The Brain is Wider than the Sky

Why Simple Solutions Don't work in a complex world

Bryan Appleyard

Cover design by David Hockney

Copyrighted material

The Brain is Wider than the Sky

Why Simple Solutions Don't work in a complex world

BRYAN APPLEYARD

Weidenfeld & Nicolson
LONDON

Copyrighted material

CONTENTS

Copyrighted material

INTRODUCTION

This is a book about, in roughly this order, neuroscience, machines and art. It began when, in August 1994, I visited Microsoft in Seattle and spent a couple of hours with the company's co-founder and then chief executive officer, Bill Gates. In the course of the visit, something began to form in my mind. It was too vague to be called a thought; rather, it was a mood, an anxiety, an uncertainty, a riddle, but it seemed to me, even in my vagueness, to be fundamental to the nature of the new world that was then just being born and in which we now live.

Over the ensuing years I explored this mood of mine, either deliberately or, because of some unexpectedly interesting book, article or meeting, accidentally. A series of clear polarities began to emerge from my initial confusion: mind and machine, art and technology, real and virtual and, most consistently, complexity and simplicity. This book is my attempt to explain and, perhaps, justify what I first felt in 1994. It wanders over many disparate fields – from poetry to neuroscience, from computer games to finance, from philosophy to climate change, from iPhone apps to iPad art – but they are all tied together by my attempt to understand the true nature of the vast change that has happened in the last two decades. It is an attempt to identify what I believe is the primary dynamic of the modern world.

Before I return to that visit to Microsoft, first, I want to give some idea of the broad themes of this story.

Some time between 1858 and 1865, her most creative period, Emily Dickinson sat at the eighteen-inch-square writing table in her bedroom and composed a twelve-line poem. This was in Amherst, Massachusetts, where Dickinson was known as a brilliant, caustic, witty but odd member of one of the small town's most prominent families. She spent much of the fifty-five years of her life in seclusion. Her recent biographer, Lyndall Gordon, suggests this was

Copyrighted material

because she suffered from epilepsy, a condition that may have been considered shameful for a woman of that time. Nevertheless, locked away in Amherst and in her head, Dickinson wrote nearly 1,800 poems that, long after her death, led to her being considered by many to be America's greatest poet.

This particular poem has three verses of four lines. The lines are characteristically short – alternately eight and six syllables – and punctuated by dashes, her usual style. The tone, rhymes and form seem light but the lines are heavy with meaning. The first verse alone anticipates much contemporary scientific and philosophical thought:

> The Brain – is wider than the Sky –
> For – put them side by side –
> The one the other will contain
> With ease – and You – beside –

Dickinson, for all her delicate seclusion, was an intellectually robust individualist, often riskily at odds with the puritanical culture of Massachusetts. She read the philosopher Ralph Waldo Emerson, one of the most celebrated figures of the age, and took from him a belief in the power of the imagination to transcend the limitations of the human condition. This points to the first and most obvious meaning of that verse: it is a celebration of the sheer scale of the brain, its ability to encompass the entire world – a poignant but potent idea for a little-travelled woman sequestered in her bedroom in Amherst.

But there is a twist in that verse. Not only does the brain include the whole sky, it also includes the mind – the 'You' or self that perceives the sky and can think about it. It is this mind that makes the brain wider than everything. Dickinson could have replaced 'sky' with 'universe' in that first line and it would still be true that the brain was wider because there is something in the brain that is not included in the physical world. We contain the sky 'with ease' because we have infinitely capacious minds.

So the mind includes but does not seem to belong to the physical universe. How can this be? This is what is known in philosophy as the 'hard problem of consciousness'. How does consciousness arise from the ordinary physical matter – mainly fat and water – of the brain? We have, for the moment, neither a philosophical nor a scientific answer to this. Human consciousness remains a mystery, the final wonder of the world, the earth's last wilderness. Great art, like the poetry of Emily Dickinson, affords us glimpses not of an answer but of the deep truth and ultimate difficulty of the hard problem.

Dickinson would have known little of science and, of course, nothing of the science of our time. But epilepsy and the way in which she turned her unique sensibility into art made Dickinson's poetry anticipate, with uncanny accuracy, the most urgent and fundamental

Copyrighted material

preoccupations of our age, and the questions raised by contemporary neuroscience, our most distinctive scientific project. ‘If,’ Lyndall Gordon writes, ‘the twenty-first century is to explore unknown pathways of the brain, Dickinson’s poetry is replete with information about dysfunction and recovery.’

Modern science is the exploration of the physical world through observation, experimentation and, latterly, through computer modelling. Since Galileo first looked through a telescope in 1609, the insights of science and the fruits of those insights in technology have been astounding. We can now explore the ultimate constituents of matter and the outer limits of space and time. We can catalogue the human genome, detect and even describe planets circling stars thousands of light years away. We have eradicated or suppressed lethal diseases like smallpox and polio and, in the developed world, we have almost doubled human life expectancy in the last 150 years. We have connected the world with the single communications system of the internet, men have walked on the moon and our machines have trundled across Mars. In spite of which, we can still only stare in wonder and ignorance at the human mind that has achieved these things. The brain has remained much wider than the sky.

But, at last, we may have a way into the brain and the mind. Thanks, primarily, to Functional Magnetic Resonance Imaging (fMRI), we can now watch the brain in action. The fMRI machine detects blood flow in the brain – increased blood flow in a specific area is associated with increased brain activity in that area. So now scientists have a tool with which they can correlate mind processes with clearly identifiable brain areas and processes. They have constructed, it seems, at least the foundations of a bridge connecting the mind and the brain and therefore, potentially, a way of solving the hard problem.

The possibility has inspired both awe and investment. Neuroscience, thanks to the MRI machine, is now the most fashionable science. Neuroscience stories routinely make it into the newspapers. The latest speculations are reported as if they are fully established facts like the discovery of a new continent or planet. MRI scans have become scientifically underpinned horoscopes, new ways of understanding ourselves and our destinies.

Results of brain scans are being studied for insights into economics, politics, advertising, marketing, sociology, anthropology, religion and art. Politicians think neuroscience will help them know their voters better and marketers believe it will help them sell more to their customers. They no longer have to rely on the vagaries of surveys, focus groups and responses to questionnaires; they can, instead, watch what is really going on in the minds of their targets. With the ever-increasing power and precision of the scanners, it seems there will be no limit to our ability to know the workings of the

Copyrighted material

human mind.

The problem is that the human brain may be the most complex thing so far discovered in the physical universe and, as any good neuroscientist will admit, it is far from clear what we are seeing when we look at fMRI scans. Are the increased blood flows causes or effects of the activities of the mind? Do they merely demonstrate the blindingly obvious – that *something* is happening in the brain when we think? Furthermore, the language in which we describe the results is confusing. Neuroscientists often say, for example, 'You are accessing your language centres.' But who and where is this 'you'? It is certainly not yet detectable by the machine. Rather than solving the hard problem, the fMRI machine is just restating it.

But, to the thoroughgoing materialist, the hard problem *must* be soluble. If the mind is not explicable in purely physical terms, then what is, for us, the most important thing in the universe, the thing that seems to *create* the universe every day, lies beyond materialism. We might have to say the mind may still be material but it is incapable of understanding itself. Perhaps asking our scanners to scan the mind is like asking a camera to photograph the film or sensor with which it takes pictures. It cannot, logically, be done. In this interpretation, materialism survives but only just and on very shaky foundations.

On the other hand, if the materialist faith is true, and if these logical puzzles can be made to disappear, then the brain is a machine like any other. It can be understood as a machine, fixed as a machine and replicated like a machine. Indeed, entirely new types of brain can be created made of silicon – or some other material – rather than fat and water. The inconveniences of the biological can be superseded by the comforts of the machine.

This may happen in the near future. The current rate of technological innovation has convinced some that we are within two or three decades of building the ultimate machine. At this moment – known by enthusiasts as the Singularity – we will build a computer more intelligent than ourselves which is capable of either booting itself into ever higher levels of intelligence or of building new, even smarter machines. It will relieve us of all our technical and biological burdens. The machine will take over.

This idea of the thinking machine, though now very familiar, is actually quite new. The meaning of the word 'machine' has changed radically over the last twenty years or so. The first great machine of the Industrial Revolution was the steam engine and it remains, in our imaginations, the symbolic machine – big, metal, noisy, often dirty and, in fact, rather clumsy. It demonstrated the effort and contrivance needed to replace or improve on nature, primarily, in this case, horses.

The first computer, built, though never completed, by Charles Babbage in the nineteenth century, looked like any other machine of the Industrial Revolution. At first sight, it was just a rather special

Copyrighted material

kind of engine and, indeed, Babbage called it a Difference Engine. His later version, called the Analytical Engine, was, unlike the first, programmable using punched cards. The appearance of these machines, combined with the fact that they were both called ‘engines’, disguised the truth that they were entirely new machines. Looms produced cloth, steam engines pulled wagons and guns killed people – they changed the physical, visible world. But Babbage’s computers solved sums. Their output was entirely abstract, pure thought. Physically, they did not change the world at all; mentally, however, they were the start of a revolution that would change everything.

This moment of transition from material to abstract machine output was the moment when our new machine age was born. The virtual world, in which we now partially live, was produced by machines that are the descendants of Babbage’s engines. Most importantly, it was the moment when a new model of the human mind came into being, a machine model. After Babbage, it became commonplace to imagine machines thinking.

But the machines in our everyday life did not really start changing until the arrival of the personal computer. Before that we had, for example, cars and washing machines, essentially industrial-age engines. Radios and TVs were different. They plucked invisible waves from the air and made sounds and pictures we could hear and see. But that is *all* they did. We, meaning the lay consumer, could not make them do something else.

The computer, however, is a *universal machine*. That term is important because it defines where we are now and where we may be in the near future. The structure of the modern computer was first outlined by the great British mathematician Alan Turing in 1937. It was called the Universal Turing Machine. This meant that it could calculate anything that could be calculated. The intellectual implications of this idea were enormous – not least, there was the issue of what could *not* be calculated – and so were the practical ones. Turing’s machine was the computer as we now know it.

The arrival of the personal computer brought this machine into the home. We were given a universal machine to go with the car, the washing machine and the TV. At first, however, its universality was baffling. Consumers were not programmers and, for most of us, computers were simply glorified typewriters, or word processors as we now called them. Or, from 1979 with the arrival of the Visicalc spreadsheet software, they helped businesses keep track of their accounts. Or they played games.

Somehow, it wasn’t enough. In an episode of the TV comedy *Friends* from the mid-1990s, Chandler opens a new laptop and brags about its apparently enormous capabilities. Yet, when asked what he would do with it, he sheepishly replies that he might play a few

Copyrighted material

games. In fact, as I shall explain later, games were to prove a crucial driver in the explosion of computing power that was to follow. But, at the time, games were an explicit acknowledgement that we had no idea what to do with these potent and mysterious new machines.

But the internet made the true universality of the computer evident. Through sudden access to what seemed like all the information in the world, through shopping, social networks, blogs, maps and satellite photographs of the entire planet, through virtual online worlds, we learned that these machines in our homes could do almost anything. And the frantic pace of the increases in processor speed and memory convinced us that, in time, we could drop that 'almost'.

These new machines close in on our lives just as the science based on the most important new machine – the computer – closes in on our minds. Brain-scanning technology is only made possible by the exponential increases in computing power and speed we have seen over the last sixty years. Caught in this pincer movement is the as yet inexplicable human mind, apparently the product of the human brain, still irreducibly complex.

But what does complexity mean? Its definition is precise and is the opposite of the simplicity that has, for more than seven hundred years, been the Holy Grail of Western rationality.

William of Ockham was born in about 1288. Ockham, the place of his birth, is a small Surrey village south-west of London, now about half a mile from the M25 motorway; in William's time it would have been a day's ride from London. He was evidently a bright child and was sent into the city to join and be educated by the Franciscans. He later studied theology, probably at Oxford, though he never completed his course, perhaps because his prodigious intellect was already beginning to lead him astray. He would eventually be excommunicated by the Church after concluding that Pope John XXII was a heretic. He died in Munich aged sixty.

William is now regarded as one of the giants of medieval thought, an equal of Thomas Aquinas or Duns Scotus. Like them, he was a member of a movement known as scholasticism. This was not a single philosophy but a rigorous, analytical and questioning way of thinking that, in many ways, anticipated the scientific method and, therefore, the modern world. He is famous, far beyond the confines of academia, for one big idea which became known as Ockham's razor. At its simplest, this states that 'entities must not be multiplied beyond necessity'. The technical term is 'ontological parsimony', meaning that explanations of the nature of being (ontology) should be as simple as possible (parsimony). Like a razor it shaves away all unnecessary factors. The general principle is that if part of an explanation is not necessary, then it should be removed.

This seems reasonable but there is a problem. William's razor is a logical tool in philosophy, but in science it can only ever be what is

Copyrighted material

known as a heuristic, a method of understanding. In other words, it may be sensible for a scientist to use the razor and go for the simplest explanation, but there is no logical basis for him then to insist that this explanation is correct. However much we may like the idea, we have to accept that the universe has no obligation to be the simplest possible universe. Einstein understood this. He said, ‘Everything should be kept as simple as possible, but no simpler.’ Yet William’s belief in the simplest possible explanation is constantly evoked in the literature of popular science. He has become a secular saint of materialist rationality.

Simplicity has now become a brand. In engineering and design, for example, there is the KISS – keep it simple, stupid – principle, first named by Kelly Johnson of Lockheed Skunk Works. Many architects, especially the designers of urban apartments, still adhere to the command of Mies van der Rohe, ‘less is more’, on the basis that any unnecessary elaboration is always a bad thing. The media loves simplicity and always shaves news stories, especially political ones, down to the simplest possible two-way arguments. Drugs companies want us *simply* to take a pill. Advertisers live by simplicity because they want people to think that *simply* by buying their product you can solve your problem. Politicians pursue simplicity because they think anything else would distract people from simply voting for them.

Then there is the seductive idea of the simple life. Pressured by their work and the complications of the modern world, people seek simplifications. Most holidays are sold as simple interludes of sun, sand and sea. Specialised holidays, usually with quasi-religious overtones, are ‘retreats’ from the complications and turmoil of our lives. Organic foods are sold as simplifications freed of all the suspicious interferences of chemicals and genetic manipulation. Alternative remedies are sold as simpler, more natural solutions than the sinister products of Big Pharma. Periodically, simplification fads emerge on the chat shows and daytime TV, led by books with titles like *Simplify Your Life, Simplify Your Time* and *Don’t Sweat the Small Stuff*.

The simplicity heuristic has escaped from science and entered the human world. Ironically, it is often used, as in those quasi-religious retreats, as a way of escaping from the technological fruits of science. But can it really work in the human world if it is only, in reality, a useful but specialised and provisional technique in science? Can simple solutions work in a complex world?

Furthermore, is this spiritual ideal of simplicity really what it seems? In *Four Quartets* T. S. Eliot speaks of ‘a condition of complete simplicity’ but then he adds in brackets ‘costing not less than everything’. In other words, true spiritual simplicity is, in fact, everything, it is complex. This is something to be achieved, not a default condition to which we can revert like ‘pure’ food or the simple

Copyrighted material

life.

The opposite of the kind of simplicity that is now so often evoked as a good thing is complexity. An important verbal distinction needs to be made here. For my purposes, complexity is not the same as complication. The two are often used as if they were interchangeable. Complication is merely quantitative: it arises because of the sheer number of elements involved. Complexity is qualitative: something new arises from the various elements

The difference between complicated and complex things is obvious once you look for it. The instruction manuals for certain Japanese cars and cameras are complicated; they form a disorderly pile rather than a coherent view of the machine and how it works. Computer software – especially Microsoft Word – has grown more complicated over time because faster processors and larger memories have encouraged designers to add more features. The plots of bad movies or novels are often complicated; they do not hang together.

In contrast, a complex thing would be the experience of driving the car, writing a great book with Word or watching *The Man Who Shot Liberty Valance*. In these cases, it all hangs together, something new has emerged that could have happened in no other way and which may feel simple but isn't. It feels simple because complexity comes naturally to us. We are complex and we welcome complexity; it feels like home.

Since Galileo, it has taken four hundred years for science to embrace the idea of complexity. In each of the last three decades of the twentieth century, a new fundamental theory emerged which seemed to modify the view of science in the tradition of William of Ockham and Galileo, a tradition that viewed the world as a coherent and decipherable system of cause and effect.

These new theories were closely linked. In the 1970s it was catastrophe theory, which concerned the way small changes in systems could lead to very large effects. For example, a ship in a storm may rock for a long time and then suddenly capsize. What exactly changed? Chaos theory in the 1980s was similar but went further. Small changes in initial conditions could produce enormous and unexpected effects – the flap of a butterfly's wings in Tokyo causing a storm in New York was the famous example. The crucial point about chaos was that its exact effects from moment to moment were intrinsically unpredictable. This suggested there was a limit to our knowledge of the world.

Then, in the 1990s, there was complexity science. This is often confused with chaos theory, but in fact the two are quite different. Chaos theory is deterministic. Though exact outcomes are unpredictable without infinitely precise knowledge of the initial conditions – exactly how and where the butterfly flapped its wings, what the weather was like, at what angle the wings flap – we do know

Copyrighted material

the range of possibilities of the initial conditions, the 'state space' as it is called. But in a truly complex system like the living world, we cannot even define the state space: complexity is non-deterministic.

As Stuart Kauffman, one of the most prominent complexity theorists, points out, chaos theory was not truly radical; it did not break the Galilean model of science. But true complexity is a revolution in that it reveals a universe in which some aspects cannot be captured by any laws of nature. 'We have entered,' he writes, 'an entirely new philosophic and scientific worldview . . . This is, indeed, radical. From it spreads a vast new freedom, partially lawless, in the evolution of the biosphere, economy and human history in this nonergodic [never returning to the same state] universe.'

Many disagree with Kauffman's radical views of the importance of complexity science and some say he has strayed outside the boundaries of 'real' science. I have heard him called 'a poet of science' rather than a scientist. In addition, as a result of uncertainties about what it means and how it might be applied, complexity's exact status as a science has changed repeatedly. There is no doubt that it is still struggling to define itself as a distinct discipline. But, equally, there can be no doubt that complexity science's one big central idea does raise fundamental doubts not just about Galilean science but also about how we see ourselves and where we think we are going.

The first and still the most influential contemporary expression of the basic truth of complexity was in an article published on 4 August 1972 in the journal *Science*. The author was Philip Warren Anderson, a physicist who, in 1977, won the Nobel Prize. His paper, 'More Is Different: Broken Symmetry and the Nature of the Hierarchical Structure of Science', was an attack on reductionism.

Galilean science is based on a belief in reductionism, that, in the words of Steven Weinberg, another Nobel Prize-winning physicist, 'the explanatory arrows always point downwards'. This means that we understand the world by breaking it down into its smallest constituents. In some sense, this computer is 'really' atoms, protons and quarks. Reductionism is the belief that if we understand these fundamental units of matter, then we can ultimately understand everything.

Anderson was writing at a time when reductionism was accepted without question; to a large extent it still is. His key point was that reductionism could not explain how we got from there – subatomic particles, fundamental forces – to here – the world as it is and as we experience it. The explanatory arrows pointed downwards but did they actually explain anything? Plainly not, because we could not use them to deduce causal arrows going upwards.

'The main fallacy,' Anderson wrote, 'in this kind of thinking is that the reductionist hypothesis does not by any means imply a "constructionist" one: the ability to reduce everything to simple

Copyrighted material

fundamental laws does not imply the ability to start from those laws and reconstruct the universe. In fact, the more the elementary particle physicists tell us about the nature of the fundamental laws, the less relevance they seem to have to the very real problems of the rest of science, much less to those of society.'

Reductionism suggests there is a way of looking at the world that must, logically, have greater truth value than any other. This table, says the reductionist, is 'really' composed of almost empty space. Weinberg's arrows all go downward because they are the only arrows we have. We think the laws to which these arrows point 'explain' the universe from the Big Bang to this table, but we cannot show how that might happen. The reductionist would respond that, in theory and, possibly, in the future, we can. The response of Anderson – and the ensuing generation of complexity scientists – would be that, in fact, we can't. The upward causal arrows, as opposed to the downward explanatory ones, are unknowable.

So, says Anderson, the reductionist idea that there was a hierarchy of sciences that always ended in physics was simply wrong: 'Psychology is not applied biology, nor is biology applied chemistry.' With a graceful literary flourish, he ended his paper with a famous dialogue that took place in Paris in the 1920s.

F. SCOTT FITZGERALD: The rich are different from us.
ERNEST HEMINGWAY: Yes, they have more money.

As well as being the greater artist, Fitzgerald was also the greater scientist. Reductively counting dollar bills is no way to understand the full complexity of what wealth does to a person. The rich, Fitzgerald was saying, are different in kind not just in quantity. More, as Anderson would put it, is not just more, it is different.

Anderson and the complexity scientists were reiterating the ancient insight that some things are greater than the sum of their parts. At one level this may seem to be nothing more than common sense. We know that people are more than their liver, lungs and other organs, and we certainly know they are more than their atoms and molecules. But what common sense misses is the deep significance of the word 'more'. If a system like a human body produces something more than its parts, where does that 'more' come from and what is it? The question is fundamental and threatening to reductionism and simple-minded materialism.

In complex systems 'more' is defined as 'emergent properties'. These are things the system can do that are not predictable from the constituents of that system, because they do not arise simply as a sum of all the properties of the parts of the system. A computer may be predictable from parts such as its memory, processor, hard disc and screen; it is emphatically not predictable from the qualities of silicon,

Copyrighted material

aluminium or glass. But the best example is the most complex system of all, the human brain. Somehow, this particular organisation of fat and water generates the conscious human mind. Cars, wars, office blocks and poetry are all emergent properties of fat and water.

This is a basic summary of a vast and ever-changing scientific discipline, but it is enough, for the moment, to demonstrate the importance of the idea of complexity. Emergent properties may be obvious to the layman but they represent a fundamental change in our understanding of the world. As with chaos theory, complexity theory suggests there is an absolute limit to our knowledge. Emergent properties are not predictable. They are new things in the world that seem to come from nowhere. We can make an attempt to understand them backwards – by tracing the pathways that made them emerge – but this is not necessarily possible even with apparently straightforward complex systems. You can trace the making of a car backwards fairly easily if you just go back to the factory, but what about the history, economics, sociology and chemistry which also went into making that car? Even if you could do that, you still couldn't trace the pathways forwards from, say, the Big Bang with which our universe began to a Porsche Boxster.

Complexity theory has been a revolutionary force. In sociology, anthropology, psychology, political science, finance, management, economics and many other areas, the implications of complexity are slowly being worked out. Implicit in all this is the realisation that complexity is a desirable thing; it stabilises systems and makes them robust, able to survive shocks.

These are unconditionally good developments which mean that, in these areas, we are moving on from some simple-minded thinking. For example, in economics the idea of humans as simple terms in an equation, units like atoms that respond predictably to inputs but with certain outputs, has now been more or less thoroughly discredited. Or, in anthropology, we are now much more aware of the role of entire cultures rather than just the parts that we can fit into our pre-existing models. In politics both the big simplifications of collectivism driven by an all-powerful state and individualism driven by an economic war of all against all no longer have any useful meaning.

Yet traditional Ockhamist–Galilean science has been the most successful human project we have ever known. It has given us wealth, health and steady economic growth. What could possibly be wrong with showering us with all the things we want when we want them? We have grown rich; we are, in our homelands at least, at peace. If the West's 2,500 years of intellectual and physical struggle were not meant to achieve this, what were they meant to achieve? Is becoming more like a machine or, indeed, submitting to a machine so bad if it means we live longer, do not die violently or starve? We are, as a species, ever more effective at transforming the world and our lives.

Copyrighted material

Since the late twentieth century, however, we have begun to show signs of being all too effective. Nuclear weapons have given us the power to destroy all life or at least our civilisation. Population growth suggests we might strip the planet of its resources. Pollution, primarily through carbon dioxide emissions, threatens to cause uncontrollable heating of the atmosphere. The apocalypse, it seems, is the price we must pay for the triumphs of Galilean science. Perhaps it is time to move on, to think differently.

There are further questions raised by simplification and the rise of the machines: what are we in danger of losing? If we go on down the road to the Singularity, when the machine finally takes over, who will we then be? Are we in danger of losing complexity, the very thing we should value most and the very thing that best defines our humanity? Machines simplify, they categorise and index. They demand simpler forms of behaviour. Like Ockham's razor, they strip us to our essentials.

We are at the beginning of this second machine age. The change involved is so vast we can barely see it. This book is an attempt to describe that change. The first machine age began in the mid-eighteenth century and gave the developed nations 250 years of relentless economic growth. The second gives us – what exactly?

Art has always been the best guide to what we most profoundly are and to what we are becoming. Writers, architects, visual artists and musicians define our species and our predicament. This book starts and ends with that conviction. Poets have seen what is at stake in the two machine ages. Confronted with the clanking, metal machines of the first age, one poet in particular was alarmed at what was being lost:

> The world is too much with us; late and soon,
> Getting and spending, we lay waste our powers;
> Little we see in Nature that is ours;
> We have given our hearts away, a sordid boon!

That poet was William Wordsworth, longing for a return to an enchanted age of gods and myths. The second age has already gone even further than the first in accepting science's two escaped heuristics – Ockham's razor and reductionism – into the human realm. Now we routinely accept the 'nothing but' of simplification and reduction. This table is 'nothing but' empty space, humans are 'nothing but' machines, I am 'nothing but' an animal.

This leaves the poets pining not just for the old gods, but also for our selves. The American poet John Ashbery wrote in 1998, 'Renewed by everything, I thought I was a ghost'. He felt the terrible power of all the novelty of the consuming, machine-using contemporary world, the way everything seems to change all the time,

Copyrighted material

our selves included. The poet’s self had become a ghost haunting the shopping malls of the world.

But it is Emily Dickinson’s poem ‘The Brain is wider than the Sky’ that most exactly captures the contemporary sense of the strangeness of human consciousness. It also defends that strangeness, that ability, unique in nature, to include the whole world and the thinking self in the as yet unobserved and undetected location we call the mind. If she were alive now she would be asking: will the machine brain – or our brains when adapted to the demands of the machine – still be wider than the sky?

This book is about neuro- and computer science, about gadgets and games and about some of the great delusions of our time. It is also about what lies above and beyond all of those thing and it begins in Seattle in 1994.

Copyrighted material

1

A DIVIDED MAN

At the climax of my visit to Microsoft I was left alone in a room.

'You'll want to collect your thoughts,' said the woman from public relations.

Perhaps, I thought, this was a room specially set aside for thought collecting prior to a meeting with Bill Gates.

I had spent a couple of days on the Microsoft campus in Redmond, a suburb of Seattle. This place, I had realised, foreshadowed a new world. Old world companies had offices and factories; new world companies had campuses. The word 'campus' was being used to make it clear that this was not any old drab workplace. A campus, after all, is a kind of home where whole, serious, thoughtful lives are lived.

But the word was not just symbolic, it also signalled a real change. The office – factory distinction had become quaint or meaningless. Computer software is not made of metal or plastic, the sorts of things used in factories, it is made of numbers. Software could be produced in what had been called offices and were now to be called campuses. And software was rapidly becoming the most important thing in the world. It told the hardware what to do; it was the mind of the new machines.

Microsoft's campus was a landscape of trees punctuated by low buildings with ribbons of tinted windows and white walls. Each building was surrounded by parked cars. Signs were few and the tinting of the window glass made the place feel anonymous and, at first sight, deserted, possibly abandoned. Everything was happening inside. In the middle of the campus there was a little pond which they called Lake Bill. It was inhabited by Canada geese that deposited bluish dung all over the place.

Copyrighted material

When I first arrived, the receptionist did not greet me. She just waited for me to type my name and business into a laptop computer that printed out my pass and told her who to call. Then she said: ‘Take a seat.’

Inside each building – they were called Building One, Building Two, etc. – there were just grey corridors lined with small cubicles. In each a person was working at one or two computer screens. A few looked up as I passed, but most were too immersed in their screens to notice anything.

In 1994 the old world was heavily pregnant with the new one. The birth was said to be imminent. Personal computers (IBMs and Apples) had been around since the beginning of the 1980s and I was already an ‘early adopter’, one of those people who must have new gadgets as soon as they come out.

I had been disappointed. Nothing was connected to anything else, at least not in a useable or useful way. The new machines were only what was inside them. So computers just sat there being more troublesome and demanding than the typewriters they replaced. The hottest new technology was CD-Rom which did, at least, offer us some chance to make these beige boxes do something interesting. Nevertheless, I was excited. We were about to cross a threshold, and in the very near future, all the computers in the world would be connected. The beige boxes would become not just what was inside them but what flowed through them and what flowed through them would be everything. We would become like the all-seeing eye on the dollar bill; nothing would be hidden from us.

This was why Bill had agreed to meet me. He had written a book, *The Road Ahead*, about something he called the Information Superhighway. We would all have access to all the information in the world. This was thrilling. But my meeting was not just about Bill’s book. Microsoft was also about to launch a new operating system codenamed Chicago.

First, they wanted to make sure I understood. I had to spend three days at the campus, being shown round and meeting important people. This was very demanding because I didn’t actually know very much about computers.

I met Nathan Myhrvold who was in charge of advanced technology. He was a bearded, chubby man who laughed a lot, mainly at his own jokes. He talked in strange swoops and screeches and seemed dazzled by his own cleverness: ‘We’re surfing on some great wave of technology and there’s this guy on the surfboard [Gates] who can surf.’

There was Chris Peters, in charge of word processing. He looked like a nervous undergraduate, possibly, I imagined, fond of hiking. Unlike Myhrvold, he was not pleased with his cleverness; rather, he was almost oppressively aware of its oddity and limitations. ‘We

Copyrighted material

I would say: 'You got married recently . . .' or 'I know your mother just died . . .' and instantly he froze and the loud voice faded almost to a murmur.

He froze because, at the personal level, he did not want to be known. He argued that his character was unimportant; all the new technology would happen anyway, he was just one more player in the market. He became almost abusive at the idea that anything other than pure reason was involved in business. Twice he slapped me down for using emotional terms.

'No, no, no, there's no need to involve emotion. If you're going to run a business well you'd better not be sitting round here going "Oh yeah, I hate this guy". I mean, come on, it's fun, you should laugh and be very energetic . . . You don't get really angry that much . . . You don't want to act out of emotion. Fine, maybe I live my life like that, but I don't make business decisions that way.'

So he kept the life veiled behind banalities – 'I do sleep and read and other things' – and I was left with hints and indicators. There were plenty of published anecdotes from the past – portfolios of speeding tickets picked up while driving at 100 mph-plus around Seattle late at night, shadowy girlfriends clinging on to the few hours when he is not in front of a screen, a race with bulldozers hijacked from a building site, a general atmosphere of obsession interrupted by frenzied distraction and of spoilt, unreal boyishness.

He was a divided man. Three-quarters of his mind was work – the rocking – the rest – the immobility – was something unformed, a need to understand and control the world beyond his work. This was two years before Steve Jobs returned to Apple in 1996 to endow computers with aesthetic, quasi-spiritual values. With Jobs, the need was the work. Gates had no such aspiration; his machines were simply tools. But he did want to *know*, to include the immaterial, the ill-defined, in his material, exact world of software code. It was this need in him that started me on this journey.

Perhaps family would answer his need. He had just married Melinda French, a marketing manager at Microsoft. There were rooms in the house he was building for two or three children and a nanny, none of which then existed. Gates was ready for fatherhood; he had written the code, now it just had to be installed. He had even decided his children would not inherit his money – about $6 billion at the time. He planned to give it all away to charity and that, sixteen years later and with three real as opposed to virtual children, is precisely what he did.

'I just don't think it's all that helpful to inherit large wealth,' he said. 'I guess it's a personal philosophy, you have to judge. Everybody spends a lot of time thinking what's good for their kids, I'm sure. And in my case I have decided that having a substantial amount of wealth is more negative than positive.'

Copyrighted material

But, I pointed out, people change when the children were actually born.

‘I don’t think I will. But you’re right. I accept that that’s consistent with what others have told me. But I think there’s a little bit of philosophy in this that will not be changed. And I have some friends who feel the same way.’ That phrase ‘little bit of philosophy’ stood out from the usual flow of his conversation. It suggested a still point in the centre of the turning world of the technocrat, something that the eternal novelty of innovation could not alter.

His own upbringing was privileged – a successful lawyer father and a brilliant mother, Mary. Mary in particular was, until her death two months earlier, a constant presence in Bill’s life. She died before she could receive the Citizen of the Year award from her local county, honouring her as ‘an exceptionally talented, civic-minded citizen’. In 1983 she had become the first woman chairman of the executive board of the charity group United Way of America.

So soon after Mary’s death, parenthood was, unsurprisingly, on his mind.

‘Parents, yes, absolutely, I think parents are a major influence, maybe mine more than is typical because of my dad’s career and the kind of challenges he had and what my mom was doing with non-profit organisations. You can always kind of share those things. They got us to read about the world and talk about it. They treated us as though understanding those things was actually relevant and I went to some pretty good schools and was given a certain sense of self-confidence. There were some things I was good at and I was encouraged to pursue those things. I continued to share with my parents, to spend time with them and value their feedback even as my career got to unexpected dimensions.’

‘Even as’ suggested that he saw the possibility of a conflict between the values of his parents and the ‘unexpected dimensions’ of the business he was in, a business built on overthrowing much of the world of the previous generation. Given his claims for the world-transforming powers of the internet, he was being prescient.

Gates, like many successful men, was a gambler.

‘Oh yeah,’ he laughed, ‘I could lose a lot of money. Confidence will do that to you.’

His big bet now was this strange, amorphous entity known as the Information Superhighway or just The Highway as they called it on campus. Bill had an intuition about The Highway: he thought it would be huge, the biggest thing since the telephone, and he had written this book – *The Road Ahead* – to explain why. I asked him why it was called ‘*The*’ rather than *A Road Ahead* or *The Road Ahead in Computers.*

‘Intentionally,’ he said before I had quite finished framing the question. ‘The basic premise of the book is that this advance in

Copyrighted material

INDEX

Copyrighted material

By the same author

The Culture Club: Crisis in the Arts

Richard Rogers: A Biography

The Pleasures of Peace: Art and Imagination in Post-War Britain

Understanding the Present: Science and the Soul of Modern Man

The First Church of the New Millennium: A Novel

Brave New Worlds: Genetics and the Human Experience

Aliens: Why They Are Here

How to Live Forever or Die Trying: On the New Immortality

Copyrighted material

A Weidenfeld & Nicolson ebook

First published in Great Britain in 2011
by Weidenfeld & Nicolson

This ebook first published in 2011
by Weidenfeld & Nicolson

© Bryan Appleyard 2011

The right of Bryan Appleyard to be identified as the author of this work has been asserted in accordance with the
Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, without the prior permission in writing of the publisher, nor to be otherwise circulated in any form of binding or cover than that in which it is published without a similar condition, including this condition, being imposed on the subsequent publisher.

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

ISBN: 978 0 297 86031 0

Typeset by Input Data Services Ltd, Bridgwater, Somerset

Weidenfeld & Nicolson
An imprint of the Orion Publishing Group Ltd
Orion House
5 Upper Saint Martin's Lane
London WC2H 9EA
An Hachette UK Company

www.orionbooks.co.uk

Copyrighted material