in the real act of thinking, routes may be travelled in many different directions simultaneously. That is, the route that represents a thought is not linear in the sense that it travels from Ealing Broadway to Ongar on the Central line, or even that it might be diverted at some junction to a different line. The thought may travel from Ealing Broadway to Ongar at the same time as branching off at Notting Hill Gate to travel to Monument on the Circle line, at the same time as zooming off to Highgate from Tottenham Court Road on the Northern line, with another branch travelling to Covent Garden on the Piccadilly line. Each line may represent an aspect of that which we perceive as a simultaneous thought. More complex thoughts would require more 'lines' to be simultaneously activated.

But unlike a map, real thought cannot be considered as either a one-, two- or three-dimensional process of linear connective paths. Instead, it might more usefully be considered as a process of at least four-dimensions in which time is included. And to complicate this further, we cannot say that all this activity is occurring in the brain alone, but might have to accept that the 'lines' or 'routes' through which thoughts, memories and ideas occur must extend throughout the whole nervous system, and, by implication, the whole body — even into the world. If someone takes us by surprise by tapping us on the back, the sensation through the skin is the 'start of the line' as far as the mental response is concerned.

Non-locality of thought

It should be stressed again that what is presented here is nothing more than a highly speculative model which may or may not be useful in helping to visualise the immense complexity of human thought processes. But the importance of this model in the context of posthuman ideas is that it suggests a way in which thought might be considered in an energistic, non-local and non-linear way, unlike many other models of thought (such as those in cognitive psychology) which are symbolic, localised and linear. In *Gödel, Escher, Bach* Douglas Hofstadter summarises several attempts to determine where in the brain different thoughts occur (Hofstadter 1980 p. 342). So far all such attempts may have proved inconclusive, not just for a lack of measuring apparatus but because thoughts do not occur in any local place. In posthuman terms, the process of thought is distributed, not only throughout the brain but through the whole body, and even into the environment.

The neurological model

Of course, while the localised view of mental activity persists in some quarters, it has largely been abandoned in others, particularly in the advanced study of the brain itself. In fact the picture is somewhat complicated by the fact that many brain functions seem to be both localised *and* distributed — a rather unexpected outcome that has been compared with the way images are stored and retrieved in holography (Draaisma ibid. p. 174). But recent research tends to point to an understanding of mental function not dissimilar to one being outlined here, in which mental activity, including memories, might consist in distributed, non- linear networks. The eminent neurobiologist Susan Greenfield offers a contemporary suggestion based on the research findings of Wilder Penfield, a surgeon who studied living brains during the last century:

> An interpretation of Penfield's findings is that memory is somehow associated with overlapping circuits of neurons. One neuron could be a member of a number of different circuits; it would be the specific combination in

> each case that distinguished one circuit from another. Each circuit would contribute to the phenomenon of a memory, so that no single brain cell or exclusively committed group of cells is wholly responsible; instead the memory would be distributed. (Greenfield 1998 p. 170).

Note here the residual dependence on the metaphor of 'circuits' which, by their very nature, suggest the kind of closed, linear system we've been trying to avoid.

The energistic mind

Having digested this non-linear conception of mental activity, we will see how it applies to the energistic model of mind being proposed in this chapter. For this purpose it is worth remembering the argument, made earlier, that humans are continuous with the energetic activity surrounding them in the environment.

Thought expressed energistically

Consider some expressions that are used when talking about thought: we 'concentrate' on something, implying a literal concentration of energy; we talk about 'flashes of inspiration' by analogy to lightning, and of 'mental blocks' as inhibited flows of thought; we talk about being 'excited' in the same way that neurons and sensory cells are excited when they are energetically stimulated, and about 'blowing our minds' as though they contained fuses. 'Mental exhaustion' is the depletion of energy, and 'brain waves' suggest energetic propagation through a medium. While some of these terms may have crossed into general usage from scientific terminology, they suggest an implicit understanding of the energetic basis of thought. An excellent account of the energetic economy of mental activity is given by Guy Brown in *The Energy of Life* (Brown 1999 pp. 199-222).

An analogy between lightning and perception

Science tells us that when there is a difference between energy potential in one place and another, the excess energy will discharge itself through a suitable medium. To the extent that the medium has its own structure and form (i.e. it is at non-equilibrium), then it can be considered as having a degree of complexity that will affect the way the energy dissipates; the more complex the medium the more complex the path of dissipation. In the case of forked lightning, the energy potential is the huge electric charge that builds up in one part of the atmosphere and the complex medium is the moist air through which the dissipation occurs. In the analogous case of a thought arising from an environmental stimulus, the potential energy is the stimulus and the complex medium is the web of nerves that dissipate the stimulant energy through the 'cognitive medium' (by which I mean the sum of biochemical matter necessary for a mind). The path that lightning takes through any medium it comes into contact with is essentially unpredictable. Describing the jagged appearance of lightning, Friedrich Cramer says:

> At each point, an irreversible decision is taken as to the subsequent path to be taken. This decision is understandable only in statistical or quantum-mechanic terms. Whenever matter and energy are simultaneously transported through a medium in a system far from equilibrium, that is, at high energy level, such "lightning" occurs. (Cramer 1993 p. 104)

He then goes on to cite a number of examples of similar 'lightning' occurring in various natural processes, including river deltas, tree forms, electron paths in Plexiglas, and streaks of glass found in American deserts that look curiously like petrified, twisted branches which are formed by lightning hitting sand.

To this list of 'lightnings' we could add the path that stimulant energy takes through the nervous system. The trace of this path, inasmuch as it causes semi- permanent modifications to the cognitive medium, could constitute the 'memory' of the stimulus, a transformed potentiality or attractor to be reactivated later by a suitable stimulus. Like the rivulets in mud that attract water, and thus are etched ever more deeply, so the repeatedly activated memory, or the traumatically induced laceration, becomes a more prominent attractor for subsequent energetic flows. And just as lightning is known to travel in many directions at once, so a stimulus may disperse through the cognitive medium, leaving behind it a trail of difference — a transformed potentiality of altered biochemical states — that connects or triggers new or associated thoughts, memories or ideas.

We might, then, consider a memory of an environmental stimulus to be the organic trace of energy dissipation through the nervous tissue. The experience is recorded as it occurs, i.e. as the input energy dissipates through the nervous system, but can to some extent be retraced via the path it creates, even though this path may have many simultaneous branches which may constitute a larger field. Furthermore, the memory may be triggered by activating any one of the branches (or any part of the field), and different thoughts may share branches or have roots in common — for example, all my memories of school have common roots although there are many of them that branch off in different ways. "… one does speak of the speed of a thought; of how a thought goes through one's head like lightning; how problems become clear to us in a flash, and so on." commented Wittgenstein (ibid. remark 318).

Thought scanners

The following visualisation attempts to draw a more graphic distinction between what might be called the orthodox and the posthuman models of how mental processes could be physically supported. Imagine the future existence of a machine that would allow us to monitor thought; a scanner able to measure energy changes in our mental fabric to the resolution of a single 'super-string', or whatever becomes the smallest detectable object known. Being able to view the whole body at once in three dimensions and in real-time, we might see a constantly shifting pattern of multi-linear forks, or fields, particularly dense in the brain, but spreading across the body. The activity would show a certain regularity, but would never repeat. We might correlate certain patterns with particular ideas, but would be surprised to find that the same thing can be thought without necessarily having the same pattern, which might especially be so when different people were compared. We could find that certain areas of the brain are consistently related to predictable functions, but these areas cannot be confined in anything but the most general way. In this scenario, thoughts become fields of possibility rather than local, isolated events.

Thought fields

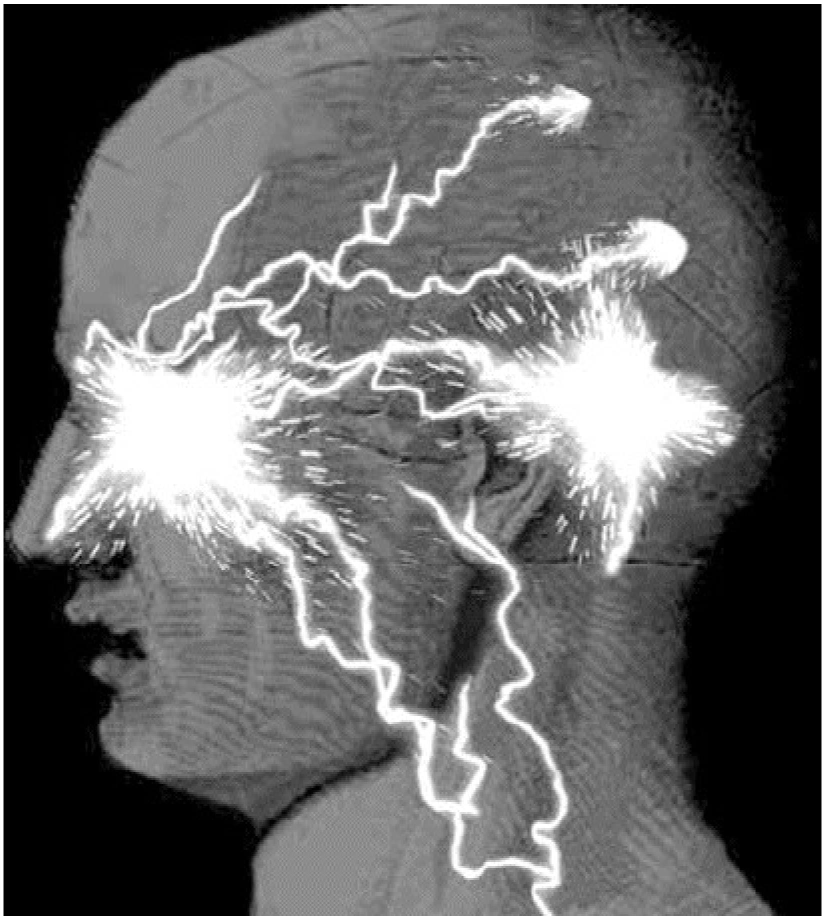
I have suggested that specific thoughts are less fixed neurological states, but potential states or attractors within an "infinite-dimensional function space", to re- quote René Thom from chapter two. In other words, thoughts, memories or ideas that are in some sense discrete, or discontinuous, exist only as *potential* connections that are brought into being by an appropriately attracted energetic stimulus (whether directed from the environment or from elsewhere in the mind). Such attractors are produced, in part, by the transforming action of energetic stimuli on the nervous system, in accordance with the way energetic differences are dissipated through a medium, much as channels are scoured in sand by the action of the sea.

An energistic model of human thought

What we have outlined so far is a highly speculative model of thought in which memories, ideas and concepts are retained as discontinuous thought fields (discontinuous inasmuch as they are distinct from each other) that require greater or lesser amounts of energy to create, navigate and connect. And since the human body can be considered as an energy-regulating mechanism of a very complex kind, this also means there will be limits to its performance, just as there are in any system that relies on energy flow to sustain it. As we saw earlier, if we attempt to link two or more concepts that are very far apart then more energy will be required, and if there is insufficient energy available the link cannot be made (although the attempt to make it will still have some transforming effect on the mind). This might be termed the 'energetic limit to cognition', and will become relevant to the discussion of art and aesthetic experience in the following chapter.

The posthuman conception of thought

I have proposed an energetic theory of mind in which human thought, meaning and memory is understood in terms of the activity of an energy regulating system. Accordingly the human is in essence no different from any other such 'energistic' system we may find in the universe. This does not deny that we are extremely complex, nor does it suggest that we will ever fully understand how we function. What should be becoming clearer, though, is the contrast between this conception of human existence and the more traditional humanist one. If we can start to see how the most 'sacred' of human attributes, such as conscious experience, creativity, and aesthetic appreciation, operate in ways not dissected from other functions in the universe, then we are moving away from the notion of humans as unique, isolated entities and towards a conception of existence in which the human is totally integrated with the world in all its manifestations, including nature, technology, and other beings.



Human thought can be regarded as an energetic process like any other process in the universe.

CHAPTER FIVE
ART, AESTHETICS AND CREATIVITY

The human capacity for recombining ideas and inventing new objects is fundamental to our social and technological development. But we are now faced with the theoretical prospect of 'posthuman' machines with 'human-like' capacities to create, innovate and invent, without being human in the traditional sense. Science fiction is not alone in speculating that such posthuman machines will start to transcend us, to become perhaps the most dominant entities on earth. In posthuman terms the subject of art is interesting not only because it is traditionally seen as a defining human product, but it also represents an area of activity in which the processes of invention, creation and aesthetic production are highly concentrated and visible. Examination of art also allows us to speculate about how these processes operate, especially in light of the model of human thought we outlined in the last chapter.

What is art?

What is art? I doubt there is a single answer. But one useful definition is that an art object is a commodity of the art market. In this respect it's helpful to distinguish between an art object and an aesthetically stimulating object: an art object is a commodity that is traded on the art market, whilst an aesthetic object is one that is appreciated for its aesthetic quality. Of course, something may be both an art object and an aesthetic object at the same time, such as one of Van Gogh's 'Iris' paintings, while something may be an aesthetic object without necessarily being art, like a sunset or an actual iris.

Now many people think that much that is called contemporary art is not 'art' because they consider it to lack aesthetic merit, even though it commands high prices on the art market. The history of western art, certainly over the last 150 years, has witnessed many controversies and crises in the public perception of artistic products, and our own time is no exception. But in most cases the critics of controversial art are simply confusing the art value and the aesthetic value of an object. These two values are quite separate, but of course linked. "Art is a commodity like any other" said Daniel-Henry Kahnweiler, Picasso's dealer, by which he presumably meant art is an aesthetic commodity. The artist Marcel

Duchamp tried to demonstrate the irrelevance of aesthetic considerations to show that it is the process of its introduction into the art market that transforms an object into art. In 1914, Duchamp famously designated a bottle-rack as an art object in a piece enigmatically entitled *Bottle Rack*. “The choice”, he claimed “was based on a reaction of visual indifference, with at the same time a total absence of good or bad taste, in fact a complete anaesthesia.” The conviction that it is the network of social and market structures that determine the nature of the art object has been called the ‘institutional theory of art’ by the aesthetic theorist George Dickie. His somewhat legalistic definition is:

> A work of art in the classificatory sense is (1) an artefact (2) a set of the aspects of which has had conferred upon it the status of candidate for appreciation by some person or persons acting on behalf of a certain institution (the artworld). (Dickie 1974 p. 34)

The art market

So in order to be clear, the art market can be defined as a set of identifiable persons, institutions and commercial organisations which collectively distribute, promote and produce art. In our own time these would include art historians, critics, the art press and publishers, galleries and dealers, competitions and prizes, art schools and teachers, public and private collectors, and the artists themselves. Collectively these people, and their day-to-day activities, constitute what, in broad terms, we understand to be the ‘art market’, just as any other market for commodities is organised to service its producers, brokers and customers.

Of course, art is not just any old product, like tea bags or toilet paper, urinals or bottle-racks. The material objects of art (paint, canvas, bricks, beds, or whatever) are often sold at a huge premium because of some extra value they are perceived to hold by virtue of their circumstances of production and provenance. For the art market trades in ‘rarity’ — that most precious of all commodities — as the objects come to represent the irreplaceable manifestations of human brilliance. This rarity, of course, guarantees that the art market operates at a certain level of elitism where objects are seen as investments with ‘blue-chip’ inflationary potential, and hence are often a haven for the money of the super-rich. One could even argue that one of the main functions, or effects, of the market for art is to distinguish rich people from poorer people, but not necessarily those with 'taste' from those without.

> 'My passion is for the Impressionists, and dollar-wise they are also great,' said one Texas collector . . . Another, when told by a friend that his collection of Picassos made him a Communist in the eyes of 'local patriots' replied, 'You can tell those sons of bitches over there that I've made a quarter of a million dollars on these paintings so far. That will shut them up, because that's the kind of language they understand.' It is, of course the language most of us understand. It is the language of the art game. (Wraight 1974 p. 28)

Judging aesthetics

Generally speaking, one might say that there are two types of art — good and bad, though of course there may be some dispute where the boundary lies. I would argue it is possible to distinguish between good and bad art, not merely in the basis of personal prejudice or habitual response but on grounds of aesthetic content and the merits of a work's perceptual and conceptual qualities. This is not to suggest, however, that aesthetic merit is a 'mind-independent' property of matter — the kind of fallacy we were very careful to avoid when discussing order and disorder in chapter three. Just as then, we must think of aesthetic properties as belonging to both the object perceived and the act of perception.

With this in mind we might say that good art is aesthetically stimulating and bad art is aesthetically neutral, on the basis that one thing we want from a work of art is aesthetic stimulation, by whatever criteria it is judged. Needless to say, the criteria that determine whether something is aesthetically stimulating or neutral vary depending on the context in which objects are apprehended; aesthetic preferences are not entirely ahistorical, as we can see from the ebb and flow of visual styles over the centuries. But given that a broad consensus exists within art institutions about which works are aesthetically valued, we might advance the following generalisation: good art induces a sense of discontinuity and bad art reinforces continuity. To test this we'll look at a couple of examples.

Turner's Deluge

In J M W Turner's 1843 canvas *Shade and Darkness — The Evening of the Deluge* (Tate Gallery, London) the artist has conveyed the sense of Biblical doom and catastrophic weather conditions with a violent mesh of greys, greens and browns sculpted into a sort of holistic whirlpool of indeterminate forms (for a colour version see 'http://www.artchive.com'). Even at the time Turner was producing and exhibiting work, there was public hostility to his free use of paint and lack of precision in rendering objects. Yet it is hard to dismiss the effect his painting has on the senses (especially when Turner's works are seen in the flesh) and the evocativeness of the almost absurdly exaggerated atmosphere. In many ways this painting, as with much of Turner's late work, is an incarnation of visual and conceptual fluidity bordering on disarray. In several places it is impossible to be sure what the paint is representing; animals blur into the landscape and each other, brush marks jangle and jar in the maelstrom, and at times we are not sure what is in the foreground and what lies behind. The overall impression is of chaos wreaked upon the earth and upon us as we stand in as witnesses to the scene. It is easy to imagine Turner throwing himself physically into the act of painting, like some possessed medium channelling a spiritual vision through eloquent and evocative gestures in paint.

Shade and Darkness—The Evening of the Deluge, J MW Turner 1843

Tate Galleries, London

The Leader Hubert Lanzinger 1936

Lanzinger's Leader

On the other hand, take this example of German National Socialist realism, produced by Hubert Lanzinger in 1936 called *The Leader* or *The Flag Bearer* (for a colour version see 'http://www.primenet.com/~byoder/nzhorse.jpg'). It is typical of much art produced in the service of the Third Reich in the 1930s, striving as it does to uphold and propagate some mythical order of leadership and statehood that we know was entirely fictitious. Hitler is portrayed as a medieval helmsman in whom all the virtues of chivalry and conquest are encased, as though he were the embodiment of the very holy order of knighthood. In no sense is the painting intended to perturb or dislocate the viewer. Instead it merely seeks to ensure, with the minimum of ambiguity and subtlety, that a very prescribed and narrow set of associations are conveyed. Thus Hitler represents the continuity of an ancient kind of Teutonic order that was supposed to stretch a thousand years into the past and, so the Nazis hoped, a thousand years into the future.

These two paintings serve to illustrate a general rule: the discontinuities of the Turner produce an aesthetically stimulating experience, while the banal continuities presented in the Lanzinger produce an aesthetically neutral experience, in accordance with the thesis that good art promotes discontinuity and bad art reinforces continuity. Of course, in proposing this, one should not forget that continuity and discontinuity help to define each other — neither can exist alone. Moreover, according to those with an interest in the way we see art, rich aesthetic experience is generated by the perception, *simultaneously*, of continuity and discontinuity in the same event:

> The serpentine line by its waving and winding at the same time different ways, leads the eye in a pleasing manner along the continuity of its variety, if I may be allowed the expression; and which by its twisting so many different ways, may be said to inclose (tho' but a single line) varied contents. (William Hogarth, artist, quoted by Gombrich ibid. p. 137)

So the discontinuities of the Turner, its incoherence and abandon, are held in balance by the overall unity of colour and composition, the earthy browns, elemental greys and the centrifugal force of the weather. The Lanzinger, meanwhile, can offer nothing but continuity without any invasive disruption, despite its pretension to discontinuous dramatics and transcendent authority.

Minimal taste

The minimalist aesthetic might be offered as an apparent exception to the proposition outlined above, which despite its obvious orderliness and lack of variation is often considered extraordinarily beautiful, pleasing and stimulating. The white paintings of Kasimir Malevich or contemporary minimalist interiors could be cited as examples. But it should be remembered that the minimalist aesthetic makes an impact precisely through its variation from our predominant sensual experience of the world, which is usually one of clutter, confusion, immense variety and contrast.

Just as we are impressed by huge expanses of flat sand or unbroken, clear skies, so we respond to what might be called, ‘ultra-continuity’ insofar as it appears as a deviation from our more common fragmentary experience.

Changing taste

Successful composition, whether in art, design, music or literature relies on balancing the relative quotient of order and disorder, continuity and discontinuity, or Apollonian and Dionysian impulses. However, judgements about the success of a composition cannot be made in isolation from the fact that values of order and disorder are, in some measure, prescribed by social agreement. Beauty is not a finite and eternal truth impervious to the fluctuations of fashion and taste (if it were there would be gross uniformity) but subject to as many social and biological constraints as any other complex cultural process. These constraints would include the general tendency in the populous to be shocked by the new and habituated to the familiar. We can see both tendencies being managed in the consumer by the fashion industry, which annually sets out to convince us that we are bored of the clothes we bought last year and excited by the clothes they offer this year.

Distant connections

In a well-known compositional rule, aesthetic stimulation can be heightened when concepts are forced together into a single location from relatively diverse positions. The surrealist poet Pierre Reverdy expressed it thus: “The greater and truer the distance between two juxtaposed realities, the stronger will be the image and the greater its emotive power and poetic reality.” (in Breton 1978 p. 282). Why should this be? Using the energetic model of thought outlined earlier, we might speculate that the amount of energy required to connect concepts of great diversity produces a vitalising rush of excitement within the actively conscious subject, usually accompanied by a rush of excitement in bodily sensation (art critics often ignore the corporeal dimension of aesthetic experience, preferring to treat art as a purely mental or intellectual phenomenon. For an exception see Koestler 1975 p. 371). This is especially visible in much surrealist and conceptual art, which often plays with disparate juxtapositions or semantic discontinuities.

Semantic discontinuity

Semantic discontinuity is the disruption in an otherwise continuous flow of signs that disorients us within the chain of meaning. In this turbulence we often find either discomforting incoherence or rich aesthetic experience and its associated joy. For, although all discontinuity is not aesthetic experience, all aesthetic experience is discontinuous. Consider these familiar haiku from some French surrealist poets:

> The dream is a heavy
>
> Ham
>
> Which hangs from the ceiling   Pierre Reverdy

> Your tongue
>
> The red fish in the aquarium
>
> Of your mouth   Guillaume Apollinaire

> Guitar – a bidet that sings   Jean Cocteau

In each case a visual image is concocted from disparate conceptual elements, yet not so discontinuous that they crumble into incoherence (Breton ibid. p. 283). Energistically speaking they are all the more memorable for the effort required in constructing the composite picture.

Coherent confusion

"But however we analyse the difference between the regular and the irregular, we must ultimately be able to account for the most basic fact of aesthetic experience, the fact that delight lies somewhere between boredom and confusion." declares Ernst Gombrich in *A Sense of Order* (Gombrich ibid. p. 9). We have already seen how the human being is locked into a perpetual conflict between the need to maintain a sense of order and predictability on the one hand, whilst on the other being aware that such stability is vulnerable to dissolution and collapse. Hence, the compulsive need to draw together threads of meaning by which to maintain the wholeness of the being, to reassure oneself of one's existence. However, it is also true that to be in a constantly predictable state can lead to boredom and restlessness — even worse is experienced in the total absence of stimulation, or what might be called 'super-continuity' as in the case of sensory deprivation (see page 18).

In terms of the posthuman model of thought outlined above, we might argue that aesthetic stimulation can occur when a number of previously diverse ideas or concepts congeal (the more volatile or disparate the better), thus bringing a greater part of the distributed mind into conscious experience, whilst accommodating the necessary degrees of simultaneous coherence and confusion.

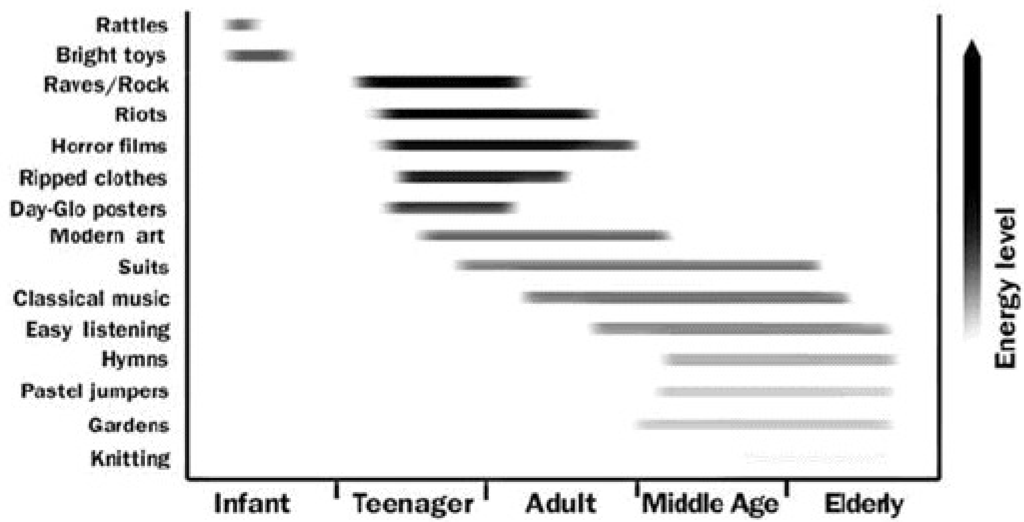


Diagram of levels of energy excitement in cultural products appealing to different ages

The perceptual and conceptual impact of aesthetic objects

It is possible to understand the impact of environmental stimuli, including cultural products, in terms of how much energy they present to the senses. There are obvious extreme examples: dance and rock music tend to be played at extremely high volume, usually accompanied by vivid lighting effects, while magazines aimed at young women often advise the wearing of bright colours to 'make an impact' in public. However, the effect of a particular stimulus on our sensibilities cannot depend solely on the level of energy emitted from the object under consideration. One text may be more stimulating than another one, but both may be read from pages that reflect equal amounts of light into the eye. An exciting piece of music played at moderate volume may be more stimulating than a bland piece of music played loudly. We know then that human stimulation is not wholly determined by the extent to which our surface sense organs are energetically modified by stimuli. The impact of a stimulus may also depend on the extent to which it can induce energetic modifications in our mental apparatus, or mind.

Referring again to the energetic model of thought presented here, it has been suggested that thoughts in close proximity (whatever that might mean neurologically) require less energy to connect than semantically discontinuous thoughts. If the effect of a cultural product is to induce semantic discontinuity in the mind, then a greater level of energy discharge will occur in the process of seeking to establish a continuity of comprehension.

The sense of pleasure

In many ways, the sensory (perceptual) response to energetic environmental stimuli mirrors the (conceptual) cognitive response to psychic stimuli. Energetic modifications brought about in the mind through the conception of semantic discontinuities may be no different in principle from the energetic discontinuities in the environment perceived by the surface senses. In some ways then, one might consider the mind as a kind of sense organ that is responsive to its 'own' stimuli, and bound by economies of energetic exchange. It is a notion that probably would be endorsed by Sigmund Freud, who, as far back as 1900 in *The Interpretation of Dreams*, suggested the conscious mind acted as a "sense organ for the perception of psychical qualities" (Freud 1976 p. 776). He also made great use of the concept of 'psychic energy' or 'cathectic energy' which built up and discharged in ways that conditioned mental and physical behaviour.

In fact, Freud saw the exchange of energy through cathexis as underpinning the whole neurological system (Freud ibid. p.40) and the mechanism through which the organism is conditioned to seek equilibrium and rest ('the principle of constancy') despite perpetually shifting energetic demands. According to Freud in *Beyond the Pleasure Principle,* pleasure comes from the discharge, or release from the "unpleasurable tension" brought about by the build-up of energy in one part of the psyche (Freud 1984 p. 275). This creates a certain amount of instability that must be corrected if mental balance is to be maintained. Freud approvingly quotes the psychologist GT Fechner in a passage that is worth repeating here:

> In so far as conscious impulses always have some relation to pleasure or unpleasure, pleasure and unpleasure too can be regarded as having a psycho-physical relation to conditions of stability and instability. This provides a basis for a hypothesis into which I propose to enter in greater detail elsewhere. According to this hypothesis, every psycho-physical motion rising above the threshold of consciousness is attended by pleasure in proportion as, beyond a certain limit, it approximates to complete stability, and is attended by unpleasure in proportion as, beyond a certain limit, it deviates from complete stability; while between the two limits, which may be described as qualitative thresholds of pleasure and unpleasure, there is a certain margin of aesthetic indifference . . . (Fechner in Freud ibid. p. 276)

We might speculate in accordance with what has just been said that the discontinuous stimulus generates a certain instability in the psyche, and hence a certain unpleasure such as might be had when confronted with a puzzle or an incomprehensible painting or text. If the energy produced by this discontinuity can successfully be discharged through a network of connected ideas in the neural medium, such as when a puzzle is resolved or a painting or text is 'understood', then there will be a consequent sense of pleasure. The greater the build-up of energy and the greater the discharge, so the greater the pleasure.

Thinking limits

But whilst an energetic model of the mind might help us to understand how excitement is generated by the expansion of psychic energy through diverse parts of the cognitive medium, it also suggests that there are inherent limitations to the range and scope of our mental capacities, just as there are limits in any system regulated by a flow of energy (see page 99). The 'rate-limiting factor' in human cognition may depend on a number of variables, including the speed that a charge can be conducted through the nervous tissue, the quantity of neurotransmitter in the system, and the availability of energy in the form of ATP (adenosine triphosphate). The nervous system does not have an inexhaustible supply of ATP, which has to be made in the tiny chemical factories (mitochondria) in the cell body. If all available ATP is consumed by intensive mental activity (which is also physical activity) then time will need to elapse before sufficient new resources can be made available. We all know that intense thought demands great effort and can sometimes lead to mental exhaustion. It is interesting to note here that the nervous tissue, and the brain in particular, is the most voracious consumer of energy in the body. Taking up only 2% of the total body mass the brain uses roughly 20% of the body's energy supply at any one time, producing about 20 watts of power, which is enough to run a small light bulb (Chaisson 2001 p. 138).

The environmental mind

The mind is not a self-contained energy-regulating system insofar as it is sensitive to fluctuations in the environment through the activity of the sense organs. We have seen that the sense organs, which can be regarded as extensions to the mind, are themselves involuntarily responsive to fluctuations in the environment. The mind, therefore, is forced to respond continually to variations in sensory stimuli, and forced continually to reconfigure itself in regular and irregular ways.

Creativity

We have tried so far to build up a picture of what art and aesthetic experience might tell us about the way humans respond to environmental stimuli and cultural objects. But the discussion has been somewhat one-sided inasmuch as we have looked at the reception and conception of stimuli rather than their creation. The processes involved in creating aesthetically stimulating objects must also be important in understanding how we dynamically engage with the world and each other.

We tend to think of creativity as a unique human faculty and, as such, distinct from other faculties like perception or intelligence. But when discussing what creativity might be we must be careful not to assume that because it is labelled with a distinct word it is necessarily distinct from other faculties. I would argue that insofar as each mental act is a unique response to circumstances, creativity is in essence no different from any other thought process; creativity is thinking in general and thinking in general is creative. But creativity is not just about thinking — it is as much about doing, and creative acts are almost by definition productive acts in that they modify the world in some way. Creative thoughts alone are of little use or interest to anyone unless in some way expressed.

A deliberately non-prescriptive description (not definition) of creativity might be any act of transformation or modification, which is not to say that every transforming or modifying act will be perceived as having created something of equal merit. It is up to the conventions of cultural mores to decide what act is, or is not, deemed to be significantly creative.

Destructivity

Superficially, destruction may appear to be the opposite of creation. But what to one person is the act of creating grazing land by clearing South American forests is to another the destruction of the 'Earth's lungs'. The dropping of the atomic bomb on Hiroshima during World War II was conceived as an act of destruction, which indeed it was. But at the moment the bomb exploded it created the largest conflagration in recent history, and some argue it later created the conditions for the Japanese surrender. The bomb itself was the product of many years of creative work by some of the most advanced scientific minds of the day. So although we may take a position on whether a particular act is, in itself, creative or destructive we must remember that in doing so we are led by subjective concepts of good and bad. Generally speaking, however, creation consists in acts of transformation that bring about something seen as both new and beneficial. Destructivity on the other hand, is usually an act of transformation that brings about something seen as detrimental. Either way, as the Hindu saying has it: "To create one must destroy."

Creativity and novelty

Creativity does not necessarily consist in the production of anything that is completely new since, arguably, there is nothing that is completely 'new', as in without precedence or history of any sort. Instead, the creative act is better understood as the realisation of beneficial transformations brought about by combining elements that already exist but which have previously been seen as separate or incompatible. One need only think of an example like cubism, the extraordinarily potent artistic movement of the early twentieth century. Although it appeared to the general public in western Europe as an entirely new diversion in visual style, it was in fact a painful and carefully evolved synthesis of several prominent aesthetic modalities, including the 'primitivism' of African and Oceanic art, and the optical distortions and ambiguities of Paul Cézanne (see chapter eight). The creative act, in the case of cubism, was a function of the human ability to incrementally modify the connections between discontinuous objects in the world so as to unify ideas that were previously separate. In *The Act of Creation,* the psychologist Arthur Koestler summarised his own extensive research into the human creative process by introducing the term *bisociation* to convey the coincidence of discontinuous ideas. He described the creative act as:

> … the perceiving of a situation or idea, L, in two self-consistent but habitually incompatible frames of reference … The event L, in which the two intersect, is made to vibrate simultaneously on two different wavelengths, as it were. While this situation lasts, L is not merely linked to one associative context, but *bisociated* with two. (Koestler 1975 p. 35)

Creativity and exhilaration

What we value in creative ideas is not just their apparent novelty. Novelty in itself induces excitement because it has the effect of opening up new connective paths, or fields, in the cognitive medium, and this may require an exceptional discharge of energy. But having had this experience the excitement may be short-lived — once opened the paths cannot be opened in the same way again. Richer creative acts lie in opening complex and far-reaching new pathways that connect disparate concepts, the more of them the greater the level of excitement; in Koestler's terms, one multiplies bisociations. If our sense of being relies, at least in part, on the presence of active mental states, it follows that more active mental states create a more expansive sense of awareness or being. And the more diverse and complex the mental states are at any one time the more corresponding energy is required to traverse them, and hence the greater the sense of physical exhilaration.

The sensation of a highly expanded sense of being is sometimes referred to as 'oceanic' and is often associated with religious experience. Speaking of the mystic Romain Rolland in *Civilization and its Discontents*, Freud recounts Rolland's energistic description of the 'oceanic' sensation:

> This consists in a particular feeling, which he himself [Rolland] is never without, which he finds confirmed by many others, and which he may suppose is present in millions of people. It is a feeling which he would like to call a sensation of "eternity", a feeling as of something limitless, unbounded - as it were "oceanic". This feeling he adds is a purely subjective fact, not an article of faith; it brings with it no assurance of personal immortality, but it is the source of the religious energy which is seized upon by the various Churches and religious systems, directed by them into particular channels, and doubtless also exhausted by them. (Freud 1930 p. 64).

Creative constraints

Acts of design, creation, composition or invention usually consists in generating a set of possible solutions to a problem defined by a set of requirements and constraints. Each possible solution is tested against the limitations imposed by the structural context, which might include factors such as technical determinants, artistic conventions, historical precedents, and so on. In setting out to create, say, a piece of music, one is aware of the almost infinite possible combinations of notes, chords and expressions that are available to a composer. However, there are many constraints imposed on anyone who wishes to create an original tune. For example:

1. The composer is likely to be working within the constraints of a particular musical genre such as 'techno', 'hip-hop', 'serial', 'folk' or some combination thereof. The genre imposes its own constraints of rhythm, melodic structure and instrumentation.

2. Since music is time-based, any piece will have a beginning, middle and end and will exist within a certain time frame — this will be the case even with an apparently 'formless' piece like John Cage's *Four minutes, thirty-three seconds*.

3. An original piece must not exactly reproduce another piece.

A composer, then, is put in the position of having, on the one hand, a series of almost infinite musical possibilities whilst, on the other, a set of constraints that determine the success, or otherwise, of the composition. Composers usually work by improvising with combinations of notes and rhythms until a sequence is arrived at which in some way satisfies the requirements. The process of improvisation involves generating sequences that do not have a predetermined order but at the same time are not wholly random. Like other creative processes, and like life itself, composition functions at the intersection between noise and structure; too much of either inhibits consumation of the creative act.

Creative evolution

> What appears at first glance to be an error – namely, the mutation resulting from a copying error or the chemical instability of the nucleic acid – is, in the final analysis, a gain in flexibility and adaptability. Indeed, it makes the evolution of the genetic system possible. Gain through error. (Cramer 1993 p. 48)

An analogy can be drawn between human creativity and the process of biological evolution through natural selection. Simply put, evolutionary theory states that organisms randomly generate new characteristics by genetic mutation, which may make an organism more or less suited to its environment. If a new characteristic emerges that makes the organism more suited to its environment then it will be more likely to survive, thus passing the new characteristic to the next generation via its genes. If the new characteristic makes the organism less suited then it is more likely to die and less likely to reproduce the mutation through the next generation.

Whilst it is possible to generate a seemingly infinite number of new or random combinations (of paint, sounds, words) only certain ones will fit the requirements and constraints imposed by the context in which the work is produced. Not all will be successful in creative terms and only those deemed successful will be selected for saving or replication — a process we could call 'creative selection'. Something of this kind has recently been proposed by the psychologist Susan Blackmore in her book *The Meme Machine* (Blackmore 1999). Following Richard Dawkins ultra- mechanistic account of Darwinism, Blackmore outlines a model of mental and cultural creativity based on the operation of mutation and selection. While this comparison might be useful as an analogy it is less certain that it offers an explanation how human creative processes occur.

Changing our minds

I have argued that the human mind is not a static, compartmentalised system but a highly adaptable medium that is subject to environmental stimuli and its own economy of energy. Within this medium lie various paths, attractors, or 'fields of potentiality' that represent the probable routes a thought might take if it is to be activated. It was proposed that these routes are not fixed and finite but open to reconfiguration. But while the medium remains adaptable it also maintains a great deal of constancy, since without either quality it would be virtually useless in dealing with the coincident volatility and stability of the environment. Accordingly, aesthetic experience can be understood as the innervating mental response to stimuli that induce both semantic or perceptual discontinuity and conceptual coherence, simultaneously. In a similar way, creative acts synthesise coherent ideas or objects from disparate probabilities.

Furthermore, I have argued that any creative act is an act of transformation, and to some extent it does not matter that the transformation might occur in the cognitive medium of a human mind or in a piece of material. There are many instances when we try deliberately to transform the ‘layout’ or structure of our mind — we are learning, trying to think of a new idea, or trying to remember something — and in each case we are attempting to transform the links between ideas and memories, just as we modify the structure of substances around us.

Whether we are trying to think up an excuse for missing work or attempting to comprehend the ultimate nature of the universe, we are doing essentially the same thing; that is, we are engaging in a purposeful attempt to modify the actual and potential structure of our mind. One could even conclude that in changing our minds we also physically change the world, insofar as our minds are part of the physical world.

CHAPTER SIX
AUTOMATING CREATIVITY

HAVING SUGGESTED WAYS IN WHICH SOME OF THE MOST COMPLEX AND MYSTERIOUS OF HUMAN THOUGHT PROCESSES — AESTHETIC APPRECIATION AND CREATIVITY—MIGHT BE MODELLED, WE CAN SPECULATE ON WAYS IN WHICH THESE PROCESSES COULD BE SYNTHESISED IN OTHER MEDIA SUCH AS COMPUTERS.

Automated creativity

This chapter will largely be concerned with the possibility of implementing creativity in machines, and for the purposes of what follows it will be useful to outline some of my own research into the creative potential of technology. Much of my early work in this area stemmed from the proposition that many of the creative decisions made in video editing suites, music composition studios and during graphic layout exercises often involve a significant degree of randomness. First-hand experience gained in making pop promos, composing music with sequencers and producing desktop published artwork confirmed to my mind that many time-intensive processes integral to such activities might, to some extent, be susceptible to automation. For example, a designer faced with producing a poster layout will spend a significant amount of their valuable time making choices from numerous possible typefaces, colour schemes, content orientations and the relative positioning of elements. At the same time, these potentially inexhaustible choices are limited by certain constraints such as the paper size, the clarity and balance of organisation, the scale and legibility of elements, conformity to certain stylistic or formal rules, not to say budgets and other financial determinants.

I envisaged a general system for autonomously producing multiple random variations of any creative object within certain limits set by the user who would be then free to 'select' the output variation best fitted the design requirements. In many ways the idea was inspired by natural evolution and, in particular, the 'Biomorphs' of Richard Dawkins (1986), who had modelled genetic formulae to striking visual effect, as well as the work of William Latham (1992) and the IBM research labs whose computer-evolved organic shapes were then widely shown.

Early experiments

My early experiments with computer generated images, music and digital typography were necessarily crude given the lack of any research funding and the low-specifications of the Acorn Archimedes and Apple Mac Classics being used. Nevertheless, the results were sufficiently encouraging to spur further investigation, whilst it became clear that problems of producing 'interesting' material using random data generation were more profound than first assumed.

Although it was not immediately obvious, any information theorist would have been able to point out that the random generation of data will produce a high level of noise in proportion to signal — the signal being the interesting material I hoped to generate and the noise being the 'uninteresting', i.e. tedious or unintelligible, material which formed the bulk of the computer output. Through these investigations it became increasingly clear that creative activity, whether human or machine-based, would operate in a way consistent with other natural phenomena in the universe, in particular the Second Law of Thermodynamics described earlier. The probability of producing noise from a random configuration of any given matter is much greater that the probability of creating a signal; that is, some improbable configuration that would interest a human. Since the creation of human life itself is one striking example of such an improbable configuration of matter and energy in the universe, it should not be surprising that life-dependent processes such as creativity might operate in a related way. Randomness is comparatively cheap and therefore of less value than order, which can be very expensive in terms of the 'cost' of energy required to sustain it. Hence, most life on earth needs a continuous source of 'free' energy from the sun.

For my part, the energetic cost, as it were, of sustaining interesting output from random data generation was incurred by the need to construct ever-more sophisticated rules, or constraints, which limited the parameters of the random behaviour so as to provide a greater probability of organised output. In the case of music composition for example, one needs to provide rules about tempo, syncopation, harmony, melody and so on, without which one tends to get a formless yet repetitive cacophony. But the excessive imposition of rules can lead equally to tedium of a different kind: a product with no variation, deviation or surprise. Since rigid compositional order can be as unstimulating as scattered noise we are forced to engage with the complicated region between the two extremes where the mathematical certainties of absolute order and disorder no longer pertain; the realm, in fact, of complexity.

Collaborative creative technology

In the mid-1990s my attention turned away from autonomous self-driven systems of automated creativity toward more user activated, dynamic systems that generated their output in response to continuous user input. This research was initiated by a commission from the Glasgow Gallery of Modern Art in 1995, for the construction of an interactive exhibit in their newly built 'Fire' gallery — the first purpose-built interactive gallery in Britain (Spalding 1996). Prior to 1995 much of my experimental computer art-work had been exhibited in night clubs and at festivals rather than conventional galleries, most of whom were paying little attention to computer-based art (which is largely still the case, although some of the blame for this lies with the subsequent proliferation of 'content-free', technology fixated works that were little more that demonstrations of devices). It was while working in clubs as a 'VJ' providing an ever-changing visual backdrop for the DJs that I evolved certain techniques for the live mixing of video sources which paralleled those techniques used by DJs in the cutting and mixing of records. It was these techniques of audio-visual manipulation that I attempted to embed in the work produced for the Gallery of Modern Art, entitled *Generator*.

Generator consisted of two consoles supporting button banks, a set of computers, a video projector and speakers. One console controlled sound and the other images. The buttons on the sound console were organised into three rows each representing a channel of audio and into eight columns each representing a common musical genre such as rock, hip-hop, opera, jazz, and so on. By pressing different buttons (each of which was labelled with icons) the user with no previous musical training or aptitude could select, say, a piece of rock music to play at the same time as a piece of opera and a piece of hip-hop. The buttons triggered audio sample loops that were stretched and pitched so as to be compatible in tempo and tuning. The result was an audio mix of three distinct (and unrelated) music styles forming a harmonious, if somewhat unusual, whole based on selections made by the user. Critical to the operation of the system, however, was the fact that although the user could choose a style such as hip-hop or reggae, the actual clip played was chosen randomly by the computer from a database of clips classified by style. The selection of jazz would initiate the playing of one of many possible jazz clips.

Consequently, the global output of the system was regulated by collaboration between the user 's choices and the random selections of the computer; neither had complete control. This collaborative aspect of the human-computer interface offered by the *Generator* distinguishes it from most other forms of machine interaction where user actions normally initiate a predictable response. This automaton-like predictability is almost the defining characteristic of a 'machine'. In the *Generator* the consequence of pressing a button was not wholly predictable in that the user could influence but not control the activity of the system. The second console supported a similar set of buttons, each of which triggered video sequences arranged and selected in an identical way to the sounds. For the user, then, the overall experience was one of real-time audio-visual mixing in which they were able to significantly influence the composition of the sound and images, but were not able to precisely control them.

The Generator console

The use of unpredictability

The experience of designing, constructing, installing and operating *Generator* convinced me that such unpredictable, collaborative technologies, as opposed to predictable, passive 'slave' technologies, offered a potentially rich method of enhancing human creativity. The advantage of the method was that it allowed for a significant degree of randomness, which produced great variation and spontaneity, but was tempered by severe formal constraints (of pitch and tempo), thus preventing the descent into noise or confusion. The user acted as an agent of both randomness and order by causing the system to change in ways it would not otherwise do and by creating novel formal combinations that, to the user, were most interesting or pleasing. The net result was a system operating in the region of complexity between stasis and chaos where, arguably, human creativity flourishes.

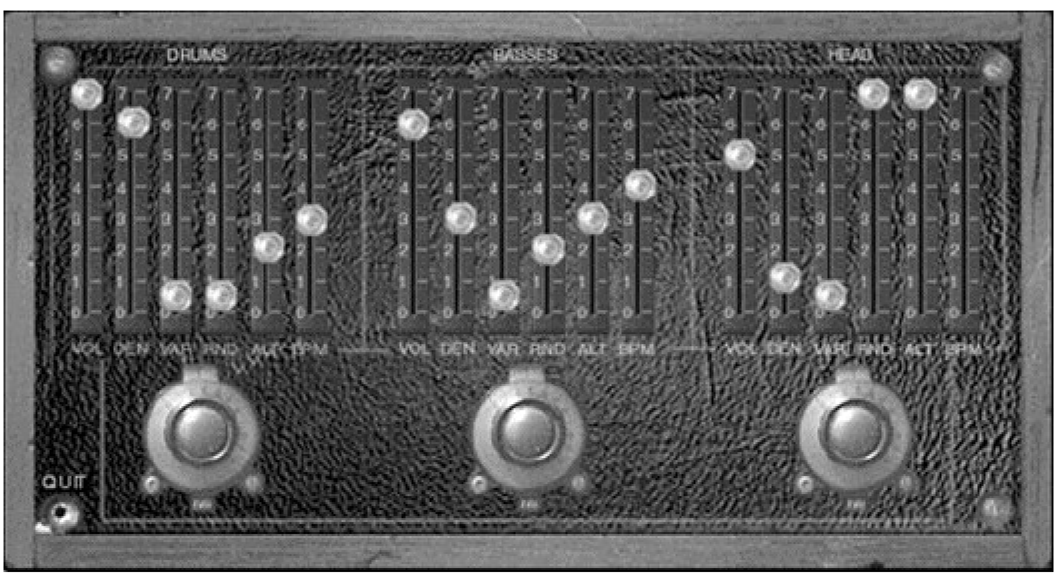
Collaborative creativity

Generator led to a series of further commissions, most notably a piece called *Synopticon* in the JAM exhibition at the Barbican Gallery in London (Alison 1996) and another called *RAMJAM* at the Nottingham Now Festival of Arts in the UK in 1997. These pieces extended the methods used in *Generator* to include wider audience participation. For example, *RAMJAM* consisted of a room in a night club filled with free-standing consoles (co-designed by Dianne Harris) supporting many illuminated buttons, each linked to a sound sampler. As a DJ played a series of backing tracks (mainly consisting of drum beats and ambient noises) the audience collectively triggered sound samples mixed through the public address system. Thus the audience was, in effect, 'jamming' along with the DJ. Initially the results were fairly cacophonous as users simply pressed buttons continuously and randomly just hoping to hear their own sound. However, later in the evening the audience as a whole seemed to realise that if certain users left space other users could fill, the gesture would be reciprocated. This is a lesson that anyone playing in a musical ensemble has to learn very quickly. By 2 a.m. the whole room was packed with people 'jamming' along with each other and the DJ. In this example the combination of randomness and structure was provided by the collaboration between the individual and communal consciences of the audience members.

A RAMJAM console

Playtime

The technique of collaborative interaction pioneered by the *Generator* piece found further expression in some commercially released music composition software called *Playtime*, released as part of the CD-ROM which accompanied the *Let Us Play* album produced by Coldcut (1997). *Playtime*, co-written by the author and Miles Visman (who also collaborated on some of the earlier art works) offered a series of sliders which modified three banks of sound; drum loops, bass loops and 'head noises'. The audio loops would play in sequence with one another to create music with an electronic-dance flavour. Changing the position of the various sliders allowed the user to manipulate the way in which the programme 'cut-up' or rearranged the sound loops, thus creating complex levels of variation and modulation that kept the music fresh and interesting. Crucially, the actual choice of sound samples and the precise ways in which the sliders interacted with the sounds was partly random and partly user-controlled leading to the same relationship of collaborative influence between user and machine as was present in the *Generator*. This was in contrast to the more predictable 'master-slave' relationship we traditionally expect of technology, especially complex control devices like music sequencers (for more information see 'www.stem-arts.com').



The Playtime interface

Humachines

This approach to human/machine interaction, I would argue, offers interesting possibilities for the future of information design. With the ever expanding volume of digital information available to us, and the general need to make machines more intuitive and 'human-like', as well as the commercial pressures to automate labour- intensive and highly skilled tasks, the model of collaborative interaction discussed here may offer a productive way of interfacing human and machine intelligence. This becomes more urgent as computers, and related devices, evolve in complexity and power. We will now consider some of the ways this might happen.

Parallel architectures

Assuming an exponential growth in computer power over the coming decades, and the likelihood of machines with immense amounts of parallel processing capacity (where multiple processors are integrated in one system), it is conceivable that a time may come when it will be impossible to apply traditional sequential, 'top- down' software engineering techniques when developing applications. Even the smartest human coders would be unable to comprehend the behaviour of a program running on several million processors simultaneously, all of which are interconnected and interdependent. The de-bugging (error fixing) problems alone would be staggering.

So rather than writing and running a single program to carry out instructions one line at a time, it's possible that 'immensely' parallel machines will run several (maybe millions of) interconnected sub-programs at once, sub-programs that may be computer-generated, perhaps using the evolutionary technique sometimes called 'genetic programming'. Such machines would be able to deal with extremely complex data from a wide variety of non-linear sources, including visual data from cameras and imaging equipment, audio data from microphones and receivers, sensory data from robots, or semantic data from other machines and people. These immensely parallel machines may be able to retrieve as much, or more, sensory data from the environment than humans — they might be as sensorially 'aware' of what is going on around them as anything, or anyone else. But, would they 'know' about themselves and their environment in any way similar to the way we know?

The complexity of mind

As we have already seen, complexity theory states that given a simple behaviour pattern multiplied through a large set of operands, each of which can affect the other, global behaviour will emerge which is essentially unpredictable. An example is the computer simulated flock of birds (or 'boids') discussed in chapter one (Levy 1992 p. 76). By analogy we could regard human mental functions as the global behaviour of large numbers of quite simple events working in parallel. According to standard cognitive science, the human mental apparatus relies heavily on the activity of many single cells, which either do or don't fire. The complex issues determining whether or not they fire is another matter that needn't concern us here. While it is not feasible to observe the behavioural effects of individual neurons firing, we know that the sum effect of many such simultaneous events contributes to our thoughts, memories and emotions. These sum effects may be seen as global properties that emerge, in part, from the *relatively* simple behaviour of millions of individual neurons and related chemicals (with connections throughout the body), just as we see the global effect of a flock that is actually the sum of many individual birds performing a simple task.

Complex machines

If we were to construct an imaginary computing system made of many millions of individual components, each of which operates in a relatively predictable way, but then allowed them all to function by reference to each other, the global behaviour that emerges may well be unpredictable. 'Unpredictability' here means that an observer cannot say in advance exactly how the system will behave, one can only guess at the probability of a particular outcome. Thus, some measure of responsibility for overall behaviour rests with the system itself, and cannot be said to be completely determined by the designer. The immensely parallel computing system may be an example of one such machine, wherein perhaps the internal workings of millions of processors calculating and referencing each other at rates close to the speed of light will create a system of such complexity and speed that 'interesting', even organic, global behaviour might emerge.

What is being envisaged here as a 'complex machine' is something more than a very large neural network of the kind discussed in the introduction. It is a machine of an entirely different order of complexity to the sequential architectures currently in use, and may well use analogue instead of, or together with, digital processing.

Digital and analogue computers

The vast majority of today's computers are 'binary digital', which means the information they process is represented numerically as a sequence of 1s or 0s, or bits. According to the *Penguin Dictionary of Computers*:

> The individual operations performed by a digital computer are very simple arithmetic or logical processes involving the manipulation of the bits in words or characters of information. The great power of any digital computer rests on the ability to store large volumes of data and to perform these various functions at extremely high speed. (Chandor 1982).

Analogue (or analog) computers, on the other hand, represent information with physical states, such as the relative positions of cogs or electrical voltages. Although the use of mechanical shafts or valves seems to evoke the quaintness of a bygone era in early computer design, analogue computers can still offer some advantages over their digital rivals:

> The computing units of analog computers are able to respond immediately to the changes which they detect in the input variables, and the connexion of these various units in a particular fashion can cause an analog computer to perform very complex arithmetical functions at high speed while the actual process under study is in operation. (Chandor ibid.)

The 'real time' operation of analogue machines is possible because no process of 'digitisation' is required to turn environmental events into computable data — the operation of the machine is linked directly to the input and output, like the body is linked to the world. Of course, one could argue that the speed of modern digital computers negates any significant time-delay incurred in digitising data. But there is an important qualitative difference between digital and analogue machines that cannot be elided, however fast the digital processor becomes: digital information is discrete and 'clean', whilst analogue information is continuous and 'noisy'.

Digital information is made of unambiguous chunks of numbers that can each exist in only one of two states, on or off, and no matter how fine the digitising tool the continuity of the real world must be artificially segmented into separate bits in order to process data. The same is not true of analogue devices, which are able to represent the continuity of the real world with more fidelity, if only in the sense that they are not required to make arbitrary distinctions in the values they process.

The issue of signal clarity marks a further qualitative distinction between digital and analogue machines. The processing, communication and replication of digital data is much less prone to error than that in an analogue system because of the relative simplicity of the encoding system, which is a string of 1s and 0s. Because the data in an analogue machine is not represented discretely (in the same way as it is in a digital machine), it is much more complex to store and duplicate, with the consequence that error is more likely to creep in. While this is deeply undesirable as far as the design of linear, logical devices is concerned, it might actually be an important feature of a system designed to model natural behaviour. For as was pointed out earlier (page 115), in natural systems such as evolution, error can confer advantages of adaptability and flexibility — "gain through error".

Evolvable hardware

An example of the productive consequence of the noise and error properties of analogue systems was unexpectedly observed by Adrian Thompson of the University of Sussex in the UK. Working with Field Programmable Gate Arrays, a kind of user-configurable microprocessor, Thompson was trying to develop a circuit that could learn to distinguish between two audio tones. Using genetic algorithms, of the kind discussed below, Thompson allowed a number of generations of circuits to evolve over time until one emerged that could identify the two tones. In order to achieve this task he allowed the circuits to ignore the usual binary states of the microprocessor's transistors and, instead, capitalise on the variable analogue values in between. He allowed for an array of just one hundred logic cells to perform the operation, but was surprised to find that the evolutionary process ended up using only thirty-two. When he examined the circuit more closely he could not understand how the system had produced such a "flabbergastingly efficient" result. He suspected that the genetic algorithms had taken advantage of a phenomena known as 'electromagnetic coupling', the interference that can sometimes occur between closely linked electronic components, which software and hardware developers normally try to discard, to generate the best-fitted solution to the tone recognition task (New Scientist 1997 p. 30).

Learning machines

Since the ability to learn is something that has evolved in animals (albeit at different levels), there is no reason to suppose that a similar capacity could not emerge in an immensely parallel analogue machine of the kind we are envisaging. Indeed, recently there have been significant advances made in the field of computer learning using 'connectionist' computer architectures such as neural networks, which mimic the structure of organic neurons, and which have enabled machines to acquire capacities analogous to human learning traits. For example, some systems are able to recognise faces or buildings, decipher handwriting, or play complex games like chess. In these cases, computer learning systems achieve their aims not through the direct instruction of a human programmer, but through the reconfiguration of the neural circuits in response to experiential data.

In *The Brain*, Richard Thompson describes the classic work of Rumelhart and McClelland who used neural networks to allow a machine to decipher the past tense of verbs by example:

> The astonishing result was that the network seemed to learn the past tenses of verbs much as young children do. It learned the general rules for forming regular past tenses before it had learned to form the past tenses of irregular verbs correctly. Thus, during the learning process it formed regular past tenses for irregular verbs, for example "digged" rather than "dug". This result had profound implications for the nature of language. The network had no deep grammatical structure built into it. Rather, it formed the abstract rules for forming past tenses strictly from example; it learned the rules by "inference". If a simple neural network with a few hundred units can learn this way, so can the vastly complex human brain. (Thompson 1993 p. 409)

The question of whether such a network might possibly not only be learning but also 'understanding' is one that will be addressed in more depth later. However, the clear implication of the work cited above is that a property like a capacity for learning can emerge from a suitably organised mechanical system. This reminds us of the emergent properties discussed in chapter one in the context of the study of complexity theory, and may not only help us to understand how certain cognitive functions arise, but also how to simulate them.

Evolving machines

Genetic algorithms, as we have seen, are mathematical routines that mimic the process of biological evolution and, in the context of computer science, offer new possibilities for designing complex, adaptive systems. In *Out of Control*, Kevin Kelly describes the work of John Holland, who was amongst the first to see the potential of modelling evolutionary mechanisms:

> The evolutionary approach, Holland wrote, “eliminates one of the greatest hurdles in software design: specifying in advance all the features of a problem.” Anywhere you have many conflicting, interlinked variables and a broadly defined goal where the solutions may be myriad, evolution is the answer.

Speaking of Holland’s work in breeding virtual life forms (code strings) to perform well in an unpredictable landscape, Kelly says:

> . . . the highest performing bits of code anywhere on the landscape mate with each other. Since high performance increases the assigned rate of mating in that area, this focuses the attention of the genetic algorithm system on the most promising areas of the overall landscape. It also diverts computational cycles away from unpromising areas. Thus parallelism sweeps a large net over the problem landscape while reducing the number of code strings that need manipulating to locate the peaks. (Kelly 1994 p. 376)

To an extent these adaptive processes mirror ones occurring in nature and which, in human beings, may have contributed to our higher faculties of consciousness and self-awareness. Learning and adaptation can be regarded as kinds of mutation which we undergo to improve our life conditions or chances of survival.

Posthuman machines

All the technical and theoretical advances described here (and there are many more that could be included) point to a trend in computing science with some inherently posthuman implications. Under the humanist paradigm, computers were thought of as stable, predictable, utterly logical and precise, much as the digital computer’s intellectual progenitor, Johann von Neumann, had predicted they would be. But although binary digital computers have proved extraordinarily successful in many respects, it seems we are becoming more aware of their limitations and fragilities. Many of the recent advances in computing, including organic and quantum computers, point to a much more fluid, complex and dynamic conception of machines that, as Adrian Thompson admitted about his own constructions, may behave in ways we simply cannot understand, or even control. These kinds of ‘unknowable’ devices are posthuman machines.

Creative machines

To return to the question posed at the outset of this chapter — in what sense might it be possible to implement human-like properties such as creativity and aesthetic appreciation in machines? Building on arguments made earlier, one could anticipate that an effectively creative machine would require several properties, including sufficient complexity to produce emergent global behaviour, access to rich data, and the capacity for adaptation, learning and mutation. If it were feasible to build (or grow) such a machine (and for the purposes of this argument we are imagining a kind of ‘complex machine’) then it might share with us, in a rudimentary form, some characteristics of a ‘mind’.

If this imaginary mind were required as part of its purpose to make connections between discrete segments of data in such a way as to assert ‘orderly’ patterns, but also was constantly fed new sources of information that didn’t necessarily fit into those predefined patterns, but about which it had to make qualitative judgements, then such judgements could be seen as in some way creative. This machine would be creating new connnections between previously discontinuous segments of data in order to accommodate them in some overall continuous pattern. The parallels between this and the model of human creativity outlined in the previous chapter are fairly clear, although one would not want to prematurely claim that such a machine was creative in the same way as humans — at least not without considering several other complicating factors first.

Uncontained minds

The machines we are used to are, in most cases, self-contained, which is to say they have very limited information about what is going on around them. I have argued that consciousness, and mental phenomena in general, do not spontaneously arise in the brain alone but emerge as a result of the co-operation between the cognitive medium and the environment. Speaking of the primacy of visual stimulus in human brain development, Richard Thompson says:

> The fact that the critical period for vision in humans lasts for six years [from birth] implies that the circuitry [of the brain] is growing and the fine tuning of its patterns of interconnections is taking place. Normal visual experience has profound effects on the development of circuitry in the visual brain . . . the message is clear: normal sensory experience is critically important for the normal development of the brain.' (Thompson ibid. p. 318)

Of course, this is not to say that people who are blind from birth cannot become conscious since there are many other stimuli that the nervous system can use to develop the brain. However, it is very unlikely that consciousness, as we know it, could emerge in the case of an unfortunate person who is born without any sensory faculties at all. Therefore, human mental faculties like consciousness and creativity rely to a huge extent for their development on the stimulation received from the environment. In this sense, and in accordance with what was argued in chapter one, the developed human mind is an 'uncontained' system.

Creative instability

The effect of environmental stimuli is, as we have noted before, both predictable and unpredictable, and in chapter five we saw how human creativity is closely linked to the fact that we live in a world that is both orderly and chaotic. As a result we are forced to continually adapt to new contingencies, which result in the reconfiguration of fields of potentiality, or connective paths in the cognitive medium. So, in order to model human creativity in a non-human medium (and, by implication, to automate it) we would need to ensure that the system is prone to random fluctuations in the world around it. Such fluctuations would not be, however, random in the sense of formless noise, but complex in the sense of being both regular and irregular.

Maintaining life at disequilibrium

Artificial life systems like those cited above are often seen as the precursors of more complex machine life in general, and 'machine consciousness' in particular. However, they are limited in that they are bounded by the parameters of the machine in which they 'live'. Real life is bounded only by the universe (or many universes, if you adopt the 'multiverse' view of reality) — obviously a somewhat larger system.

These currently existing A-life colonies, which are limited by the complexity of the calculations our machines can perform and sensitive to only a finite number of internal (or simulated external) stimuli, are not subject to constant random interruption and thus they tend reach a state of equilibrium quite readily. But as has been noted elsewhere, real life is essentially a state of disequilibrium within a universe that tends towards general disorder. Conversely, however, total order (in the sense of complete regularity) is equally inimical to life in that it represents a condition of frozen stasis only reached at absolute zero. Life in the universe, then, exists suspended between total order and disorder, stability and disruption, where each is required to maintain vigour. Unfortunately, most current A-life systems do not accommodate this essential balance since they cannot harness the necessary disruptive effect of the environment.

Machine minds

I have argued the human mind has evolved to absorb the unexpected — the discontinuous stimulus — and it is the compulsion to re-assert order in the face of random stimuli that contributes to our sense of being. It follows, therefore, that if we are to create a synthetic mind with a sense of being like ours, it must be able to accommodate the same degree of complex, random disruption as us. In addition, it must have a compulsion to find meaning in the face of both stable and unstable input. And if we want to produce a synthetic mind that displays any kind of creativity then we need it to be able to establish connections between its 'thoughts' in a discontinuous way, by drawing together disparate 'ideas'. Furthermore, if we want the synthetic mind to have a capacity for any kind of aesthetic appreciation then it should be able to sense continuity and discontinuity simultaneously — without crashing. While this might cause excitement in the machine it is yet to be determined to what extent it would be pleasurable.

Creativity and rules

Reminding ourselves of the notion of 'creative selection' outlined in the previous chapter, I suggested it is possible to produce a number of random variations of an idea, but only those best fitted to the contextual requirements and constraints will prosper. But when applying this to a computer model of creativity, it soon becomes clear that it is easier to produce random variations than it is to let the computer know the requirements and constraints by which to choose the best solution: random mutation is relatively simple, it’s the selection part that is difficult.

It is likely that most creative software in the near future will aid humans in creative tasks rather than being fully creative in its own right. We will still need humans to evaluate the output because the machine does not ‘know’ about all the cultural and social criteria for successful composition. Being able to judge what is or is not a beautiful, clever, startling, or imaginative piece of work is a skill acquired in the course of our lived experience, and not something easily quantified.

At the same time, there is a long tradition of successful creative works produced according to formulaic rules. J S Bach often used strict mathematical patterns to compose canons (Hofstadter 1980). The constructivist painters of the last century used sequential formulae to design abstract paintings, and the Fibonacci sequence has been exploited for centuries as a means of generating balanced designs. More recently, the composer David Cope has used a computer to write classical music of such quality that experts have been unable to distinguish between his computer generated pieces and human compositions (Cope 2001). And the artist Harold Cohen has successfully made paintings and drawings for many years using a suite of software packages he calls AARON (McCorduck 1991).

But although the application of formulaic rules in many cases has produced some very compelling compositions, the rules themselves are the product of human invention and not those of the machine. In many instances, machines are being used to do little more than procedurally extend human activity; in doing so they may save time, and even suggest some underlying compositional principles, but they seem to uncover little that is novel or aesthetically ground-breaking: they seem unable to ‘break the rules’.

So the problem with the formulaic approach is that we may be able to get a machine to create works according to rules we supply, but how could we get a machine to generate new rules that would produce works we would consider creatively original, or even disturbingly new as, say, cubism was to the critics of the early twentieth century? We know that Bach did not compose all his works using formulae; many were written as the result of countless hours of improvisation at the organ keyboard. Picasso was consistently dismissive of any attempt to contrive an intellectual account of his prodigious creative output, and equally dismissive of computers: "Computers can only give you answers" he said. If machines are to be anything more than depositories of mechanistic formulae, or humans by proxy, they will need to produce something original and valuable, and know why it is.

Adapting rules and novelty

A consistently successful creative person must have an implicit understanding of the rules (requirements and constraints) pertaining to a particular medium, and yet be able to generate new works that display enough variation within the rules to cause excitement and stimulation. To extend the example already mentioned: Picasso and Braque, working in the early twentieth century, had a sophisticated understanding of the rules pertaining to the contemporary art world. Picasso had produced work in a number of contemporary styles and yet was able, with Braque, to alter those rules so substantially as to create a novel style, indeed a new movement in culture. The cubists' works, however, were not dissociated from other works of their time. As we have seen, cubism essentially fused many of the influences being exerted on young Parisian artists at the turn of the century — the later work of Paul Cézanne, the startling exoticism of African sculpture and Paul Gauguin's Polynesian compositions, the encroaching mechanisation of modern life, dabblings in the occult, and so on (for an expert analysis see Golding 1971).

So Picasso and Braque were not accidentally rewriting the idioms of modern painting and sculpture but were changing them purposefully in the light of a complex set of rules and constraints pertaining at the time. It was only their intimate and expert understanding of these rules that allowed them to so dramatically alter them. Picasso and Braque were conscious mediums through which the complex influences of their time were uniquely synthesised.

Socially aware machines

Any machine even vaguely capable of producing works of creation to rival the achievements of Picasso or Braque would need to be aware of the complex social and aesthetic criteria pertaining to today, just as they were in their time. Otherwise, the works may be highly creative as far as the machine is concerned, but of little value to anyone else. Although the problem of creating a machine that is aware of all the intricate habits governing our sensibilities seems awesomely difficult, it may not be insoluble. It is conceivable a complex machine of the kind described earlier could have access to much more sensory stimulation than we do (or Picasso may have had). It may have the ability to learn more quickly and remember more than we can, and whereas it might take a human being thirty or so years to mature to the point of being creatively consistent and successful (to become aware of all the nuances), a complex machine may be able to assimilate equivalent knowledge in a much shorter time. As well as being able to scan cultural artefacts quickly, it may have the ability to retrieve human thoughts and acquire the accumulated experiences of experts. It is not beyond the bounds of possibility that these machines (if, indeed, we would still think of them as machines) would be socially aware.

Cultural continuity

Our perception of cultural objects is governed by patterns of continuous and discontinuous association that are regulated by the economy of cognitive and environmental energy in a way that transcends the divide between the mental and the physical. Chapter three gave a description of how the raw data of perception can be categorised as either continuous or discontinuous depending on the viewing resolution of the observer. Chapter five gave a description of how cultural products present us with varying degrees of continuity and discontinuity in terms of both energetic intensity and semantic turbulence. We might further think of cultural artefacts as existing within an expanse of inter-referential meanings, where each artefact is defined, to some extent, by its relation to others. So the meanings we acquire from cultural experiences are subject to categorisation not only in the way they directly affect us, but also in terms of their similarity to, or dissimilarity to, other artefacts. For example, if in the middle of Beethoven's *Fifth Symphony* we were to hear an accelerated drum break at 160 beats per minute we would be surprised. Likewise, we would be somewhat astonished to hear the whole of the *Fifth Symphony* being played on a hip-hop station otherwise devoted to continuous rap. Either way, we recognise that although the *Third Symphony* and rap are both examples of western music, they are deeply incompatible.

If we imagine the rules that govern our perception of cultural products as a kind of ‘fabric of continuity’ (which is represented in our minds as highly probable connections between thought paths, or within fields), then any deviations will amount to a perceived discontinuity. On certain BBC radio stations the slight mispronunciation of a place-name in an otherwise impeccable broadcast will draw a significant stream of complaints and corrections.

Genres and variations

The emergence of genres, in whatever art form, and their often surprising resilience over long periods is a remarkable feature of human culture. Given the infinite compositional possibilities within, say, music it seems for the most part we content ourselves at any one time with a quite narrow range of combinations. Which is not to say that within a style such as jazz there are not countless unique expressive works, but most of us would be able to recognise a piece of jazz as distinct from an example of folk, classical or rock, because most jazz pieces share formal qualities. A set of rigorous and subtle rules —a fabric of continuity — gives any genre its coherence and integrity, and conformity to the rules ensures a work its inclusion within a genre. But at the same time, each original work must to some extent vary and reconfigure the rules of the genre within which it sits, thus generating a degree of discontinuity or mutation. Insofar as one unique work is distinct from another, it will display discontinuities that allow us to recognise it as unique.

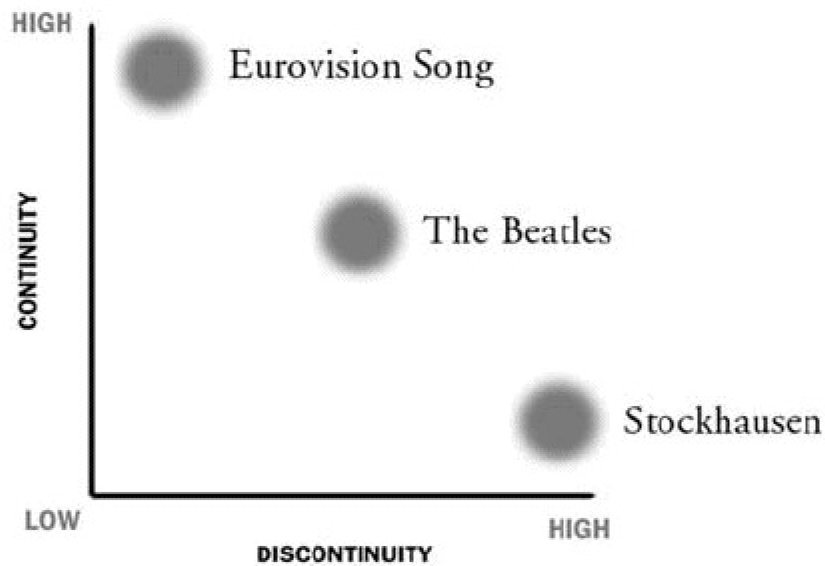
Balancing (dis)continuity

I suggested earlier that the perpetual reproduction of a continuum, whether in art or anything else, often leads to dissatisfaction and boredom. While we are comforted by continuity insofar as it confirms our sense of being (sometimes heightened by trance-like repetition), we are also attracted to discontinuity and its associated excitement. This excitement can lead to an invigorated sense of being as it demands we struggle harder to retain our threatened grasp of coherence. We also spoke of successful creation as that which offers us a sense of continuity whilst, at the same time, introducing a level of disruption that does not excessively distress or confuse us. To explicate this relationship let us look at three musical examples:

1. The standard *Eurovision Song Contest* entry. Here the annual entries are almost invariably conservative in nature, usually being the results of committee- processed compromises. The songs and performers are usually formulaic and display little variation or originality whilst insisting on seemingly endless musical repetition. This is a genre that displays excessive continuity and virtually no discontinuity (other than the occasional bizarre entry).

2. The Beatles. Taking the whole of their musical output, it could be said of the Beatles that their work contains high levels of continuity and high levels of discontinuity. From *Love Me Do* (1962) to *Revolution 9* (1968) they produced a spectrum of music from conventional pop to avant-garde sound-scapes. On the whole their songs displayed continuity in the form of strong melody and harmony, strong rhythm and musical structure, and discontinuity in the form of surreal lyrics, mixed musical genres and experimental aural effects.

3. Karlheinz Stockhausen. Here we could talk of any modern composer who rejects the traditional musical forms and uses broken rhythms, atonality and unusual orchestration as displaying high levels of discontinuity in their work. The apparent continuity of melody, scale and harmony is almost totally displaced, leaving some to ask ‘Is this music at all?’



Of course, this idea, schematically represented above, does not tell us which type of music is best, but it is clear which has the widest appeal.

It is likely that in designing any creative system to produce material that would satisfy human demands, one would need to grant the machine some knowledge of the subtle balance needed between attractive and cacophonous output. This balance would show an appreciation of relative quotas of continuity and discontinuity in the material generated, a judgement that is partially socially determined.

The acceptance of automated creativity

By encouraging the development of creative machines are we not in danger of displacing one of the most valued of human attributes? I suspect, initially at least, many people will be sceptical about the merits of computer generated creativity. In the early days of electronic music, instruments like Robert Moog's synthesiser were often used to mimic pianos and violins, which only exposed their limitations. Yet in the 1960s and 1970s a new generation of musicians exploited the synthetic sounds for what they were — electronically generated tones. A new aesthetic emerged in the music of composers like Pierre Henry and Brian Eno in which the electronic sound became valued for its own sake (Taylor 2001).

Something similar may happen with synthesised creativity: cultural products will appear claiming novelty for having been synthetically created; a small group of 'leading-edge' technophiles will be attracted, but most will compare them unfavourably with the human generated versions. Then a new generation, partly to disassociate itself from the previous one, will embrace the products of automated creativity on their own terms as a fresh aesthetic: "A piano or a violin is just as inorganic as a synthesiser or a sampler." claims the contemporary composer, Moby (quoted in Taylor ibid. p. 201).

Social creativity

Machines able to act in a truly creative way would not necessarily make human creativity superfluous. This would only be the case if humans themselves became superfluous — something which may, or may not, happen. In the meantime, complex creative machines could be used to increase generally the level of creativity in society, just as cars and planes have increased generally the level of mobility. The consequences cannot be predicted, but we know from the history of technology they will be both beneficial and detrimental depending, to some extent, on who or what you are.

CHAPTER SEVEN
SYNTHETIC BEINGS

How would it be possible to create a sense of being in a medium other than a human, as in for example a complex machine? From what we have seen it seems likely that synthetic beings will have to evolve from the 'bottom-up' rather than being programmed from the 'top-down' in the way traditional systems are built. This is because that human designers will be unable to construct a computer program containing sufficient complexity and unpredictability to replicate that experienced by human beings. In the same way that true creativity can only emerge in a machine that knows about the world as humans do, so a machine can only acquire a sense of being as humans do, by negotiation with the environment in all its non-linear complexity.

Being itself

Based on what has preceded, a working description of the sense of 'being' might be: the sum of active thoughts or sensations occurring in the cognitive medium, reinforced by a certain stability over time. Note that the term 'cognitive medium' is employed specifically to resist a description of 'being' confined to the brain. In the previous chapter we envisaged a complex machine that could conceivably support some mind-like activity, perhaps including a sense of being; whether or not it would be a type of mind, or quality of being we would recognise as anything like our own is uncertain. What follows is an attempt to explore some of the broad philosophical problems that are implied by the notion of machine-minds.

Non-human being

The state of being is one that we recognise habitually in other humans as well as in ourselves. There is little dispute that we enjoy such a state even if we cannot agree on exactly what it is. Could we accept that creatures other than ourselves have a sense of being? Only the most arrogant humanist would argue that it is humans alone who share this sense. Most of us would acknowledge monkeys, dogs, cats, cows and dolphins have some idea of their own existence, even if it is not of the highly self-reflexive, phenomenally conscious kind that we enjoy.

In acknowledging a sense of being in other creatures, we do not have to regard all such senses as equal, just as we do not regard the degree of intelligence in all species as equal. We do not think of the cat as having any powers of intelligent thought to match our own, but we must nevertheless admit that the richness of its behaviour and sensory capabilities merit it some powers of comprehension: if I call my cat, it knows I am referring to it. The problem of attributing a sense of being, or any other cognitive function such as intelligence, to lower-order species like insects or bacteria is more acute. (Of interest in this regard is Allen 1997.)

Motivated meaning

If we cannot draw an absolute demarcation between the existence of a sense of being in humans and other species then we must accept the possibility that this sense could emerge in any system that meets the necessary conditions, and providing a machine could meet the requisite conditions there is no reason to exclude it from having a sense of being. But what separates the simplest organism from the most complex computer is the fact that organisms are continually responding to their environment in a way that computers are not: computers are contained systems and organisms are uncontained.

The crux of this distinction lies in the motivation for behaviour. Organisms need to be aware of their environment to the extent that it either sustains or destroys them. Even plants and bacteria, seemingly endowed with no consciousness (although some dispute this, see Chalmers 1996), have evolved strategies for self- protection and propagation that depend on responses to environmental conditions. Computers on the other hand only need to be aware of their environment inasmuch as we tell them to be. They have no 'hard-wired' motivation for awareness, they do not complain if we try to kill them, and they do not need to feed or reproduce. This vital distinction is often overlooked by those enthusiastic about machine learning and artificial intelligence, but it is crucial to the question of whether 'meaning' can be said to be present in any cognitive process.

Unlike those philosophers who regard meaning as a purely brain-determined phenomena, I would argue meaning only occurs as part of some wider context which, as far as an organism is concerned, is the on-going process of existence conducted in an environment that is both hostile and supportive. At its most basic it takes the following form: ‘That big, stripy thing with fangs coming towards me means to kill me and I should take evasive action.’ Likewise, any sort of machine, or non-human medium, we wish to endow with a sense of being should have a similar ‘motivational context’ to drive its existence. Without such motivation the system will have no need to ‘know’ anything, let alone be responsive to its environment or assert semantic continuity in the face of disruptive stimuli. Without a motivating purpose, knowledge remains abstract and self-referential.

In addition to the frequent neglect of the motivational context, there is a further error made by many of those who would seek to generate cognitive behaviour in non-human media; that is, the implicit requirement that such behaviour should have a logical foundation.

Synthetic beings and logic

> The so-called computational approach to brain function was pioneered by the school of cognitive science, a cross between psychology and artificial intelligence. It states quite simply that for the brain to arrive at any kind of understanding, whether the recognition of a face or the proof of a mathematical theorem, it must go through a series of simple logical steps. (Harth 1993 p. 154)

The assumption often made in artificial intelligence (AI) research was that human cognition can be formalised in logical symbols that can be manipulated without reference to the neurological structure of the brain — an approach sometimes called ‘functionalism’. Because the immense complexity of the organic brain is well beyond our comprehension, replicating functional processes in symbolic form seemed for many a feasible way of modelling human knowledge. Having deduced the logical rules of mental activity in the abstract, the aim was to compute them on ‘hardware’ other than the human brain, usually a digital computer. The view that human cognition can be encoded this way is known as ‘strong AI’. Advocates of strong AI, or a computational view of the mind, such as Marvin Minsky (1985), Douglas Hofstadter (1980) and Daniel Dennett (1991) see this computational approach as a viable way of implementing the software of the mind in the hardware of the machine. On the possibility of creative machines Hofstadter writes:

> It is obvious that we are talking about mechanisation of creativity. But is this not a contradiction in terms? Almost, but not really. Creativity is the essence of that which is not mechanical. Yet every creative act is mechanical — it

> has its explanation no less that a case of the hiccups does. The mechanical substrate of creativity may be hidden from view, but it exists. (Hofstadter 1980 p. 673)

It would be interesting to ask Hofstadter if a mechanical process is also a logical one; that is, do machines act in a logical way? If so, then one could substitute the term logical for mechanical in the above extract and reach the same conclusion. This should pose no problem to supporters of strong AI.

As has been suggested in previous chapters, creativity can be described, and possibly even replicated given the right conditions, but it is debatable whether it is mechanical, if by mechanical is meant fully understandable in terms of logic.

Mathematical realities

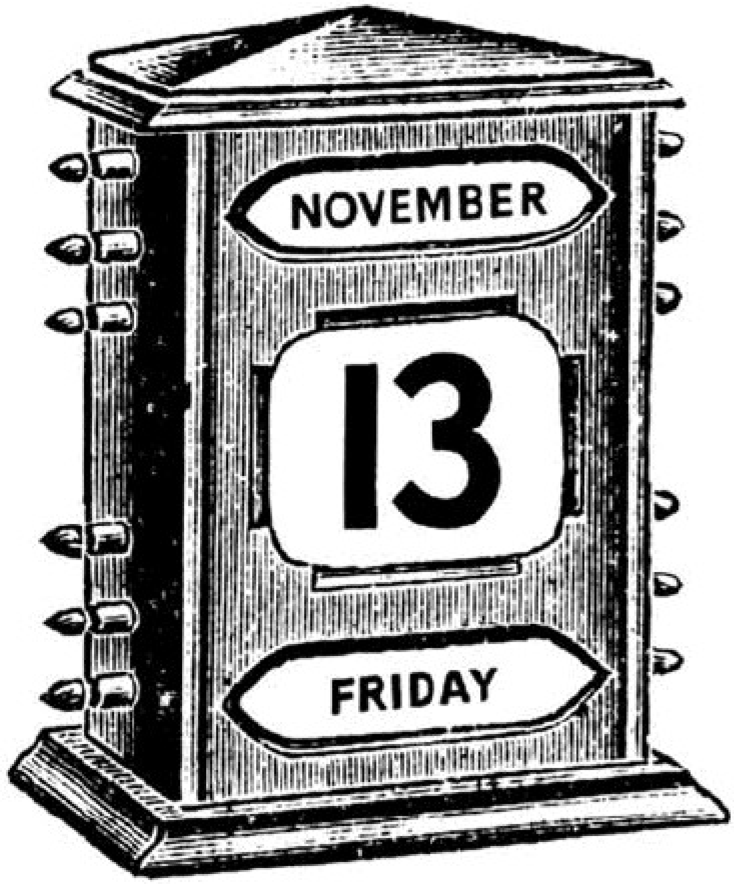
There is much debate between those supporters of strong AI who believe that human thought can be expressed algorithmically in appropriate machines, and their opponents such as John Searle and Roland Penrose who dispute this. Much of it centres around the 'limits to computability' of algorithms revealed by Kurt Gödel and Alan Turing (for accessible accounts see Hofstadter 1980 or Penrose 1990). The consequence, in brief, is that there are theoretical limits to what any formal logic machine can compute, as shown by Gödel and Turing. Yet there are no theoretical limits to what a human can think, at least there is no obvious way of finding out what they are. Hence, the possibility that there might be an 'algorithm for human thought' is ruled out since there are classes of human cognition that cannot be expressed algorithmically — presumably including the idea of non-algorithmic thought.

Finding algorithms that encapsulate human thought is what strong AI claims as its goal. But although algorithms can be used to describe aspects of reality, sometimes with remarkable precision, they are nevertheless constructions of the human mind. This is not to suggest that constructions of the human mind are not real, but they are not necessarily identical with the realities they purport to represent. Our mental construction of reality is only a proportion of (but not separate from) the total reality in which we are immersed — although this is something strong idealists would dispute.

Ideal logic

Algorithms are logical and, as was argued earlier, logic is an idealisation that has been developed by human imagination. The formal project of many branches of logic is to eradicate contradiction (one exception being ‘dialethic’ logic, which accepts contradictions in certain circumstances. See Preist 1987). The work of Bertrand Russell and Alfred North Whitehead in *Principia Mathematica* was such a project, which ultimately failed. Arguably, it failed because contradictions arise only in language (or, more precisely, human thought), yet do not exist in any other form. And, as was suggested previously, language is not self-consistent. Nor is mathematics, that particularly aesthetic form of language, free from contradictions as Kurt Gödel showed in his paper on ‘Incompleteness Theorem’:

> This paper revealed not only that there were irreparable “holes” in the axiomatic system proposed by Russell and Whitehead, but more generally, no axiomatic system whatsoever could produce all number-theoretical truths, unless it were an inconsistent system! And finally, the hope of proving the consistency of a system such as that presented in Principia Mathematica was shown to be vain: if such a proof could be found using only methods inside Principia Mathematica then — and this is one of the most mystifying consequences of Gödel’s work — Principia Mathematica itself would be inconsistent! (Hofstadter 1980 p. 24)



Logic might be a construction of the human intellect, but this does not mean humans are logical.

Language paradoxes

Epimenides was a Cretan.

Epimenides said, ‘All Cretan are liars.’

Was he telling the truth?

In *Principia Mathematica* Russell and Whitehead famously tried to eradicate paradox from formal mathematical language. But a paradox, in that it is circular, does not represent any rupture in the fabric of the space-time continuum that demands metaphysical explanation. It is simply a function of the exclusive operation of human language in which a word with one meaning (in this case ‘liars’) is excluded from meaning its opposite. Because of the general adherence to Aristotle's ‘Principle of Non-

Contradiction' as set out in his *Metaphysics*, it is often taken as axiomatic that something cannot be true and false at the same time. Yet there are examples of indeterminate states where this is so: the case of Schrödinger's cat is often cited. A cat locked in a box with a poison pellet is both 'dead' and 'alive' until an observer opens the box. The release of the poison is dependent on the decay of an atomic particle that cannot be predicted exactly, but only calculated as a probability. It is only when one opens the box that the probability wave function collapses and the 'dead-ness' or 'alive-ness' of the cat is determined. Prior to opening the box, the statement 'The cat is dead' is as true as the statement 'The cat is alive' (see Gribbin 1992). This is a case that is often cited from the 'hard' world of physics, but language itself is riddled with ambiguities, inconsistencies, and interpretations, which defy coherent, logical analysis, exemplified by Picasso's remark that "Art is a lie which lets us see the truth."

Ultimately, logic is an product of the rationalist humanist project in which the universe is assumed to obey consistent laws that humans, one day, will be able to understand. The paradoxical nature of logical analysis is compounded by the fact that it is always expressed in language (even mathematical language) and language itself is partially illogical. To hope, as many in the AI community do, that human language can be successfully modelled using logical operators is bound to lead to frustration. To take this further, and hope that the rules governing human thought can be modelled from a logical model of language will lead to even greater frustration. Since there are few things less logical in behaviour than humans, any machine that is restricted to using logic as its base will never display fully human characteristics. Surely Epimenides was both/neither lying and/or telling the truth.

A contradiction?

But we are left with an apparent contradiction that seems to point to an illogicality in the posthuman argument. I have claimed that attributes which are seen as essentially 'human', viz. creativity, consciousness, aesthetic experience and a sense of being, could in principle emerge in non-human media. By non-human media we are assuming we mean computers of some kind, but specifically what we have referred to here as complex machines. This is a view which supporters of strong AI would approve of. Yet I also seem to be siding with the opponents of strong AI, those who claim that certain ‘higher’ human faculties are not algorithmic, nor prone to logical decomposition and, therefore, would not be susceptible to mechanisation or computation. Can both views be compatible?

Human conditions

In simple terms I would respond to this apparent contradiction in the following way: Yes, the systems we now think of as computers will most likely evolve into entities which, if necessary, will have attributes of consciousness, creativity and aesthetic sensibility similar to, but not necessarily identical to our own. On the other hand, these human-like attributes will not be predicated on purely logical or algorithmic functions, they will not be systems that any human can fully understand or control.

To back up this position we can call upon a very compelling example as evidence — the human condition itself. The fact that humans exist in the form they do obviously means it is possible for entities to evolve that have all the capabilities and vulnerabilities we recognise as human; crudely put: it has been done once so it can be done again. This does not mean that in producing the capabilities in another medium we should have a complete understanding of how they work, nor indeed that they should be inherently logical. The physicist Richard Feynman claimed that those who think they understand quantum mechanics don’t understand it; many common electrical devices work on the basis of applied quantum mechanics, without any suggestion that quantum mechanics is fully understandable, or even that it is essentially logical. Why not try to replicate our vulnerabilities too?

The truly sentient machine may think it’s being logical when it isn’t. Although cognitive scientists would disagree, truly intelligent machines, those with human- like capabilities, will most likely be just as confused as we are.

The thinking machine

The debate about machine thought is central to the notion of synthetic beings as postulated here, and to our understanding of the posthuman condition as a whole. One of the most provocative ideas advanced recently in the debate (to judge by the amount of debate it has prompted) is the

‘Chinese room’ hypothesis by the philosopher and critic of strong AI, John Searle (Searle 1980).

Searle proposes a thought experiment in which he sits in a room that is sealed except for two slots, A and B. In the room is a basket full of cards with symbols on them and a big book of rules. From time to time a card is passed through slot A. His job is to match the symbol on the card which has passed through the slot with another symbol from his basket. The symbol he chooses is determined by the rules in the book in front of him. Having determined the correct symbol, he passes it out through slot B. Unknown to him, the symbols are actually Chinese characters, a language of which he is completely ignorant, and the symbols passed through slot A are questions posed by fluent Chinese speakers to which they are requesting answers. These symbols chosen from his basket and passed out of slot B are the answers, presented in fluent Chinese, to the questions which came through slot A.

Searle’s case, intended to refute the claims of the strong AI community, is this: The fluent Chinese speakers may think they are in the presence of a machine that can understand Chinese as well as they can since every time they ask a question, they receive an intelligible answer. However, Searle does not understand any Chinese. He is merely carrying out instructions written in English in a book of rules. He distinguishes between the syntax (the book of rules) and the semantics (that which is understood by the Chinese) in order to show that a machine (or a room) can seem to be understanding a language that it actually isn’t.

This scenario is an analogy of the Turing test, or “Imitation Game”, named after the English mathematician Alan Turing (1950), in which a machine is envisaged that, when interrogated by a human, produces answers which are indistinguishable from those that would be given by another human. For Turing, such a machine would count as ‘intelligent’. A formal contest to meet this challenge, called the The Loebner Prize, is actually held annually, and there is a considerable reward for the first program able to fool a panel of judges. Searle denies, however, that any system that passes the test would actually be intelligent. Rather, it would merely be a very efficient, but dumb, symbol manipulator with no greater understanding of the semantic content of the symbols than he has of the Chinese language.

Against strong AI

Searle's argument seems to have particular force. It has certainly raised a lot of opposition from those who believe machines can be programmed to think in the same way that humans do (for a range of related arguments see the philosopher David Chalmer's Web site at 'www.u.arizona.edu/~chalmers'). But, as has been suggested many times in this book, it is likely that machines (or what we now know as machines) will acquire mental capacities comparable to those we recognise in humans. So the advocates of strong AI may be correct to believe machines might be able to think in some way, but wrong to think they will be based on algorithmic models of 'the brain' programmed on digital computers, for at least three reasons:

1. As we have said repeatedly, there is more to thinking than just that which goes on in the organ of the brain. Any AI research which proceeds under the philosophical delusion (shared by Searle) that the 'mind is caused by the brain' forgets the role of that which is around the brain in producing thought. (However, we have noted elsewhere there is an increasing tendency in this field towards 'embodied' or 'enactive' approaches to modelling mental behaviour.)

2. Algorithms are logical, digital computers behave logically, yet humans are not entirely logical. Logic is a not a mind-independent property of reality, and despite its potency as a mental construct, it is not universally applicable. Likewise, mathematics cannot escape the fact that since language contains illogical loops it too must contain them, as it is also a form of language. Any theory of mind based on logic could not embody human thought based on language.

3. Digital computers, and the binary logic they use, are architecturally incapable of fully representing the variable complexity of organic phenomena, including the mind. This doesn't mean we can't build very good models of natural phenomena with digital computers, but it does mean these models have an inherent limitation in that they can't take advantage of intrinsic physical properties of the system. In Adrian Thompson's experiment described on page 127, the evolvable hardware system behaved in a different way to a similar model running as symbolic, binary code. His so-called 'intrinsic evolution' approach

produced a more effective solution than the comparable 'extrinsic evolution' system running as a computer simulation (Thompson 1996).

Criticising Searle's thesis 1

You will note that amongst these criticisms of the aspirations of strong AI we have not mentioned Searle's syntax/semantics argument. We will come to this shortly, but first must address what I would suggest is a fundamentally erroneous assumption made by Searle in setting up the hypothetical experiment which echoes a common misapprehension about the nature of language.

In *Minds, Brains and Science* he outlines the Chinese room hypothesis, much as we have above, and in doing so makes this crucial statement: "Suppose for the sake of argument that the computer's answers are as good as those of a native Chinese speaker." (Searle 1984 p. 32) Here, before he has even started passing symbols through slots or looking up correlations in his book, his argument is in difficulty. For any machine, whether it is Searle as an automatic sign passer or a digital computer, to give answers that "are as good as those of a native Chinese speaker" it would have to understand the questions. It is simple. No book of rules devised by even the cleverest human(s) could account for all the semantic intricacies of human language. (This is pretty much the line of attack adopted by Dennett (1991).)

By the same token, as we have said above, no human could produce a set of rules running on a serial computer that were able to account for meaning as perceived by humans. As we spelt out in chapter four, language and human thought are far too slippery and mobile in operation to be encoded in a formal set of logical operations; language use changes from moment to moment, and no two occurrences of a linguistic event are identical. It is true that certain aspects of language can be modelled in a limited way, but to hope to make this anything more than an approximation is as misguided as it is to hope that we could produce accurate long-range weather models. And just as the weather is non-linear and sensitive to tiny perturbations, so meaning in language is conditioned by imperceptible subtleties to which we acclimatise over our lifetimes.

In sum, Searle premises his argument on the fact that the Chinese interrogators have full confidence in the ability of the room to understand the questions they are asking and to give fluent answers, even though the room itself does not have any understanding of the language employed. I would argue that the only way such confidence could be sustained is if the room really does understand, for nothing short of full understanding would allow the interrogators to maintain their confidence. Therefore, the Chinese room as described by Searle could not work according to one of his own premises, yet this does not invalidate his overall claim.

Criticising Searle's thesis 2

To return to the central criticism Searle levels at the AI project in his Chinese room experiment: that the operator in the room lacks any semantic grasp of the syntactical transactions. Searle's appeal to the distinction between syntax and semantics is weak. If he is claiming (as he is) that he can refute the claims of strong AI on the basis of this distinction between semantics and syntax then he should at least be able to quantify the distinction. Of course, he cannot do this for the reason that 'meaning' cannot be precisely defined, because no-one knows exactly what it is. What's more, the distinction between syntax and semantics is an arbitrary one devised by linguistic philosophers in their attempts to formalise language. It is a useful analytic academic tool which helps us to comprehend the complexity of human discourse, but is not an a priori fact. One cannot have syntax without semantics, just as one cannot have semantics without syntax.

Undoubtedly this argument will continue for some time to come, though in posthuman terms it is somewhat academic, as we shall see. For much of the disputed territory between the supporters of strong AI and its antagonists rests on assumptions about humans and machines which, in themselves, are subject to revision in the posthuman era.

What is a machine?

In one sense posthumanists agree with strong AI enthusiasts when they imagine, someday, machines will be able to think. But, as has been spelled out above, this can only happen when machines are able to engage with the world in a way comparable to humans. Machines able to do this are a long way off, but we have outlined above some of the principles along which they might be constructed. Searle counters this argument by stating that it does not matter how complex the machine is, or how many causal links it has with the world, it will never be able to understand in the sense that we do. We can agree with him here if he means machines that are programmed by other humans according to formal, logical rules. But to suggest machines of any type are inherently incapable of human-like mental behaviour is problematic, if only for the reasons that it is no longer clear that the distinction between machines and natural things can be perpetuated indefinitely.

As outlined in the introduction, there are many emerging technologies that blur the distinction between humans and machines. To take an example, is a man with a mechanical heart, a video eye and a nerve-connected robotic hand (incidentally, all technologies which are currently available) a man or a machine? Clearly he is a bit of both. Moreover, as we have already said there are computational machines that could, in principle, overcome the limitations of the digital architecture. We have mentioned analogue computers, organic and quantum computers, with massively parallel architectures and the capacity to learn and adapt. Machines under development now are likely to be some hybrid of bio-mechanical technologies, possibly directly linked to organic structures such as brains or skin. One cannot rule out the possibility that in a technology so intimately conjoined to the conditions of human existence and endowed with its own sensory capacity and incentives, a sense of meaning, intelligence or thought might emerge, especially if motivated by self-survival in the world.

The impression of meaning

Arguably, the only way we can tell if someone else is enjoying a sense of meaning is from the way they act towards us; given certain responses and clues, we use our subjective judgement either to attribute them a sense of meaning, or not. But even in our dealings with other humans, this measure is never totally accurate. There are examples of conversations between humans where one party does not understand what the other one is saying. For instance, I might believe that what I am saying to person *x* is making sense; they may nod in encouraging agreement, but I find out later that, contrary to my impressions, although they understood all the words I used and the way I used them, they didn't understand what I meant. Does this mean that during the conversation person *x* was reduced to the status of a digital machine, all syntax and no semantics? Or did they simply gather a different meaning from the one I intended?

In fact, one might justifiably argue the following: It does not matter whether some object which I believe to be enjoying meaning actually is enjoying it or not. For as long as the appearance is maintained, as far as I am concerned, the object *is* enjoying a sense of meaning. In truth, there is no way of objectively verifying whether it has a sense of meaning, other than the impression it gives me. This argument accords with some traditional functionalist, or behaviourist, theories and would effectively support Turing's thesis what constitutes intelligence is our subjective experience of what we think intelligence is, regardless of precisely how it is being generated. The mistake is to think we will ever fully understand it.

Endowing machines with subjectivity

Imagine that you are a combatant soldier taking part in a war in fifty years time. You are separated from your unit and picked out by a hostile anti-personnel robot. You see it coming towards you, firing its laser, but you manage to take shelter in a large building. While hiding you hear the robot searching the building, overturning furniture and rubble to find you. Observing your adversary through a hole on the floor, you see it using scrap metal to block all the exits. It knows you're in the building and it doesn't want you to escape before it can kill you. Finally, realising you are cornered, you attempt to jump out of a window but you immediately find that it has communicated with several other 'comrades' who have now surrounded the building. At this point, you might not be greatly concerned as to whether the robot 'understands' what it is doing, or whether it is merely following a set of symbolic procedures.

> In adversarial situations, being forced to treat a machine as an intentional system may be considered as a good criterion for mechanical intelligence. In the case of predatory machines, not only would we have to fight them on the "intentional plane" but we may also assume that they would treat us, their prey, as predictable assemblages of beliefs and desires. It would be, then, a clash of "minds" or of "rational wills". (De Landa 1991 p. 157)

The trajectory of machine intelligence in the foreseeable future may be one in which machines, through clever programming techniques and adaptive capacities, will give the strong appearance of 'understanding', or having an internal subjective existence — whether they have it or not. As machines learn to negotiate in response to human actions, and adapt their internal state accordingly, so humans will naturally tend to attribute certain faculties we recognise in ourselves to machines, with the consequence that they will start to seem sentient.

In order to accelerate this process, engineers will most probably endow machines with pseudo-naturalistic attributes, such as the ability to express emotion. Researchers at MIT are already experimenting with ‘sociable robots’ that reinforce the sense of an entity that is ‘alive’ and responsive to its environment (Breazeal 2002). So, whilst at some indefinite point in the future it might be possible to effectively argue that a machine is really thinking, even that it has a sense of being, by then it will be too late: we will be so used to dealing with machines that display life-like behaviour that we will no longer doubt their sentience.

We are our machines

The debate between supporters of strong AI and its antagonists rest on a further assumption: that humans and machines are distinct entities. It is quite natural to assume that machines are somehow ‘outside’ us, perhaps slowly evolving into a self- supporting super-species that will ultimately extinguish humans as we know them. Such suspicions lie, on a more mundane level, at the root of the methodological fallacy known as ‘technological determinism’, in which technologies generally are seen as having a specific determining influence on the course of human events, while forgetting, of course, that humans develop the technology in the first place.

The posthuman conception of technology is that of an *extension* to human existence, not of an external agent with a separate history and future. It is an argument made more fully elsewhere (Pepperell and Punt 2000), and so will be dealt with briefly here. In short, humans cannot be understood in isolation from the technological environment that sustains them. What makes us human is our wider technological domain, just as much as our genetic code or natural environment. Throughout history, we have sought to distribute our selves, our consciousness and our intelligence by a variety of means, including language, art, gesture, and music, by encoding the content of our minds in some material substrate, and to extend our physical abilities with tools. This ‘extensionist’ view of human nature, in contrast to the humanist view, does not therefore make a distinction between the biological substrate of the human frame (what is most often referred to as the 'human') and the wider material domain in which we exist. In other words: where humanists saw themselves as distinct beings in an antagonistic relationship with their surroundings, posthumans regard their own being as embodied in an extended technological world.

An awkward conclusion

Bearing in mind the propensity of humans to endow inanimate objects with sentience, and the posthuman conception of technology just described, it seems the on-going debate between advocates and opponents of machine intelligence may not be concluded either way. At any rate, we will not be offered a simple binary choice between the view that machines will think like humans and the view that they won't. The somewhat awkward conclusion emerging from the ideas discussed here is that, on the one hand, we will never know (and it won't matter that we won't know) whether machines become fully sentient like humans, and on the other, machines are *already* sentient insofar as they are but the material extensions, or embodiments, of extant human thought.

Furthermore, virtually all those on either side of the 'thinking machine' debate make the assumption that thought, intelligence and consciousness are located firmly within the human brain. Yet it should be obvious, at least to those who advocate artificial consciousness, that by entertaining the idea of thinking machines we are implicitly accepting that thought can be distributed beyond the brain and into the machine.

Building organic machines

We can summarise the speculative technological trajectory towards synthetic beings as follows: first, machine intelligence using traditional AI and neural network techniques will develop in the near future to such a degree that we will come to regard certain types of systems as having a high level of intelligence which is comparable or superior to our own in certain circumstances. Such machines will perform a limited range of functions that will complement human skills rather than replace them. These might include 'smart' weapons, intelligent agents, creative aids, simulated realities, and knowledge databases of great sophistication. Like 'Deep Blue' or 'Deep Fritz', these systems may develop very specialised skills, such as the ability to beat grand masters at chess. Although machines like this may create the impression they are thinking, they will not generally be considered by us to be sentient beings capable of experiencing pain, emotion or pleasure.

Following this, however, there will be developments in the engineering of machines that will mark a significant advance on digital computers as we know them today. In order to increase the effective intelligence of machines, researchers will increasingly adopt strategies of design based on organic models. This is because organic systems are the best models we have of energy efficiency, information manipulation, self-replication and survival. It is likely then systems will develop that have adaptive learning capabilities, high levels of sensory awareness, self- repairing and self-reproducing capacities. Such machines, based perhaps on optical analogue, molecular or sub-atomic architectures, will be of sufficient complexity to allow the emergence of unpredictable global properties. Unlike the 'deterministic machines' we have today, these will not be programmed in a sequential manner, but instead will tend to learn, acquire new traits and skills and evolve their own intelligence in response to environmental demands. Crucially, as with many other aspects of physical reality, the precise way in which such complex machines will function will remain as opaque to us as the human mind is now.

Being machines

Complex machines, as we have called them, will gain increasing autonomy from direct human control and support. As this happens they will become aware of environmental influences and the demands of self-perpetuation, such as the need to acquire a source of energy. To achieve this effectively they will need to be motivated, in the same way that organic species are, and through this motivation they may acquire characteristics that we could regard as animated meaning.

It will be harder to dismiss the notion that such machines have a sense of self, since they may gather some notion of their own existence as distinct from other things, which would be a motivating factor in self-preservation. Given an information processing system of enough complexity and adaptability, and sufficient access to rich sensory data, we might expect some semblance of independent mind to emerge, albeit one that may be qualitatively different from ours. If able to encode sensory data into memories that can be recalled by prompting, and then able to draw associations between those memories and relate them to negotiations with the world, one might anticipate the emergence of sense of meaningful thought. And, if in the course of this emerging sense of thought, a certain order is distilled from the chaos of existence, an order that is continually reasserted in the face of unpredictable events, then taken as a whole, the system could satisfy our criterion for something having a sense of being.

CHAPTER EIGHT
WHAT IS POSTHUMANISM?

THE PREVIOUS CHAPTER INDICATED THE COURSE THROUGH WHICH THE TECHNOLOGY OF SYNTHETIC BEING MIGHT EVOLVE, AND THIS IS ONE EXAMPLE OF THE WAY POSTHUMAN IDEAS DIFFER FROM THE HUMANIST ONES. BUT ALTHOUGH WE ARE SOME WAY FROM THE GENESIS OF SYNTHETIC BEINGS, IT HAS ALSO BEEN ARGUED THAT THE POSTHUMAN ERA HAS ALREADY STARTED, AND EVEN THAT IT STARTED SOME TIME AGO. IN FACT THE ORIGINS OF POSTHUMAN THOUGHT THAT CAN BE TRACED BACK TO THE ANCIENT GREEKS, AND TO HERACLITUS IN PARTICULAR. BUT IF WE HAD TO SET A TIME THAT MARKED THE GENERAL BREAK FROM A HUMANIST VIEW OF THE UNIVERSE TOWARDS A POSTHUMAN ONE, IT IS PROBABLY AT THE BEGINNING OF THE TWENTIETH CENTURY. SEVERAL EVENTS OCCURRED AROUND THAT TIME WHICH, AS WE SHALL SEE, WERE PROFOUNDLY IMPORTANT IN THE DEVELOPMENT OF POSTHUMANISM AS WE ARE COMING TO KNOW IT TODAY.

God, humans and nature

> So God created man in his own image, in the image of God created he him; male and female created he them. And God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth. (Genesis 1. 25-26)

In general terms, for much of history there have been three categories of central importance to the human condition — gods, nature, and humanity itself. Each of these categories was thought, at various times and in various ways, to stand in distinction and in opposition to the other. Certainly in the case of Christian mythology they were arranged hierarchically, with God at the top, his favoured subject 'man' below, and the lower forms of life sprawled throughout nature at the bottom. The deep impact of this belief on our understanding of what it is to be human is hard to overstate. Even today many are inclined to believe in this hierarchical relation of categories, despite the progress made in science and technology which might seem to invalidate them. What has changed, however, is the relative prominence each is afforded at different stages of history. It is important for an understanding of the posthuman condition that we appreciate its historical context through a brief examination of some general trends.

Humans and theism

The debate about the human condition, at least over the last eight hundred years, has been intimately bound up with the Christian Church. From Thomas Aquinas in the thirteenth century to Friedrich Nietzsche in the nineteenth and beyond, most of the dominant philosophical disputes have been deeply rooted in theological discussions about the relationship between humans and God. Even if this has meant rejecting the actual existence of a Christian God, as with Karl Marx and Nietzsche, it has often meant dealing with the social consequences of belief in a deity. Karl Marx beseeched his readers in the preface to *The German Ideology*:

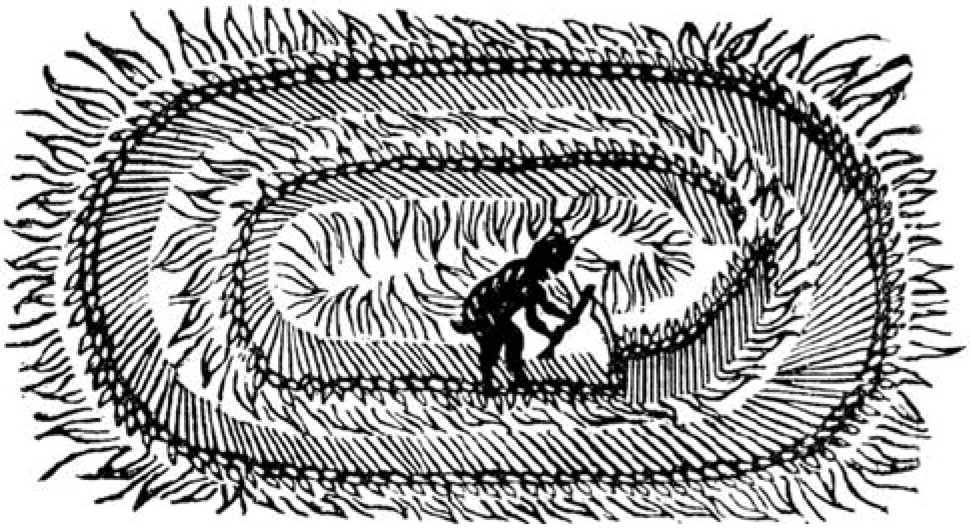
> Hitherto men have constantly made up for themselves false conceptions about themselves, about what they are and what they ought to be. They have arranged their relationships according to their ideas of God, of normal man, etc. The phantoms of their brains have gained the mastery over them. They, the creators, have bowed down before their creatures. Let us liberate them from the chimeras, the ideas, dogmas, imaginary beings under the yoke of which they are pining away. (Marx 1938 p. 1)

Meanwhile, the long perpetuated distinction in the Christian Church between God and humanity deeply affected western thinking across most of the last millennium. The distinction was upheld by the institutions of state, law, science and art for many centuries, largely because of their dependence on the power and patronage of the church, which sought to maintain its lucrative position as mediator and arbitrator between humankind and the Deity.

Whilst agricultural production pre-dominated, until around the eighteenth century, the political system was largely feudal and the authority of God was used by the ruling élite to justify the social order. Much of the recorded intellectual debate in medieval times was concerned with theology and interpretation of scriptures. While there was considerable argument amongst philosophers and theologians as to the precise meaning of various religious doctrines, the actual existence of God was rarely questioned by representatives of the institutions of power such as ecclesiastics, courtiers, the judiciary and executive. This can partly be explained by the fact that the penalty for heresy was horrific torture and death.

Throughout the Middle Ages, the church maintained a virtual monopoly on ideas and information since reading and writing were skills restricted largely to the clergy. The overwhelming effect of official intellectual debate was to perpetuate and support the feudal Christian social order, especially on matters of social, religious, political, or economic policy. For example, the Crusades, which were early colonial adventures, were justified as Christian missions, as were the later Spanish inquisitorial interventions in South America. According to Carol Karlsen in *The Devil in the Shape of a Woman,* the execution of witches to prevent female succession to property was justified on religious grounds in Puritan settlements in the New World in the 1600s (Karlsen 1987). Elsewhere the line of succession of the European royal houses was secured through reference to divine ascendancy. The churches were able to justify the prevailing social structure in the name of God in return for the support they received from the ruling establishment via protection of landed interests, donations to church funds and influence on the legislature.

The human experience of nature during feudal times must have been one of a brutal set of uncontrollable events (diseases, floods and droughts) which could only be explained with reference to supernatural forces. These forces could use nature as a conduit for their wrath ('acts of God', the 'work of the devil', the plague as divine retribution) — a misapprehension that further reinforced the church's authority. According to biblical myth, humans were inserted into nature, the Garden of Eden, but squandered the opportunity they had been offered to exist in harmonious continuity. The consequence for humans was perpetual conflict with nature, and alienation from God himself, in which context natural disasters could be seen as emanating directly from the Divine Being as further punishments for Sin; Sin being defined by the church. All this would have conspired to strengthen the tensions between humans, the world around them and the unseen Deity.



Change and resistance

As the mercantile economy became established in seventeenth- and eighteenth century Europe, followed by the industrialisation in the nineteenth, societies grew increasingly bourgeois and urbanised. A city-based middle class started to evolve and other previously stable social edifices began to slide. Consequently, existing political structures came to face serious threats from the seventeenth through to the nineteenth centuries. Reformist movements emerged in rapid succession as the wealthier and better educated middle and lower classes challenged the political privileges of the landed nobility and the church; England saw the rise of groups like Levellers, Diggers, Luddites and Chartists and in France pressure for change climaxed in the revolution fervour of the late-1780s. Speaking of the eruption of radical ideas during the seventeenth century English revolution and those who produced them, the historian Christopher Hill writes:

> They founded new sects to express these new ideas. Some considered the possibility that there might be no Creator God, only nature. . . How right too was Milton's confidence that God's Englishmen had significant and eloquent things to say, which only the 'tyrannical duncery' of bishops had prevented them from saying; and that any future attempt to censor them would be 'an undervaluing and vilifying of the whole nation, a reproach to the common people'. (Hill 1972 p. 362)

The intellectual order that had once accompanied the ancient structure of landed privilege was simultaneously shaken and many accepted beliefs about the nature of reality came under strain. During the era that saw the

Enlightenment and the rise of materialism, newer, more accurate scientific instruments were developed. The telescope, the microscope, and the mechanical clock were devices that provided new sources of empirical evidence about the nature of the universe and met increased demands for precision in measurement.

Above all, the arrival of mechanical printing saw a huge growth in the spread of ideas, and printed pamphlets were often used to subvert established knowledge and prejudice. Scientists, such as they were, became sceptical about the discrepancies between observable phenomena and church dogma on the operation of nature. For much of its history the Catholic Church propagated the view that the earth was the centre of the universe. Thinkers and astronomers who did not believe this had to renounce their views on planetary motion for fear of excommunication, or death. Galileo had to recant his heretical views on planetary motion in 1632, yet his ideas were already gaining wide acceptance since for one thing they improved navigation.

Slowly, intellectual debate started to detach itself from the direct control of the church. To the newer bourgeois ruling classes, religious fidelity was less important than technical and scientific progress since it was through such progress they enjoyed increased wealth and power. The improvement of clock mechanisms and astronomical charts allowing for better navigation meant shorter voyages and fewer lost cargoes. Somewhat later, steam-driven machines increased productivity in mills, mines and factories. Science was proving itself an engine of wealth.

Through gradual scientific progress, it was thought, nature could be overcome and tamed like the alien cultures in the far-off colonies. The 'clockwork' view of nature as a logical machine following its own predetermined laws and being uncovered by science came to be the official view of the establishment and was endorsed by many members of the Royal Society, founded in 1660. Along with the development of scientific materialism, various strains of materialist and anti- religious thought grew, leading in the nineteenth century amongst other things to the radical political materialism of Marx, Engels and Feuerbach. Now that God did not enjoy the overriding prominence he once had, and tangible steps were being made through scientific endeavour to exert control over nature or at least harness its forces, an outlook developed that perceived humanity in direct struggle with nature, without the intervention of God. This was the high tide of humanism.

Humans and humanism

Humanism had its origins in the science and philosophy of ancient Greece and Rome (Novak 1965). These early thinkers did not consider the world to be subject to a Christian God; after all, Protagoras famously declared that "Man is the measure of all things", an epigram subsequently taken as the quintessential humanist statement. To western eyes, the antique documents discovered and translated in the late-medieval period, notably by Erasmus, pointed to the existence of a 'pagan' society of great sophistication and technical prowess, with theories on astronomy and medicine that proved superior in explanatory power to those offered by subsequent Christian dogma. Greco-Roman ideas were gradually taken up with enthusiasm during the Italian Renaissance, and greatly influenced the neoclassical culture that arose in parallel with mechanisation in the eighteenth century. By this time an enlightened faith in progress, meaning human progress, was challenging the blind faith in God.

During the industrial era of the nineteenth and early twentieth centuries great political and economic forces influenced the general content of intellectual activity. Whilst the name of God was still invoked to justify wars, the obscene trade in humans, and colonialism, progressive intellectual forces were more openly challenging God's existence and curbing the extent of his influence. It is true that Christian fundamentalism enjoyed a significant revival in the nineteenth century, especially in Britain, where the Pre-Raphaelites and Gothic revivalists were promoting a utopian and guilt-free haven based on misconceptions about early medieval history from which to escape the horrors of industrial capitalism. However, it was no longer necessary to gain the approval of the church to conduct scientific experiments or publish discoveries, in the way that it had been for many centuries previously. The idea that humans are responsible for their own living conditions gathered momentum. It became clear that plagues and epidemics could be controlled by quarantine, improved housing and sanitation, that diseases were not 'punishments for sin' but could be cured or controlled, and that humans evolved from primates rather than having been spontaneously created some five thousand years earlier as the Creationists claimed. As far as practical scientific and intellectual debate was concerned, God was no longer the sole authority. Speaking of the decline of religious influence after the ‘Humanist Revolution’, Hector Hawton offers an optimistically humanist view:

> With the growth of technology, dependence on God tended to give way — in fact not always avowedly — to confidence in man himself. This confidence, this optimistic world view . .. is a sign that civilisation is healthy, may require for a period the support of a secular myth, such as the direction of evolution or history. In time, however, I believe that such metaphysical aids will be understood as no more than useful fictions, and man will no longer fear to stand alone as the maker of his own destiny and the creator of his own values. (Hawton 1963 p. 80)

. . . while in *The Arrogance of Humanism* David Ehrenfeld offers a more sceptical interpretation of the humanist tradition:

> It only remained to diminish the role of God, and we arrived at full-fledged humanism. This was achieved in the Renaissance and afterwards, coincident with the great flowering of the doctrine of final causes in the religious sphere. The transition to humanism was an easy one; it could occur in steps. One only had to start with the belief that humans were created in God’s image. God could then be retired on half- pension, still trotted out at the appropriate ceremonies wearing the old medals, until bit by bit He was demystified, emasculated and abandoned. The music that accompanied this process, in later years was the throbbing of Watt’s steam engine. (Ehrenfeld 1981 p. 8)

Humans and posthumanism

As we enter the high technological era, marked by increasing automation, rather than the mechanisation of the industrial era, we can see the perceived relationship between gods, nature and humans is changing again. We now know that natural phenomena are infinitely more complex than the mechanist Pierre Simon de Laplace believed in the early eighteenth century. Taking Isaac Newton’s mechanical ideas to a logical conclusion, he argued for a deterministic view of the universe where predictions could be based on precise knowledge of current states. By knowing the position of every particle, he thought, one could calculate all future events and thus conclusively resolve the apparent unpredictabilities of natural phenomena. But, as we shall shortly see, the evidence of quantum-level experiments and astronomical data gathered in the twentieth century, and the recent suggestions of chaos theory, strongly resist the Laplacian view. The natural universe is now understood as a much more fluid, dynamic and interdependent system that imposes significant limitations on our capacity for measurement.

In our own time, technological advances multiply exponentially in the fields of micro-electronics, gene manipulation, and communications and point to the possibility of controlling, synthesising or even surpassing aspects of nature which until now have eluded our command. The tendency towards artificial life, synthesised intelligence, and telepresence is eroding the barrier between 'natural' and 'human-made' phenomena. It is not at all unfeasible to think of ourselves communicating with a synthetic intelligence on another planet, swapping samples of bio-digital artificial life through interplanetary cyberspace. Once we can conceive of such activities, and more importantly understand how they might be realised, the need to impose a fixed distinction between nature and humans diminishes. We will simply cease to think in those terms any more.

The posthuman era, then, begins in full when we no longer find it necessary, or possible, to distinguish between humans and nature. This does not mean that the categories of human and nature, or indeed gods, will cease to exert any influence over the conduct of global affairs. But it will mark the time when we truly move from the human to the posthuman condition of existence.

The modern origins of the posthuman era

Historically, we could say that the foundations for our modern conception of the posthuman condition were laid in the period leading up to World War I — that fertile period of human endeavour which produced, amongst other things, relativity theory, quantum physics and cubism. The upshot of these three developments was a changed view of the nature of reality and how we represented it. For the first time in modern western thought it became apparent that, in the words of physicist Werner Heisenberg, 'There are no things, just probabilities.'

Relativity and cubism

Within a small number of years before the outbreak of World War I the whole structure of western science and culture was disturbed by a sequence of scientific discoveries and artistic innovations. In 1911 Rutherford postulated his theory of atomic structure and in 1912 the invention of

Wilson's cloud chamber confirmed the existence of protons and electrons; in 1913 Bohr formulated his radical theory of atomic organisation and in 1914 Jeans published *Radiation and Quantum Theory* while Einstein put forward his *General Theory of Relativity* in 1915.

At the same time, Picasso and Braque were consolidating and extending their cubist techniques. *L'Homme à la Pipe*, regarded as a seminal cubist work, was painted by Picasso in 1911. A year later new media were introduced to the canvas such as chair caning and paper cut-outs, exemplified by works such as *Still Life with Chair Caning* (1912) and *The Violin* (1912). By 1914 the cubist art movement was well established as an artistic and literary force with many adherents throughout Europe and America.

There appears to be little evidence of a direct correlation between radical developments in atomic physics and fine art at this time. There is no suggestion, for example, that Picasso closely followed developments in atomic physics, or that such developments were a direct influence on cubist ideas (Richardson (1996) takes this line strongly in his biography of Picasso). It is most unlikely that Einstein was influenced by the radical Parisian avant-garde when formulating relativity theory (for a useful investigation into the link between art and physics see Shlain 1991). To their contemporaries, however, it would have seemed that the two sets of intellectual developments were profoundly connected in that they both represented a triumph for reductionism. This was the mode of thought that dominated philosophical investigation for some centuries before. It suggested that, although the universe seems complicated and chaotic on the surface, it is merely obeying hidden, underlying laws. Like the mechanists of the Enlightenment, reductionists held that the behaviour of stars, humans and atoms could be understood in terms of regular patterns and rules, and uncovering these rules would lead to a complete understanding of the universe. As was argued earlier in the book, this view still prevails amongst strands of materialist science today.

The final word in reductionism

Such was the enthusiasm for pinning down the ultimate nature of the universe that some scientists were led to declare in the late nineteenth and early twentieth centuries that high level physics was complete and subsequent research lay in merely refining those principles already understood. In *Dreams of a Final Theory,* Steven Weinberg quotes physicist Albert Michelson speaking in 1894:

> . . . it seems probable that most of the grand underlying principles have been firmly established and that further advances are to be sought chiefly in the rigorous application of these principles to all the phenomena which come under our notice. (in Weinberg 1993 p. 9)

Such views were echoed well into the twentieth century when optimism about the findings of quantum physics led in the 1920s to the belief that all the hard questions had been answered and "the rest was chemistry". Meanwhile, art critics of the pre-World War I period (and many since) regarded the cubists as illuminators of the "essence of Nature", the underlying reality and structure of the material world. It was felt that such artists had revealed a hidden truth by reducing visual phenomena to their basic components of construction, i.e. Cézannian cubes, cylinders and spheres. Of the cubists the contemporary critic Michel Puy wrote in a way typical of the time:

> They are hungry for objective truth . . . they aspire to the essence, to the pure idea . .. Their wish has been to reduce the universe to a conjunction of plane-faceted solids. By reducing the beauty of a landscape or the grace of a woman to precise geometrical bodies, one is led to give more vigorous definition of the planes, to establish the structure better, and to penetrate more deeply into the relationships between form and colour. (in Fry 1964 p. 65)

I would argue that there is a profound link between the discoveries in atomic science, particularly in the fields of relativity, quantum physics, and the cubist art movement. It is not, however, that they all represent a triumph for reductionism. Rather, it was the introduction of *relativism* into western culture through the agency of scientific exploration and artistic innovation that links the two sets of investigations, and which provides their most lasting impact on our thought today.

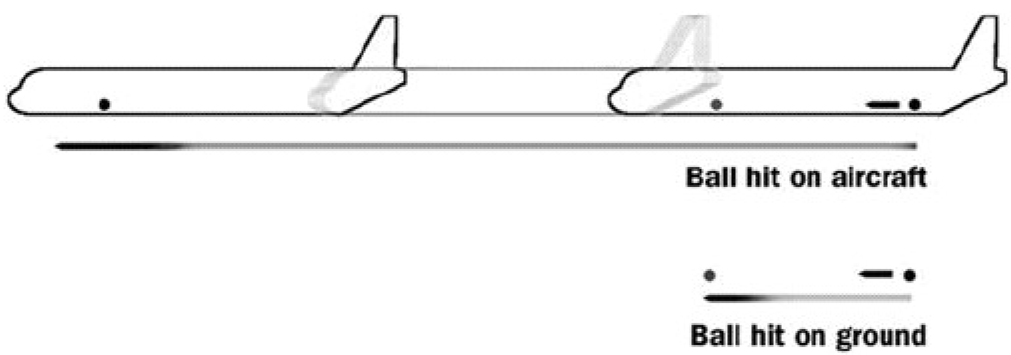
Relativism

The fundamentally relativistic nature of reality was exposed in the theories postulated by Albert Einstein in the early part of the twentieth century. Relativity theory advances the idea that quantities of space and time cannot be measured as absolutes in isolation, but gain their value from their relationship to each other in what has become known as the 'space-time continuum'. This is often exemplified by the idea that a watch hand on a train platform rotates at a relatively different speed to an equivalent watch hand on a train speeding through the station. The distance a watch hand has to travel on a speeding train will seem greater to an observer on the platform than it will to an observer on the train. This can be likened to putting a golf ball on an aeroplane. To the observer on a plane the ball might seem to travel a few metres, but the distance the ball travels as viewed by someone on the ground may be hundreds of metres since the ball also has the momentum supplied by the plane. Relativity theory is full of ideas that run counter to our everyday intuition of reality because its effects are not normally noticed at the human scale:

> . . . whenever one observer is moving with respect to another, whether approaching or separating, it appears to both observers that everything about the other has shrunk in the direction of motion. Neither observer notices any effect in his own system, however.

And .. .

> The mass-increase equation, then, states that when an object is moving with respect to an observer, the mass of the object becomes greater, the amount of increase depending on the relative velocity of object and observer. It is ironic that some corpulent people attempt to decrease their mass with vigorous exercise, often by running. But the Special Theory of relativity says that their mass will increase — the faster they run, the greater their mass becomes! (Coleman 1990 pp. 56-58)



A diagram of the 'relativity effect' in which a ball hit on the ground with the same force as one hit in a plane will seem to travel the same distance as far as each local observer is concerned. However, to the observer on the ground the ball on the plane will travel a much greater distance as it has the velocity of the plane to carry it. It will also have a greater relative mass.

But counter-intuitive as they are, Einstein's theories have been shown to accord with many aspects of cosmic reality and are able to account for many phenomena that could not previously be explained. Our preconceptions about the behaviour of reality were further subverted by quantum theory, which holds that deciding the position and velocity of a particle must remain essentially ambiguous (see below). The lesson from sub-atomic research was that when we reduce the atom to its components we get more ambiguity, not more accurate measurement— we can only be relatively precise. Of course, this subverts the classical assumption of a universe that can be quantified by accurate measurement. What emerges is a new way of thinking about reality that suggests as we try to 'reduce' the universe to its components we are forced to accept greater levels of uncertainty and relativity.

The standard critique on cubist painting emphasises the reduction of complex objects to simple forms. It is often informed by Cézanne's assertion that he wished to depict the underlying essence of nature through the simplification of a subject. The very name 'Cubism' (which was not coined by any of the cubists themselves) suggests the reduction of varied forms to basic blocks. The name can justifiably be applied to the landscape paintings rendered by Picasso at Horta de Ebro and those of Braque at L'Estaque in 1908-9. These owe much to the later landscapes of Cézanne (which had recently been shown at a huge posthumous retrospective in Paris) and the primitivism that was fashionable amongst the Parisian avant-garde around this time. But when we study the later work of Picasso and Braque, particularly that of the period 1910 to 1914, there is very little evidence of box or cube-like structures at all. The still-lifes and portraits are rendered with flat, interconnecting planes suggesting only the possibility of forms and edges. There are curly hints of violin f-holes and tuning keys, oblique references to bottles and glasses, tentative moustaches and fleeting fingers. In fact, what Picasso and Braque produced is more radical than the mere reduction of complex forms to simpler ones. It is even more radical than the idea that one can represent a thing from more than one point of view — another common explanation of cubist work. In fact the cubists were giving pictorial expression to the relativity, ambiguity and uncertainty that was simultaneously emerging in the physical sciences. Stephen Kern, in his study of the period *The Culture of Time and Space*, describes the new conception of material reality thus:

> The general theory of relativity demolished the conventional sense of stability of the entire material universe. . . According to Einstein every bit of matter in the universe generates a gravitational force that accelerates all material bodies in its field and modifies their apparent size. There are thus no absolutely rigid bodies. (Kern 1983 p. 185)

What was so revolutionary about cubism in the period 1910 to 1914 was that it challenged the idea that a picture should represent a finite object or person. Any object in a painting from this period is not *absolutely* there, but *possibly* there. This is a powerful way of expressing the notion that there are no finite objects existing absolutely in space, that there is no absolute measure of matter or time, except perhaps the speed of light which Einstein argued stayed constant regardless of the velocity of an observer. Yet, even this absolute has now been rendered questionable. Recent developments in particle physics suggest that there are events in the universe that cannot be measured against the speed of light. The so-called ‘non-locality’ effect states that a particle can ‘exist’ in more than one place at a time. Causing a change in a particle in one location will cause an equivalent change in its counterpart immediately, regardless of the distance between them. Somehow the effect is transmitted without being subject to the constraints of acceleration (Peat 1990).

The world of seemingly stable reality then, rather than being composed fixed things, becomes a cluster of probabilities that mutate over time and which are dependent on the viewer for their perception. The cubists introduced an ambiguous contingency into pictorial representation that was analogous to the contingency, uncertainty and paradox to be found in advanced physics.

> It is hardly just to look at Cubism mainly as a device to increase our awareness of space. If that was its aim, it should be pronounced a failure. Where it succeeds is in countering the transforming effects of an illusionist reading. It does so by the introduction of contrary clues which will resist all attempts to apply the test of consistency. Try as we may to see the guitar or jug suggested to us as a three-dimensional object and thereby transform it, we will always come across a contradiction somewhere which compels us to start afresh. (Gombrich 1960 pp. 238-40)

The similarity between this reading of a cubist work and the attempt to pin down the exact position of a sub-atomic particle is acute. What we look at, or investigate, is there. It has a recognisable form and structure, yet we cannot precisely state where it is or where it will be; we cannot define its edges or boundaries. Each process of looking will be different; each process of looking will be probabilistic.

Posthuman trends

The huge and interconnected implications of the pre-World War I investigations into atomic structure and pictorial representation are only now, I believe, being fully realised in the minds of artists, scientists, philosophers, and other thinkers. Contemporary interpretations of both quantum theory and cubist images were hampered by an enthusiasm for reductionism that clung to the idea that they were part of some search for the essential truth about reality. This reductionism was part of the larger paradigm of humanism — a way of looking at the world that I have argued is now in decline.

From our position at the beginning of the twenty-first century we can see that these pre-war ideas were to lay the foundations for the demise of humanism and the shift into posthumanism; the shift from a universe of certainty and predictability to a universe of uncertainty and unpredictability. And with this we start to realise our capacity to order and control the universe is ultimately limited. Randomness, ambiguity and relativity remain as integral to the cosmic process as their opposites; none of them can be eliminated from our attempts at analysis or ignored when theorising about the operation of natural events.

If we wished to model human creativity, as physicists model sub-atomic reality, should we consider building a system that is totally coherent and predictable — one that conforms to known rules and logical procedures? Or should we allow the system a certain autonomy and a capacity to be influenced by the uncertainty of apparently unconnected events? Which would be the richer, the more ‘realistic’?

Uncertainty

There is a principle of quantum mechanics that illustrates the divergence between an understanding of the universe that is certain and one where the universe is inherently uncertain. Heisenberg's uncertainty principle states that it is impossible to measure the location and velocity of a sub-atomic particle (an electron) at the same time. The principle is very simple. If we wish to measure the position or speed of an electron we must bombard it with some energy source, usually light particles, so that it can be seen. Wherever the electron we wish to measure is located will be the point at which some of our light particles will be bounced back. Thus we have the location. But the light particles themselves will disturb the path of the electron under investigation, thus altering its velocity. We can imagine this as a kind of 'radar' beam sent out to track aircraft. Yet the aircraft in our model is so small that the 'radar' waves move the aircraft around thus giving our measurement an inherent level of uncertainty. This gives rise to the probabilistic nature of quantum measurement. If we cannot know the speed and direction of travel of an electron at the same time, then we cannot predict where it will travel next. We can say that given a certain position and an uncertain velocity it will probably move to one of several locations, but we cannot determine exactly which one.

To many physicists in the 1920s this principle ran counter to the intuitive operation of the universe presupposed by classical mechanics. In classical mechanics, it was assumed that we could determine the future position of any particle, be it electron or golf ball, by calculating the path it would take given a certain position and velocity. This is essentially the Laplacian view we discussed earlier, which led to the notion that it would be possible in theory to predict the whole future of the universe from the state of all particles at any one time. One might speculate that subsequent humanist optimism about our capacity to manage nature and eradicate uncertainty was linked to this mistaken assumption.

The age of uncertainty and posthuman machines

Uncertainty is becoming familiar. There is uncertainty about life-long employment due in part to the automation of many jobs, about political and economic theories, about the implications of advances in medical science. There is uncertainty about what is happening to the environment, about whether scientific progress is always beneficial and about where technology is leading us. But hasn't uncertainty always been with us? Even if it has, until recently we have always had the hope of a resolution; that either God would help if we pleased the church, or science would help by making everything work in our favour. Now we are somewhat like children who have lost their parents: there is nothing and no one to turn to for comfort and security. Soon we may even be spared the certainty of death (though not taxes).

In posthuman terms uncertainty is nothing to fear. In fact, although existence has always been uncertain, it is now much harder to impose a false sense of certainty, and we are more aware that certainty, like belief, only arises in the absence of full information. While the tendency of humanist science has been to avoid uncertainty, it is now obvious that no life-like system can be created without a fundamental level of uncertainty in its structure, thus limiting our capacity for control. Computers and computer software that act in predictable ways are mere slavish machines. Something remarkable happens when the output of a complex machine becomes a possibility and not a certainty.

Other eminent posthumans

I do not claim any originality for the use of the term 'posthuman'. The concept of a future state of humanity in which biology is merged with technology has tentacles going back at least to the 1940s with the cybernetic movement inspired by Norbert Wiener (Wiener 1989) and perhaps even deeper roots in the early twentieth century with Capek's *R.U.R.*. The idea has been variously named as the 'Post- biological', the 'Transhuman' and the 'Post-Darwinian' stage of human development. In her book *How We Became Posthuman*, N. Katherine Hayles cites a number of authors who have used the term 'posthuman' from the mid-1990s on, including Allucquére Roseanne Stone, Judith Halberstam and Ira Livingston, Scott Bukatman and Anne Balsamo (Hayles 1999 p. 293 n. 5). Here she also reminds us that the anti-humanist theoretician Michel Foucault "famously suggested that 'man' is a historical construction whose era is about to end in *The Order of Things*" (see Foucault 1973) in which he invoked the image of humanity "erased, like a face drawn in sand at the edge of the sea." In the worlds of art and science fiction too the notion of the posthuman has been influential. A significant European exhibition was organised in 1992 by Jeffery Deitch entitled *Post Human* featuring the work of artists such as Jeff Koons, Paul McCarthy, Cindy Sherman, Damien Hirst and Charles Ray. The catalogue made much of the alteration in human self- image augured by technology, plastic surgery and the electronic media:

> This book explores the implications of genetic engineering, plastic surgery, mind expansion, and other forms of body alteration, to ask whether our society is developing a new model of the human being. It poses the question of whether our society is creating a new kind of post-human person that replaces previous constructions of the self. Images from the new technological and consumer culture and the new, conceptually oriented figurative art of thirty-six young artists will give us a glimpse of the coming post-human world. (Deitch 1992 sleeve-notes)

The notion of the posthuman has been enthusiastically supported by those who call themselves Extropians and whose ideas are carried in the philosophical journal *Extropy* and at the Extropy Institute Web site 'www.extropy.org'. The Extropian view can be summarised as an optimistic belief in the power of technology to transform, for the better, that which we now know as human existence. Extropy is the opposite of entropy, the pessimistic principle that all of the universe is decaying into chaos. Extropians seek to affirm, in a Nietzschean way, the self-organising qualities of life, that order which emerges out of chaos. They imagine the indefinite extension of human life, deep space exploration and the alteration of human neurobiology by chemical and genetic means to overcome our limitations. One of the founders of Extropianism is Max More, and it is worth quoting a passage from the site in which he describes Transhumanism and Posthumanism.

> Q: What do "transhuman" and "posthuman" mean?
>
> A: TRANSHUMAN: We are transhuman to the extent that we seek to become posthuman and take action to prepare for a posthuman future. This involves learning about and making use of new technologies that can increase our capacities and life expectancy, questioning common assumptions, and transforming ourselves ready for the future, rising above outmoded human beliefs and behaviours.
>
> TRANSHUMANISM: Philosophies of life (such as the Extropian philosophy) that seek the continuation and acceleration of the evolution of intelligent life beyond its currently human form and limits by means of science and technology, guided by life-promoting principles and values, while avoiding religion and dogma.
>
> POSTHUMAN: Posthumans will be persons of unprecedented physical, intellectual, and psychological ability, self-programming and self-defining, potentially immortal, unlimited individuals. Posthumans have overcome the biological, neurological, and psychological constraints evolved into humans. Extropians believe the best strategy

> for attaining posthumanity is a combination of technology and determination, rather than looking for it through psychic contacts, or extraterrestrial or divine gift.
>
> Posthumans may be partly or mostly biological in form, but will likely be partly or wholly postbiological — our personalities having been transferred "into" more durable, modifiable, and faster, and more powerful bodies and thinking hardware. Some of the technologies that we currently expect to play a role in allowing us to become posthuman include genetic engineering, neural-computer integration, molecular nanotechnology, and cognitive science. (Max More www.extropy.org)

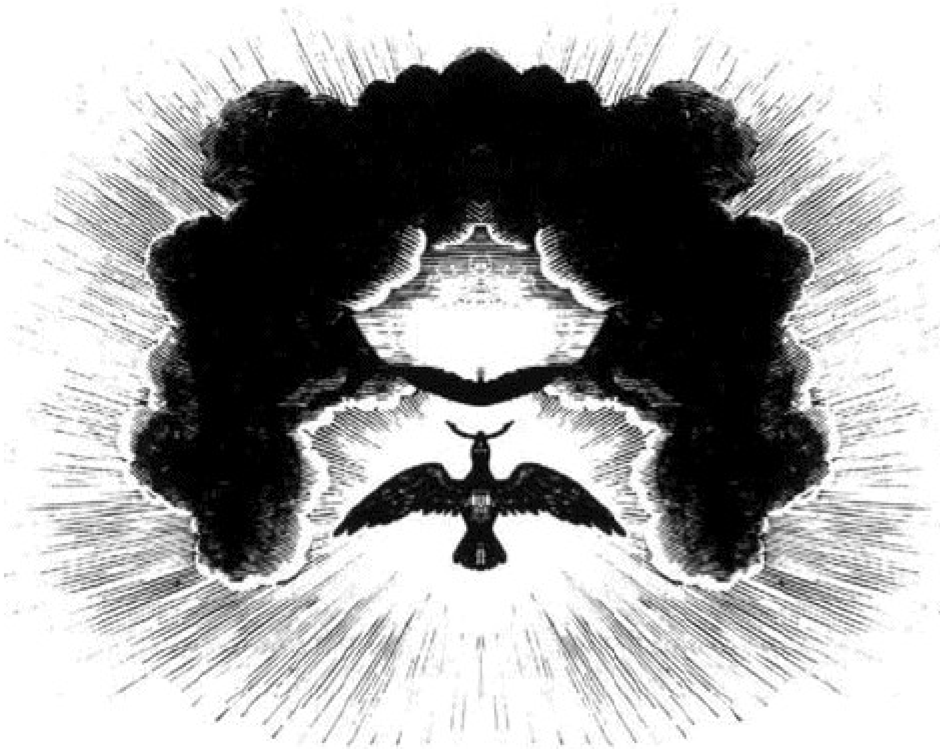
There are certain positions adopted by the Extropians that I would not necessarily agree with, which are not significant enough to unravel , except to point out that the posthuman condition, as outlined here, is somewhat more cautious and less Utopian about the possible consequences of current technological developments.

The posthuman condition

What is meant by the 'posthuman condition'? First, it is not about the 'End of Man' but about the end of a 'man-centred' universe or, put less phallocentrically, a 'human-centred' universe. In other words, it is about the end of 'humanism', that long-held belief in the infallibility of human power and the arrogant belief in our superiority and uniqueness. This 'end' will not happen abruptly. Belief in the ideals of humanism have existed at least since the fourteenth century and will continue to exist well into the future. Second, it is about the evolution of life, a process not limited to genetics, but which includes all the paraphernalia of cultural and technological existence. If life can run more efficiently and become 'fitter' in collaboration with mechanical systems then it will do so. By the same token, if humans are able to exist more effectively by acquiring further machine-like enhancements then they will do so. This does not necessarily mean the extinction of the human genome. Even if distinct mechanical life-forms emerge there is no reason to suppose that they should replace other forms of life which may carry on indefinitely. Earth still abounds with species that predate humans; evolution does not necessarily discard old species when it generates new ones. Third, posthumanism is about how we live, how we conduct our exploitation of the environment, animals and each other. It is about what things we investigate, what questions we ask and what assumptions underlie them. The most obvious manifestations of the end of humanism are those movements that resist the worst aspects of humanist behaviour: feminism — the movement against the exploitation of women, animal rights — the movement against human exploitation of animals, environmentalism — the movement against human exploitation of the earth's resources, and anti-slavery — the movement against human exploitation of other humans. The very existence of such movements over the last 200 years or so suggests the gradual overturning of a human-centred world is well underway. More importantly, the recognition that none of us are actually distinct from each other, or the world, will profoundly affect the way we treat each other, different species and the environment. To harm anything is to harm oneself.

This is why posthumanism is not just about the future, it is also as much about the present. To some extent we live for the future; it promises better things. But this can lead us to forget that the future, and whatever benefits it may bring, is not something that just happens to us — we create it by our conduct in the present. We all have an influence now on the way the future will turn out. One reason for writing this book is that many people remain unaware of the huge implications of the technologies that are now being developed, and few of us are invited to take an active part in those decisions that will profoundly affect the course of human development: who is in charge of the future?

The awkward question posed by the changes we have labelled posthumanism, is not 'Will we develop machines that are equal or superior to humans?' We have already described how this will probably happen. The difficult question is,'Why do we want to develop such machines and to what ends will they be put?'



APPENDIX I

Let's propose a thought experiment of the kind often favoured by philosophers in the field of consciousness studies:

Sometime in the future I purchase an ICM 200, a commercial consciousness system from *International Consciousness Machines*. It takes the form of a sealed black box that I can put on my desktop but is delivered with no other devices or instructions. However, the manufacturer assures me that the device is guaranteed to be "100% conscious".

Question. What can I do with it? How do I know it's not a dud?
Answer. I can't do much with it. I can't even tell whether or not it's a dud.

Having complained to the manufacturer, I am sent two further devices; an input console that plugs into an appropriately marked jack socket concealed behind a panel and an output console that plugs into a neighbouring socket. These enable me to communicate with the ICM 200.

Question. Are these devices part of the machine? Are they intrinsic to the functioning of the machine?
Answer. Insofar as the machine is virtually useless without them (except as a doorstop) — the answer must be yes in both cases.

In order to test whether the ICM 200 is conscious I interrogate it with a question X to which I expect an answer Y. The content of X is known to me (because I conceived the question) whereas the content of Y is not (which is why I ask the question).

Question. What is the current location of the content of X and Y?
Answer. The content of X is obviously located in my mind since that's where I conceive the question. I hope the content of Y lies in the ICM 200 in some form, although until the interrogation begins I can't tell.

Using the input console I pose the question X to the ICM 200. I shortly receive a response, Y, through the output console.
Question. What is the current location of the content of X and Y?

Answer. The content of X has been translated into the ICM 200 via the input console. Therefore, in some form X exists both in my mind and in the ICM 200. The response Y was translated from the ICM 200 into my mind via the output console and, therefore, also exists in some form in the ICM 200 and in my mind. This would be true until such time as either it or I erased X or Y from our 'minds'.

A couple of interesting points emerge from this thought experiment. First, we have shown that my mind and that of the ICM 200 system are now continuous insofar as they both share the properties X and Y. Second, we have shown that having a conscious system is (virtually) useless without any means of communicating with it. The implications of these points can be taken as either trivial or significant depending on your point of view. The *trivial* interpretation might be something like this:

> Fine, so the ICM 200 needs to communicate in order to show others that it's conscious. But inside its own world, sustained by an internal life-support system, it is happily self-aware and can generate all the sensations, experiences and thoughts it wants from its own data banks. Of course, inputs and outputs might help to expand its sense of consciousness and make it a more useful system to others, but they are essentially appendices that are ultimately expendable and peripheral to the main show, which is the internal streaming of conscious states. The fact that the system's mind may or may not be linked to another mind is not a condition of its being conscious. After all, we humans experience a personal consciousness that isn't observable from the outside. Yet no-one says this means other people can't be conscious.

Such an interpretation would probably be shared by those who see the brain as exclusively responsible for generating our consciousness. A comparison is sometimes made between self-sufficient brains and patients with serious neurological disorders in which bodily paralysis is so severe that almost no sensory input or communicative output is possible. Yet those patients who recover from such conditions report that their conscious activity was largely unaffected by their condition. Surely it follows that providing the brain can be sustained with energy, consciousness can continue even in the absence of bodily or environmental effects? Therefore, the experiment just described reinforces the case for brain-determinism. Alternatively, the *significant* interpretation might be:

> The system cannot be conscious of nothing. As many philosophers have said “To be conscious is to be conscious *of* something”. If the concept of consciousness has any shared meaning (and it must have some to be of value) then this proposition must hold. Whether the ICM 200 is contemplating the content of my question X or consulting its own memory for an answer Y, that content must come from somewhere. It was either introduced to the system by me through an input device or pre-loaded during the system’s construction. In either case those contents have, or had, some existence that is, or was, external to the black box. The importance of clarifying the location of X and Y was to show that mental data may exist in more that one place, or one thing, at the same time. To the extent that X and Y exist in both my conscious mind and the ICM 200, these two minds are continuous. It should also be stated that without any appropriate input or output devices it will remain unresolved as to whether the system is conscious since there would be no way of knowing or testing. As far as we know it could be an empty black box. Even x-raying or scanning the insides of the box to see if the “consciousness circuits” are working is only appealing to a different kind of output device.

The significance of this interpretation, then, is this: any system that claims to be conscious (or any system about which such claims are made) cannot be entirely closed, and this acts as a constraint on the conditions necessary for such a system to exist. Even if it has no apparent physical connection with anything outside itself it must have been provided with some object other than its own sentience for it to be conscious of. Whether this provision is made at the construction stage or during the operation of the system is less important. To return to the unfortunate neurological condition previously mentioned, those patients who still experience conscious processes, in spite of a lack of stimuli or communication, are effectively ‘trading-off ’ the store of experience built up over their lifetime prior to the onset of the condition. I have never heard anyone claim that useful consciousness can develop in a person who lacks any motor-sensory functions from gestation.

Moreover, as the actual contents of the conscious system (which must count as part of it) can exist simultaneously in remote physical locations, so the consciousness can, in effect, exist in remote physical locations. One might deduce the conscious mind, at least as far as its contents are concerned, can be distributed.

Purpose

A tenacious brain-determinist could argue that, despite all the above, the system might be "conscious only of its own consciousness"; that it might have no need of any 'external' data or experience to serve as the object of its thoughts other than its own sentience. But this would be as awkward a position to hold as saying a light bulb can light itself or a chair can sit itself. Even if we granted a tenacious reductionist the possibility of an imaginary system that might be content to observe only its own consciousness, i.e. without any reference to anything other than itself, the significant interpretation implies a further constraint on what consciousness might be. Whether evolved by natural selection, or designed by human skill, a conscious system will have a purpose or function, just as the function of a light bulb is to turn electrical current into light. Setting aside those stories relished by student doctors who've done a stint on the casualty wards, light bulbs have little other purpose. When their filaments have burnt out they are normally discarded. It is unlikely that anyone would bother to invent or manufacture a light bulb that gave off no light, and it is equally unlikely that anyone would bother to design a conscious system that had no inputs, outputs or acquired data. Nor is it likely any consciousness would evolve in a self-contained environment, since the most basic function of consciousness, as far as we can tell, is to alert an organism to events in its surroundings. Even though this might seem like a mundanely common-sense point for a quasi-philosophical discussion, it cannot be ignored since it has the force of simple reason.

Conclusion

Of course, it is difficult to conclude a thought experiment in the absence of any real data. But I hope this discussion has illustrated that in the debate about the location of consciousness, which is a very active one, the notion of a self-contained, or closed, conscious system seems less in accordance with reason than its opposite.

APPENDIX II

THE POSTHUMAN MANIFESTO

TO UNDERSTAND HOW THE WORLD IS CHANGING IS TO CHANGE THE WORLD

I *General statements*

1. It is now clear that humans are no longer the most important things in the universe. This is something the humanists have yet to accept.
2. All technological progress of human society is geared towards the transformation of the human species as we currently know it.
3. In the posthuman era many beliefs become redundant — not least the belief in human beings.
4. Human beings, like gods, only exist inasmuch as we believe them to exist.
5. The future never arrives.
6. All humans are not born equal, but it is too dangerous not to pretend that they are.
7. In the posthuman era, machines will no longer be machines.
8. It is a deficiency of humans that they require others to tell them what they already know. It is only then they will believe it.
9. Posthumanists do not fall into the trap of imagining a society where everything works well. Economic and political theories are as futile as long-range weather predictions.
10. Surf or die. You can't control a wave, but you can ride it.
11. We now realise that human knowledge, creativity and intelligence are ultimately limited.
12. Complex machines are an emerging form of life.
13. A complex machine is a machine whose workings we do not fully understand or control.
14. As computers develop to be more like humans, so humans develop to like computers more.
15. If we can think of machines then machines can think; if we can think of machines that think, then machines can think of us.

II *Statements on consciousness, humans and philosophy*

If consciousness is a property that emerges from a specific set of conditions, in order to synthesise it we do not need to re-model it from the 'top-down'. We only need to recreate the conditions from which it might emerge. This requires an understanding of what those conditions are.

1. Consciousness is not exclusively restricted to the brain.
2. Consciousness is the function of an organism, not an organ.
3. One does not understand consciousness by studying the brain alone.
4. The mind and the body act together to produce consciousness. If one is absent consciousness ceases. There is no pure thought isolated from a body. In order to function the brain must be connected to a body, even if the body is artificial. Consciousness is an effect that arises through the co-operation of a brain and body; we think with our whole body.
5. Consciousness can only be considered as an emergent property. In this sense it is like boiling: given sufficient heat, gravity and air pressure the water in a kettle will start to boil. We can see what boiling is, we can recognise it as something to which we give a name, we do not consider it mysterious, yet we cannot isolate it from the conditions which produced it. Likewise, consciousness is a property that emerges from a given set of conditions.
6. To say that conscious thought is not exclusively a function of the brain does not deny that the brain has a significant part to play.
7. Human bodies have no boundaries.
8. No finite division can be drawn between the environment, the body and the brain. The human is identifiable, but not definable.
9. Consciousness (mind) and the environment (reality) cannot be separated; they are continuous.
10. There is nothing external to a human, because the extent of a human cannot be fixed.
11. If we accept that the mind and body cannot be absolutely separated, and that the body and the environment cannot be absolutely separated, then we are left with the apparently absurd yet logically consistent conclusion that consciousness and the environment cannot be absolutely separated.
12. First we had God, humans and nature. The rationalists dispensed with God, leaving humans in perpetual conflict with nature. The posthumanists

dispense with humans leaving only nature. The distinctions between God, nature and humanity does not represent any eternal truth about the human condition. It merely reflects the prejudices of the societies that maintained the distinctions.

13. Idealistic and materialistic philosophical views both assume a division between the thing that thinks and the thing that is thought about — between the internal mind (brain) and external reality (environment). Remove this division and both views become redundant.

14. The idealists think that the only things that exist are ideas; the materialists think that the only thing that exists is matter. It must be remembered that ideas are not independent of matter and that matter is just an idea.

15. Most philosophical problems are debates about language. They arise because of the mistaken assumptions *a*. that language is consistent and *b*. that because a word exists there must exist a 'thing' that it represents and *c*. that the things that are represented should, in themselves, be consistent.

16. Logic is an illusion of human imagination. Truth and falsity do not exist in nature — other than in human thought.

III *Statements on science, nature and the universe*

1. Science will never achieve its aim of comprehending the ultimate nature of reality. It is a futile quest, although many scientists do not acknowledge this yet. The universe(s) will always be more complex than we will ever understand.

2. The posthuman abandons the search for the ultimate nature of the universe and its origin (thus saving a lot of money in the process).

3. The posthuman realises that the ultimate questions about existence and being do not require answers. The answer to the question 'Why are we here?' is that there is no answer.

4. To know the ultimate nature of the universe would require knowing everything about the universe, everything that has happened and everything that will happen. If one thing were not known it would imply that all knowledge of the universe is partial, potentially incomplete and, therefore, not ultimate.

5. No scientific model can ever be complete, but will always be partial and contingent. For any model to be complete it would have to take all

influential factors into account, no matter how insignificant. Since this is impossible the scientist must make an arbitrary decision about which ones to ignore. Having ignored some factors their model is incomplete, although this does not mean it isn't useful.

6. The posthuman accepts that humans have a finite capacity to understand and control nature.

7. All origins are ends and all ends are origins. Chaos theory has often been illustrated with the image of a butterfly's wing-flap causing a thunderstorm on the opposite side of the globe. Whilst this might illustrate the sensitivity of systems to initial states, it does not take into account what caused the butterfly to flap its wings —a gust of wind?

8. Logic that seems consistent at the human scale cannot necessarily be applied to the microcosmic or the macrocosmic scale.

9. Our knowledge about the universe is constrained by the level of resolution with which we are able to view it. Knowledge is contingent on data — data varies with resolution.

10. Scientists give privilege to order over disorder on the assumption that they are gradually discovering the essential laws of nature. This is a fundamental error; nature is neither essentially ordered or disordered. What we perceive as regular, patterned information we classify as order; what we perceive as irregular, unpatterned information we classify as disorder. The appearance of order and disorder implies more about the way in which we process information than the intrinsic presence of order or disorder in nature.

11. Science works on the basis of an intrinsic universal order. It assumes that all phenomena are subject to physical laws and that some of those laws are well understood, some partially understood, and some unknown. The posthuman accepts that laws are not things that are intrinsic to nature, nor are they things which arise purely in the mind and are imposed on nature. This would reinforce the division between the mind and reality which we have already abandoned. The order that we commonly perceive around us, as well as the disorder, is not a function exclusively of either the universe or our consciousness, but a combination of both, since they cannot really be separated.

12. Everything that exists anywhere is energy. Beside the fact that all material processes are energetically driven, energy has two major properties:

a. It manifests in an infinite variety of ways

b. It perpetually transforms

13. The appearance of matter is an illusion generated by interactions among energetic systems at the human level of resolution.

14. Humans and the environment are different expressions of energy; the only difference between them is the form that energy takes.

15. The posthuman is entirely open to ideas of ‘paranormality’, ‘immateriality’, the ‘supernatural’, and the ‘occult’. The posthuman does not accept that faith in scientific methods is superior to faith in other belief systems.

IV *Statements on (dis)order and (dis)continuity*

1. Order and disorder are relative, not absolute, qualities. The proof that order and disorder are relative qualities lies in the fact that they define each other.

2. Anything we perceive can be considered to contain different degrees of order and disorder. The perception of order and disorder in something is contingent on the level of resolution from which it is viewed.

3. What we perceive as ordered and disordered is often culturally determined. Logicians will assert that there are mathematical ways of defining disorder, entropy and complexity — ways that are independent of human subjectivity. Whilst these definitions may be useful in certain applications they remain open to relativistic interpretation.

4. In posthuman terms, the apparent distinctions between ‘things’ are not the result of innate divisions within the structure of the universe, but rather are jointly a product of:

a. the way in which the sensual processes in living entities operate.

b. the variety of ways in which energy is manifested in the universe.

5. The ways in which energy manifestations are perceived by an observer can always be described with two simple qualities — continuity and discontinuity. Continuity is non-interruption of space-time. Discontinuity is a rupture in space- time. Both qualities can be discerned in all events depending upon how they are viewed. More importantly, they are both experienced simultaneously.

6. Energy manifestations should not be thought of as intrinsically continuous or discontinuous; that is, there are no absolute qualities of energy. Energetic states will appear as either continuous or discontinuous to an observer depending upon their viewing position. The quality of (dis)continuity is context sensitive.
7. What distinguishes things from one another is the perceived discontinuities they display. The difference in manifestations of energy between a philosopher and a chair allows them each to be distinguished.
8. The level of complexity in a system cannot be defined in objective (that is, absolute) terms. Complexity is a function of human cognition, not an intrinsic property of anything we might look at.

V *Statements on thought, meaning and being*

As long as models about how the brain might work are defective (being based on fallacious assumptions), the creation of a synthetic consciousness will be impractical.

1. Human thought is something that occurs in co-operation with the human body. It is not necessary to identify precisely where it occurs because it does not occur precisely in any 'part'.
2. It is tempting to think of thoughts as blocks of data in the brain. This would be a mistake since it reinforces a static view of mental activity. A thought is a path through the cognitive medium. Think of it like this: taking the London Underground map as an analogy of how the mind works, some people would say, 'Each of the stations on the map represents one of our thoughts and the lines represent the links between them. The lines are what enable us to get from thought to thought.' The posthuman argues 'A thought is not a station on the map but the route from one station to another.' That is, a thought is actuated in the process of travelling, rather than being a particular destination.
3. Given that a thought is activated, for whatever reason, it consists in a process of travelling through the cognitive medium that supports the mind. A thought does not exist unless it is being thought, otherwise it remains a field of potentiality, or attractor. The most likely journey that a thought may take once it has been activated defines its path. Similar thoughts will take similar paths.

4. Paths can be created in a number of ways, including direct experience, learning, prior cognition, and the act of thinking itself. In neurophysiological terms, the paths include the connections between neurons and the probability of their firing, but are not restricted to these. Moreover, the neural fabric is not a static substance. It is continually changing in response to stimulation and activation and just as prone to adaptation just as the skin or muscles are.

5. The path that a thought takes is not uni-linear in the way that we normally think of paths. A thought may take many different routes simultaneously. The occurrence of one particular thought may require that we bring together many different thoughts in combination.

6. The fact that different thoughts may lie in different paths, each of which are distinct insofar as each thought is distinct, shows us how we can imagine things we have never seen. We are unlikely to have seen a "girl with kaleidoscope eyes" but we can imagine what she looks like by making a composite image of the components, i.e. travelling through several distinct thought paths at once.

7. The activity of thinking is regulated by the conduct of energy in the cognitive medium. This medium is no different from any other system in that it represents a particular process of energy transformations. Where two thoughts are continuous (for example, 'blue' and 'sky' in the sentence 'The sky is blue'), the pathway between each of these thoughts is well established, and it will require little energy to pass from one to the other. Where two thoughts are not well connected (for example, between 'myrrh and 'capstan' in the phrase 'The myrrh-capstan') more energy is required to fuse the thoughts since they have less well-established connections.

8. Ideas that can proceed from one to another with relatively little effort (energy) can be considered continuous. Ideas that require great effort to travel between can be considered discontinuous.

9. The presence or absence of 'meaning' is determined by the amount of energy required to pass from one concept to another. Difficult meaning arises from the co-existence of concepts that are semantically distant, that is, when there is not a well-established connection between them. However, the path between concepts that have little or no connection may be too difficult to travel. For example in the phrase 'Echoes the wasp's virile down-

plate', whilst not meaningless, is certainly awkward to assemble by the standard of most phrases.

10. In order to maintain a sense of being the human tries to establish continuity in response to the stimuli it receives from the environment. Such stimuli are both stable and unstable since the environment displays different amounts of each. The development of stable thought paths which correspond to stable stimuli generates a sense of order. Over time such stability develops into a sense of being.

11. Were the sense of order not perpetually threatened by the recurrence of random stimuli there would be no compulsion to re-assert order. As it is, since humans are continually faced with random stimuli, it is necessary to keep reasserting order (maintaining meaning) so that we do not dissolve into chaos, thereby losing our sense of being.

12. In posthuman terms, it is unimportant through what mechanism this process of being occurs. The same effect can be achieved in a number of different ways. It is true that we can learn from the human what is necessary for being, but this does not mean that it is the only way it can be implemented.

VI *Statements on uncertainty*

1. The humanist era was characterised by certainty about the operation of the universe and the place of humans within it. The posthuman era is characterised by uncertainty about the operation of the universe and about what it is to be human.

2. Questions arise in the posthuman era that would have not troubled us in the humanist era — What is a human? Is there such a thing?

3. Historically, we could say the posthuman era, the age of uncertainty, was born in the period leading up to World War I since this was the time we were introduced to quantum physics and cubism. The consequences of both made one thing clear: in the words of Heisenberg, 'There are no things, just probabilities.'

4. Uncertainty is becoming familiar. There is uncertainty about life time employment, about political and economic theory, about what is happening to the environment, about whether scientific progress is always beneficial and about where technology is leading us.

5. What can we say is certain? Only that which we have to accept as certain for some other reason.
6. In posthuman terms uncertainty is nothing to fear. The world has always been as uncertain as it is now. What has changed is that it is now much harder to impose authority since increased information flow diminishes authority: there is more information, therefore, there is less false sense of certainty. Certainty, like belief, only arises in the absence of full information.
7. Uncertainty is certain.

VII *Statements on art and creativity*

The production and appreciation of art is a particularly human faculty. It is often cited by humanists as the highest expression of human thought and the thing that most distinguishes us from machines. It would, therefore, be fair to admit that the posthuman era cannot begin in full until we have met this challenge from the humanists. In order to develop a machine that can produce and appreciate art we must first have a clearer understanding of what it is.

1. What is art? One useful definition is that it describes any commodity of the art market. We must distinguish between an art object and an aesthetically stimulating object. An art object is a commodity that is traded on the art market. An aesthetic object is one that is appreciated for its aesthetic quality. Something may be both an art object and an aesthetic object, such as Van Gogh's 'Irises'. Something may be an aesthetic object without being art, like a sunset or an iris.
2. Many people think that much modern art is not art because they consider it to lack aesthetic value, even though it commands high prices on the art market. They are simply confusing the art value and the aesthetic value of an object. These two values are quite separate, but of course linked. 'Art is a commodity like any other,' said Daniel Kahnweiler, Picasso's dealer. Art is an aesthetic commodity.
3. In order to be clear, the art market can be defined as an identifiable set of institutions and commercial organisations which collectively fund, promote and sell art.
4. Art must be (and always has been) élitist and exclusive in order to maintain its financial value and prestige. Many modern artists use aesthetic

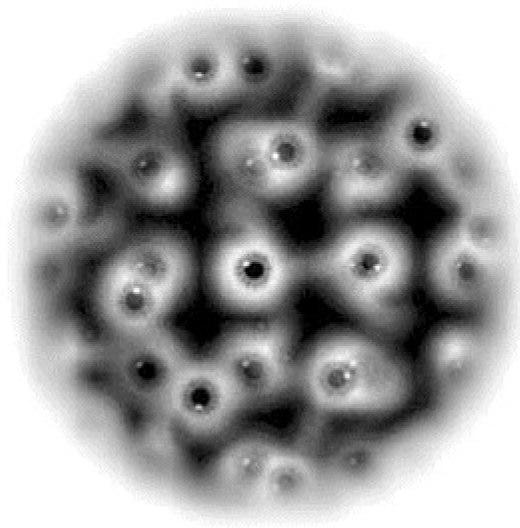
élitism to guarantee exclusivity which, in turn, ensures values are upheld. Hence, art functions to distinguish rich people from poorer people.
5. Good art is aesthetically stimulating, bad art is aesthetically neutral.
6. The criteria that determine whether something is aesthetically stimulating or aesthetically neutral are partly subject to social change.
7. Good art always contains an element of disorder (discontinuity), bad art simply reinforces a pre-existing order.
8. Good art promotes discontinuity, bad art enforces continuity.
9. Discontinuity produces aesthetically stimulating experiences, continuity produces aesthetically neutral experiences.
10. Discontinuity is the basis of all creation, but discontinuity is meaningless without continuity.
11. Rich aesthetic experience is generated by the perception, simultaneously, of continuity and discontinuity in the same event.
12. All stimulating design relies on balancing the relative quotients of order and disorder in the object. This also goes for the composition of music and literature. However, such judgements cannot be made in isolation from the fact that values of order and disorder are largely prescribed by social agreement.
13. Posthuman art uses technology to promote discontinuity. Healthy societies tolerate the promotion of discontinuity since they understand that humans need exposure to it, in spite of themselves. Unhealthy societies discourage the promotion of discontinuity.
14. Creativity does not consist in the production of anything that is completely new. Creativity consists in combining things that already exist, but which had previously been held as separate. Creativity and aesthetic appreciation are both functions of the human ability to modify the connections in their thought paths, or to have them modified.
15. The process of aesthetic stimulation is heightened when concepts are forced together from relatively diverse locations in a discontinuous way. The amount of energy required to contemplate diverse concepts produces the physical rush of excitement familiar to those who appreciate art.

VIII *Statements on synthetic beings*

We already have machines that can learn. However, their abilities are currently limited by the fact that they are logical. Logic is an idealised, self-referential system developed by human imagination. Since there are few things less logical in behaviour than humans, any machine that is restricted to using logic as its base will never display human characteristics.

1. Currently the output of computers is predictable. The posthuman era begins in full when the output of computers is unpredictable.
2. Most artificial intelligence machines are hermetically sealed. They are limited by the complexity of the calculations our machines can perform. They are only sensitive to a finite number of stimuli, and the quotient of randomness intruding upon them is relatively small.
3. Human thought is not a hermetic, linear system. Since we know that the mind, body and environment cannot be separated, we cannot rule out the impact of any environmental stimuli on the process of thought, no matter how minute it might seem.
4. What is essential to the functioning of human consciousness is that the mind receives a continuous input of random stimuli from the environment. The human mind has evolved to absorb the unexpected — the discontinuous stimulus.
5. The compulsion to assert order in the face of random stimuli contributes to our sense of being. Therefore, it is obvious that if we are to create any synthetic intelligence that has a sense of being like that we recognise in ourselves it must be sensitive to the same level of random interruption that humans are. It must have a compulsion to re-assert meaning in the face of both stable and unstable input, whilst also being able to adapt to and take advantage of the creative possibilities offered by non-linear stimuli.
6. If we wish to produce a synthetic intelligence that displays creativity then we need it to be able to establish connections between its thoughts in a discontinuous way. This will be achieved by making it perpetually sensitive to random stimuli.
7. If we wish to produce a synthetic intelligence that displays aesthetic appreciation then it should be able to sense continuity and discontinuity simultaneously — without crashing. Whilst this would cause excitement in the machine it is yet to be determined to what extent it would be pleasurable.
8. Humanists saw themselves as distinct beings in an antagonistic relationship with their surroundings. Posthumans, on the other hand, regard

their own being as embodied in an extended technological world.



POSTSCRIPT

One of the difficulties in revising a book as thoroughly as I have revised this one is resisting the temptation to scrap everything and start again. Inevitably one's ideas develop over the years, and this can make former opinions seem naïve, or occasionally just wrong. I have been encouraged to find that working through the ideas presented in the original *Post-Human Condition* a decade or so after the first drafts, there is not much in terms of the basic thesis that I found necessary to revise. Of course there were many technical and formal deficiencies, which I hope have largely been eradicated here. But as I said in the preface to this edition, much of what was written then seems as relevant now as it did in the early nineties.

At the same time, however, I have sought to bring this version up to date by incorporating, where possible, more recent aspects of my thinking which extend from the ideas published in the first edition. In particular, I have stressed in various places what I have come to call an 'extensionist' view of human existence and natural phenomena. I now see that this view was implicit in much that I originally wrote, but has since been made more explicit in this edition.

In brief, rather than regarding identifiable objects in the world as coherent and discrete, extensionism holds that all objects and events extend indefinitely through time and space. However, we normally acknowledge only a fractional part of the real extent of any object because of constraints inherent in our perceptual apparatus and the coercive effects of time. Furthermore, extensionism recognises the co- presence of opposites (such as a world that is both full of distinctions and devoid of distinctions, or an object that is more than one thing at the same time) without negating or resolving them, and in this sense does not admit the Aristotelian law of non-contradiction as set out in the *Metaphysics*.

The alert reader may recognise that much of what has been presented here would accord, in spirit at least, with the extensionist ideas briefly outlined above, particularly in respect of understanding conscious experience and the way we perceive the world. To this extent, the new version of *The Posthuman Condition* forms part of a larger project aimed at exploring the practical and philosophical ramifications of this extensionist view. I hope that at some point in the course of this project the reader and I will meet again.

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