DIGITALIS/MAKESHIFT 1

Part II – Invaders of the sand

There is also this other world however, which was familiar to Dyson, and which he knew a bit about. Something of the world that had surrounded his Princeton childhood was out there, the story of the emergence of computing. It seems to have begun almost out of the blue. One day the New York based impresario-publishing agent, John Brockman, rang him. Brockman had read the short nature-technology essay by Dyson in the Japanese magazine *Switch*, where Dyson recalled his youthful days, playing in among both the trees and remains of the old computer left-overs, gradually rusting away in the backyard barns of the Princeton Institute of Advanced Study. Brockman, who has ceaselessly promoted a sizeable array of science writers in the cause of his Third Culture synthesis, was keen for Dyson to write a considered, quasi-academic book on the history and possible futures of the Internet. Although there had been quite a few quickly written books thrown out into the reading market place, there wasn't anything that attempted to look at the phenomena with both depth and rigour. This for Dyson was a fascinating challenge, for despite being around some of the leading players in the early computing history, he had neither read, nor knew their histories. Here was an opportunity to revisit a part of the past he was, by chance or some variety of design, tangentially related to. And it was also a way, as he recounts it, of learning about these machines, because at the time, pre *Darwin Among the Machines*, 'I did not understand them at all.'

In *Darwin Among the Machines*' preface, Dyson returns back to his earliest West Coast times. He writes of listening to the deep reverberations of boats as they chugged up and down the Inside Passage. He writes, 'As I had sometimes drifted off to sleep in the forest canopy … and wondered whether trees might think, so I sat in the engine-room companionway … and wondered whether engines might have souls.' This question threads its way through the chapters of the book. If this sounds romantic and fanciful, the book itself is a carefully crafted exploration of the prehistory and emergence of computers, the software running them, and this prehistory convergence with evolutionary theory, leading quickly into the heady question of whether the digital domain is a new form of life. 'Life's second coming', as it is very grandly referred to at one point. Not life as we know it, and completely different to animate, biotic life as usually understood, but definitely life-forms nonetheless. The book was written over four years, between 1993 and 1997, and is recognised as one of a very few academically coherent examinations of where digitalisation may be heading. Yet it begins with, and is embedded in, history. To get a sense of Dyson's apprehension of technological evolution along with evolutionary technology, you need to begin with the much debated history of Evolutionary Theory, with Lamark, with Charles Darwin's father, Erasmus, and particularly, in the story Dyson chooses to relate, with Samuel Butler. With Charles Darwin's eighteenth-century adversary Butler standing in the historical foreground, Dyson threads a way between the evolutionary reductionism of orthodox Neo-Darwinism and a belief in a religious Godhead as the source 'from design' for life on this planet. Dyson signs up to symbiosis rather than selection being the key, if still renegade, process of evolutionary change and adaptation. This allows for all sorts of interesting threads of thought to unravel. The broader message of the book is that, along with collective intelligence for humanity emerging via the Internet, and all the other signals of connectivity, this rapidly accelerating electronic environment is showing many signs of emergence, the condition where more complex systems shows traits of intelligence – artificial intelligence – which are not there at the simpler, less complex levels of single computers. In this application of evolutionary behaviour to machines, Dyson presents a detailed history, moving deftly from generation to generation and from century to century, of those who contributed most to the universal machines' progress into existence: engineers, scientists, logicians, mathematicians and philosophers. Starting with an unusual trio of early modern precursors, Butler, Thomas Hobbes and Robert Hooke, the towering early pre-computer figures Wilhelm Leibniz and Charles Babbage, he moves through to the more recent and recognisable scientific giants of the mid-twentieth century, notably Alan Turing and John von Neumann. His childhood home, the Princeton Institute, bobs in and out of view, with reminiscences from the engineers of one of the first computers, the Institute of Advanced Study machine, as it takes shape in the fifties. 'Something about abandoned machines', he writes of these first-hand childhood memories of the Institute in the chapter, 'Rats in the Cathedral', and continues, hinting but not fully saying what that something may be, 'the suspension of life without immediate decay – evokes a mix of fear and hope … We blindly dissected the fossilised traces of electromechanical logic out of which the age of digital computers first took form.' In the preceding chapter, focusing on Von Neumann – an alpha league cold war warrior if ever there was one – a hair-raising weave between atomic bombs and the emergence of computers is followed with cool precision. Von Neumann's research both launched 'the breed of stored program computers that surround us today', and used naturalistic descriptive language – organs, neurons and memory – closer, he notes, 'to biology than engineering'. This world, the close ancestry of today's computing empire, Dyson acknowledges 'bore the paternity of war'. Invoking a seemingly mutant symbiosis, he renders computers as intimate associates to atomic bombs, blithely placing the shoe on the other foot. 'Perhaps it was the bombs which were also testing the computers, rather than the other way around.' For Dyson, von Neumann's greatest legacy to computer networking is 'to be found not only in the architecture of individual computers, but in the proliferation of weapons against which networks of computers offered the best hope of defence.'

In chapter after chapter there is a wealth of historical and statistical detail, including, for instance, recounting early in the book the jaw dropping rate of computer growth: that the global population of integrated circuits is 'growing by more than 100 million units per day … (and) production of silicon wafer, approximately 2.5 billion square inches for the year 1994, is expected to double by the year 2000' (did it?) and so on. All this to demonstrate the breath-taking rate of growth of electronic machinery enveloping the planet. But it is as the book approaches its ending, with the history beginning to drop away, that Dyson lays out some of the most dramatic and startling conclusions. All through the book, implicit and near each chapter's surface, are the workings of symbiogenesis, and particularly its originator, Nils Barricelli, who though lesser known, Dyson describes as Samuel Butler's successor. It was Barricelli who saw that processes analogous to evolutionary behaviour, the emergence of digital or numerical symbio-organisms, in effect computer software, could happen in the wink of a micro-second within the universe of a computer, through processes akin to symbiogenesis in first nature, where coalitions of micro-organisms could combine towards greater complexity. Barricelli cautiously described these numerical symbio-organisms as 'life-like' rather than actually living, but in the process the threshold between the simply computational and that of artificial biology had been crossed. With the growth of the digital realm into computer-to-computer communication, and from there into the distributed network now known as the World Wide Web these new life-forms have expanded to encompass the whole planet, comprising a global organism, and possibly a global intelligence. And if this is a form of intelligence, as Dyson makes clear he thinks it is, the relation is symbiotic with carbon life. 'In less than forty years, adding one subsystem at a time, we have constructed a widely distributed model that is instructing much of the operation of human society, rather than the other way around.' Such an explanation for artificial life may be uncontentious in A-Life circles, but in the last two chapters he ponders the origin of this 'invasion' of these new forms of life and intelligence, these 'sub-vital units – microprocessors'. They come from the sands of earth or, reaching further back from the chemical fusion of silicon and oxygen, the constituent elements of silica. Although these are now proliferating, through accelerated self-reproduction, the coming of silicon-based cyberplasm does not necessarily imply the end of organic carbon-based life. Comparing microelectronic components with those of chemical structures, Dyson points out the former is chemical in process while the latter 'depends largely on relations between electrons'. And it is humans who have acted as servants to this emergence. The silicon-based intelligence relies on communication for their survival and multiplication. Communication is enabled by the realisation that silicon was a semiconductor 'able to act as an electrical switch with electrons as its moving parts.' Through the mid-twentieth-century science fiction writings of Olaf Stapledon, Dyson discusses the living qualities of electrons; that is, how electrons can be interpreted in certain circumstances as possessing 'a mind of their own'. 'An electron within an atom has no distinct individuality', Stapledon stated, 'But the electron may recover its individuality and leap free from the atom, to join perhaps with some other atom and once more die from individuality into a new corporate being.' In both *Last and First Men* and *Star Maker*, Stapledon outlines a distant future where the symbiosis of humanity and machines has long since happened. In *Last and First Men*, Stapledon imagines a war of the worlds scenario two billion years hence, where clouds of Martian micro-organisms, versions of these 'sub-vital units', though individually powerless, 'maintain communication via faint electromagnetic fields … (and) constitute a collective intelligence.' Dyson brings this alien vision down to earth, replacing the Martian *Matrix*-like extraterrestrial intelligence with his earth-bound silicon intelligence inhabiting an equally distributed Mind: the World Wide Web. To this he adds the caveat that it is extremely early days. 'The World Wide Web, a primitive metabolism nourished by the substance of the Internet, will be succeeded by higher forms of organisation feeding upon the substance of the World Wide Web.'

'If all goes well,' he adds in the final pages of the book, 'our children will be linked ever more closely to the myriad ganglia embedded in their lives, while remaining members of the human race. In the distant future, they may look back on us as children and wonder how, before symbiosis with telepathic machines, it was possible to communicate, or even think.' There follows a half page or so forewarning about what could go wrong, beginning with a quote from the British biologist J.B.S. Haldane, to the effect that evolution has been characterised by a downward, degenerative course. But after two hundred plus pages of dense cool prose telling us about the inevitability of this future, it comes across as almost out of place, particularly as, within paragraphs, he is summoning – again rather oddly – Thoreau's elegiac observation that in maintaining wildness we preserve the world, as witness to the point that we have exchanged literal physical wildness, for that of the endless expanse of the digital wild.