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Artefacts, Technicity and Humanisation

industrial design and the problem of anoetic technologies

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Abstract

Artefacts, Technicity and Humanisation

industrial design and the problem of anoetic technologies

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This thesis concerns the intellectual heritage and autonomy of West European and American industrial design as a discourse community at a moment when biotechnological developments are challenging the certainty of what it means to be human. Proceeding from the assumption that industrial design is an autonomous intellectual engagement played out through the interpretation of technology as an artefact, the thesis identifies how this is a critical moment for industrial designers, who appear to be unable to respond to a problem of the apparent disconnection and the progressive displacement of the human in reference to technology. The thesis identifies the cause of this as the understanding of the artefact, which has conventionally been placed at the centre of its analysis. The way that this has been constructed has not only impacted on design solutions but has led to a particular understanding of technology. It is this understanding of the artefact that has ceased to be sustainable and has precipitated the crisis. The thesis argues that, by revisiting the artefact as a mutable consequence of culture, it is possible to relieve the problem by opening up the scope for finding new methodological approaches. These can be used to develop design strategies that are sufficiently subtle and coherent in their terms to engage with the open complexity of future discussions of the distributed and enacted human.

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Acknowledgements

> Thirty spokes share the wheel's hub. It is the centre hole that makes it useful. Shape the clay into a vessel. It is the space within that makes it useful. Cut doors and windows for a room; Therefore, profit comes from what is there; Usefulness from what is not there. (Lao-Tzu)

What is not here has changed me for ever. But some words must be found to find a way to reveal the network of assistance and love in which I have been fortunate to find myself over the course of the past five years or so. Sometimes the actors in this network are visible in the thesis; however, more often they have provided a subtle and invisible web of magic, which has held everything together. Some actors deserve a particular public acknowledgement here, of course, not least among these my supervisors Professor Michael Punt and Robert Pepperell, who have become my friends and who have shared their intellectual insight with such extraordinary generosity and patience. That I cannot find the appropriate words to express my gratitude adequately will hardly surprise them.

It is also important to mention Professor David Jeremiah and Professor David Smith, who provided some of the impetus and confidence required at the start of this project. Thanks are due to friends and colleagues at University of Wales Institute, Cardiff and University of Wales, Newport, including Professors Gaynor Kavanagh, Paul Seawright and Anne Carlisle, who have been both generous and gracious in making it possible for me to undertake the research while I have continued to teach in their various Faculties. Thanks, of course, to Mike Phillips and my research colleagues in Transtechnology at the University of Plymouth, whose challenge and support have been invaluable and to Dr Kieran Lyons for his companionship on this particular road trip.

Thanks and love are also due to my Ma and Pa for their perpetual support and for their generous contributions to my library. But of all the actors in this brief life to whom I owe the most, it is Yvonne, whose sustaining belief and tolerance have ultimately made this whole project possible. Thanks to other actors, Alfie and Emmett, entering and exiting stage left and right at frequent intervals to offer joyous distraction. And finally to Don and his Dancing Wu Li Masters, whose light was not shining (at least on this plane) to share in the pleasure of typing this last line before I submit the thesis.

Thank you

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

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A number of relevant seminars and conferences were regularly attended at which work was often presented; external institutions were visited for consultation purposes and several papers prepared for publication. The events and conferences at which this research has been directly shared are:

- THOMPSON, S. 2007. 'Mind the Gap: Technology as soma'. *Journal of Human-Centered Systems*. vol. 4, no. 21. London: Springer.
- *Science in the Dock – Art in the Stocks*. March 2006. Public Lecture. ESRC Social Science Week. Exeter: Terracina Gallery.
- *Research Symposium II*. February 2006. Cardiff: University of Wales Institute, Cardiff.
- *Research Symposium II*. February 2006. Cardiff: University of Wales Institute, Cardiff; School of Art and Design.
- *Wearable Futures Conference 2005*. September 2005. Caerleon: University of Wales, Newport.
- *Theatres of Science Conference 2004*. September 2004. Ponty Pridd: University of Glamorgan.
- *1st International Design and Engagability Conference* (IDEC). July 2004. Birmingham: University of Central England.
- *DATA International Research Conference 2004*. July 2004. The Design and Technology Association. Sheffield: Sheffield Hallam University.
- *New Synergies between Science, Literature and the Arts*. July 2004. Science and Literature Society. Paris: University of Paris.
- *Spring Research Symposium*. February 2004. London: University of the Arts, London.

  and also

- *Transtechnology Research Seminars*. 2005–2008. University of Plymouth.

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Question

What intellectual moves are necessary for industrial designers to 'talk' about biotechnologies in terms that have some continuity with their history?

Preamble

> If we superimpose $E=mc^2$ on a new awareness of Nature, seeing it as the unbeatable model of elegant and economical design, we begin to believe that less can indeed be more, and an unconscious slippage back in the direction of mysticism gets under way. Accepting the hypothesis that the brighter we get, the more we can do with less, it presently follows that if this is a good thing, then doing much more with much less must be an even better thing. Then, if we cautiously extend the evolutionary line in the direction of infinity we come to the interesting realisation that the ultimate goal of technology has to be doing everything with nothing. This, of course, is precisely what God did, as reported in the admirable concise account in the book of Genesis. One wonders if the conjunction of mineral reserves being depleted to an eventual vanishing point, and the real goal of technology doing everything with nothing, is serendipity or something more. The more immediate problem, I suppose, is how do we determine when to start closing down the design schools? (George Nelson, 1979)

The origins of this thesis

An abiding interest in the way that people interact with technologies drew me into the study and practice of industrial design. This research, however, started in a moment of *relaxation*. Watching television one day, I encountered something that seemed to throw into question so much of the way I had thought about people and technology. I was watching a documentary following the racing driver Ayrton Senna testing a Formula One car. At one point Senna, sitting strapped behind the steering wheel of his racing machine in the pits, was talking to his mechanics. Senna began to describe, in passionate and frustrated tones, how he could feel the engine failing. Senna explained he could feel this failure *in his body*; the mechanics looked at each other uncomfortably; the computer telemetry indicated that the engine was running perfectly well. The interesting thing about this story is that Senna's sensation was vindicated; shortly after that conversation the engine was indeed found to be on the brink of catastrophic failure. This might have been coincidental, of course, but it seemed that Senna was speaking with the authority of a driver who often claimed that he possessed an intuitive metaphysical ability to anticipate a car like no one else.

This seemed interesting. Now alerted to the idea that people and technology may connect with a kind of anoetic sensuality, I began to discover that Senna was not alone in his experience of this metaphysical phenomenon. When they speak informally, many other people - such as musicians, sportsmen and women, and fighter pilots, for example - talk of being 'connected too' or 'at one with' their technology. Reading around I found that this kind of rhetoric, where it was accounted at all, was often discounted, ignored, or set to one side as a matter of poetic licence. I wondered why a phenomenon that was so apparently commonplace would be treated as if it were some kind of peripheral whimsy by some and whether it might have any credence in science. I began to read about ideas of proprioception, blind sight, temporal dislocation and other autonomic neurosomatic phenomena. These ideas were extraordinary and interesting, but they did not seem to connect to the way in which I had thought of design. These ideas seemed to point towards a kind of excess in the body and some kind of holistic connectivity with technology acting as part of a continuous soma. My design logic told me that interaction was a process of orchestrating the interactions between the epistemic opposition of the human and the technological. I had spoken and written about the design of interfaces and socially constructed interactions, yet my reading seemed to point to a rather different kind of relationship. It seemed that, interesting as these scientific ideas were, something would need to happen prior to their incorporation by designers into their logic.

I began to wonder whether this sense in which the human and the technological became a single holistic entity was more of an issue of a linguistic syntax that demanded a degree of epistemic opposition in its terms rather than any practical reality. There certainly appeared to be no formal way I could account for this idea as a kind of design aesthetic and I wondered if that might be a problem. The observation born of my design education and training also appeared to be something that had weight in my own life. Everyday I inhale a compound of Beclometasone Dipropionate, known more colloquially by its trade name Qvar. The function of Qvar is to enable the triggering of certain enzymes in my pulmonary tract, thereby enabling anoetic breathing. Without this steroid, asthma would make me acutely aware of every breath, and that awareness is a debilitating intrusion into my sense of myself. Inhaling this steroid is a design decision; the interaction of this steroid in my soma is a design aesthetic. Some would claim that some loss of the narrative of breathlessness has somehow distanced me from the true experience of life. Others might claim that the chemical has somehow invaded my soma, alienating me from my true humanity. It does not feel like this to me. Qvar is an aesthetic of joyous quotidianness. In an orthodox industrial design account, this aesthetic would most likely be embodied in the grey and red plastic of the inhaler and in a conversation regarding the deterministic magic of being freed from the tyranny of asthma.

Perhaps one of the key contributions that industrial designers have made to humankind has been the way in which they have made the extraordinary potentiality of technology seem utterly ordinary. The extraordinarily skilful way in which designers have enabled people to reconcile their lives with technology is evident all about us every day. I wondered if there might perhaps be some special intellectual skill associated with making the extraordinary seem quotidian that might be connected in some way to this idea of people feeling as though they were at one with technology. I wondered if the intellectual skill associated with making human life seem complete through technological means might be hinted at in the International Council of Societies of Industrial Design (ICSID) definition of industrial design. In essence, this definition suggests that industrial design is an intellectual means of 'humanising technology'. Although the implications of this are open to some debate, there did seem to be an epistemic discretion implicit in its terms that denied the possibility of the experiences Senna and the fighter pilots described. The quotidian essence of the process of humanisation in my use of Qvar seemed to demand a new kind of design conversation embodied in the intellectually and aesthetically unaccounted (anoetic) act of breathing: just breathing.

This residence of aesthetic in the anoetic seemed to have profound implications for the way in which designers might understand what it means to humanise technology. One of the interesting things about the industrial design community is that it has tended to construct its own theoretical and historical ideas. As for many of my fellows, industrial design histories have played an important role in how I have understood industrial design. I was aware that the industrial design histories relate what seemed to be *the* story of a single linear heritage. These similar histories seemed to centre on the products of the endeavours of relatively recent members of the industrial design community and relied upon descriptions of their material outputs in the form of technological artefacts in order to tell stories. Often the reasons for choosing to include these technological artefacts in a history appeared to be a matter of their beauty or as a means of representing social and cultural changes over time. Many technologies seemed to have a material artefactual presence in culture, but many did not. The material things seemed to be presented as evidence of industrial design; the things without material presence seemed not to be. When set against the rather self-evident idea that for the most part the rich complexity of individual lives has been ephemerally accounted, it would seem that the artefacts in industrial design histories could provide only a fraction of the evidence of a process of humanisation. I was aware that, as a designer, I might share some vernacular and informal discourse with a rather extensive community that stretched as far and as wide as our knowledge of humanity allowed us to know. I was aware too that the heritage of my community was not particularly well accounted for. I wondered if the history of the process of humanising technology had become lost, because, for most of human history until quite recently, designers have been people of rather low social standing. The history of that process might merely be beyond the scope of institutionalised places of scholarship and have become estranged from the intellectual scrutiny it might deserve.

I wondered if other attempts to analyse culture and society that accept complexity and fluidity in their terms of analysis might be a useful way to understand the problem I had identified. By widening my understanding of the nature of human-technology relationships, I might be able to find some means of opening a conversation that did not seek epistemic distinction in its terms. The rather complex ideas of technology as a social construction that I encountered in contemporary sociology and anthropology certainly seemed to run against the projections of uncritical simplicity with which I was familiar as an industrial designer. These ideas did seem to be finding a way of talking about the human and the technological in one conversation. Sometimes the ideas they presented offered a way forward, and on other occasions they seemed to be unconsciously intent merely on unpicking the intellect of industrial design. Cyborg literature seemed to take the quotidian and to unpick it in order to claim a kind of fetishistic alienation of the human species from itself by technology. Even in the most simplistic terms, this logic appears to deny the coterminous biological and intellectual evolution of humanity and technology. The logic of the cyborg is sometimes extended by others who speak of future 'artilects' or 'robo-sapiens'. These species of creature are projected to outstrip human capabilities in some way or another. When I reflected on my own industrial design heritage, these ideas seemed familiar, having resonance in rather archaic ideas of the man-machine and the other previous claims of rupture in the trajectory of human history. Given the extraordinary way in which people retained their sense of humanity, industrial designers in the early twentieth century must have found a way past the logic codified in a supposed new age of the machine. I was sure that the tactic of many erstwhile colleagues, who had sought to engage with the future by inventing new design practices in reference to particular outputs or to particular procedural methodologies would not be productive. These designers seemed to be distancing themselves from industrial design and its intellectual heritage, I thought it might be more productive to focus attention in a positive way upon the unique intellectual contribution of the industrial design community to the world and to extend this forward into a new technological paradigm.

Today it feels quite ordinary, and often boring, to be one of the 'prosthetic gods' that many once projected, quotidian to a degree that it is now necessary for cyborg literature to unpick and remind us of the anoetic presence of technology. Even though the technology of the future may seem unimaginably extraordinary in our terms given this trajectory, it is worth considering that its success will depend to some extent upon a means to make it quotidian. However, while the absence of a positivistic conversation in which the human and the technological are considered to be coextensive does not appear to have had any particular impact upon the success of industrial designers so far, it might not be sustainable to continue to discount it. I wondered if the absence of a serious discussion of the anoetic and of problems with epistemic discretion might go some way to explain why industrial designers are finding it difficult to project their expertise towards the design of some emerging technologies. Conversations regarding biotechnology suggest that it will transform life in the twenty-first century, but industrial designers have very little to add by way of an opinion about it. Industrial designers have even less to say about how biotechnology might be shaped into a useful and quotidian facet of life in the future. This lack of engagement with an emerging technology is surprising. After all, the industrial designers I know all have some view or other of technological development. These views range from some who express a kind of childish excitement in the design of futuristic dreams to others who find technoscience itself to be deeply worrying and politically problematic. Industrial designers' opinions on such matters extend to almost every shape and form of technology, but not, it seems, to biotechnology. One might expect industrial designers, acting on their enthusiasms, to be right in there, speculating and conceptualizing future biotechnological opportunities, but for the most part they are not. I could find almost nothing in industrial design literature other than some rather lukewarm assertions of a future transformation. Industrial designers have similarly struggled with technologies that do not appear to be materially accountable and have struggled in the past to develop design practices that engage with the particularities of immaterial logic. The additional problem for designers is that biotechnologies are not only difficult to account for in material terms but eschew orthodox epistemic discretion. How, for example, do you humanise something that is in effect materially indistinguishable from that with which it is supposed to interact.

When I began to enquire how insistent ideas of epistemic distinction might be implicated in my research, it quickly became apparent that the logic of language might have some significant part to play in the problem I had identified in design logic. The rhetorical tactic of antagonistic opposition prevails throughout Western logic and is particularly evident in languages such as English. This becomes particularly evident when designers attempt to describe moments in which the human and the technological become indistinguishable through conditions of immateriality or in anoetic interaction. Similarly, individual designers trained in the syntax of the Western world can call upon any number of analytical tools to help them describe technology in material and cultural terms as a visual aesthetic; in comparison, there appears to be a relative absence of terms to describe an aesthetic of enaction. It quickly became evident that deeply embedded cultural ideas and particular rhetorical conveniences in language had slanted the idea of human-technology relationships in favour of a rather narrow terminology that demands differentiation. Some degree of stability of course comes from the logic of a language that is good at fixing terms, but this happens at the risk of excluding or obscuring other equally plausible positions. In a mindset that recognises stability as problematic, it becomes possible to see how rhetorical conveniences have become encrypted into the logic of analysis. The player piano, for example, may be easily described as a technological artefact. This artefact can replicate with a degree of cadence and subtlety a tune played originally some time ago in another place. In this description, where the function is contained in a single convenient logic that understands a closed and bordered artefact (player piano) encourages the impression that the tune was 'stored' on a punched roll of paper and played again when combined with the artefactual mechanism of the player piano. We might ask where the music is actually stored; in the holes punched in the paper perhaps? But then how then do holes store music? Considered carefully, the metaphysical mystery of magical holes can be revealed as an invention of a misplaced metaphorical assumption of storage. The tune is stored not in the roll of paper, but in the potential of the full complexity of a rather extensive system involving organic and inorganic mechanisms. This system involves musicians, pianos, card, holes, punching mechanisms, and so on. It becomes clear that, in order to understand fully what is going on, we must consider this system in its entirety and the actors at play within it.

I had now discovered that my industrial design understanding of the world, founded in a form of Western logic that reduced the human species to an entity in antagonistic relation to the world, seemed to be unsustainable. If my understanding of the boundary between the human and the technological were not to be accepted for its rhetorical convenience, I realised that it would be important to explore ideas of fluid instability and to establish why these might be a problem for industrial designers.

Since this problem was particularly identified with industrial designers, it seemed sensible to continue to think like an industrial designer. Thinking in that way would retain some sense that this research was an extension of a rather longer heritage, although it might suggest some radical shift in intellectual approach. I realised that throughout the process of retrieving ideas I could only hope to endeavour to continue to think like an industrial designer, using the skills I had learned of drawing on a very wide range of ideas and flocking them together in a synergistic analysis. This skill set is one of the things that sets industrial designers apart from others' intellectual attempts to engage with the problems and opportunities presented by the complexity of human-technology relationships. As designers we have developed a number of strategies for resolving a degree of fluid complexity into rather simple applications. The techniques used in an industrial design project appeared to be an ideal means to come to terms with the implications of epistemic distinction in the human and the technological. A trick that designers employ in order to solve problems is simply to reverse the terms of the question. This technique suggests that, rather than focusing attention upon ideas of transformation and otherness, the designer should look for continuity. In order to function efficiently industrial designers have to know something about almost everything and in consequence they have become exceptionally skilled at flocking ideas together as a means of analysing and organising uncertainty, fluidity and complexity. I realised that, if my research could be presented in that spirit as a form of practice, drawing together and testing in a synoptic manner an eclectic range of ideas, it might have some chance of coming together like a design solution. I have therefore endeavoured to construct a form of synergistic design meta-analysis, combining the prosaic with the poetic, such that a picture can be presented that has functional resonance with an audience both of industrial designers and of others who are interested in how people enact their lives through technologies. I will know if I have been successful if these ideas open the way for the industrial design community to regain its place at the centre, rather than the periphery, of intellectual debate.

The reader and the author

Not everyone will read this thesis in the same way, of course. This is an industrial design text and an addition to a rather long history of attempts by industrial designers to initiate or extend conversations rather than an attempt at either a formal philosophy or a manifesto for development. Designers such as Loos, Dreyfuss Van Doesburg, and others, for example, are still read today. One reason why these texts should retain their vitality is that there is very little stability in industrial design theorisation, and they provide a point of navigation or anchorage in intellectual fluidity. As times change and as particular intellectual problems become more or less important, the stability of these texts remains and enables members of the industrial design community to chart a path or trajectory. While the view of these texts and their usefulness as a waypoint may change, the texts remain, providing evidence of a moment of intellectual endeavour. Industrial design not codified with the authority of medicine or the law is an open community, and anyone can call him or herself a designer. This means that, while industrial design has vitality, it is prone to continual fluid shifts in its terms. One consequence of this fluidity is that it becomes essential for anyone reading design ideas to remain alert to the instability of the intellectual place in which ideas are posited.

Because this thesis will be subject to that same fluidity it is not particularly useful, or even possible, to say with any degree of absolute certainty to whom any particular text is addressed. It must be sufficient to say that my thesis is likely to be read by anyone with an interest in the progression of industrial design or with a concern to understand the part its intellectual nuance may have in shaping the world of tomorrow. In that it deals with ideas of materiality and the realisation of life in relation to ideas of technology and culture, the thesis will be read by those who are interested to understand how design is constructed as an intellectual activity. Design philosophers and theorists, such as Tony Dunne and Fiona Raby or John Thackara or those who read around them, might read the ideas in this thesis and find them to have some resonance with their own explorations. The thesis could be read as an adjunct or philosophical counterpart to the research interests of Joseph Giacomin's

'Perception Enhancement Systems' research team at Brunel University. (Giacomin, 2008) Where Giacomin's research explores some of the engineering potentials and problems associated with subtle interactions, this thesis sets out some of the ways in which those ideas are embedded in design discourse. This thesis then, might have some use to those who read philosophers such as Vilem Flusser and share his interest in the more subtle aspects of design and the role of technical apparatus in the formation of being. This interest might seem to imply a reader who is involved in education to some extent. It might also imply a reader who is associated with a design studio, such as IDEO, in which ideas and scholarship are as important as commercial expediency. It will certainly imply a reader, whether or not from the industrial design community, who is interested in understanding a thoughtful process that seeks to understand how people construct their lives with technology. The reader of this thesis will probably be unwilling to accept that industrial design is merely an uncritical tool of commerce, a creative adjunct of marketing, engineering or popular culture. Accordingly, the ideas presented here explore how the relationship of humanity and technology might be intellectually problematised. However, these ideas are presented not in the form of a more orthodox critical cultural study but in a spirit of creative endeavour as an attempt to bring a moment of productive stability in a climatic moment of complex uncertainty.

I trained in industrial design in the United Kingdom during a period in which the doctrine of functionalism appeared to be washing out of design education in favour of a form of pragmatic commercial and material strategy. I could not find any particular complaint with that strategy during the years I spent as a practising commercial designer before becoming a full-time academic. However, my research practice has been to explore ideas emerging in the arts, humanities and sciences, and to bring these ideas into the context of design practice and the design of curricula. I have found myself to be one among a few industrial designers who draw upon ideas that present a challenge to established models of order, but I have retained a sense that industrial design has a pragmatic objective. The theoretical practice in this research has taken emerging ideas of debordered uncertainty, fluidity and deconstructed logic back into industrial design in order to shape a conversational philosophy for that community. These ideas have a resonance in ecology, but also in the physics and metaphysics of consciousness. I have argued elsewhere that recognition of the debordered and extensive logic of postdigital and postmechanical thought invites a reappraisal of operative design logic. Where many industrial design theorists accept technology as a given and as a means to development, I have tended to place emphasis upon the role of design in the ontological formation of schema. In this respect I have found myself to be one of only a very few industrial designers who contribute to an emerging conversation that looks for how scientific ideas of consciousness resonate in the lived experience. My particular contribution to these conversations has been to challenge the comfort of intellectual assumptions of epistemic differentiation in the construction of ideas of how people function in the world and to test these in commonplace instances. This thesis is a small part of that project and an important stepping stone in a rather longer project.

Why this thesis is important

Aside from being an addition to a long and established heritage of speculative design textual practices, this thesis presents a significant contribution to the discourse of the industrial design community by bringing together a unique constellation of theories opening a conversation that can find no differentiation in the human and the technological. The new knowledge is generated through a synergistic analysis that forms a logic reflecting a realisation that closure is no longer a viable objective and that the provisional is better accepted as a reality of an emergent holism that accounts for the human as a distributed and enacted life. This thesis is significant because, in the first instance, it brings forward a discourse of hope and continuity, into a climate of disjuncture and terminal conversations. In the second instance, the thesis provides the foundation of a new kind of conversation among members of the industrial design community, maintaining materiality at the core of its discourse but in a manner that is productive in discussions of emerging technological paradigms.

The thesis shows how the problems industrial designers have with understanding and accounting for humanity in the context of emerging technologies reside in the way in which they understand and analyse the world by constructing convenient, although artificial, boundaries in their logic. The application of this rather simple logic has a rather profound implication, because it shows that, although biotechnology, which appears to present a rupture to the continued trajectory of industrial design logic, is treated as an exotic other, the means to engage with it is actually already encrypted in the ICSID claim. For example, by demonstrating how it is quite possible and plausible to understand biotechnologies in similar terms to the way the industrial design community might understand the steam engine or any contemporary artefact, the thesis reconnects ideas without the hyperbole of so much technoscientific rhetoric. One unique way in which it does this is by understanding how biotechnologies emerge from a scientific discourse that does not understand the world in terms of fixed and accountable materiality. Biologists understand the world in terms of autopoietic flows of supercomplex determinants that come together momentarily. This view presents a field of possibilities rather than a fixed and predictable structure and shifts the analysis of material culture towards terms of autopoietic flows and momentary hardenings. In establishing how processes of autopoiesis can be found in the intellectual territory of industrial design, a direct connection is made with the logic of biotechnology. This takes the form of a kind of extent analysis that understands reality across a range of imaginings within so-called topological domains. This kind of analysis recognises that, when the world is considered at any degree of finite attention, it is only as complex as the complexity of its analysis. This technique has some precedence in the intellectual tactics industrial designers use when they are containing mechanical or digital complexity in rather more simple boxes. As this thesis draws upon the way in which the complexity of industrial designers' histories are similarly boxed through periodisations, an otherwise unidentified strategic lacuna is revealed in the historical projection of industrial design. The thesis shows how shifts of materiality evident in these periodisations can be understood to develop because profound change occurs in the understanding of the human. Periodisation in industrial design histories also reveals how the scale of a supposed material reality can be understood to be a cultural construction that is subject to intellectual shifts over time. In that way the intellectual problems associated with biotechnology are shown to emerge because of a certain kind of acceleration in the complexity of the analysis of the human.

The ideas here can be productively understood as a prototypical attempt to form a new language of materiality that throws into question the gathering uncritical assumption of the value of tangible media as a coherent design strategy. That strategy is understood in this thesis to be an attempt by designers to regain stability in their terms of reference. Instead, an alternative position is outlined that shows how the industrial design community could be more productively engaged in finding a means to find an aesthetic of enaction. This aesthetic is identified as founded in a subtle and intense degree of granular complexity commensurate with emerging understandings of the human as a soma distributed throughout the world. It is likely that, at this degree of complexity, no meaningful closure of the human will be found possible.

The methodological strategy

Any exploration of the world in terms of the ineffable, elusive or quixotic will have to find a way to deal with the limitations of a language. The English language is not particularly well equipped to deal with terms that are considered to be permeable and without borders. Industrial designers, like other rational-minded people, are trained to seek closure and rational simplicity. They are expert, however, at dealing with complexity and fluidity in their terms. Designers use processes such as sketching that 'talk' about the world in a fluid terminology while retaining some of the logic of closed and fixed materiality that forms the discourse of their community. The strategy employed here in this thesis is to identify ideas, paradigmatic of emerging directions in contemporary thought, that can be characterised by their acceptance of the provisional as a means to a more complete understanding. These ideas, accepting that closure is no longer a viable theoretical objective, work together in a way that makes it possible to discuss humanity and technology in a single conversation and as a single epistemic entity. One consequence of this approach is that the rhetoric may at times appear polemical, as it attempts to shift the analysis of industrial design into a new territory and to draw in a number of ideas from outside its usual terms of reference. This approach, however, makes it possible to begin to understand the world once again as a continuity of interacting essences. The language will sometimes recall the syntax of times before the rationality of science, which accepted that closure might be an unviable theoretical objective if a more complete understanding of the world was to be achieved.

The analytical method employed in the construction of this thesis bears some comparison to a design process. Ideas from a broad basis are swarmed, such that, when read together, they form an assembled body of knowledge that is not in itself exclusive but creates a pattern open to future reformation. The thesis, in as much as it deals with a discourse of abstractions, can then be understood as a conceptual and critical industrial design practice, written in the spirit of reflective and creative practice, although presented as a theoretical, textual design intervention.

The words in this text have come through a form of reflective and creative practice (Moon, 2004) in which ideas have been gathered through a survey of a wide selection of literature and then surveyed *de novo* such that a wider more panoptic picture can be constructed. I have avoided taking an entirely forensic analysis, and, being a member of that community, I cannot view industrial design from a remote standpoint. This, however, has made it possible to paint a richer and wider picture, which has retained resonance in the terms of the industrial design community. Where a forensic analysis would have tended to focus on a single facet of the problem, flocking ideas together reveals interactions, which can be analysed in order to give form to a wider problematic. An analysis from a remote standpoint would have tended to view a problem without necessarily understanding the subtle nuances of the object of its observation. Because I have been able to view industrial design from within its own terms, a more intimate and enacted theoretical picture of continuity has been constructed, nuanced in such a way that it has meaning in its own community. Accordingly, this thesis assembles an experiential and implicit body of ideas (Schön and Schön, 1991) and undertakes a synergistic analysis informed by a close reading of the practice of the industrial design community and much that is unfamiliar or disavowed within the scope of its discourse. This literature is used in order to formulate general concepts by abstracting common properties of instances and expanding ideas in relation to contemporary design practice.

Literature has been surveyed because of its direct relevance to industrial design as it is practised, and other literature because it could be identified as relevant to the broad intellectual perspective of the thesis, but always in terms that might be relevant to the design community. Much has been edited out of this thesis. This was necessary if only for matters of expediency and the determining limitations of the word count. The words here might productively be read as the first section of a much larger text that would include ideas that are more concerned with the subtle functioning of the soma. Ideas of the role of free will, non-conscious functioning, cognition and precognition and impulsive reaction that go some way to explain how people function in the world have simply, and reluctantly, been left out, although they could provide the scope for a further text. The words that remain act together to put in place some of the philosophical and creative foundations for a future kind of industrial design logic that has some resonance with its own heritage. In the process of research, much other literature has been reviewed and rejected from the final thesis if it could not be grounded in terms that might be useful to further the understanding of the industrial design community (for example, if it relied upon sophisticated familiarity with the technical language of philosophy or mathematics). Ideas have been rejected if they were found to be insufficiently rigorous in their terms of debate. This particular rigour has been necessary because in the process of research many ideas conflated objective physical phenomena with entirely subjective matters of faith and fantasy. Where these conflations were undertaken without criticism, the resulting ideas were discounted from the thesis, even though some intellectual nuance may remain of them in the broader argument.

A strategy of interacting concrete examples with theoretical ideas has been employed. This has made it possible to play with ideas in a way that both reveals the subtle implications embedded in the quotidian and also tests theoretical ideas in the practice of everyday life. For example, the juxtaposition of a futuristic technology such as DNA computation is considered alongside an artefact as mundane as a bicycle in order to open out questions of enaction and the process of consciousness in the 'use' of technology and whether it is viable to consider technology as an extension of the human body. DNA computation, as it is imagined publicly, might not be the most effective or perhaps the most likely of emerging technologies to impact in the short term, but its implications are profound. The nature of this technology throws into question orthodox understandings, being at once a material and spatial supposition of the human and technological. The bicycle, on the other hand, in an operative sense, throws into question the epistemic discretion of actions and actors. Both the exotic DNA computation and the quotidian bicycle raise questions of enaction and the process of consciousness in the 'use' of technology and whether it is viable to consider technology as an extension of the human body.

The thesis takes a view that there is a single holistic universe of interconnected possibilities. A thesis recognising the unbordered nature of the world could easily become a theory of everything, and any exclusion is bound to be artificial and a matter of rhetorical strategy and convenience. Throughout this thesis, complex ideas are unpacked and tried out through everyday examples of quotidian life. Care is taken to identify a range of ideas that explore how the human and the technological can be talked about in a single conversation. Though not without its critics, actor network theory has reflected a realisation that closure is no longer a viable objective and that the provisional is better accepted as a reality of analysis. The inclusion of actor network theory into the thesis has made it possible to account for the materialisation of artefacts in terms of hybrid social and cultural energies in which people are determining actors in the performance of technologies. The interactional nature of the analysis that underpins actor network theory is such that its exponents are able to argue that humanity and technology must be considered as a hybrid condition. The inclusion of ideas of actor network theory into the discourse of industrial design could bring a new approach to the analysis of the artefact that finds a mutable and fluid process. An understanding of the artefact as something mutable and fluid would throw a rather more subtle light upon the process of humanisation such that it would become necessary to find coherence in those revised terms.

The methodological strategy for deciding which ideas should be included or discounted has been similar to that described by Katrina Meyer (2004) in her analysis of online discussions. Meyer uses a number of categories described in earlier studies. These categories align with the views taken of texts encountered in this research. It is not important to list where any particular text might fit into any, some, or all of the following categories, because their role in the thesis may not necessarily align with the decisions implicit in their initial inclusion. Throughout the process of research, ideas can change in status, moving between the periphery and the centre of analysis.

(i) There are some ideas that have provided a solution to problems encountered in the research. These ideas have provided a way out of difficulties. These ideas educate the researcher, show him that his analysis might not be entirely new or reveal rather longer histories of ideas that might be studied in order to find a way through problems. These kinds of ideas are perhaps what one might expect to encounter in a research. They are included and cited because they ground and support ideas.

(ii) Some ideas are included because they are constructed by fellows engaged in a process of creative exploration in a manner that bears comparison to this research. These ideas discuss other problems in a similar way to the functioning of the analysis here. Sometimes these ideas are useful because they have emerged from a research that has encountered similar problems to this thesis. These ideas are often familiar to the researcher and have provided some of the impetus to the research. They are also what one might expect to find in any research and are almost always included and cited as examples in justification of ideas and approaches to analysis.

(iii) Other texts integrate and synthesise ideas. These texts are perhaps the most complex to analyse. Their inclusion or exclusion is always the most problematic and the most likely to lead to the reader asking why another particular idea was not considered. This fluidity must be accepted. In the end all texts are constructed from a given intellectual and cultural location and are informed by the reading the author has previously undertaken. It is inevitable that a text of limited scale and scope will miss the benefit of others' ideas. In this thesis, these texts are included and cited in sections of more complex analysis as a means to help ideas along and to bring a form of intellectual rigour to speculative and creative practice.

(iv) Some ideas are included because they trigger new ways of thinking leading to new ideas and new insights on the problematic. These ideas are most likely to be encountered in reference to other research, occurring by chance on the radio or television during moments of relaxation in an entirely unrelated context. These ideas are found useful as a means of illustration through agility of synthesis. They are almost always included and cited as exemplars of other ideas and are perhaps a more prominent feature of creative research.

(v) Finally, some ideas are included as a matter of play. These ideas are proposed because they make other ideas seem unstable, because they bring delight or just because there is some resonance in them that invites readers to speculate on their own account. These are most often included and cited in a way that sits alongside the body of the text and the drive of the argument, as interesting sights on a long journey.

Introduction

This thesis is about Western European and American industrial design as a particular practice and discourse at a moment in time when the trajectory of technological development is throwing into doubt the certainty of understandings of the boundary between the human and the technological. It proceeds from a discussion of how this might be a critical moment for the intellectual fellowship of industrial designers, as the particular insights they once relied upon when dealing with questions of the material formation of the technological world have now begun to seem somewhat irrelevant in the formation of the future. Rather than applying an alien theory to industrial design, this exploration uses its design instincts to draw upon a broad spectrum of ideas and to assemble them through a process of synergistic analysis. This process assembles ideas as if they were actors in a network of conversations that interact to give form to a discursive conversation.

Rather than adding its voice to the many who call for the end of industrial design, this thesis takes its impetus from the opportunity it presents for designers to reconsider the essential principles that underpin their intellectual community. Through a critical analysis of literature, it shows that, if industrial designers are to continue to talk in terms that have some continuity with the trajectory of the historical narratives that sustain their intellectual community, a more subtle attention to the artefact than that provided by recent design theorisations is required. Rather, it will be necessary to find a means to analyse the artefact without seeking closure through forms of material and representational analysis and to act upon a strategy that understands materiality to be tied to the complexity of analysis. This strategy reveals borders and epistemic heterogeneity to be matters of conceptual and rhetorical convenience and so it becomes possible to discuss humanity and technology in a single conversation.

By calling upon the idea of the topological domain and by using a 'designerly' form of extent analysis, it becomes possible to find a way to engage with ideas without necessarily calling upon epistemic discretion or the encapsulation of terms in epistemic locations. Taking a more fluid view of human-technology relationships, it is then possible to insist that design processes of humanisation must be accounted across terms at any given degree of complexity and granular sophistication in the conceptual and technical models held in human-technology relationships. This allows the thesis to explore how designers understand questions of the human and the technological in a new way, which allows for sufficient debordered, fluid granularity in terms. The conclusion is that a sufficiently subtle understanding of the world, which is coherent in its terms with the molecular complexity of future discussions, will demand the construction and incorporation of a form of designerly extent analysis. This presents a reinvigoration of the industrial design community's discourse, maintaining the centrality of its expertise with materiality, but in new terms of debate.

The thesis is divided into eight chapters.

An allegory that provided much of the impetus to the research remains as a coda in an appendix to the thesis. It serves the thesis as a narrative retelling of its ideas, as they are shown to be enacted in a form of scenario, albeit based on a rather extraordinary story of extremis. The allegory recalls Bruno Bettelheim's account of Joey the Mechanical Boy as it appeared in *Scientific American* in the mid-1950s. The story of Joey is deconstructed in order to provide an allegory, eschewing closure to reveal how the process of humanisation can be understood to be tied to a process of intellectual coherence. This allegory is presented here because it provides a means to open up a number of ideas through the design analysis of drawings presented in the account of therapy by the psychologist Bruno Bettelheim. After an introduction to Bruno Bettelheim's account (which appeared at face value to be one of trauma and therapy), the coda questions the process by which Joey is liberated from a particular and rather exceptional, technology-engendered psychosis.

Chapter one opens the thesis by confronting industrial design and its particular autonomies. This locates the research, establishes a clear view of how industrial design can be identified and interrogates the intellectual tactics that give it autonomy and authority to act within its own terms and as a wider intellectual agent. The key claim made in this chapter is that industrial design can be usefully understood as an intellectual community. This makes it possible to reveal how its autonomy resides in its subtle management of fluidity in terms that go about a particular ambition - a critical position that is not fully accounted in its discourse.

Before any theoretical examination of industrial design can commence, it is important to be sure about what one means and implies by that term. One problem with the term 'industrial design' is that it is difficult to define without excluding any number of other ways of describing the unique contribution it might make to the world. Thinking about industrial design as an intellectual community can provide a means of analysing the licence and scope that designers appear to accept when they define their own bounds and goes some way towards an explanation of why industrial design does seem to have some coherent presence in the world. Although not regulated with the rigour of medicine or law, 'industrial design' is consolidated into a recognised profession by a number of affiliated institutions, which are loosely held together under the umbrella of a further official body consolidating other national design bodies. One important institutionalising body, the International Council of Societies of Industrial Design (ICSID), suggests in its description of industrial design that it is an intellectual means of 'humanising technology'. ICSID provides no explanation of what this might imply. In making this claim, industrial designers appear to be unique among other professions and practices. When industrial design is understood as a kind of intellectual community, then we can begin to realise how industrial design is a rather particular although fluid discourse that orbits about this rather profound but uncritical claim of itself as an intellectual means of humanising technology.

The impetus to humanise technology places the human and the technological in oppositional epistemes. However, individual members of the industrial design community find themselves having to work with a number of fluid terms when they think about how they might construct this process. While the 'human' and the 'technological' are considered as discrete epistemes, they are terms that are almost entirely fluid. This makes it difficult for the community to frame in precise terms what it means to humanise technology. However, being a creative and reflective community that deals with a discourse of abstractions, industrial designers are well placed to explore how they might construct, with a degree of coherence, a process of humanising technology when the terms of reference are in constant flux. Over the twentieth century the industrial design community humanised technology by making the extraordinary seem quotidian. Individual industrial designers do seem to be able to communicate with a clarity that belies the complexity of the forces shaping their intellectual community and the intellectual challenge in the process of humanising technology. They do not have a formal tradition of accounting for this expertise. This establishes industrial design as an intellectual community founded in fluidity that is not always aware of the full extent of the subtlety of its own enterprise.

If one takes the view of industrial design that it is an intellectual community consolidated about an intellectual process founded in epistemic discretion, then it becomes possible to explore with some authority how that process is thrown into question by the disconnection and the progressive displacement of the human reference in technology. **Chapter two** outlines how emergent technologies that appear unaccountable in orthodox material terms point towards a more critical, epistemological displacement of the human referent in understandings of technology. This enables the claim to be made that rupture in the industrial design community's critical discourse is symptomatic of a schematic problem that can be resolved through a strategy of reconnection.

While there is much that individual members of the industrial design community can refer to that can help them to describe technology in material and cultural terms as a visual aesthetic, there is little that exists by way of a formal or technical language in Western culture or in readily available terminology to describe an aesthetic of use or enaction. This has lead to a prioritisation of the visual evaluation of the cultural values of technology over any other kind of aesthetic. This problem is brought into sharp focus by the emergence of new technological forms. One recent emerging technology has lead to suggestions by some of the emergence of a new species of Artilects (artificial intellects). Projections of technology such as these, which give rise to new paradigms of human and post-human existence, are demonstrated as being symptomatic of critical problem in the understanding of the intimate relationship between humanity and technology and can imply some lacunae in the understanding of what the process of humanisation might imply. Such projections have resonance in some of the early twentieth-century fears of man-machines. Some erstwhile members of the industrial design community have responded to the intellectual challenge posed by the apparently immaterial nature of electronic and media technologies by inventing new forms of design practice.

The inclination to give discrete names to these diverse, but intellectually similar, design practices serves to distance the intellectual heritage of the industrial design community from the intellectual capital generated in any discourse connecting the process of 'humanising' mechanical technologies. This inability to connect may play some part in causing the threatened rupture in the community's intellectual discourse.

For a number of years industrial design has been promoted as an adjunct of successful business development and growth. The success of the industrial design community at finding clients among corporations and small manufactures can suggest that design intellect remains a vibrant focus of cultural, strategic and economic creativity. There may be a number of ways the industrial design community might move forward, overcoming the rupture that threatens its intellectual discourse. Industrial designers may decide to embrace a form of limited continuity in a model of their practice, accounting only for these technologies as they fit established practices. They could divert their attention to deal with some other, more pressing problem. They may decide to shift attention to one of the other challenges confronting humanity - not least, of course, the problems of climate change and carbon emissions. The industrial design community may come to a view that it can best engage with the future by looking beyond the development stage of bioscience. At one extreme of this particular engagement, the industrial designer would become a kind of fantastical imagineer, limited to promotional activities or to the design of props for futuristic drama. Perhaps the most difficult route the industrial design community might take would be to look for continuity with its intellectual heritage and seek to establish a vision of the future where a trajectory of biotechnological development can play out as a quotidian facet of some future culture. Continuity might not be beyond possibility, if biotechnology and the other emerging technologies of the future could be connected to industrial design's intellectual trajectory. This seems to imply that the way that industrial design is understood and projected may be in some way responsible for the rupture.

When that rupture in the industrial design community's critical discourse is understood to be symptomatic of a schematic problem, then a strategy of continuity will necessarily be founded in some aspect of discourse that has resonance in past practice and in some consolidating aspect of industrial design practice. **Chapter three** explores more fully how the industrial design community is formed around a sustaining narrative in which the artefact acts as the keystone of analysis. Particular focus is placed upon the causal link in the tendency to rupture in the industrial design community. This is revealed as emerging from a strategic lacuna in technological artefact-based histories where the process of humanisation is regarded as ahistorical.

An 'artefact' can be defined by the evidence it provides of a process of humanisation - that is, it provides a particular type of 'solid' evidence of human interventions into the world. The human *concern* with shaping materials into useful and familiar 'artefacts' is at least as old as human histories allow us to know. For many thousands of years, people who tended to have the lowest social standing were responsible for the making of artefacts. Their heritage in the vernacular and informal may go some way to explain why the industrial design community has tended to construct its own theoretical and historical discourse. Histories of the industrial design community emerge from within that community and often appear interchangeable. Together, design histories, repeating a similar story, reinforce one another and provide a consolidating narrative for the industrial design community. This consolidating narrative is built around a coherent, although largely invariant and chronologically constrained, model of the industrial design community's trajectory. Scholarly industrial design literatures place a particular form of material artefact at the centre of analysis. Industrial design histories are told through industrially produced artefacts, mostly, although not always, from the late nineteenth and twentieth centuries. Histories of the process of humanisation are implied to be accountable in material cultural terms, while artefacts are often presented as being in the absence of people and appear as fully resolved entities that belie the fluidity in their terms of analysis. Consequently, the imagination of the artefact is established in uncritical terms and in a constrained and linear history.

It becomes evident that industrial design can visibly connect its consolidating narrative with emerging technologies only if they avail themselves to the orthodox accounts that are used to track the process of humanising technology. A more subtle attention to the rethinking of the artefact *in* industrial design analysis can provide a means of exploring how the process of humanising technology might be retrieved in industrial design narratives. In **chapter four** emerging understandings of cultural networks are used to interrogate how the 'resolved' technological artefact informs and shapes understandings of the process of humanising technology. The strategic lacuna identified in chapter three is posited as an emergent consequence of a deficit in reductivist methodologies, which pay insufficient attention to autopoietic cultural networks, and the impact of agency and supercomplexity. However, when the materiality of the artefact is understood to emerge as an autopoietic consequence of flowing materialisations of intellectual forces, then it becomes possible to see how the artefact at the locus of industrial design logic might be connected to the developmental logic of biotechnology.

The consolidating narrative provided by industrial design histories leads designers to suppose that artefacts can be interrogated to reveal something of the culture of the people who made them. It has seemed a reasonable enough idea to designers that they might trade upon established or projected cultural values and build them into the design of contemporary artefacts. However, linear histories of technology, such as those projected in the consolidating narratives that industrial designers use in their intellectual community, are unreliable. Histories of technology can be shown to be selective in their sources and project one among any number of possible trajectories for any given artefact. While artefacts endure, for the most part the human relationships, passions, laughter and tears that go to make up the rich complexity of individual lives are accounted only in memories or in subjective narratives. Analysed in isolation of its use, the artefact can provide only some fractional evidence of a process of humanisation and the full complexity of the forces that determine its appearance. A number of ideas are brought together to suggest that artefacts are better understood as self-emergent (autopoietic) and flowing materialisations of supercomplex intellectual forces. When artefacts are understood in these terms, it becomes possible to see why attempts to 'reverse engineer' or to unpick supercomplexity might be beyond the scope of human intellect without an accepted understanding that closure should be eschewed. Furthermore, it makes it possible to see how orthodox presentations and analysis of the artefact may be problematic.

A new account for the history of the process of humanising technology becomes possible when artefacts are understood as self-emergent (autopoietic) and flowing materialisations of supercomplex intellectual forces. These new accounts are freed from the constraints applied by deterministic shifts in materiality because development is shown to be an intellectually imagined process. Shifts in materiality then might be better understood as an emergent consequence of paradigmatic shifts in intellectual understandings. This opens up the possibility of constructing a more connective narrative for the industrial design community. **Chapter five** tests this reconnection, extending the idea of the topological domain (an analytical tool of biology) in order to explore how it might be used to shape understandings of what it means to humanise technology. The historical narratives that sustain the industrial design community are reimagined through two speculative historiographies. These are specifically designed in order to demonstrate how the process of humanising technology can be tracked alongside developments in intellectual logic. Complexity in understandings of the human in the world are tracked through a trajectory revealing how technology comes to be understood and represented in terms that are tied to the complexity of understandings of the human. This developmental trajectory is tracked first through humanist understandings of the man in an antagonistic landscape through to ecological understandings of interconnected species; and then through understandings of the human as a corporeal entity through to understandings of cultural construction.

The idea of the topological domain suggests that the world is only as material as the complexity of its analysis. Many of the sustaining narratives of industrial design are divided into 'machine ages'. This idea of a discrete periodisation of a trajectory is rooted in Banham's influential description (1955) of the first and second machine ages, but is, of course, an entirely artificial construct. Historical periodisation into discrete ages serve to simplify and reduce complexity but are problematic, unless they are themselves analysed for the reflexive grouping, or collating, of rather uncertainly codified ideas. (On occasion, the historical periodisation of the 'machine age' will be used here, but only when it is necessary as a colloquial term in reference to where it is employed elsewhere.) In industrial design histories, the machine ages appear to represent changes in the way in which artefacts appear to be consolidated in smaller and smaller material objects. This is a linear process moving from the massive and noetically obvious monumental, towards microscopic evanescence and hence into anoesis. However, the 'machine ages' can be understood to be an artificial construct and to provide evidence of shifts in the scope and extent of analysis (the topological domain) rather than physical materiality. The manner in which materiality is imagined appears to be tied to broader philosophical understandings of the place of the human in the world. Understood in this context, the scale of a supposed material reality is shown to be a cultural construction. An alternative history can demonstrate how technology could be imagined in humanist terms. This implies a tectonic landscape in sympathy with broader intellectual understandings of the world. An alternative history can demonstrate too how technology could be imagined in terms of organic life in sympathy with broader intellectual understandings of the world. The complexity and fluidity of contemporary analysis may go some way to explain why materiality is now understood to be a fluid and mutable construct and why large monumental technologies were not discussed in these terms. The intellectual location of the industrial design community has necessarily shifted in order to ensure that its process of humanisation has remained coherent in terms of pertaining topological domains. This may explain why it has only recently become intellectually logical for industrial designers to focus attention upon some 'immaterial' technologies, even though they have prescience earlier in the trajectory. It may also point to the necessity for another shift.

When it has been established that technology comes to be understood and represented in terms that are tied to the complexity of understandings of the human, it becomes plausible to set out some steps for how industrial design might recover its autonomy. This autonomy will be determined, not by the development of a new material form of technology, but by an emergent intellectual understanding having resonance with the biotechnological understanding of the human. In **chapter six** a number of intellectual opportunities that biotechnology offers to the conceptualisation of technology are interrogated. This process makes it possible to insists that, when the human is understood in terms of enacted moments of a hybrid condition, the imperative of design can be understood as a process of the orchestration of valence at the material site of interaction.

One way to understand what it means to humanise technology is in terms of an intellectual and creative process in which valence is maintained between prevailing understandings of the world and its manifestation in the material artefact. In these terms, it is becoming increasingly difficult to talk about the human and the technological in discrete terms. A model of actor network theory, drawn from sociology, is employed as a means to take a more fluid view of human-technology relationships. Actor network theory has been the subject of considerable criticism, for the most part oriented towards accusations of reduction and the provision, in essence, of an incomplete analysis. However, these criticisms can be understood to reflect a realisation that closure is no longer a viable objective and that the provisional is better accepted as a reality of an emergent holism that accounts for the whole human as a distributed and enacted soma (referred to here as holanthropic analysis). Actor network theory makes it possible to understand how lives are played out in cooperation with technologies and to take a more subtle and unbounded view that accounts for interplay without seeking closure but rather accounts for the materialisation of artefacts in terms of hybrid social and cultural energies. These accounts demonstrate that humanity and technology can now no longer be considered separately but that humanity must be considered as a hybrid holanthropic condition.

It is necessary to ask why industrial design has not incorporated a process of the orchestration of valence at the material site of interaction into the terms of its analysis. Taking a lead from an anthropological understanding of technology as an evolutionary component of intelligence-given form and enacted through social and cultural processes, **chapter seven** reviews attempts to resist a necessary inclusion of hybridity into analysis. Ideas of alienation are shown to emerge from classical ideas of technicity, which deny the evolution of the hybrid species. A previous attempt to understand enaction from a design standpoint is reviewed and shown to be limited by its failure to account fully for the distributed soma in its analysis.

Many attempts to unpick the hybrid nature of the human condition founded upon ideas of an essential heterogeneity, such as that of cyborg theory, do not fully account for hybrid holanthropic evolution and are forced to imply that somehow people are alienated from their true selves by technology. These theories consider the human and the technological in degrees of differentiation and frequently make the ordinary seem traumatic and focus attention upon technology as an alienating force, rather than a facet of a hybrid holanthropic condition. It becomes possible, then, to suggest that industrial designers, lacking confidence in their intellectual heritage, have allied the process of humanisation to attempts to reverse this supposed alienation and to reconstruct a social narrative of the cyborg by intervening into social situations and by separating the human from the technological. Environmental scientists, reflecting recent moves in scientific logic, argue that linear and reductive modes of science are not sufficient to engage in complex questioning of the manner in which human beings understand themselves and the world, an inadequacy particularly evident in relation to the things humans make in order to interact in the world. Classical ideas, underpinning much Western logic, that reduce the human species to an entity in antagonistic relation to the world are unsustainable in intellectual and ecological terms and appear to go against the way in which people anecdotally describe their lives. Holanthropic analysis then establishes that technology can be understood only as some component of intelligence tied to the evolutionary trajectory of the species, but given form through social and cultural processes. Once one begins to talk in terms of evolutionary biology, however, the soma cannot be discounted in any analysis of being in the world, and more critically cannot be isolated from it either. This invites a new form of holsomatic analysis. The theoretical construction of the physical human has, for the most part, remained fixed about a perceived materiality that has resonance with the familiar and everyday body. One upshot of this is that, while humanity and technology can now no longer be considered as anything other than a hybrid holanthropic condition in social and cultural analysis, the same cannot be said of attempts to understand the human soma. While it may appear self-evident to contemporary designers that humanity and technology are heterogeneous, it is becoming increasingly recognised by cognitive scientists that cognition can be more completely understood, not as a purely perceptual interpretation and analysis *of* the world, but in terms of an embodied and somatic engagement *with* the world. Some design-led approaches to embodied interaction appear to be entrenched in methods of analysis that make it difficult to incorporate the full holsomatic account into design logic.

In order to make progress, it is important to return to a review of how granularity in analysis provides a changed view of reality and not a changed reality. This demonstrates how it is important when one considers human-technology relationships to undertake a form of extent analysis in order to be sure that valence is maintained in terms. A number of attempts to maintain stability in terms have been made by members of the industrial design community, but these must be overcome if a form of extent analysis that accounts for holsomasis is to be included into their discourse. The role of **chapter eight** in the thesis is to provide a closing argument suggesting that, in order for industrial designers to find a way to engage with the anoetic, it will be necessary for them to find a means to 'artefactualise' the enaction of the hybrid-human at a subtle and intense degree of granular complexity. At this scale and complexity it will become clear that no meaningful closure of the human is possible and that therefore a means will be required for some kind of extent analysis to engage productively with a new found holanthropy.

It can be demonstrated that material scale and extent are linked to the granular sophistication in the conceptual and technical models that are applied to their analysis. An artefact that might appear in orthodox analysis to be a single resolved entity can be shown to be a collusion of many differing modes of analysis set about a range of topological domains. It can then be seen that the materiality and complexity of the artefact are tied to the complexity of its analysis and that this is subject to a significant degree of fluid play. The human soma can be understood in similar terms. However, one reason why people might be reluctant to discuss the idea of holsomasis in terms of coextensive experiences of human technology interaction is that some of these ideas can be associated with previous more hysterical claims of the Futurists and of the 'New Ego', which have become somewhat dislocated from the trajectory of technology history.

Joe and Josephine, the familiar ergonomic line drawings of the human developed in the mid-twentieth century, provide a bounded model of the human for designers and can be understood as an attempt at stability, fixing the human body as a given artefactual form. While everything else may appear to be fluid, designers imagine that they can at least rely upon this model of the human as a fixed material entity. Fixing the human body as a resolved and material artefact may have provided a form of hysterical continuity for industrial designers but has made it impossible for them to account for the ways in which humanity can be considered a hybrid holsomatic condition.

The thesis concludes with a speculative scenario, which reviews some of the ideas contained within the thesis, and sets out some parameters for a future form of industrial design. If, by eschewing the limited artefact models of the human that they hold, industrial designers can come to terms with this understanding, then they will find their imagining of the artefact will shift to a scale coherent with emergent intellectual understandings of the world as a complex and unbound singularity. If artefacts are understood as a materialisation of some hybrid-human enaction, then the anoetic can be considered to point to a need for materiality to be understood in similarly complex and molecular terms. The particular intellectual trajectory and heritage of industrial design, described by generations of people who have taken complexity and brought it into the world as a series of forms, could be brought to bear upon emerging understandings of the world as a continuum.

If designers were to eschew the tendency to define themselves by the nuances of their practice and instead take a view of their expertise as residing within one topological domain or another, they could describe themselves in the terms of the scale of attention they give the world. They would then need to understand that the impetus to humanise technology implies that they should seek a condition of quotidian experience at any degree of granular attention by transforming complexity into the quotidian. In order for industrial designers to find a way to engage with the anoetic, it will be necessary for them to find the means to artefactualise the enaction of the hybrid-human at a subtle degree of granular complexity. Such a granular logic will demand a holsomatic understanding at a range of granular degrees of complexity. At this scale and complexity it will become clear that no meaningful closure of the human is possible. There is not yet any answer as to how designers might take the potential of DNA computation and other biotechnologies, but at least they might then have something of the terminology required in order to construct a brief for the design of one kind of future.

Chapter one

Industrial design and its autonomies

1.1 **An autonomous conglomeration called industrial design**

It is difficult to define industrial design without excluding any number of other ideas that might appear to describe the unique contribution of industrial design to the world.

1.2 **Industrial design and institutional regulation**

Although not regulated with the rigor of medicine or law, industrial design is consolidated into a recognised profession by a number of loosely affiliated institutions, which are held together under the umbrella of a further official body consolidating other national design bodies.

1.3 **Industrial design and technology**

Industrial design's description of itself through its institutionalising body suggests that it 'humanises technology', although it provides no explanation of what this might imply. In making this claim, industrial designers appear to be unique among other professions and practices.

1.4 **Industrial design and its intellectual community**

Industrial design can be understood as an intellectual community. However, industrial designers find themselves having to work with a number of fluid terms when they think about how they might construct a process of humanising technology.

1.5 **Industrial design and the function of fluidity**

Industrial design does seem to have some coherence, and industrial designers do seem able to communicate with a clarity that belies the complexity of the forces shaping their intellectual community. Industrial design has the intellectual skills to explore, with a degree of coherence, how it might construct a process of humanising technology when the terms of reference are fluid.

1.1 An autonomous conglomeration called industrial design

It is difficult to define industrial design without excluding any number of other ideas that might appear to describe the unique contribution of industrial design to the world.

Industrial design, indeed design in general, cannot be precisely defined. The design theorist Tony Fry (1999. p. 4), for example, suggests that design:

> occupies an uncomfortable place, certainly in the English language. No common meaning exists or is likely to get consensual agreement. An understanding of design will never be theoretically secured, simply because design gets configured so differently in the relations of various discourses of its practice, presentation and economic exchange. Object, form, appearance and process, individually or in various permutations, all get designated as what design is. What results is seemingly commonly agreed understandings that are in fact misrecognitions predicated upon the differently adopted referents.

Even designers share this uncertainty as to what constitutes design. This uncertainty can lead to rather ill-thought-through attempts to describe themselves (for example, McCormack, 2007). This uncertainty becomes evident when they evaluate the success of their endeavours. See, for example, Terence Conran (1996, p. 10):

> People have tied themselves in knots trying to define the whole concept of 'good' design and filled many pages with dense critical theories in the process ... You cannot, however, quantify [it], you can only recognise it when you see it.

Some kinds of design activity can be described with some approximation. The craft of ceramics is no doubt an intellectually subtle practice but does share an essential material focus that helps those who are not ceramicists to define it. This material essence helps ceramicists to understand themselves too. Consider ceramicist Donna Hetrick's personal statement (2007):

> Clay is so simple and so ancient. I am fascinated by the many facets of pottery making, from digging clay out of a riverbank, to building a primitive kiln in the hillside or sitting mesmerized as I watch the orange glow of a kiln against the night sky.

Industrial design, however, cannot be so easily described. The essence of industrial designer cannot be described by the manipulation of a particular material, nor can it be understood to be contained by a particular technique. Materials such as wood, ceramics, metals and plastics, or techniques such as weaving, moulding, spinning, beating or extruding, which define other crafts and creative activities, are included within the resources of industrial design, but do not define it.

While not defined by the outcomes of its intellectual endeavour, the products of industrial design may bear some morphological resemblance to the outputs of other creative practices and crafts. Among other things, industrial designers are responsible for the formation of clay pots, decorative accessories and garments . When individual designers describe what they do, they hint at something rather subtle and complex that is contained within their intellectual approach to organising the world. For example, on the homepage of its 2006 website (www.theproductgroup.co.uk), the Product Group, a small UK-based design consultancy, describes their process in terms of the controlled and schematic production of a number of qualities:

> Consumers, buyers, in fact all of us shop with ideals in mind; lighter, faster, cleaner, easier, stronger, sexier, cheaper, more comfortable, efficient and stylish. We all want contemporary, eye-catching products with real advantages. Understanding the influences and rationale at work in the high street allows us to assemble a vision of what the next step should be. Shaping that vision into a desirable product is about controlling how technological, mechanical and formal aspects are spliced together to give that creative edge.

The Product Group speak of 'ideals in mind', of 'assembling a vision' and about the 'splicing together' of the complexity of an intellectual process in order to 'give' something it illusively terms 'that creative edge'. There is an implication in this language that design is something that cannot be easily expressed; rather, there is some implication of an occult sensibility, which cannot be explained readily, but which emerges out of some rather fluid and complex negotiation of ideas and forces. The Product Group implies, too, that design is not best understood through the products of its intellectual endeavours, but for its value as a process in itself. This is something that IDEO picks up on. On its website (www.idea.com), IDEO, a large multinational design consultancy, part of the multinational Steelcase corporate group, talks little of the products of its endeavours but rather places its focus upon processes of transformation and the realisation of latency:

> Independently ranked by global business leaders as one of the world's most innovative companies, we use design thinking to help clients navigate the speed, complexity, and opportunity areas of today's world. We help organizations in the business, government, education, and social sectors innovate and grow in three ways: We identify opportunities for growth by revealing people's latent needs, behaviours, and desires, and visualizing new ways to serve and support people. We design new offerings - products, services, spaces, media and software-based interactions - and preserve the relevance and delight of the original idea from concept to market expression. We enable organizations to transform their cultures and build the capabilities required to innovate routinely.

IDEO offers an eclectic vision. The designers at IDEO design in a strategic setting that 'helps' clients navigate, 'identifies opportunities' and 'enables'. In its strategic attempt, IDEO can best describe design by its relationship to other dynamic management techniques. It cannot adequately describe design without these references. Designers just do design: And this mysterious process of design is somehow allied to a strategic vision. The term 'design' can of course be associated with other terms that might appear at first glance to define design to a particular craft or process. But, in the case of industrial design, no craft or process resides at the essence of its definition.

Industrial design - unlike ceramics, for example - is not defined by a particular process. Industrial designers appear to share something of a sense that they are engaged in a process, although the nature and scope of this process appear to be rather opaque. Informally, when pressed for a definition, industrial designers tend to default to a view of themselves as being somehow responsible for the formation and realisation of the 'stuff' of the technologised world.[1]

> Ran into jwz at the Meat Beat Manifesto show and he posed the question to me, 'What does an industrial designer do?' My smart-ass answer was 'make stuff!' followed by examples of what industrial designers make these days: furniture, video game controllers, tools, dashboards for cars, etc. But I think my answer was biased by what I want to do as an industrial designer. (All Art Burns, 2005)

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[1] Industrial designers are aware that they share with many of their fellows a fascination with the latest gadgets and with new materials and technological processes. The numerous industrial design research centres and university courses that focus upon an ever-developing and always-changing technological landscape indicate a particular concern with the most up-to-date technology among industrial designers. Of course these centres have emerged in response to drives from designers' clients bringing new technologies to market. Nevertheless it is probably worth speculating that many designers are attracted to the profession by their interest in technology.

The idea that industrial design is defined, or in this case 'biased', by the experience of the individual designer is an interesting illumination of the fluid nature of the industrial designer's rationale. This fluidity is extended to industrial designers' expertise as well. The Industrial Design Society of America (IDSA) demonstrates this fluid expertise in its attempt to explain industrial design to the commercial world. In its description, IDSA (2005) is at pains to cover the many fields that may reside within the industrial designer's expertise and that may be mapped onto the expertise of their, non-designer, clients.

> Education and experience in anticipating psychological, physiological and sociological factors that influence and are perceived by the user are essential industrial design resources. Industrial designers also maintain a practical concern for technical processes and requirements for manufacture; marketing opportunities and economic constraints; and distribution sales and servicing processes. They work to ensure that design recommendations use materials and technology effectively, and comply with all legal and regulatory requirements ... Their expertise is sought in a wide variety of administrative arenas to assist in developing industrial standards, regulatory guidelines and quality control procedures to improve manufacturing operations and products.

By implication, the International Council of Societies of Industrial Design (ICSID) definition appears to demand an extraordinarily wide range of intellectual skills in order for an individual to 'anticipate the psychological, physiological and sociological factors' that might suggest industrial designers have an ambition encompassing almost all human knowledge. Broad sweeping assertions such as this do little to focus upon the specific skill or intellectual motivation of the industrial designer. Nevertheless, and despite all this uncertainty and changeability, there is something in the world called industrial design, and there are people who think of themselves as industrial designers and who sense that they share something of a rather extensive and worthwhile heritage.

1.2 Industrial design and institutional regulation

Although not regulated with the rigor of medicine or law, industrial design is consolidated into a recognised profession by a number of loosely affiliated institutions, which are held together under the umbrella of a further official body consolidating other national design bodies.

Industrial design can appear to be a freeform activity, performing a range of disparate tasks without the certainty of a clearly bounded remit. This lack of clarity is extended into its activity in the world where industrial design exists without a formal regulatory framework. Unlike architects or doctors, for example, industrial designers must work creatively and even unconventionally, yet must conform to standards of public health and safety and to the standards imposed by their clients. These rather ill-defined standards to which an industrial design is supposed to subscribe are represented by a network of institutions.[2] The International Council of Societies of Industrial Design (ICSID) draws together these national bodies into one organisation with global reach, representing industrial design and its practitioners to the world. There are over 150 design organisations around the world that are affiliated to ICSID. It can be compared with the World Council of Churches or Oikoumene.[3] Both ICSID and Oikoumene act as a coming-together of a diverse community of those who share something. It would be surprising to find ICSID described as an ecumenical movement; nevertheless the shared ambition to act as facilitators of dialogue make their rationales appear similar.

Where Oikoumene (2007) is described as 'a unique space: one in which [member churches and faith groups] can reflect, speak, act, worship and work together, challenge and support each other, share and debate with each other ...', ICSID (2007), drawing its membership from a diverse collective of 'professional associations, promotional societies, educational institutions, government bodies, corporations and institutions ...', is described as a means to facilitate an international forum, consolidating its institutional prospectus with a declared prospectus to 'contribute to the development of the profession of industrial design ... an international platform through which design institutions worldwide can stay in touch, share common interests and new experiences, and be heard as a powerful voice'.[4]

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[2] For example: The Chartered Society of Designers (CSD) in the UK, the Industrial Design Society of America (IDSA), the Association of Women Industrial Designers (AWID), Design France, Japan Industrial Design Promotion Organisation (JIDPO), the Korea Institute of Industrial Design Promotion, and Verbandes Deutscher Industrie Designer (VDID), or Design Zentrum (otherwise known as 'Red Dot') in Germany.

[3] Oikoumene (2007) claims that it is 'the broadest and most inclusive among the many organized expressions of the modern ecumenical movement'.

[4] Many industrial design organisations provide definitions. These definitions must be regarded with some care. They often appear intended to project their constituent designers in a particular manner for commercial benefit. It is arguable, for example, that the IDSA holds a view of the designer as an

This comparison is not superficial: both ICSID and Oikoumene can stand only for a set of rather fluid values: neither can license its members nor the individuals who make up the localised bodies that subscribe to it. Having no jurisdiction whatsoever over individual designers, ICSID, like Oikoumene, exists in the midst of rhetoric of universal immutability. No one seems to agree on what constitutes the correct practice of industrial design, and it may be that there is no truly correct practice. Industrial design lacks the valediction of a strong externally recognised institutional identity such as that enjoyed by the legal or the medical professions. While anyone may call himself or herself a priest, individual religious ministries do have some authority over that title; this is not, however, the case in industrial design. In consequence anyone can describe him or herself as a 'designer'.[5] Nevertheless, ICSID is widely held to be the consolidating centre of debate, and, given the breadth and international nature of its membership, it represents the nearest thing to an institution that industrial design has. In the absence of any other institution, the understanding and projection of industrial design that ICSID provides make it likely to be the best place to look for a definition of industrial design. In its definition of industrial design, the board of ICSID appears alert to the broad spectrum of the community of its members. It appears as if, alert to the risk of excluding anyone, ICSID has devised a somewhat open, broad, encompassing and unbounded definition of industrial design. It is reproduced here in full.

> **Industrial Design**
> **Aim.** Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life-cycles. Therefore, design is the central factor of innovative humanisation of technologies and the crucial factor of cultural and economic exchange.
>
> **Tasks.** Design seeks to discover and assess structural, organizational, functional, expressive and economic relationships, with the task of:
> * enhancing global sustainability and environmental protection (global ethics)
> * giving benefits and freedom to the entire human community, individual and collective final users, producers and market protagonists (social ethics)

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extraordinary manager. While a useful projection of the designer as a commercial device, this interpretation does little to further an understanding of the intellectual task of the design profession.

[5] While the in the UK the Chartered Society of Designers (CSD) proclaims that anyone employing a designer who bears its membership or fellowship 'can be assured of a professional service' (CDS, 2005), membership of the Society is neither universal nor necessarily a prerequisite to the claim of designer status.

* supporting cultural diversity despite the globalization of the world (cultural ethics)
* giving products, services and systems, those forms that are expressive of (semiology) and coherent with (aesthetics) their proper complexity.

Design concerns products, services and systems conceived with tools, organizations and logic introduced by industrialization - not just when produced by serial processes. The adjective 'industrial' put to design must be related to the term industry or in its meaning of sector of production or in its ancient meaning of 'industrious activity'. Thus, design is an activity involving a wide spectrum of professions in which products, services, graphics, interiors and architecture all take part. Together, these activities should further enhance - in a choral way with other related professions - the value of life. Therefore, the term designer refers to an individual who practises an intellectual profession, and not simply a trade or a service for enterprises. (ICSID, 2007)

The ICSID definition recognises that industrial design takes many forms and is readily adaptable; it allows space for the pragmatist, the idealist, the engineer, the entrepreneur and the philosopher all to find their place among those who claim to call themselves industrial designers.

However, in its exegesis the designers are tasked with the explicit aim of the 'innovative humanisation of technologies' (ICSID, 2006). There is no hint at what this might mean, but upon examination this rather simple claim stands out as a significant and unique ambition. The stated claim that industrial design humanises technology carries with it any number of assumptions, not least among these that technology is not human. An analysis of this almost throw-away assumption can provide the basis of a more rigorous consideration than ICSID provides.

1.3 Industrial design and technology

Industrial design's description of itself through its institutionalising body suggests that it 'humanises technology', although it provides no explanation of what this might imply. In making this claim industrial designers appear to be unique among other professions and practices.

The IDSA definition extends the institutional assumption that industrial design humanises technology into a commercially strategic role. It calls upon a number of implicit institutionalised understandings of supposed human characteristics or 'anticipations' of industrial designers' expertise in consequence of their education:

> education and experience in anticipating psychological, physiological and sociological factors that influence and are perceived by the user are essential industrial design resources. (IDSA, 2005)

These anticipations represent in themselves an institutionalised 'psychological, physiological or sociological' view of the human and are therefore subject to the debate and variation within the various institutions from within which their terms emerge. The designer is posited as being somehow able to demonstrate the intellectual skills both to synthesise and to hybridise this breadth into a coherent practice with an implicit investment in human qualities and to orchestrate them into successful technological forms:

> The industrial designer's unique contribution places emphasis on those aspects of the product or system that relate most directly to human characteristics, needs and interests. This contribution requires specialized understanding of visual, tactile, safety and convenience criteria, with concern for the user. (IDSA, 2005)

The ICSID definition is more explicit and posits the designer as someone more akin to a distributed influence in human affairs, rather than located in an isolated - while informed - position of masterful synthesis. The ICSID definition can be viewed as an assumption of the human as standing for a set of essentially Western and humanistic values. In this way the ICSID definition posits industrial design within ethical frames of striking ambition and scope.

- Enhancing global sustainability and environmental protection (global ethics)
- Giving benefits and freedom to the entire human community, individual and collective. Final users, producers and market protagonists (social ethics)
- Supporting cultural diversity despite the globalisation of the world (cultural ethics) (ICSID, 2007)

These ambitions are, of course, far-reaching and extraordinarily ambitious. In the ICSID definition industrial design is presented as an institutionalised ring-fencing of a number of intellectual strategies that enable designers to establish, through a somewhat opaque process of analysis,

> the multi-faceted qualities of artefacts, processes, services and their systems in whole life-cycles. (ICSID, 2007)

This intellectual activity is located in an organisational frame, but is expressed as a means of adding value to the commercial exchange of goods and processes and orchestration of relationships:

> structural, organisational, functional, expressive and economic relationships. (ICSID, 2007)

However, there is a hint that industrial design is a poetic activity too, transcending the purely commercial. Industrial design is also a creative and aesthetic activity: according to ICSID, the designer's special skill is the ability to give proper complexity:

> products, services and systems, those forms that are expressive of (semiology) and coherent with (aesthetics) their proper complexity. (ICSID, 2007)

This is a particularly vague notion. There is no attempt to explain what it means to give something its 'proper complexity', nor how aesthetics is necessarily implicated in the process of making things coherent. When, as it is in the case of the ICSID definition, semiology is linked explicitly to ideas of expression, it ignores the full range of rather less-explicit possibilities of understanding how people might negotiate the world. All these rather vague and questionable possibilities are brought together in the ICSID definition in one rather neat phrase. Industrial design is

> the central factor of the innovative humanisation of technologies ... (ICSID, 2007)

ICSID provides no critical attempt to deconstruct the various tensions implicit in these ambitions nor to explain why terms have been employed nor to interrogate their voracity. Proceeding, then, from the assumption that technology is contra-human, the ICSID definition appears to be a deliberate attempt at the projection of an open and conjectural space. Perhaps indicative of a reluctance to become involved in the philosophical complexities of the implications of its definition, ICSID appears to have created a deliberate space for the designer to wonder. How, for example, a semiotic method of ensuring coherent and expressive forms might connect in practice to an ambition to ensure cultural diversity; how forms that are coherent with their proper complexity are necessarily more aesthetic; or even why complexity should be proper at all or indeed what is implied in the choice of that term. The epistemic locations of the human and technology as supposed oppositional terms are, however, a closed debate.

What constitutes humanity is as much socially and historically constructed as it is biological. To be human can imply any number of ideals and actualities; a condition of being, a somatic state, a behaviour, or a genetic code. The human cannot be fully defined by excluding any of these possible definitions, and the notion of the human in play at any given moment is subject to a complex juggling act of many possible definitions. The problem in defining the human really begins only when an imbalance occurs in this complex problem when some new definition becomes possible - consider, for example, the perceptual problems of 'test-tube' babies,[6] although nothing of this complexity is implied in the ICSID definition. Crossman and others (1999) have argued that institutions can be understood to emerge in part as a consolidation and codification of a frame through which a diverse collection of individuals can reflect upon and project themselves. Humanisation is part of a somewhat inexplicit claim that design brings something special to the process of realising technology and presents an easily digestible and apparently readily understandable, if trite, concept; doctors make people well, lawyers understand and construct societal rules, so industrial designers humanise technology. While they might demonstrate a wide variety of practice, the concept that they humanise technology is reiterated in descriptions industrial designers give of themselves. For example, the Design for Humanization of Technology (HUMANTEC) is described on its collaborative homepage as a project bringing

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[6] The shocking prospect of a means to extend fertilisation and human conception 'out of body' was met, by the popular press in the United Kingdom in the late 1970s, with predictions of moral collapse. The response of the UK government was to initiate the so-called Warnock enquiry, setting an academic, theological and scientific committee - chaired by Baroness Warnock - the task of defining an ethical code for the newly realised 'fiction' of 'test-tube babies'. Warnock (1984) wrote in her preface to the report of the enquiry, 'the task set the inquiry was not an easy one. The issues raised reflect fundamental moral, and often religious, questions which have taxed philosophers and others down the ages.' Subsequently such issues of taxing philosophy have given way - outside a minority of certain fundamentalist religious positions - to more quotidian and fiscal debate within the National Health Service. People conceived in techno-science whom most of us accept as full members of human society warrant hardly a mention, even - on occasion - within families for whom the inclusion of techno-science in such a fundamentally 'natural' event is merely regarded as a 'helping hand'. Such is the familiarity of this technology that Warnock does not even achieve reference in the Wikipedia. Who could conceive that in-vitro fertilisation would be anything other than a routine - albeit individually miraculous - procedure? Who would dare to ask the 'test-tube' child whether he or she recognised his or her 'otherness' or the inhumanity of his or her conception? The knee-jerk fear of techno-science now seems rather naive, even irrational; that such a *fundamental moral question*[ing] of what it is to be human turned out to be rather uneventful should not surprise us. It has happened time and again.

universities, design centers, producers of technology and furniture manufacturers [into] a continual dialogue and exchange in order to obtain a panorama of possible scenarios for humanizing workplace technologies. (HUMANTEC, 2004)

Humanisation appears to be a somewhat nebulous concept that is readily attachable, without the necessity of a critical stance, to other attributes of a process of designing. For example, 'the high reliability and improved performance without equal are characteristics of product where the most evident aspect is the reduced volume and consequent 'humanisation"' (intelshow.com, 2003). Humanising technology can appear as an implicit assumption of good design practice, as in Runcie and Wildman (2002), where 'humanisation' is posited in the title but largely ignored as a concept (see also Runcie and Wildman 2002).[7] Humanising technology can be used to imply a particular stance in the approach to design. Nomensa (2007) imply that they involve people in their process.

Nomensa apply a human-centred design (HCD) process to projects, and support and advise our clients on how to best incorporate them into their own processes. HCD (also known as 'User Centred Design') is a group of methods that involves end-users in the design of the product from day one.

But there is nothing in the description of the Nomensa process to explain why the involvement of people necessarily humanises technology. This process of involvement is felt to justify the inclusion of humanising technology into the company logo:

nomensa
humanising technology

Rather as clay is to the ceramicist, some process of humanisation then appears to be at the centre of industrial design. Unlike clay, which is physical and apparent, humanisation is far less tangible and a whole degree more fluid, setting technology as an opposition to a perceived notional idea of the human as some kind of constructed entity or value. Over the

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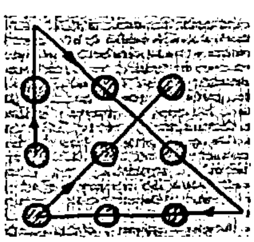
[7] In the United Kingdom Design Council's 'Humanising Technology' project, reduced volume is attached somewhat arbitrarily to a notion of humanisation, assumed (we must guess) to be attached somehow to a process of ecological sustainability and the reduction of complexity (see Runcie and Wildman, 2002, 2003).

course of the last quarter of the twentieth century, the understanding of what it is to be human became increasingly subjectified. Mike Michael (2000, p. 1), for example, reflects the complex drift towards the sociological construction of the human in the opening line of *Reconnecting Culture, Technology and Nature*: 'There are no humans in the world. Or rather humans are fabricated - in language, through discursive formations, in their various liaisons with technological and natural actors, across networks ...'. A humanised technology must itself rely upon understandings of what it is to be human, or of what constitutes a human, that are non-consensual and negotiable. They shift more radically than any understanding of clay, can never be declared with any certainty and must always remain a fluid and elusive construct. And so industrial design sets out to resolve a problem that is caused by its own institutionalised conception. Somehow industrial designers have to make sense of all this, without becoming engaged in a constant endeavour to bring humanity and technology together into some form that is itself an internal contradiction.

In *How Designers Think* Lawson (1997, p. 230) illustrates the design process, and the particular cognitive skill of the designers, with the nine-dot puzzle. As Lawson (1997, p. 229) says: 'In design, pseudo-puzzles can be easily created by fixing a limited number of constraints and then puzzling out the results.' The nine-dot puzzle presents a common trap into which the unwary fall when they set about solving problems.[8]


The nine-dot puzzle

Lawson argues that the failure to solve the problem of the nine-dot puzzle is a consequence of the construction of an unspoken rule (that the lines drawn should be contained within the space of the nine dots). People attempting to solve the puzzle spontaneously invent this rule and assume it to hold, when of course this is not the case. When the lines are extended

[8] The task set in the nine-dot puzzle is simple: join the dots with only four straight lines and without lifting the pen. After some struggle, many give up the task, which seems impossible - unless, of course, one extends the line beyond the bounds of an invisible box implied by the dots.

beyond the limit of the dots and the task is resolved in an instant. Lawson (1997, p. 230) extends this metaphor to argue that designers are confronted with problems that are trapped within self-imposed rule sets and to claim that designers are more able than the general population to 'think outside' commonly assumed rule sets.[9] This model can be extended to the understanding of industrial design itself.

Gray and Malins (2004) have described how 'spectacles', 'sieves' and 'filters' can be used as metaphors to describe how designers research ideas. Although a tempting metaphor, designer sunglasses or sieves imply a process that is predictable and even. Unlike the ceramicist, who can have a fairly common and coherently transferable conversation about clay, in industrial design the task of humanising technology is not laid out by ICSID or any of the more localised institutions. One understandable and justifiable reason for this is that, since the human is an extraordinarily uncertain and mutable idea, there can be no established codification as to how designers should interpret their claim. As a consequence, industrial designers can be at liberty to take a view of the particular micro-dynamic or macro-dynamic process of humanisation pertinent to their concerns. Accordingly, a designer may take any number of views of what it means to humanise technology, ranging from the socio-political to the philosophical. Any consensus of what it means to humanise technology then must emerge from the complex interaction between any number of interpretations of what it is to be 'human' with similarly fluid interpretations of the 'inhumanity' of technology at play at any moment in time.

1.4 Industrial Design and its Intellectual community

Industrial design can be understood as an intellectual community. However, industrial designers find themselves having to work with a number of fluid terms when they think about how they might construct a process of humanising technology.

Industrial designers often describes themselves as a community:

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[9] This research, acting initially on a hunch that industrial design could and should have something to say about biotechnology, explicitly sets out to remove where possible self-imposed constraints and to include a broad and inclusive range of ideas - some of which might seem quite extraordinary in the context of industrial design - and to work with them. Ideas are played off one another to create a resolution in which the lines go far outside what is claimed as a self-imposed box. Accordingly the thesis sets out to eschew an apparent tendency among recent industrial design researchers to accept their intellectual posture as a given, or strategically to review industrial design from a distance without necessarily understanding the critical implications of the assumptions they make in arriving at a given solution.

The Spirit of the Industrial Design Community is in the constant discussion of ideas that we have. (RMIT, 2005).

Veterans of the industrial design community know ... (McDonough, 2005)

Designed to bring together the PC industry, the industrial design community, and end-users ... (AGM, 2005)

Online communities (for example, JISC, TAXI, Core77, AIGA, Designtalkboard, reBang, DesignSponge or Coroflot) provide 'a place for anyone interested in the creative industry to sit down and have a virtual chin-wag' (Designtalkboard, 2005). Other locations are intended for more considered and scholarly discussions: the JISC PhD Desig', the Design Research Society and the Design Philosophy Society discussion resources are examples of this.

In formal modes of information studies the notion of the analysis of 'communities of practice' is a recognised, although somewhat contentious, field.[10] Wegner (1998, p. 527) describes the community of practice as 'the informal relations and understandings that develop in mutual engagement on an appropriated joint enterprise' and the formation of a 'situated social construction of meaning'. The concept of the community of practice can provide a way to understand how things get done in organisations without resorting to an analysis of the formal rules or methodologies claimed by an organisation of its management structures. This provides a useful way of understanding the meta-conception of uncertain organisations and of analysing virtual communities where the specificity of inspection is in contention. In an analysis of industrial design, by thinking of it as a community, it becomes possible to interrogate how the understanding of the community is predetermined by its own established problematic.

In industrial design the idea that technology is humanised becomes an 'activity system about which its participants share understandings concerning what they are doing ...' (Wegner, 1998

[10] Communities of practice became something of a buzzword among those concerned with corporate management with the publication of 'Cultivating Communities of Practice' (Wegner, McDermott and Snyder, 2002). Wegner and colleagues distil ideas developed over the preceding decade and present them as an easily digestible text and, with managers in mind, as a tool for action. While this text presents models of successful organisations, the concept of the community of practice is primarily a tool of analysis. Writing in the *Journal of Information Science*, Cox (2005) presents a useful comparative analysis of four 'seminal works'. Cox suggests the term 'communities of practice' is becoming increasingly ambiguous and is losing its meaning in the face of challenges to the notion of both community and practice.

p. 528). This shared problematic becomes a rhetorical narrative. Brown and Duguid (1991), for instance, have stressed the importance of a shared narrative in the formation of a community and the essential nature of its reinforcment among its participants. Gherardi, Nicolini and Odela (Cox, 2004, p. 529) suggest that the term community is important because it is dependent upon social processes:

> a way to emphasise that every practice is dependent upon social processes through which it is sustained and perpetuated, and that learning takes place through engagement in that practice.

Designers, like other professionals, have many formal opportunities to meet (at conferences, for example), but many design conversations take place at semi-formal events. The importance of social events surrounding a graduate show should not be downplayed as an opportunity for designers to meet and to discuss the experiments on display as a means to form a consensus in the community.

Communities are identified for study because it is possible to examine both the consolidated basis by which a community holds itself together and some of the underlying implications of the exegesis to which the members of that community appear to subscribe. When this exegesis is apparent, it is examined to reveal any underlying assumption the community members might hold. It then becomes possible to analyse how a given assumption among members of a community might prevent them from engaging with a new condition. In ethnomethodological studies (Garfinkle, 1967) some intervention is made in order to examine how the community might cope with change. We could, for example, ask whether ceramics could survive the absence of clay. By asking how clay enables that community's members to understand what it is they do, that understanding can be challenged. It might, or might not, then be possible to extend the scope of the community. However, in the industrial design community the exegesis, although clearly stated, is far from certain. The claim of humanising technology is both open to interpretation by individuals and subject to shifting understandings of both the human and the technological form.

The necessity of this focus upon the changing landscape presented by client demands and emerging technologies leaves industrial design little time to reflect and to turn its analysis back onto itself and to uncover deeper schematic concerns at the heart of its practices and processes. While designers have spent some time considering the process of design, they have placed rather less emphasis upon the philosophical centre of their community. If industrial design is truly a community of practice, then the work of design graduates would need to conform to this consensus, lest it run the risk of being dismissed as being outside the bounds of industrial design. Cox (2004 p. 531) cites Wegner, whom he claims 'finally' supplies a definition of the community of practice as those whose members are engaged in a 'mutual engagement' with an 'indigenous or appropriated enterprise, and creating a common repertoire'.[11] The implication for industrial design, when it is considered as a community of practice, is that the process of the humanisation of technology is held together by those who are attempting to understand what it means.

In order for a community to stay coherent, it is necessary for it to be shaped around a number of assumptions that are taken as givens. Studies have shown that industrial design students conceptualise their practice in a manner that appears to be constrained by the cultural assumptions that they make.[12] The discussion of the process of humanisation takes place in a community that carries with it a number of assumptions, founded in broader culture, that are likely to create a hegemony. But escape is possible; Mauss (1934) drew attention to the Habitus, which is the accepted everyday hegemonies that shape the way one lives; because one just lives that way and has never considered otherwise. Mauss refers to these everyday behaviours, phases and actions as the 'techniques du corps' and suggested that these could be escaped only when they were recognised and exposed. Bourdieu's *Social Theory* (See Harker, 1990), much cited by design researchers (see Hobson and Rogers, 2005), defines a broader social construction of identity and behaviour. If Mauss reminds industrial designers that they think as they do because they are industrial designers, then Bourdieu's Habitus suggests a view of the industrial design community as an active and self-sustaining body. The

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[11] The means by which industrial design establishes any common repertoire it might have is rather ill defined but appears to emerge in a somewhat autopoeitic manner from the defining statements of the institutions and from the shared sense of intellectual intent that binds - however loosely - the community of industrial design together.

[12] Hobson and Rogers (2005) have explored cultural difference amongst a group of Scottish industrial design students. Their albeit small-scale study was intent to reveal the effect of cultural capital (Bourdieu) in a postmodern global culture. Students were asked to sketch design a number of common domestic artefacts. The sketches were then studied in order to ascertain difference and commonality between students of differing cultural origins. Hobson and Rogers found that, in keeping with an earlier studies (Crothers, Montgomery, and Carke, 2003; see also Tseng, Scrivener and Ball, 2002, cited in Hobson and Rogers, 2005), students were more influenced by the type of product they already had experience of, rather than any cultural difference per se.

conception of the process of humanising technology can then be neither wholly objective in the face of a problem, nor the product of an entirely free creative will. This suggests that industrial designers understand the world in a way that is, to some extent, conditioned by their own terms. In other words, industrial designers understand technology to be other than human because they see about them a form of technology that has itself been constructed in a manner such that it reinforces designers' own prejudices. The Habitus, however, is not an inevitability; by being alert to it, one can act upon this knowledge. One can use self-will to overcome its hegemonic constraint upon actions.

While industrial design can be understood to be a community that places the process of 'humanising technology' at the centre of its discourse, there is an absence of any significant attempt to codify the terms of that conversation. Rather the notion of what might be implied by the human has been allowed a significant degree of play. While formal notions of what might be implied by technology has changed over time, the human has become somewhat disconnected from a chartable trajectory. Designers are at liberty to set the human where they see fit within a field of variability in oppositional terms. Technology can be interpreted by individual industrial designers to be more or less human and the human more or less technologised.

During the early part of the twentieth century, Benjamin Lee Whorf, a self-taught ethno-linguist, developed a hypothesis of linguistic relativity. The Whorf hypothesis suggests that 'all observers are not led by the same physical evidence to the same picture of the universe, unless their linguistic backgrounds are similar or can in some way be correlated' (see Carroll, 1956). Whorf died before he could fully develop his theories, but his ideas resonate today, where the world is widely accepted to be at least partially constructed in a relativistic manner from the words we use in the culture we inhabit.[13] The implication of Whorf's work is that

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[13] Whorf looked at the Hopi people of North America. For example, whereas English presents a temporal world, Whorf revealed how the Hopi language, describing events without the linearity of time, is founded instead upon the momentary validity of observation. This is rather a difficult concept for speakers of Western languages to understand. When Whorf studied the Shawnee, something similarly striking was revealed. The English phrases 'I push his head back' and 'I drop it in the water and it floats' are conceptually dissimilar and appear to us, as Western speakers, to be entirely unrelated. However, written in Shawnee, both phrases can be deconstructed to demonstrate conceptual similarity: (i) a condition of force, (ii) a point about which movement occurs, (iii) to cause to move or stop and (iv) an action on my behalf; 'ni-kwoek-ho-to' in that language. (Carroll, 1956). Through the illustration of the Shawnee language, Whorf claimed that language determines conceptualisation. Amy Stafford (2005) has questioned Whorf, referring to Suzanne Romaine (1994). She points out that, if we are so determined by our linguistic

seemingly inherently stable understandings of the world, such as the progression of time or the relationship of objects, can be entirely culturally determined. There are no truths other than the truths accepted and implicated deep in cultural understanding. For example, understandings of the universe have changed over time with the development of scientific understanding, and yet universal models prior to their subsequent discounting were perfectly adequate. In the industrial design community it appears to be something of a given that humanity is not by definition, technology; that view frames and shapes the way that problems are approached and how designers talk about their ideas.

Buchanan (2002) has outlined the 'doctrine of placement'. The 'doctrine of placement' suggests that individual members of the industrial design community occupy individual and flexible thought spaces, which are 'placed' within the broad scope of meanings of the community. By 'placed' Buchanan suggests that a cognitive model is defined by the particular individual and collective experiences of the world and by 'natural' processes of individual ideation. Buchanan (2002, p. 11) suggests that ideas, 'such as those defined by signs, things, actions, and thoughts', shape the individual placement of designers. The placement of any particular designer can be understood at any level of inspection, from the personal to the institutional.[14] When industrial designers consider what it means to humanise technology, they have no clear codified rule set to subscribe. Individual members of the industrial design community must be aware that, when they construct a cognitive model, they are themselves 'placed' and subject to the same forces of the culture and materials in which they imagine they intervene. This implies that the wider industrial design community both gives shape to and is shaped by its constituent design personalities at any given moment and is itself in a state of constant flux. The nuance and personal narrative experience that go to form particular designers are subtle and complex but come together as 'sources of new ideas and possibilities when applied to problems in concrete circumstances', but they also define 'boundaries to

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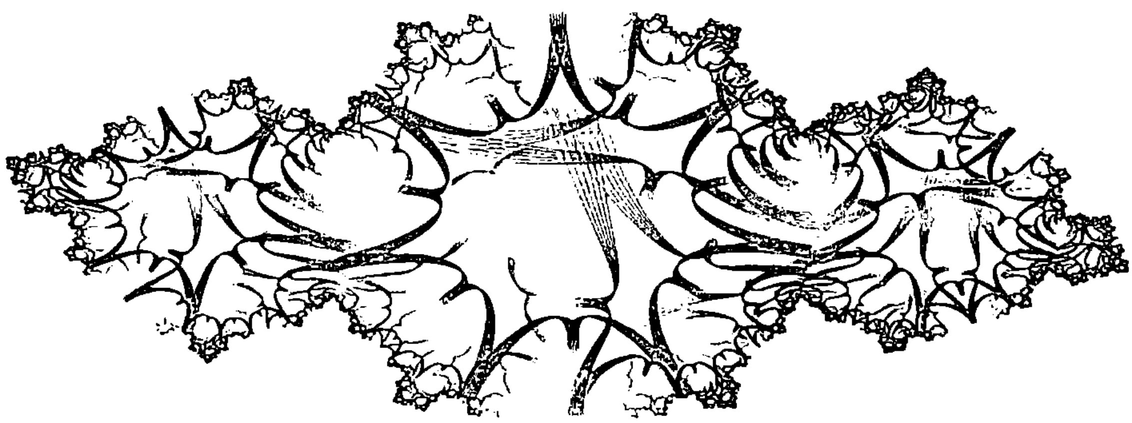
cognition, as Whorf believed, then how can we have independent thought within culture. After all, words are subject to variable interpretation even within families. (Romaine, 1994)

[14] The doctrine of placement can be thought of, perhaps, as an extension of Piagetian thought, in the sense that a 'schema' (Piaget) can be understood to be an organised 'world view' shaped by knowledge, skills and experience. Placements appear to be some kind of special 'designer schema' locating the conceptual position from which industrial designers work, and accept too that they 'have boundaries to shape and constrain meaning, but are not rigidly fixed and determinate' and are 'sources of new ideas and possibilities when applied to problems in concrete circumstances' (Buchanan, 2002, p. 10).

shape and constrain meaning, but are not rigidly fixed and determinate' (Buchanan, 2002, p. 10).What it means to humanise technology is never fixed and is subject to constant shift: Grainger suggests that, 'A concept is an instrument and a history, that is a bundle of possibilities and obstacles' (Barthes, 1964, p. 99).

Just as technology appears to change form as it develops, so the broader understanding of the human changes over time too. One consequence of this continual shifting is that the process of humanising technology is almost impossible to fix as a codified and agreed certainty. And yet the sense of what it is to be human just about seems to hold together and binds industrial design into an intellectual community.



Rather in the manner of a Spirograph, design ideas appear to orbit some invisible, unspoken, locus of the process of humanising technology. In a spirograph a combination of coordinates produces patterns that are more complex than the simplicity of their input data might suggest. Just as it is intensely difficult to take a spirograph pattern and to isolate the coordinates of its input data, so the pattern of design ideas do not reveal, with any clarity, the combinations of data that determine them. With a spirograph it is not possible or useful to glean anything by taking a momentary fix of the developing pattern. Similarly, the design process appears almost impossible to fix. Industrial design is shaped by a critical vocabulary contingent relative to a network of indeterminate vectors, themselves shaped by traditions of reasoning and by changing understandings of the human. This may seem to mirror the design process itself, which can be interpreted as a process of the management of variability. The designer must find form from complex and variable potentials and resolve these into a fixed construct that maintains the possibility for development. In 1967 Schön described processes of conceptualisation as a kind of circulatory motion in which new ideas refer to the discourse they understand to be part of their genealogy (Schön and Schön, 1967). One implication of Schön's circulatory motion is that, when designers construct new ideas, they do so with reference to the history of the community and its established precedents. The difficulty for them is that the logos about which their community is oriented (the humanisation of technology) is itself subject to its own trajectory. It is little wonder that industrial design cannot be pinned down or that a measure of good design cannot be found.

Imagine if someone had undertaken the seemingly impossible task of plotting and modelling the infinitely complex and constantly mutable intellectual forces that bind together the community of industrial design. Even if this task were completed it would not be surprising if the resulting metamodel (Tomiyama et al., 1989) would be rendered dysfunctional. Attempts to understand the process by which designers solve problems or manage their strategies are numerous. Chris Jones (1992), for example, described the 'glass box' and 'black box' approaches to design methodology. The 'glass box' approach is a design system 'based on its logical process and decision sequence. The design process [is] a series of events, which includes identification, analysis, synthesis and evaluation' (Jun Xu, 2003) and the 'black box' approach is one whereby design is a mysterious and 'abstract process that occurs in the mind of any given designer' (Jun Xu, 2003). Jun Xu has claimed that the 'black box' approach is not open to analysis, and so presents one idea reinforcing another - that design is somehow a 'magic' process. The process of humanisation then would appear to fall into the category of some kind of occult art and not a scientific process. Where we might once have imagined this in terms of a structure or perhaps a complex framework of intersecting struts, today we might think of a continually metamorphosing, poststructural and stereometric blob emerging in consequence of some kind of algorithm (Lynn, 1998, p. 91) or maybe a contorting topological surface or meshwork (De Landa, 2000, the result perhaps of some kind of complex and chaotic emergent process.

Industrial design is best understood as a community that is regulated by institutions that mask the variability in the terms about which they are constructed. This community holds itself together by subscribing to these terms without necessarily realising the role that this understanding plays in the creation of its own intellectual problematic. The variability of the terms at play in the discussions among members of the community can be no more easily mapped than a cloud of dust or a plasma field. The conersations, like the terms of the discussion, are dynamic. The practice of humanising technology is fluid, and designers themselves are dynamic: they come and go, they have lives beyond the industrial design community, they are culturally influenced and they are differently skilled.

1.5 Industrial design and the function of fluidity

Industrial design does seem to have some coherence, and industrial designers do seem able to communicate with a clarity that belies the complexity of the forces shaping their intellectual community. Industrial design has the intellectual skills to explore, with a degree of coherence, how it might construct a process of humanising technology when the terms of reference are fluid.

In his description of early science, Ferguson (1994) provides a useful allegory that can shed light on the diverse ambition of the industrial design community. Francis Bacon reflected the times in which he lived, though his disinclination to Aristotelian thought and his construction of an inductive method of enquiry were reflected in the connective and interactive nature of the alchemical and hermetic thought he sought to replace. Without a modern science, ideas could be constructed and analysed only in a field of fluid terminology and shifting associations. Bacon's scientific method can be understood as an attempt to find a way through this fluidity and a search for some degree of inductive certainty in it. However, the method of exploration would call upon the success of the occult traditions in dealing with fluidity and uncertainty. Ferguson refers to Francis Bacon's attempts to construct a model of ideation and argues that a fluid notion of engineering resides at the heart of scientific discovery. Ferguson suggests that an apparently fixed process of enquiry such as science was understood at its foundation to be a fluid interplay of intersecting processes. In *Engineering and the Mind's Eye*, Ferguson (1994) discusses the proposal made by Francis Bacon in 1624 that a new set of trades would be needed to advance the scientific revolution. Salomon's House, a kind of prototype research laboratory, would house panels of scholars who would work together to consider, discover, realise and exploit the new-found knowledge about nature and to demonstrate the role and vigour of practical experimentation and interaction in the generation of scientific knowledge. Just as there would be scholars who would drill down with intense focus upon a single isolated problem, the *Compilers*, would be other scholars - the *Interpreters of nature* - who would take a broad philosophical view of greater things. The

Compilers would carry out essential experiments, and the *Benefactors* would find the way to exploit these experiments and construct 'things for use and practice for man's life and knowledge'. Next the *Lamps* would think of new experiments affording wider generalisations about the nature of things, and finally the *Interpreters of nature* would 'raise the former discoveries by experiments into greater observation' (Ferguson, 1994, p. 155).[15] In Bacon's terms industrial designers are sometimes *Benefactors*, who would take knowledge and construct it into useful things, and sometimes *Lamps*, who after consultation would devise new experiments that would enable wider views of the world (Ferguson, 1994, p. 155). The *Lamps* would make ideas possible, and retain the fluidity. Industrial design, a complex process of accumulation, investigation, speculation and synthesis, draws together a number of disparate and often contradictory ideas and synthesises them into coherence. The industrial design community takes complexity and assembles it in such a way as to make a coherent locus about which new levels of complexity can form.

The industrial design community operates in an echo of modernism and its ideologies of the progress of humanity. Industrial designers had only a small part to play in the formation of modernist ideologies, but have allied themselves to it and supported its drift, arguably without a complete intellectual understanding of its wider philosophical implications. Now that modernism appears to be faltering as an intellectual centre of culture, individual members of the industrial design community find themselves wrong-footed and are struggling to readjust to changed circumstances. The industrial design community then cannot be at all certain of what it means by the progression of humanity, but it understands that it has some vital role to play as a kind of interlocutor in the fluid indeterminacy of human technology relationships. Picking up modernist design practice, the industrial design community is used to sorting out complexity and simplifying it into a resolved technological form. One of the skills of individual industrial designers is that they are rather adept at taking complex technologies and making them available to non-experts. One way to understand how industrial designers do this is to recognise the extent to which they nest boxes within boxes. Technologies are simplified into containers of complexity. A contemporary device may be understood as a box that itself contains other boxes that then contain yet more boxes. Plastic cases contain boxed and sealed

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[15] The House of Salomon, alluding to Salomona, the mythological King of New Atlantis.

control or power-supply units that themselves contain integrated circuits concealed in tiny boxes. Designers do this both with the things they design and with the way in which they construct ideas.[16] The simplicity of the boxed concept can conceal the complexity from the user both in an operative sense and also in terms of its intellectual precedence. The mobile phone, for example, has any number of complex trajectories of technological development, each with its own complex history. That this complex history troubles the user of the mobile phone so little is due in some part to the skill of the industrial designer, who takes a complex conceptual rhetoric and converts it into a single noun. The complex trajectory is reduced to the 'mobile phone', which can appear ahistorical. This is not an accidental process; for example, the work of Dieter Rams is described as being the product of an author of products that are explicitly simple:

> unerringly elegant and supremely versatile. Units were made in modular sizes to be stacked vertically or horizontally. Buttons, switches and dials were reduced to a minimum and arranged in an orderly manner. Rams even devised a system of colour coding for Braun's products, which were made in white and grey. The only splash of colour was the switches and dials.
>
> Rams' objective was to design useful products which would be easy to operate. Yet he achieved much more by dint of the formal elegance and technical virtuosity of his work. Rams' designs always looked effortless with an exquisite simplicity. (Design Museum-Rams, 2007)

This urge towards the simplification and reduction of complexity is reflected in the way in which the industrial design community uses language. Members of the industrial design community often use very simple phrasing; their writing is often straightforward and clear. But individual industrial designers are not stupid; the complexity of their task means that they have to work with so many people, with so many techniques and in so many different ways that their expertise resides in both the clarity of their communication and the breadth rather than the depth of their understanding. This can make the industrial design community appear shallow. Unlike many of the specialists they encounter, an individual industrial designer must, as many of the descriptions of designers suggest, know something about almost everything. Individual industrial designers call upon a wide spectrum of knowledge and cross-reference it

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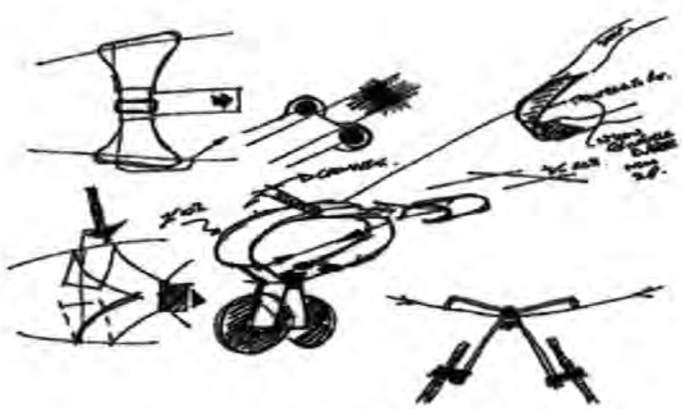
[16] It will be argued here that industrial design theories have attempted to repeat this model with the human being.

in a broad synthesising analysis in order to construct an outcome that seems to make sense. Rather than using words, the industrial design community call upon skills of sketching. Sketching can be understood as an attempt to reintroduce complexity into the design process or at least as a recognition of the complexity and fluidity in an unresolved design. Sketching is more than a merely illustrative technique; it

> is a way to think. Ideas develop and grow in the conversation between eye and hand. Sketching is not merely a matter of documenting images that are already complete in the mind's eye. Thinking occurs, quite literally, in the manual actions involved in creating the sketch. It is a way to communicate. Design ideas are made available for others' inspection, appropriation, criticism and development. It is a way to persuade. Other stakeholders in the design process may be convinced of the value of a design idea through sketches. (Lowgren, 2004)

The sketch enables designers to resolve complexity and to communicate this process, which they appear rather poor at describing to others. As Conran (1996, p. 10) says, 'you only know good design when you see it'.



Pull Over Kayak Trolley, Design Concept

See: http://www.pull-over.com/pull_over_kayak_trolley_design_process.html

Sketching is then an intensely intellectual process and not a simply a skill of penmanship. Industrial design is professionally situated, and sketching has been used with a particular end in mind. The individual member of the industrial design community's voice is expressed through a shared language of visualisation. In essence, then, sketching has been used to convey ideas that are rooted in the visible (Pipes, 1990). It stands to reason that there is no resolved mechanism to draw the invisible or the ineffable in any manner that is itself not visible. The complexity of sketching hints at the cognitive abilities of industrial designers. Sketching suggests that industrial designers are bound to be somewhat confused when concepts cannot be visually represented. Uncertain activities such as the humanisation of technology may appear at first sight to be beyond visualisation and the reductive processes of simplification. However, this may not be the case; it may be that the process of humanisation is something that should not be understood as one might understand other problems, and sketching can be extended to be an intellectual process that is not necessarily oriented towards the visible. Industrial design has a heritage in shaping ideas that others adopt. One problem that the industrial design community encounters is that its broad analysis may be challenged by others who, being specialists, understand the knowledge in question to a more significant depth. The intellectual skill of the individual member of the industrial design community is to weave ideas together to build a bigger picture that itself becomes a new view of the world. It is arguable that some of the great ideas of twentieth-century philosophy can be tracked into earlier, rather less formal and technical, design conversations. When twentieth-century philosophers (such as Heidegger) are read, there is much that resonates with the polemic of the early twentieth-century industrial design community in his more resolved philosophical logic. It is then quite possible to uncover the inexplicit intellect of the industrial design community and to claim the insight for itself. The industrial design community could argue with some justification that works of art such as Koons's *The New* or even Duchamp's *Readymades*, for example, while revealing the *art* in the everyday, fail to pay due regard to the intellectual impetus and heritage of the industrial designer. It would not surprise the industrial design community that art can be found in the vacuum cleaner or the urinal.

Individual industrial designers must be good at thinking differently and good at thinking as they act. The landscape in which designers work is constantly shifting, and so industrial design is invented somewhat on the hoof, such that designers have little time to reflect. Since the process of humanising technology appears to require a fluid and exploratory method of analysis, it cannot start with a clear question. In order to research, an individual member of the industrial design community can rarely engage in a simple literature review and then enact a study to arrive at some conclusion or other. The industrial design community finds itself enacted while it is operative, and is a bootstrapping process. While commentators can reflect upon shifts and changes in the dynamics of technological understanding across time, industrial designers are at work in a competitive commercial climate, humanising technology as best they can and making the best of what they understand at the time. The industrial design community must operate within a network of imperatives; their 'placement' is constructed by the need to liaise with and to win new clients, or with the need to get their 'boxes' to price and to market. They must operate within a shifting field of changing tastes and styles and a global marketplace that does not always value intellectual insight and anticipation. Individual industrial designers are used to uncertainty and to the questioning of orthodox perception; they are as well placed as anyone to engage with the fluidity of the oppositional terms that resides at the core of their own community. The industrial design community, it could be argued, is adept at finding ever new ways of talking about the process of humanising technology that seems to be coherent in some way with its own particular understanding of both the humanity and the technology with which it operates. In order to do this, and to remain current, individual industrial designers must constantly reimagine themselves and must engage in a process of continual, intellectual interrogation of their purpose in the world. Is it possible then that the industrial design community can question the fundamental axiom that underpins its discourse and still retain coherence in its understanding of itself as a coherent community. The many fluid processes that surround the industrial design community are themselves complex, but they function in such a way that individual designers can take complexity and resolve it into the simplicity of everyday forms. The industrial design community's methods are constructed in order to recognise the complexity of this task.

There are many texts today that speak of fracture and disjuncture and of starting afresh, but, by retaining the fellowship of the old thinkers, it might be possible to catapult debate forward without dislocation. This method of engaging in theoretical and speculative conversation recalls a way of discussing industrial design that was effective in earlier times and has some considerable precedent. Over the past 150 years or so there have been a number of texts, manifestos and treatises that have originated from designers[17] and that have resonated around the community. These provocative texts, many of which are set out in Gorman's *Industrial Design Reader* (2003), occupy a significant place in industrial design history to such

[17] For example, three particularly significant texts that are good exemplars of an intervention into the conversation of the industrial design community are Loos, 'Ornament and Crime' (1910), Theo van Doesburg, 'The Will to Style' (1922) or, more recently, Dieter Rams, 'Omit the Unimportant' (1984). See Gorman (2003) for reprints of all these examples and many more.

a degree that they remain interesting and provocative, many years after their original publication. The most successful of these texts set out a number of rationally argued position, which have in turn come to inform and inflect the direction of industrial design and the conversations of its community. Sometimes these texts have preceded, by many years, the technological developments that they anticipated. Provocative and interventionist texts have played an essential and vital role in industrial design's intellectual development, and the attempt to find coherence in history and to project the trajectory of industrial design forward could be understood to be part of that heritage.

In the 1960s Rittel, seeking an alternative to understandings of design as a systemic and structurally driven process, proposed the idea that design can be understood as series of confrontations of 'wicked problems'. Wicked problems are an acceptance of the indeterminate nature of the design process, and the resolution of 'a class of social system problems which are ill formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications of the whole system are thoroughly confusing' (West Churchman, 1967).[18] Rittel's approach is just one derivative of 'Soft Systems Methodology' (SSM), building upon Optner's concept of the mid-1960s that a system can be understood as a series of sub-systems.[19] There are any number of derivations of SSM, many of which have become systematic and formalised, but there is an analytical process that is used in science in order to study systems of massive complexity - for example, dust storms, gas flows or the flocking of birds - that bears some comparison with descriptions of the design process as a means of organising complexity.

Synthetic analysis is useful because it invites an understanding of complexity through a series of simple interactions. Auyung, a scientist at MIT, cites examples of synthetic analysis in economics and condensed matter physics. Rather than choosing isolated elements of phenomena for analysis, synthetic analysis takes a synoptic view and builds a picture of the whole or wider problem. By breaking this problem into a number of smaller 'weakly interacting

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[18] Rittel, while illuminating how complex and indeterminate the real process of design might be, adds little to the understanding of a theory of design itself. As Buchanan (2002, p. 15) puts it, Rittel 'leave[s] a fundamental question unanswered. Why are design problems indeterminate and, therefore, wicked?'

[19] Optner is widely understood to point to the beginning of Soft-Systems Methodology (SSM) as a research mode. SSM has become something of a field of research, itself (Checkland, 1999). SSM now describes a number of systems of analysis that set out to be non-mechanistic and non-prescriptive. Precise objectives are removed and replaced with fluid and holistic knowledge of fields.

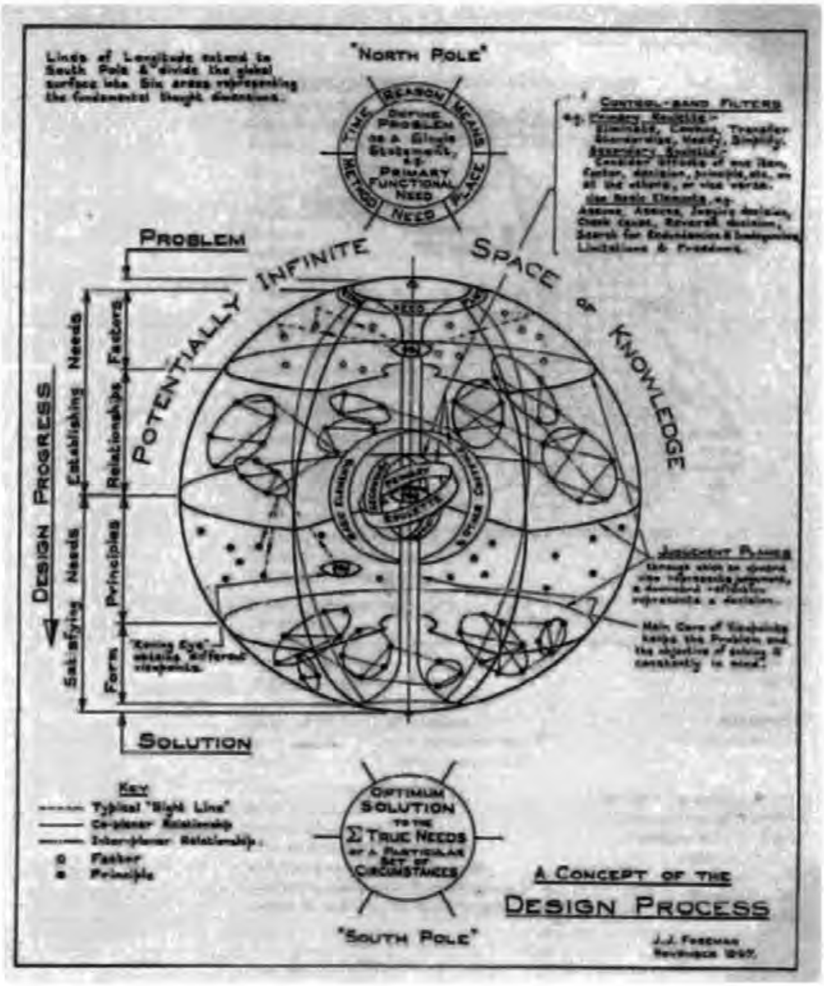
parts and modules, which are studied independently and thoroughly' (Auyang, 1999), synthetic analysis is able to construct an answer without losing sight of the wider problem.

> The process usually involves many approximations; and successive approximations improve and refine the solution. Synthetic analysis aims to answer questions about the composite system, therefore it never totally loses sight of the whole, even when it looks at the parts. In this it is opposite to reductionism, which is solely concerned with the parts. (Auyang, 1999)

Synthetic analysis brings naturalistic and scientific approaches together. For example, a nurse caring for a person and a biotechnologist working at a cellular level might appear to have very different concerns. However, synthetic analysis is an approach to understanding that brings these concerns together into one syndromic conversation.

> The best medical care will look at apparently unconnected symptoms together; the drug companies tend to promote medicines for individual symptoms but it is better I think to take a view of the syndrome as a whole and review it in the light of the patient's lifestyle. (Hopper, 2005)

Matchett's Fundamental Design Method, the so-called FDM, was an attempt to draw diagrammatically the principles of 'good design thinking' (Matchett, 1967). Matchett (1967) describes design as 'discovering and reconciling conflicts in a multi dimensional situation'. Matchett's diagram of his synthetic archetypes setting out four modes of thinking is described by Chris Jones (1998, pp. 180-1).



A Concept of the Design Process (Matchett), as drawn by Foreman, 1967 (see Jones, 1998).

(i) 'Parallel Planes' refers directly to a reflection of the position the designer holds in relation to his or her colleagues and clients.

(ii) 'Thinking from Several Viewpoints' is similar to 'Parallel Planes' except here attention is focused on the design problem rather than the process.

(iii) 'Thinking with Basic Elements' is a process-oriented approach and describes a process whereby thinking is divided into neat packages, so-called 'Techtams'. (This is almost 'M-a-t-c-h-e-t-t' reversed.) Techtams are the part of the process of analysis Jones (1998, p. 180) finds to be 'the most rational'. Techtams appear to be a rational process but are nonetheless breathtaking in scope and structure.

(iv) 'The Synthetic Archetypes' appear in a mode of 'Thinking with Concepts' and represent Matchett's attempt to understand how designers control the association of ideas. The so-called Roving Eye of the designer should be free to scan the 'potentially infinite space of knowledge' (Matchett, 1967).

> Matchett claims FDM to be a liberating practice that enhances self respect. However he admits there are emotional undertones and unpalatable aspects ... Anyone wishing to try out FDM ... should recognise he is exploring the part of experience that is accessible through religion, through art, through psychoanalysis, through group dynamics, through drug taking, through insanity, through self-mastery courses and through indoctrination: it is an aspect of experience that some people believe to be wickedness or self-delusion and others believe to be ultimate reality and the ultimate good. (Jones, 1998 pp. 181)

Matchett's approach to design methodology is far more fluid and open than that of many of his fellows. While many attempts to construct a design methodology call upon a codified reduction of the process into a linear and logical stream, Matchett attempts a process of open synthesis. The methodology of synthetic analysis as it appears and as used in science is somewhat more formalised than Matchett's design process, yet it reveals the need to retain the poetical and the empirical in the consideration of the whole. Synthetic analysis suggests that, in the initial stages of problem solving, it is important to understand the shape of the problem rather than the specifics. Empirical data can be useful only when the larger shape of the problem is recognised. In the attempt to understand how industrial design can find continuity with its historical trajectory, there should be no need to find empirical evidence to support and bring quantitative analysis to the problematic explored. Prior to gaining a response from designers with regard to a problem they perhaps do nt recognise, it will be important to come to terms with a broad range of complex and subtle problems and to weave them together into a single and comprehensible picture.[20] Some theorists, such as De Landa (see, for example, De Landa, 2000),[21] take a 'morphogenenic' approach, understanding solutions to emerge from complex flows and the coming-together of ideas. De Landa argues that this process is somewhat self-generating and almost impossible to define. In design conversation Gedenryd (1998) has set out the design process as a series of coterminous

[20] Perhaps a subsequent study will bring data into the equation.

[21] One way of understanding the differences in De Landa's approach is to understand the human as constructed of cells. Manuel De Landa (2000) can be interpreted as arguing that, while it is not possible to understand much about cells by engaging in a cultural conversation with people, it is possible to tell quite a lot about people by understanding cells. In order to gain a complete picture one must do both simultaneously.

interactions rather than a logical progression. One risk that must be accepted in an approach that takes a wide view is that the subject of analysis is likely to become huge, supercomplex and unwieldy. [22] However, this risk must be accepted as necessary if space is to be allowed for a broader intellectual picture to develop that retains the more poetical and creative aspects of industrial design and to retain its discussion in terms that the community of its fellows can understand.

[22] Recently Karabeg, Guescini and Nordeg (2005) have suggested the use of Polyscopic Topic Maps as a means of dealing with, and controlling, broad transdisciplinary information fields.

Chapter two

Disconnection and the progressive displacement of the human reference in technology

2.1 **The epistemological displacement of the human referent**
It is becoming increasingly difficult to maintain the distance between the human and the technological.

2.2 **Rupture: The crisis of biotechnology as a question of history**
The industrial design community appears to be rupturing as designers come to perceive it to be in some manner outmoded.

2.3 **Strategies of reconnection**
A way forward can be found by reconnecting with the intellectual heritage of the industrial design community.

2.1 The epistemological displacement of the human referent

It is becoming increasingly difficult to maintain the distance between the human and the technological.

One way to open the discussion of the relationship between the human and the technological in industrial design terms is to take the case of a commonplace product of contemporary manufacturing and marketing - for example, the design of a child's bicycle. The Schwinn Stingray is a single-speed bicycle that apes the chopper motorcycle. Its appeal, we must guess, were we to own one, resides almost entirely in being something we might want to be seen to own as a reflection and projection of status rather than in being a machine we would choose to ride around on. The Schwinn Stingray is heavier than a BMX or a racing bicycle. Its styling, redolent of a motorcycle, forces the rider into a mechanically inefficient position for pedalling. One might be attracted to this decorative and sculptural bicycle for its visual aesthetic appeal, but if one wished to enjoy the pleasure of the BMX rider or the velocity of the racing cyclist, one would not chose the Schwinn Stingray. Industrial design theorists could perhaps construct pages of analysis of the Stingray - its semiotic values and its social construction. However, the experiential aesthetic of the BMX or the racing cycle presents a far more problematic proposition for theorists. Where the human-technical relationship of the Stingray can be discussed in terms of a material aesthetic, it must include the owner of the bicycle in its cultural and social conversation. The consideration of the experience of the BMX rider and the racing cyclist must include some conversation with regard to the nature of the phenomenological experience of riding the bicycle. While there are many ways in which designers can describe the cultural and social experience of the bicycle, the phenomenological appears to be more problematic to quantify in design terms.

Schwinn Stingray (top) BMX (left) track racing cycle (right).

One reason why the phenomenological is problematic for industrial designers is that, if it is done properly, phenomenological analysis makes it difficult to separate the individualised experience of the cyclist, who is not traditionally the subject of a designed production methodology, from the bicycle. The owner of the Stingray is likely to be reminded of the discussion of its cultural worth and the aesthetic beauty of its design every time he or she encounters the mildest incline. The racing cyclist and the BMX rider are not reminded of the material aesthetic of their machines. For them, if it is well designed, the bicycle disappears. They do not feel its weight when they encounter the incline; they just move through space as a single entity. The well-designed racing bicycle has no material or cultural aesthetic for the athlete who races with it. There is no significant history of the way things have been used. 'The English word "use" has no recognised roots other than the Latin *usus* (meaning "use", "exercise", "practice") ... Its etymological shallowness and limitation to the Roman family of languages may even suggest that use has certain technological overtones' (Mitcham, 1994, p. 230). The design of use appears likely then to call not on some deeply held cultural history but on an ahistorical tracing of the human soma in relation to technology. The skill of the designer could be understood as a subtle orchestration of this interaction. However, nothing much appears in industrial designers' accounts that can bring any qualitative analysis to descriptions of this interplay. It appears as though designers are left with no alternative but to fall back upon a model of human-technological relations that is accounted for in terms of lumps of matter that are understood for their aesthetic and social values.

The phenomenological analysis of the bicycle and its rider finds the distinction between the rider and the machine to be at the centre of its problematic. The distinction between what is human and what is technological may seem to be something hardly worthy of discussion in respect of such a quotidian machine as the bicycle. We can guess that Sim (2001) is not thinking about Schwinn Stingrays, BMX cycles and track racing when he talks about the boundary between humanity and machine: 'The boundary between humanity and machine is becoming progressively more blurred, and there are many willing to defend this development, regarding it as where our future lies. At stake this debate is our very conception of what it means to be human.' The cars, kettles, pots and pans, and televisions that we own do make up some part of our persona, but people do not usually think of these things as a literal part of themselves. However, if a view is taken that humans and technologies are conditional extremes, then it becomes possible, though absurd, to think of humanity and technology in degrees. (For example, we might ask, to what extent is the one-legged pirate less human for his wooden leg?) We can guess, then, that Sim is referring to something other than his bicycle. We might also imagine that humans have somehow managed well enough to live with this dilemma for a long time. Samual Butler's famous and often quoted *Erewhon* (1954), ostensibly a satire of Victorian mechanistic social systems as much as a call for resistance to mechanisation, contains a moment of realisation when the distinction between humanity and technology become problematic:

> Is not machinery linked to animal life in an infinite variety of ways? The hen's egg is made of a delicate white ware and is a machine as much as an egg cup is; the shell is delicate for holding the egg as much as the egg cup for holding the shell: both are phases of the same function; the hen makes the shell in her inside, but it is pure pottery. (Butler, 1954, p. 165)

Defining the difference between humanity and technology is problematic enough even when one can understand it in material terms. If flesh is warm and vital, then an easy claim might be made of technology as cold and inert. It might seem comforting that technology does not yet hurt when it is cut; it does not yet demand a moral concern for itself, nor does it return or demand our affection. These, however, are easy assumptions; it is quite possible to make similar claims of our own hair or fingernails. In recent years the conversation about the difference between people and technology has been given new impetus by the emergence of technologies able to immerse users in complete simulation. While much attention has been paid among members of the design community to issues and ideas relating to mediated virtuality and to the definition of the real and the virtual, rather less attention has been paid to other forms of experience that consist of pure sensation. Designers have added little of any significance to the discussion of drugs, for example. However, over the past century or so, designers have played a significant part in making the extraordinary seem commonplace. Although it might be theorised in terms of virtuality, displacement or simulation, for the most part people understand, and are comfortable with, the idea that, when they watch television, they view a representation of something that is displaced in space and time.[23] What is absent, however, is a critical discussion of the aesthetic experience of using technology.

Broadly the term 'noetic', from the Greek word *no ē tikos* (the intellectual), *noein* (to think), refers to something in the mind. The term is sometimes used to ring-fence studies of 'the mind and its diverse ways of knowing in a truly interdisciplinary fashion' (IONS, 2007) or in terms of a more metaphysical understanding of consciousness (Musès, 1977) or in relation to the occult (Blavatsky, 1895). The anoetic can be more broadly understood as something in the mind that is comprehended and experienced through the filter of the intellect. If the noetic implies a thoughtful consciousness, its antonym, the anoetic (in the terms with which it is used throughout this text), refers to an aspect of mental activity that lies outside the main focus of awareness but, unlike the subconscious, unconscious or nonconscious, still forms part of the conscious experience of the subject.[24] Heidegger,[25] rather famously, developed a

[23] The means to replay images and voices of the dead seems so commonplace today it is almost unworthy of comment, but it is also something, we can imagine, that our ancestors might have found implausible or deeply troubling. Thomas Edison wrote: 'I am inclined to believe that our personality hereafter will be able to affect matter. If this reasoning be correct, then, if we can evolve an instrument so delicate as to be affected, or moved, or manipulated by our personality as it survives in the next life, such an instrument, when made available, ought to record something' (*Scientific American*, 30 October 1920).

[24] The term anoetic has some resonance in the metaphysical Buddhist concept of Vijana or Vinana, one of the five so-called aggregates of mind. While the other aggregates - form, feeling, perception and fabrications - can be understood in cultural terms (see Pali, 2007), Vinana can be understood in some interpretations as a state of pure consciousness that exists without prior or subsequent interpretation: 'vinnana is considered a sort of anoetic sentience' (De Silva, 1992, p. 50). The psychologists Kircher and David reiterate three essential forms of consciousness that emerge as scientific terms in contemporary neurophysics. Where the Autonetic is a form of self-awareness and the noetic more thoughtful consideration, the anoetic is 'the simple awareness of external stimuli' (Kircher and David, 2003, p. 181).

[25] Few other philosophers have attempted to consider the use of technologies in the construction of being as Heidegger has. Heidegger's association with, and somewhat half-hearted apology for, his fascist connections (see Farias, 2004) could be understood to have distanced his philosophy from many post-war intellectual developments in industrial design that took their impetus from left-wing politics. Even Mitcham's comprehensive review (1994) of technology, philosophy and philosophies of technology has nothing significant to review in this respect.

means of understanding the human occupation of the world as a flux between conditions of being *zuhanden*,[26] where humans are active in the world, and *vorhanden*, where the world is considered in a detached and intellectual manner. The design aesthetician Monö (1997) has proposed that aesthetics could be a study of the whole experiential or gestalt impact of a product upon wider human sensation. Monö aside, the discussion of aesthetics in industrial design histories appears to prioritise the primarily noetic, *vorhanden* over the more anoetic *zuhanden*. The industrial designer Jan Walter Parr (2003) finds it necessary to suggest that 'one can imagine how aesthetics in reality blends with other qualities. The way a nail is driven into a piece of wood by a hammer can in a broad sense be defined as part of the hammer's aesthetic quality, besides being a decisive factor for its function.' There is a scarcity, in any case, of terms in the English language that can be used to describe the purely experiential. This is not to say, however, that industrial designers are unaware of the *zuhanden* or the anoetic. For example, imagine a mobile phone. The network is now named and given a form of mythical value.[27] Industrial designers can readily intervene in the *vorhanden*. They can bring their expertise to bear on the stylised form of the phone; they can design and arrange its multicoloured screen and tangible styling. Industrial designers can help us to tell that the phone is a Nokia, a Sony or a Motorola, perhaps through their sophisticated artefact language. Then, when we make a call and the *zuhanden* comes into play, when everything disappears and we feel ourselves connected directly to the person to whom we are speaking, designers appear to have no means to analyse this, no terms for its aesthetic, and yet in that moment, when the phone disappears, it could be understood to have an aesthetic of its own that makes it somehow transcendent. Heidegger speaks of the 'regions' (Arisaka, 1996) in which *zuhanden* and *vorhanden* are active. Heidegger suggests that the vitality of life resides in the interplay between these regions. There is *bestanden* (quiet and unnoticed), *vorhanden* (apparent and loaded with semiotic significance) and *zuhanden* (immediate and active). We live our lives through a complex orchestration of this regionality.

Technologies that cannot be seen or touched have been largely excluded from industrial design histories and, by extension, from industrial design methods of analysis, except in so much as they manifest themselves in things that can be seen and touched. The concept of

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[26] *Zuhanden*, literally 'to-hand, in attention' and *vorhanden*, 'there', but not to hand.

[27] Is Orange, for example, a more socially acceptable network than Vodaphone?

dematerialisation appears to present both a problem for industrial design and, in its immateriality, a potential solution for eco-design. Persson (1999), for example, uses dematerialisation to call for a model of product design that shifts its attention from materiality to wider social understandings. In similar terms, Tonkinwise (2004) finds that the role of industrial design is thrown into question, as does Katz (1997). Tonkinwise suggests that the apparent dematerialisation of technology presents a break with the past and heralds a new form of design. Given that there seem to be as many, if not more, material technologies around today than ever before, we might ask why industrial design should no longer be pertinent. Why, for example, has it suddenly become, for some reason, important for industrial design to engage with the immaterial, when technologies apparently without material presence, the associated service cultures that supported them and the networking potentials they afforded have been in existence for over a century? While immaterial technologies, such as radio, for example, are more than a century old, there is now the prospect of a new form of technology that will be almost entirely anoetic. The struggle to engage critically with technologies that have little or no resonance in culturally accountable terms may be more of a concern for the philosopher than for the designer - unless, that is, one recognises the intent to find a means for people to live out complete and rich lives through technology to be at the core of industrial design's intellectual impetus. If industrial design is to do this, it will need to find a way to discuss the aesthetic of the anoetic. If industrial designers can do this, then they might find the means to talk about the immaterial without finding it necessary to create a new form of design.

DNA computation is an emerging technology that utilises the potential of cellular membranes and microcondrial DNA in computation processes. The striking difference between this technology and previous methods of computation is that it represents an engagement with the fundamental quantum-processing abilities of biological flesh. Through infinite parallel processing and by actuating the architecture of the human body - rather than mimicking it as artifice - these technologies offer a means by which the calculation restrictions of electronic media can be overcome. Where in many media the technologies have a mythological and romanticised birth,[28] DNA computation first emerged in a mathematically precise and carefully

[28] The voices of Fessenden or Bell crackling through space: 'One, two, three, four. Is it snowing where you are, Mr Thiessen? If it is, do telegraph back and let me know' (Fessenden, Cobb Island, 23 December 1900); 'Mr Watson. Come Here. I need you' (Bell, Boston, 10 March 1876).

moderated academic paper in which Leonard Adelman[29] proposed a means by which a mathematical problem might be solved. The nascence of DNA computation has yet to find either romance or wider public attention, nor has it progressed into the wider cultural imagination, so it is difficult to extract its essential qualities from the intensely specialist field it appears to demand.[30] Nevertheless, in broad terms DNA computation offers a means to overcome the mathematical problematic of the Turing machine by utilising organic material in a computer.[31]

> The tools of molecular biology are used to solve an instance of the directed Hamiltonian path problem. A small graph is encoded in molecules of DNA and the 'operations' of the computation are performed with standard protocols and enzymes. This experiment demonstrates the feasibility of carrying out computations at the molecular level. (Adleman, 1994)

The Church-Turing hypothesis states that every function that would normally be regarded as computable can be processed by a universal Turing machine - eventually. Deutsch (1985)[32] modified the Church-Turing hypothesis to propose that every finite physical process can be simulated instantaneously by a universal quantum computing machine positing a huge

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[29] In 1959 the physicist Richard Feynman had proposed the idea that the sub-microscopic processes by which biology 'computes' the world might one day be understood and utilised (Feynman, 1961) At this time, the possibility of Feynman's ideas coming to fruition (other than in science fiction) seemed remote. In 1994 the remote became the science possible. At about the same time as *Friends* aired on television for the first time, Adelman demonstrated that DNA computation was a mathematical and practical possibility. In 2004 - coincidentally a few days before the very last episode of *Friends* was aired - Ehud Shapiro announced the construction of the first working Dna computer (Benenson et al., 2004; see also Benenson et al., 2001 and also US Patent 6,266,569: 2001. Method and system of computing similar to a Turing machine. Shapiro, E., Karunaratne, K.S.G.).

[30] Arguably the essential text in regard to the outline of DNA computation is Calude and Păun, Computing with Cells and Atoms: *An Introduction to Quantum, DNA and Membrane Computing* (2001) Given that this text calls upon P-Theory and other forms of high-level mathematics in its explication, it hardly presents an introduction that can be read by designers or anyone other than those already familiar with its language.

[31] A Turing machine is in essence any system of logic functioning by linear yes/no or 1/0 switching, as is the case with electronic systems. Turing machines may be in series or parallel, but they cannot escape the logic of Gödel's theorum. Gödel famously suggested that a system of a given complexity (n) cannot be proven by a system of complexity (n-1). A Turing machine can prove the validity only of something less complex than itself. Artificial intelligence research was founded upon the notion of complex binary computing. Marcer has suggested that the application of Gödel's theorem would indicate that any system designed to understand another system must be at least as complex as the conception of the system under analysis in the conceptualisation of the programmer: 'The leading question of human intelligence is, therefore, the creative act of defining, specifying and solving a problem that may ultimately be apparently beyond all existing human knowledge' (Marcer, 1989) Marcer questioned the methodology of artificial intelligence research in the 1960s and 1970s and suggested that human intelligence could not usefully be considered digital in function nor capable of reduction to a classical model. The model of human intelligence based upon complex combinations of linked Turing machines was no longer adequate.

[32] In essence, a Quantum calculator undertakes every possible variation simultaneously; Deutsch's Universal Quantum Computer (Deutsch, 1985) can be sketched (inadequately, of course, but sufficiently here) as an infinite number of Turing machines working simultaneously.

(perhaps infinite) increase in the velocity, complexity and potentiality of the calculating machine.

> Imagine a set of mathematical equations that describe the ability of a jumping spider to recognise and capture its prey. These will be enormously complex, and their solution, whether by direct mathematical means or indirectly by digital approximation using a digital computer, is impossible for practical reasons. Yet the design of the machine exists in the spider's genetic material, and the spider itself is the machine that solves the problem. We can therefore postulate that Deutsch's theory defines the instruction set for a general class of machines that includes jumping spiders and biological brains. (Marcer, 1989)

DNA computation utilises the calculating potential of biological entities such as cellular membranes and microcondrial DNA. Higher-order intelligent species, including human beings, are not complex Turing machines; according to the model presented by DNA computation, they can more accurately be described as quantum calculating machines.[33]

> The striking difference between this technology and previous methods of computation is that this is a technology engaging with the fundamental quantum processing abilities of biological flesh. Through infinite parallel processing and by actuating the architecture of the human body - rather than mimicking it as artifice - these technologies offer a means by which the calculation restrictions of the Church-Turing hypothesis can be overcome. (Calude and Păun, 2001)

This technology might appear to be an amusing intellectual diversion in a design conversation and its application merely a daydream; it might also appear to be just another technological development among so many. However, we now know well that Fessenden's crackling transmission just before the first Christmas of the twentieth century very quickly became the basis of global broadcasting and the media world in which we live today. DNA computation is now no longer just a theory; its development has overcome initial theoretical and technical difficulties. DNA computation, if it were to follow a similar trajectory to previous technological developments, is likely to generate a substantial debate profoundly shifting understandings of what it is to be human in a technological construct. DNA and quantum computation can

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[33] It will be argued later in this thesis that such an analogy can be understood in a rather longer history of understandings of the human as a machine.

potentially eliminate any notion of the interface whatsoever between humanity and their constructed world.

> we appear to be approaching a time when 'willing' a machine into action will be relatively common. The separate steps between thought and realisation of a desired goal begin to blur and finally disappear. Signal flow between organic and mechanical units linked in a system gradually becomes continuous and unbroken. (Paul, 1987, p. 131)

Research into quantum computation might simply reveal the potential for a new form of faster computing or more complex methods of encryption; it might significantly enhance understandings of the functioning of biology; it has the potential to throw into question what it is to be human and to use technology.

A quantum logic DNA calculating machine would both serve the organism and be of the organism itself; it can perhaps be usefully interpreted as a means of extending, orchestrating and driving that which is already embodied within the organism,[34] intervening in processes of cognition in a way that throws into question ideas of knowledge and innate intellectual ability. One consequence of this dilemma has been to imagine a new species. As the robot could stand in the imagination as a species that was neither man, nor machine, but somehow a man machine, so the 'Archilect' (see De Garis, 2005) has emerged to occupy a similar position in the imagination of bioscience.[35] In the rather clumsily titled 'Artilect War: Cosmists vs. Terrans: A Bitter Controversy concerning whether Humanity should Build Godlike Massively Intelligent Machines' Hugo De Garis, an artificial intelligence researcher, predicts a future war between the values of the human and the Artilect. De Garis outlines a number of fears that bear striking similarity with contemporary perceptions of modernist concerns with some notional value supposed to define humanity precluded in the machine (see, for example,

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[34] DNA computation unleashes the power of universal computation. These technologies promise to eliminate any notion of the interface; they have the potential to be incorporated directly into the somatic system. Actually this understates it. These systems have the potential to be incorporated into the somatic system. Such a machine would, in orthodox taxonomy, be both technology and biology and neither technology nor biology; human and inhuman. There would be no particular need to make such a machine external to the body, because, of course, Deutsch's implication is that human beings are - as all biology - themselves quantum computers.

[35] The 'Artilect' has a somewhat uncertain history. It is often claimed tthat the term was coined by Hugo de Garis. For de Garis the future resides in a terrible dilemma as to whether humanity should build this technology and thereby - he postulates - transform itself into a new Artilectual species or Human2. De Garis foresees a future war fought between this new species and our own species, as we understand it today. It might all seem very far-fetched, but it is worth remembering that this technology is in place.

Rieger, 2005, and also Wohl, 2002). Frank Sudia (2001) raises interesting ethical considerations that point to the fraught philosophical uncertainty such technologies create, suggesting a future moral dilemma that bears some rather uncomfortable similarity with a conversation concerning slavery.[36]

The man-machine, of course, is a reoccurring theme. The complexity and dilemmas that such a concept presents are explored by scientists in speculative texts (for example, Penrose, 1989, and Perkowitz, 2005), by emerging philosophers (for example, Stanovich, 2005), as the ontological concern of theologists (for example, Kyle, 1993) or as challenges to children's imagination (for example, Cave, 2007). Even with the most superficial depth of understanding, the Artilect falls into the category of the man-machine because it appears to present a new way of expressing the blurring of epistemic boundaries. In the realm of biotechnology, the human and the technological are rather obviously collapsed into a single epistemic consideration.[37] The Artilect can be understood as another reaction to another kind of conversation in which the human and technology cannot be considered independently of one another. Biotechnology is, after all, technologised flesh. This kind of conversation throws into question the casual and arguably unresolved assumption that humanity and technology reside in a distinct episteme that sits at the heart of the industrial design intellectual locus.

2.2 Rupture: The crisis of biotechnology as a question of history

The industrial design community appears to be rupturing as designers come to perceive it to be in some manner outmoded.

If discussion boards, conference discussions and student projects are taken to indicate the shape and volume of design discussion, then it appears that industrial designers have not

[36] 'The impetus for change may come from the artilects themselves, who seek emancipation from being owned by others and the freedom to take their chances with the independent pursuit of happiness; to fail or succeed on their own terms, whatever joys or sorrows may befall them. If we are to create entities possessing free will, when all the fussing and fretting is done, we must sit back and let them make what they will of it' (Sudia, 2001)

[37] DNA computation presents a radical and direct intervention into the processes by which people become conscious and refocuses attention upon the role of technologies in the formation of notions of the self, reframing the sophisticated psychological models of the shaping of human selfhood as a social and cultural construct that designers hint at in their definitions of what it means to humanise technology. It is suggested that DNA computation technologies are likely to intervene in the somatic processes of the body, giving rise to human consciousness, which is something designers quite reasonably know almost nothing about. Designers have not previously found an imperative to engage with questions of the somatic processes that underlie human cognition. Their view of the human body is quite reasonably limited for the most part to a physical model and their understanding of behaviours and consciousness to the social, cultural models they have developed in order to understand a wholly different kind of technology.

been talking very loudly or with veryt much intensity about the intellectual challenge of biotechnology. It is not as if these technologies are a new concern: some eighty years ago the conceptual and ethical conundrums of bioscience were familiar enough to be the stuff of popular science fiction (see, for example, Huxley, 1932). If nothing else, designers, being part of the general population of the Western world, are at least familiar with the general concepts of biotechnological research, if not with the specifics of DNA computation.

At first sight the relative absence of conversations that place emphasis on the biosciences is surprising. Bioscience is just the kind of exciting and progressive technology one might expect industrial designers to be interested in. What designer would (or perhaps should) resist the potential to enrich, or even save, the lives of those who could come to enjoy the benefits of carefully designed biotechnologies. It is not that industrial designers are naturally resistant to technological development. They have, for the most part, adopted an enthusiastic stance when they are required to work with new technologies. This is not simply a phenomenon of the chatter[38] of the industrial design community. The relative absence of any significant debate, even among JISConline research discussion subscribers or in popular journals and design magazines regarding the role of designers in the formation of the biosciences, appears to indicate that this lacuna stretches into academic consideration.[39] It is possible that some technologies might appear to industrial designers to be beyond the scope of their

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[38] In the shadowy world of surveillance and counter-insurgency, 'they' talk about 'chatter', the colloquial terminology for fragments of electronic conversations alerting the attention of those who, we suspect, monitor our email, data and telephone traffic. Chatter, it is said, betrays the terrorist; an increase in the volume of chatter is interpreted by those who listen as a cause for alarm, an indication that terrorist cells are active, and that an imminent strike is possible. The industrial design community is alive with a kind of design chatter, the noise - like any conversation - rising and falling as any number of concerns are discussed. Listening in on its network community and conference participants can give some insight into the vigour and passion with which a particular intellectual problem is considered by designers. Industrial design conversations are not universally distributed. A snapshot of these design discussion boards reveals moments and places where the chatter falls silent. Topics of conversation fade, as the attention of the community shifts, and a silence can indicate that an intellectual concern has not fired the imagination of designers.

[39] It would have been entirely predictable that over the course of constructing this research other texts would have emerged and the research would have found itself shifting in response to a developing conversation. But this has not occurred. In the process of this research, despite repeated and substantive trawls, it has not been possible to locate a single reference to the potential of the applications of bioscience in any description of commercial industrial design, in industrial design course descriptions or in the pedagogical models underpinning those courses. Over the period during which this research was undertaken and the thesis constructed, no significant reference to biotechnology has become apparent among the conversations in the industrial design community. Despite much searching and many visits to exhibitions, it was not possible at all until December 2006 to locate a student thesis project that engaged in any significant way with biotechnology as a consideration of industrial design, nor did any project, speculation or thought experiment appear in frequent and extensive trawls of design images on the Internet and in magazines and journals.

engagement. However, there is some recognition in scholarship that the biosciences present a problem that designers might consider. For example, Bürdek (2005, pp. 425-6) suggests that, 'the human body is under attack on various fronts, with science leading the charge' (see also p. 431). Mau (2004, pp. 202-11) gives space to very brief transcripts of live on-air conversations with the bioscientists Freeman Dyson and Eugene Thacker, exploring their ideas, and provides a very brief review of some products of genetic engineering; asexual sheep, bald chickens and the like. However, in Mau, as in Burdek, there is no critical investigation, and biotechnology is presented as something of a fait accompli in the face of which industrial designers appear impotent. One reaction has been to deny the potential of bioscience; for example, in his introduction to *In the Bubble* Thackara (2006, p. 3) largely dismisses the scientific claims for biotechnology to be a combination of 'irresponsibility with wishful thinking'

There might be any number of reasons why industrial design appears to be so mute in the face of these technologies. However, the struggle that designers appear to have to find a critical language of the immaterial and the anoetic might point to a structural flaw in the intellectual toolkit of designers.[40] The biosciences appear to demand a very particular critical language and a philosophical stance in terms of the understanding of human-technological relationships; perhaps industrial design is not suitably equipped for such a task. Of course, designers are not alone when they struggle to find the means to discuss biotechnology. Bioscience, and by implication its technological applications, are the subject of broad media discussions, often fraught with moral dilemmas and radical dichotomies, which suggest that these technologies present a radical problem for humanity (see, for example, the introduction to an edition of the BBC readio discussion *The Moral Maze* (BBC *Moral Maze*, 2006) .[41] The

[40] Anecdotally, while teaching undergraduate students on the BA Hons Design Futures course at the University of Wales (a course that set out to investigate new parameters, conditions and forms of design), the teaching staff - and the students -discovered that we lacked both vocabulary and critical frame for engaging in any kind of sophisticated debate when evaluating the exploratory biotechnology, nanotechnology or DNA computation projects the students undertook. While the projects we ran with electronic technologies were ahead of their time and in some case are only just - almost a decade later - becoming realised as commercial products, we struggled with biotechnology. We very quickly discovered that, although biotechnology projects appeared to be vital extensions of designers' engagements with human-technological relationships, neither the teaching staff nor the students could find any critical means within the scope of design to evaluate the success of these projects. Not only were the outcomes of these projects often invisible; we found ourselves devoid of the linguistic facility to discuss them other than in the most vague ethical terms. The absence of chatter among other members of the industrial design community perhaps indicates that we were not alone in our experience.

[41] The BBC discussion programme *The Moral Maze* typifies the approach taken to these technologies, presenting extremes and binary alternatives. A transcript of the introduction to one programme is reproduced here: Biotechnology is 'an issue that divides futurologists between those who think it is the

flavour of the debate and the fears expressed in it bear comparison with much of the debate with which designers struggled during the late nineteenth and early twentieth centuries to resolve machine-mediated experiences as genuine human experiences. Over the twentieth century, industrial designers normalised the experience of technology and played a significant part in making extraordinary experiences into the quotidian reality of daily life. Industrial design has an established history of this process. However, if Tonkinwise (2004) is correct, the history of industrial design appears to take a trajectory that has disconnected it intellectually from a projected history of the biosciences.

There are many within the industrial design community who suggest that industrial design is an anachronism and that the future will demand an entirely new form of design. Under the heading 'The Death of "Industrial Design"' (reBang 2006), a discussion is under way on one of the many online communities where some designers share ideas. The host of the reBang discussion posted a topic suggesting: 'Something is wrong. And as far as I'm concerned, the job description "Industrial Designer" should be put to rest. There may not be much use for it in the future anyway. We may as well make the break now' (reBang 2006). In response, 'Joe' suggested: 'it sounds like there is a breakdown of understanding within the design and manufacturing community of what Industrial Design involves. If this is the case, I can see bigger problems on the way' (reBang 2006). Another responder, 'csven' (*sic*), suggested: 'When design is free from the restraints of manufacturing, the whole concept behind the creation of the profession falls into question. As "industrial" falls out, a new term should replace it. And most people don't understand what it means anyway ...' (reBang 2006). This perhaps points to a rather limited understanding of industrialisation. (While the term 'industrial' may no longer seem to carry the resonance that it once did, it is a superficial model of industrialisation that pictures smoking chimneys and discounts the clean efficiency

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greatest opportunity and those who think it is the greatest threat to human kind. Technology seems to be on the threshold of being able to replace Darwinian evolution and create ever more capable humans, better, brighter stronger healthier, perhaps happier and longer living. There are many different techniques and most seem within our grasp; drugs to enhance memory, genetic selection and manipulation to create super-humans and abolish disease, neural implants to improve our intelligence, cosmetic surgery to make us more beautiful, ultimately it is suggested we will merge with out technology and live to be a thousand. Should all this be embraced or rejected? The mobile phone and the car were once considered frightening novelties, or is human nature defined by our limitations? Does being more capable automatically make us better? ... human enhancement our moral maze tonight ...' (BBC Moral Maze, 2006). This brief, albeit introductory, monologue by the presenter of the programme (Michael Buerk) highlights much of the flavour of discussions of biotechnology. Darwinian evolution is subverted, humanity merging with technology to become somehow superhuman, and the ultimate choice is whether to embrace or reject these technologies.

of the biotechnology laboratory or the microcircuit assembly plant to be a process of industrialisation, imagined for another era.) If, however, the term 'industrial' is taken to imply a particular mode of replication and mass distribution, then it must also include the biosciences. If bioscience were to remain limited to small experiments in university and commercial laboratories, then perhaps it might be beyond the consideration of the industrial design community. However, it is the potential for this technology to gain wide application that brings it into the domain of industrial production. If industrial design can be understood to have a historical trajectory that is independent of the particular forms of technologies and their manufacture as they appear in any particular era, then it might be possible to find a coherent way for it to move forward intellectually.

Something evidently leads designers to feel the need to disassociate themselves from their own history, to consign the intellectual impetus of their community to history and to allow their heritage to be intellectually asset stripped.[42] A trawl through the Internet reveals a number of new forms of specialist design disciplines. Designers describing themselves, somewhat intriguingly, as: Usability Designers, Empathic Designers, Experience Designers (see, in particular, Neverstop, 2005), Ambience Designers, Engagability Designers, Media Designers, Reconfiguration Designers, Temporal Designers, Human Performance Designers, Culture-designers and Orchestrational Designers. It is a game one can play; think of an adjective or almost any specialist discipline, align it to the word design or designer and carry out a simple Internet search, and somewhere someone it seems will have adopted a specialist stance, claiming some particular insight into the design process. That former members of the industrial design community feel it necessary to invent new ways of describing themselves could perhaps be taken to indicate reticence among members of the community to be associated with a model of design that appears to be no longer suitable for a perceived future.

[42] Industrial design is beginning to get used to the idea that it doesn't engage with the most cutting edge of technologies. Colin Burns (Burns, 2001) the then managing director of the design consultancy IDEO once described the rationalisation of the IDEO design office where it was to be split it into two related streams of expertise: interaction designer and industrial designer. Burns encapsulated in his office a tension in some respects be born out as a loss of confidence, that industrial design might be equipped to engage with a new kind of conversation Burns perceived. Burns claimed interaction design to be "...about behaviour giving, in contrast with form giving - derived from vormgeving - the Dutch word for design - which is at the core of industrial design". (Burns, 2001) This split appeared to be a radical departure - in a studio established for many years as an industrial design office - where the industrial designers now seemed to represent an 'old guard' and the 'interaction designers' the progressive future.

2.3 Strategies of reconnection

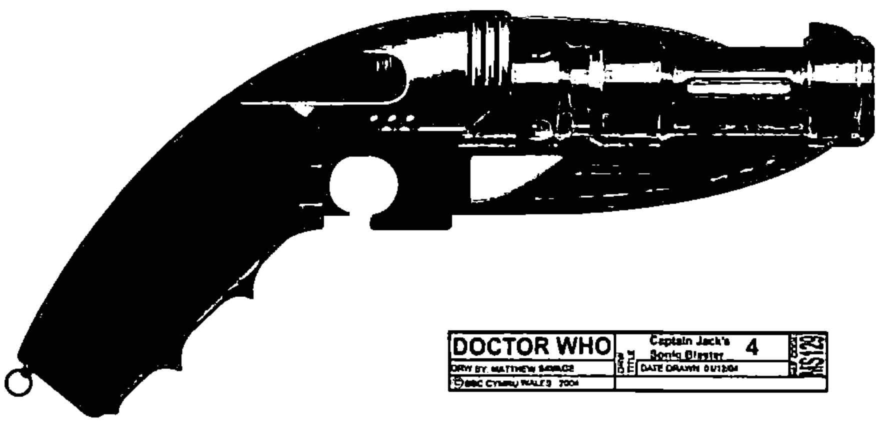
A way forward can be found by reconnecting with the intellectual heritage of the industrial design community.

It is quite possible, of course, that biotechnology represents merely a phantasmagorical problem for the industrial design community, and the philosophical enquiry such a technology appears to demand might merely represent 'straw-man' to an otherwise healthy community. Promoted for a number of years as an adjunct of successful business, the widely acclaimed projection of industrial design by corporations and small manufactures alike suggests that industrial design remains a vibrant focus of cultural, strategic and economic creativity. A consensus could emerge among members of the industrial design community that, by embracing a continuity model of their practice, accounting only for these technologies as they fit established models of industrial design, the task of engaging with technologies such as bioscience could be left to others. One upshot of this would be that the community would need to accept that its voice would be likely to become increasingly peripheral to the locus of debate with regard to human-technological relationships as they emerge in the twenty-first century. Industrial design would become something of a nostalgic craft practice that could be identified, much in the manner of other crafts, with a particular mode or material of manufacture, and would be seen to have lost the status of an intellectual impetus, orchestrating the philosophy of human-technological relations, that its histories imply it once held.

Industrial designers might come to the view that they can best engage with the future by looking beyond the development stage of bioscience. By becoming fantastical, industrial design might project speculative visions of the future where a trajectory of biotechnological development is played out to become a quotidian facet of some future culture. Designers might choose to transform or confirm fears we might have of technoscience into visions of delight or horror. They would need a substantial and critical philosophy to do this with any degree of success, however. Perhaps industrial designers may choose to take a much safer role in the projection of technologies, locating their discussion in production design and using their skills in order to fulfil a role in the entertainment and movie industries.[43] There is some

[43] There is a role in creating informed science fiction in cinema entertainment or computer gaming. Here the role of the designer is to project a degree of reality - where reality is demanded - into the fantastical. The designer of science-fiction effects must remain rooted in the physiological and physical quotidian in

tradition for this approach to industrial design - see, for example. Ludi, Ludi and Schreiber's *Movie Worlds: Production Design in Film* (2000) and this example by the designer Matt Savage (Savage, 2007) from the BBC TV series *Dr Who.*



Savage, who trained as a design futurologist and interaction designer, creates his convincing projections by blending a traditional industrial design approach that is respectful of its heritage with a future form of technology in order to create a product that is coherent both in an imaginary future and with the world of its TV audience.

Industrial design could divert its attention to deal with some other, more-pressing, problem. There are plenty of other challenges, not least, of course, the problems of climate change and carbon emissions, upon which designers could bring their expertise to bear. Industrial designers could help in the realisation of engineering solutions to these problems, assisting in the development of new methods of extracting sustainable energies or in the development of more sustainable materials or modes of technologies, for example. One example of an industrial design consultancy that has made this move is Sprout Design (Sprout, 2007).

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order to project a degree of fantasy into the subject, thereby heightening its impact and intervention in the story that is told. The most convincing science fiction maintains just enough links with the present to seem realistic and just enough cognisance of the future to retain currency. The slightest misplaced technology, or the failure to anticipate advances, can render the fiction dated; project too far and the story can veer into the fantastical. Part of the problem with technologies such as DNA computation is that it has no material manifestation. The use of such a technology in a fictional narrative might carry only intellectual resonance but present rather less spectacle. However, science fiction and the fantastical are imagined, of course, in the time of their construction and not in the era they project. The ideas they contain can carry nothing of the complexity of life in the projected era. Design in this context cannot emerge from within the broader complexity of the era in which it is projected. In short, then, the design for science fiction or of the fantastical can be regarded only as a creative speculation that references industrial design.

> sprout We are an industrial design consultancy which aims to integrate the disciplines of sustainable design and inclusive design into mainstream design practice. We use these methodologies to help us innovate new products that are better for the environment and that as many people as possible can use. (Sprout, 2007)

Industrial design might also bring a deeper intellectual impetus to the problem of ecological sustainability. Tony Fry, for example, has argued that a deeper understanding of the role of design in issues of sustainability is required. Rather than reconstructing or re-engineering the outputs of design, Fry (1999) invites a radical revision of design placement and a radical realignment of industrial design towards that of defutured, strategic and political force. In this new frame, industrial design acts as an agent provocateur pushing for revisions to social and cultural models in order to drive for sustainability.[44] Contemporary industrial design theorists such as Fry (1999) and Thackara (1988, 2006) are among those leading an urgent conversation with the intent to redirect design (they rarely use the term industrial design now) into becoming a process of planned social orchestration; they argue that designers are intellectually equipped to engage in such a massive task. Many of the solutions proposed, however, are presented as interventions into society (for example, Design21 Social Design Network), for which industrial designers carry no democratic mandate.[45]

[44] For Fry, design is 'predetermined' by the undesigned world; it cannot be extracted from it. Fry's *Introduction to Defuturing* (1999), although trumpeted at the time of its first publication, did not mark the dawn of a new design movement, as might have been anticipated. One of the problems of Fry's text is that, being a complex argument reliant upon necessary philosophical moves as it unpacks its thesis, it is constructed in a manner such as to make it unlikely to be read by designers. This complexity is inevitable and necessary, of course; this is, after all, *A New Design Philosophy* and is presented with some authority. However, while in the process of unpacking a sustainable meta-language, Fry relies upon a series of object languages drawn from a number of opposing philosophies that are not completely unpacked or located. Fry lacks the natural language to embed these ideas into the active working lives of designers, and the text becomes difficult to understand. Sustainability - or at least Fry's version of it - has made very little impact upon the way in which industrial design is conceived by both designers and their publicists. The exception, of course, is the ICSID definition; here Fry's conception of designers as not necessarily concerned with the modernist projection of progress through advancement in science is hinted at but posited alongside more recognisable concerns tying industrial design to economic structures - a move entirely counter to that which Fry might have hoped.

[45] Design21 (2006) does at least recognise that it must carry with it the authority of non-governmental politically driven organisations: 'In partnership with UNESCO (United Nations Educational, Scientific and Cultural Organization), we seek to explore the relationship between design and society. We believe that design should be more than an aesthetic exercise; that the real beauty lies in its potential to improve the way that we live and interact in our communities and our environment.'

DESIGN21
SOCIAL DESIGN NETWORK

Attempts at reordering society can have chaotic consequences.[46] Ashby's cybernetic law (1956) suggests 'the management of complex system requires the action of a system of equal complexity' It is arguable, then, that, in order for industrial designers to intervene in such a complex process without finding themselves in continual conflict with each other (the needs of humanity are not always best served by the needs of industry in any given moment of technological sophistication after all),[47] designers might find themselves adopting an ethical and strategic, ecosophical [48] stance that invites a similar if not identical intellectual engagement with shifting perceptions of the epistemic relations of humans and technology as that of biotechnology. Ideas emerging from a deep ecology movement - for example, Næss (see Glasser, 2005) - suggest another review of the epistemic separation of humanity and technology (see, for example, Botkin, 1990, and Sessions, 1995).

The intellectual vigour with which the industrial design community constructed the machine aesthetic helped to develop an intellectual methodology that ensured the sustainability of that elusive quality referred to as humanity, in spite of the unprecedented acceleration of the technological world. Rather than avoiding the particular intellectual challenges of the machine, the foundations the early twentieth-century industrial design community established made it possible for us to feel comfortable in our significantly more complex technologised world. We have become so familiar with the world of mechanised technology that we have perhaps forgotten something of the struggle past designers had in coming to terms with its

[46] Many of the ambitions of the ethical imperatives of the ICSID definition and some of the rhetoric of Design21 sound chillingly familiar to attempts to organise foreign policy. And foreign policy is a very uncertain craft, which 'attempts to contain the Soviet Union and control the oil-rich fields of the Persian Gulf, and continues today in the popular assault in Afghanistan to destroy the al-Qa'ida terrorist network. In that half century, nearly every major initiative led to an unexpected and sometimes catastrophic reaction, for which new military remedies were devised, only again to stir unforeseen problems' (Tirman, 2001).

[47] In today's 'Freakanomic' world (Levitt and Dubner, 2005), where almost any action can be interpreted as having an unforeseen and chaotic implication, it is perhaps no surprise that the intellectual community of designers should find itself in something of a crisis as it struggles with such a truly 'wicked' problem.

[48] Ecosophy : ecological philosophy.

philosophical and intellectual demands. Perhaps in order to engage with the similarly extraordinary and apparently paradoxical demands of a technology that is both human and technological, we will need a similarly vigorous intellectual focus. Rather in the manner of their forebears confronting the age of mass industrialisation, the democratisation of appliances, the emergence of mass communications, the acceleration in velocity and energy expenditure of the combustion engine, or the age of electronic and post-mechanical technologies, the contemporary industrial design community could reinvigorate its approach to technology and reimagine a new biological age of industrial design that continues its long history.

The industrial design community could revisit its own trajectory to look for continuity in the way in which previous designers responded to and resolved other moments when technology appeared to present a problem for them. If biotechnology is understood to be a problem of the conception of human-technological relationships and not entirely without precedence, then it might be possible for industrial designers to understand that any problems they might have in engaging with biotechnology might have arisen because of of a need to accelerate their intellectual approach for a new paradigm. This job is, perhaps, best undertaken by industrial designers themselves placing their own history and trajectory at the centre of their reasoning. The shortcomings that this might entail must be accepted, of course, and the resulting scheme will not be a work of philosophy or science, but it will have the advantage of being constructed with other industrial designers in mind. If it is to do this, then it will need to be constructed in terms that industrial designers can understand and find continuous with their own understandings of the trajectory of history, and to retain the instinct for clarity and coherence with scientific knowledge of other theorisations emerging from the industrial design community. It is in this spirit that this thesis is presented. Perhaps, if the industrial design community could recognise this theorisation to be a work of one of its members, then it might stand some chance of becoming incorporated into that community and into wider design discussion. This is, of course, a risky tactic, since most individual industrial designers lack some of the technical training of the philosopher. It is a risk worth taking, because, if there is a chance of retaining the extraordinary intellectual skill of the industrial designer in making technology seem normal, quotidian *and* as delightful and beautiful as it can appear in the mechanical world, then technologies such as DNA computation might offer a spectacular and rich proposition for future generations.

Chapter three

Reviewing history and the 'resolved' artefact as the keystone of analysis

3.1 **Artefacts and evidence in industrial design histories**
An 'artefact' is defined by the evidence it provides of a process of humanisation. Histories of industrial design emerge from within the design community and provide a coherent although largely invariant consolidating discourse for the industrial design community.

3.2 **The problem of disembodied resolutions of the process of humanisation**
Artefacts, presented without people in industrial design histories, appear as resolutions of an invisible process of humanisation. The process of humanising technology is ahistorical.

3.3 **The strategic lacunae and impact of the technological artefact-based histories on the inclusion of culture**
In part because they have tended to be of lower social standing, the voices of the makers of artefacts have tended to be occluded from history.

3.1 Artefacts and evidence in industrial design histories

An 'artefact' is defined by the evidence it provides of a process of humanisation. Histories of industrial design emerge from within the design community and provide a coherent although largely invariant consolidating discourse for the industrial design community.

Ozymandias

I met a traveller from an antique land
Who said: Two vast and trunkless legs of stone
Stand in the desert. Near them on the sand,
Half sunk, a shatter'd visage lies, whose frown
And wrinkled lip and sneer of cold command
Tell that its sculptor well those passions read
Which yet survive, stamp'd on these lifeless things,
The hand that mock'd them and the heart that fed.
And on the pedestal these words appear:
'My name is Ozymandias, king of kings:
Look on my works, ye mighty, and despair!'
Nothing beside remains: round the decay
Of that colossal wreck, boundless and bare,
The lone and level sands stretch far away.

(Percy Bysshe Shelley, 1817)

The previous chapters have discussed how industrial design is an intellectual community that is constructed from ideas and institutions. It has been demonstrated that, in order to subscribe to their community, industrial designers must maintain a conceptual stance that places the human and the technological at oppositional epistemes. It has been argued that this stance ensures that industrial design cannot be described with any degree of certainty and can cause problems for designers when they attempt to discuss technology in terms other than the material. This chapter explores how the histories that the community constructs of itself belie this fluidity and reinforce ideas of materiality by tracking a linear trajectory of artefacts, posited as evidence of industrial designers' intellectual endeavours.

The deliberate and skilful refinement of the world into smaller usable and useful units can be understood as an essentially human trait; one legacy of the human race will be the junk it leaves behind it. This junk tells us quite a lot about ourselves; monuments may remind us of the economics and politics of our ancestors, but the true signature of any human civilisation is made up of the small everyday things that litter the landscape. We give these things names and call them tools, or possessions, or weapons. In everyday language we can use these terms somewhat at will, but in an analysis we must take more care to describe things in more precise terms. Designers, however, do not appear to take a great deal of care when they talk. Sometimes they will refer to *objects*, on another occasion they will speak of *designs* or *tools*, 'artifact, machine, product, gizmo or spime' (Sterling, 2005, p. 8). The term 'object' has specific philosophical connotations,[49] and other terms can imply a particular form of these things or a collection of things: the 'machine', or more recent arguments in favour of terms such as 'apparatus' and the 'dispositife', for example. Recently some theorists have begun to use the term 'stuff' as a means to a wider inclusion of cultural materiality. There are good reasons why these particular terms might be used in a discussion of industrial design. The dispositife and the apparatus, for example, emerge from particular and specific approaches to understanding the world that could be understood to reflect the nature of the industrial design process of refining complexity.[50] It is arguable that each of these terms emerges from a particular discourse, loaded in favour of a particular interpretation of its arrival through particular processes and seen from a particular intellectual standpoint.

Drawn from archaeology, 'artefact' is a general term for anything made or shaped by people. It is particularly distinguished from a *manuport* - that is a natural object transported and utilised without modification. While a manuport provides evidence of deliberate human intervention, it is stripped of any embodied implication of its value, aesthetic or function. An artefact may be

[49] See, for example, http://www.helsinki.fi/science/commens/terms/object.html

[50] Although these terms are not used here, they point to a recognition of the interactive and collaborative nature of realisation. These terms will become important here as the argument unfolds and makes a move against the material implications of the artefact. The text you are reading here is constructed on a laptop. The *artefact* is that thing called laptop as it would be understood in the operative language of daily conversation and as it would appear in an industrial design history or catalogue. As an apparatus, the laptop is an assemblage of motors, circuits, levers, chemicals, each of which has a history and a cultural implication of its own. When thought of in terms of the *dispositife*, the laptop becomes an extended apparatus that calls upon a network of electricity and production techniques. In industrial design all these terms have meaning. It must be noted that Dewey utilised *artefact* to connote ideas (Hickman, 1992. p. 12). However, this is not how the term is used specifically here nor how it is widely understood. It is arguable that Dewey uses artefact in order to outline a concept that might be understood in contemporary theory as *dispositife* and not as it should be understood here.

similarly stripped of value, but it is always recognised for its embodiment of a human process. In archaeology the artefact only becomes *something* [51] when it contains, in itself or within its form, some evidence of human intervention that can be traced onto some other broader human activity. Artefacts are consciously designed and deliberately manufactured; they are evidence of the world when it has been humanised. Artefacts, then, are the material evidence of the process of humanising technologies; they fill industrial design histories.

Design history emerged relatively recently as a discrete branch of scholarship. When the Design History Society was founded in 1977, it was hoped to build and promote a history of design that would stand alongside other histories of art and architecture. This history would be given to students of design and would, it was hoped, spread the word of design out into the world. Thirty years after its foundation, the society maintains this ambition. Today the Design History Society (2006) describes itself as working

> nationally and internationally to promote and support the study and understanding of design history. Its activities are focused on consolidating the teaching of the subject in universities and colleges, and demonstrating the widespread cultural and economic significance of design history.

One impetus behind the formation of the society was the recognition that nobody other than those who had been educated in design and had worked among the designers in their community would write their history. Design histories share a similar trajectory and have some commonality with art histories and histories of architecture. Many scholars of design history found themselves working in close proximity to other historians, with whom they would share something of their discourse, but they would be intent to add visual and material histories of technological development. There would be a distinctly technological slant to design histories that was not always evident or explicit in other visual and material histories. Industrial design histories would be a means to track the development of the intellectual engagement of designers with technology. This form of history was important, because technology histories, emerging from scholarship outside the community of design, appeared to have little

[51] That is a named and identifiable item. For example, a piece of metal becomes a broach or a weapon; an unidentified collection of electronic components might become an i-pod.

understanding of the intellectual motivations of discourse within the industrial design community.

A survey reveals that, while industrial design is not entirely absent from technology histories, it is rather downplayed and rarely analysed. For example, in Mitcham's *Thinking through Technology: The Path between Engineering and Philosophy* (1994), where one might reasonably anticipate some reference to intellectual endeavour through which technologies are bought into being, there is only slight mention of industrial design. Mitcham (1994) acknowledges design to be *part* of the process by which technologies are imagined and constructed, but he pays little regard to any intellectual insight designers might have brought to the development of technological forms nor to their interpretations of the relationships people and technology share, making only a very brief reference in passing to industrial design as a 'behavioural engagement with technology' (p. 210). In this otherwise comprehensive and authoritative history of technology and philosophy, industrial design is described rather vaguely as a 'fine art of constructing' and is compared to the cultivation of plants (p. 212). Similarly, Giedion (1948, p. 192) makes only scarce reference to the industrial art of streamlining, where 'shiny enamel housings often reveal a *surprising* beauty of form'.[52] Even Mumford's comprehensive history (1963) of technology that was so influential in the twentieth century made no explicit reference to the intellectual intervention of industrial design. Armstrong (1998) refers frequently to the consequences of industrial design in the context of modernism but makes no explicit mention of the industrial designer's involvement in the process by which technologies appear.[53] One consequence of this isolation from the scrutiny and reflective criticism of wider scholarship is that industrial design has trodden a lonely path and has been forced to be responsible for constructing its own histories (see Dilnot, 1984).

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[52] Emphasis added. Giedion is surprised that trains have somehow grown to be so beautiful. This is frustrating, textual invisibility mirroring that of Koons's *discovery* and exhibition of the *art* in domestic appliances (Koons, *The New*, 1979-82) or perhaps Duchamp's celebration of the *Readymades* exhibited without reference to the modest ambition of the ceramic designer who treats a functional artefact with such exquisite skill.

[53] The temptation to engage in a frustrated polemic is something to be avoided, but it does seem, from reading technology-centred histories, as if the contemporary world arrived without any intellectual impetus from the industrial designer. The intellectual impetus of the industrial designer appears to be unworthy of inclusion in wider academia. Designers may well be justified in thinking they have not made that much progress in escaping their lowly place in the Agra.

> Certainly in comparison with the vast field of art history, histories of design are scarce ... There is also a gaping chasm between the highly specialised scholarly text, on the one hand, and expensive coffee-table books that are usually lovely to look at but have very little to say. (Hauffe, 1998, p.,7)

In 1978 Penny Sparke, describing the recent formation of the Design History Society, wrote: 'The newly emergent discipline of design history has by now spread its roots quite thickly and established itself firmly enough to show that it is here to stay' (cited in T. Bishop, 1978, p. 5). This is not to say there were no design history books prior to this time, but in 1970, in the introduction to *The Roots of Modern Design*, Schaefer (1970, p. 2) bemoaned the lack of industrial design histories that were in a position to challenge the canonical authority of Pevsner. Scheafer looked beyond industrial design and back to Mumford and subsequently to Giedion for insight, and also to Lindinger (1964) for an alternative view, but of course found only scant reference to the particular nature of industrial design. Industrial design historians are rarely found in the broader spectrum of historical scholarship and are more likely to be located as adjuncts to the history of design movements or schools. Since academic scholars from outside the world of design pay only slight attention to industrial design or its designers, it is perhaps not surprising that industrial design has been forced to retell its own story. When these stories are examined and compared, it is evident that they share a heritage and responsibility to one another. The similarities of these stories stake out the practice of industrial design; they trace a particular trajectory and chronology.

Industrial design histories are strikingly similar in both their scope and their construction. It is common for industrial design histories to refer back to Banham's 1955 history of the first and second machine ages. How industrial design became consolidated over the course of the nineteenth and twentieth centuries is an oft-repeated and familiar story; whether in any of the standard industrial design history academic texts or a glossy coffee-table picture book, the story is told *de novo* with each publication.

Contemporary design histories are visibly indebted to their predecessors. Banham's significant work of architecture, design and the modern age, *Theory and Design in the First Machine Age* (Banham, 1955), and Pevsner's *Pioneers of Modern Design* (1936/1975) still provide the prototype for contemporary histories of industrial design. Although published in the midst of a number of texts, such as Bertram (1938), Read (1953), Gloag (1934), Carrington (1935) and

Holme (1934), the style and order of Pevsner, and then subsequently of Banham, dominate the form of subsequent industrial design histories. Heskett (1980), although ostensibly emerging from a new tradition of the Design History Society, is heavily influenced by the style of straightforward historical narrative supported by illustration that Banham and Pevsner consolidated. Pevsner has been described by Corin Hughes-Stanton (1967) as 'the bible of industrial design' (cited in Schaefer, 1970, p. 1); to a significant extent this remains the case today. There is some variation in emphasis, but for the most part contemporary industrial design histories track a particular linear story of industrial design through the projection of its intellectual endeavours as a producer of technological artefacts. This trajectory is located within a rather specific time frame of approximately 150-200 years - a period described by the emergence in the Western world of large-scale industrialisation and of modernism. This trajectory, it is supposed, can be accounted for through artefacts, as Thakara (1988, p. 11) confirms: 'The century provides us with a stage play of artefacts charting modernism's trajectory ...'.

It could be argued that the reassuring familiarity with which *the* story of industrial design is retold provides one of the ways in which the community of industrial design consolidates itself and reassures itself that, despite all the fluidity and complexity that surrounds it, it has managed to come through, producing ever-more sophisticated artefacts. The community, it has been argued, is itself fluid and uncertain, but its histories provide a degree of reassuring certainty. There are differences in industrial design history texts, of course, but their story is largely interchangeable. If designers look to their histories to find their own particular trajectory, they find a common heritage in a story retold, albeit from changing directions, over and over again through its histories.[54]

A number of industrial design histories appear as picture books. The picture books, while arguably not intended to be scholarly, are nonetheless researched and presented with some

[54] This story can be told in many ways; there are histories of design movements, of materials and techniques, chronological catalogues of artefacts, reflective memoirs and analytical deconstructions of the material culture of design and its progenitors. The interwoven stories forming written histories of industrial design are somewhat interchangeable; start one book and finish another and the story will, for the most part, remain largely intact. Industrial design histories are constructed in changing climates of scholarship and with differing intent. Forty (1986), Sparke (1986), Conway (1987), Walker (1989) and Woodham (1997), for example, although not necessarily similar in intent, reflect the somewhat parallel nature of industrial design history. Lucie-Smith's *A History of Industrial Design* (1983) and Raizman's *History of Modern Design* (2003) present strikingly similar histories, although they are separated by twenty years of scholarship.

care. The story they tell, while following the line of scholarly tradition in industrial design histories, are almost entirely visual.[55] The reader can only guess that the artefacts chosen for inclusion in the picture book have some, mostly undisclosed, aesthetic value residing in the quality or ability of the artefact to represent some value the reader might understand. It seems an essential prerequisite of design histories to be copiously illustrated. Heath, Heath and Lund Jensen (2000), for example, is an intelligent history driven by illustration and supported by critical and insightful text. There are any number of other books that present often quite beautiful picture catalogues of artefacts drawn from 150 years or so of history with a commentary that reiterates the image of the artefact by description.[56] Artefacts in these books frequently appear to be related in some linear history merely because they share some aesthetic of functional similarity.

There are also a number of books that might be thought of as catalogues and are evidently intended as a professional representation of industrial design to the world through arrayed images of artefacts with their designers presented alongside. The *Design Innovation Yearbook* series (Zec, 2004) is typical of many such 'designer catalogues'. This style of representation has transferred to less scholarly industrial design histories. For example, *Designing the 21st Century* (Fiell and Fiell, 2001), while not strictly a history, presents contemporary industrial designers alongside the artefacts with which they are associated and posits them as the creators of a new century, resonating their practice with earlier designers. The book is constructed in a similar manner to an industrial design catalogue. Publications such as the *Design Innovation Yearbook*, or the popular design catalogues of artefacts drawn from history, project artefacts as the quintessential essence of industrial design. These histories, like the design museums, have served industrial design well and have played a not inconsiderable role in assuring the preservation of many, often ephemeral but interesting, comings-together of

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[55] P. Collins (1991) is a good example of a genre of industrial design history that merely presents images of artefacts without analysis. Collins presents a 'dazzling collection of vintage radios that were created in a remarkable era of product design marked by unparalleled ingenuity and innovation'. There is no attempt to explain how this 'ingenuity' is enacted through a process of design. Images of the 'radios', beautiful as they may be, are simply arrayed in chronological order with a caption detailing the manufacturer and the date of sale. In the absence of any remark, the reader is left to come to some form of intuitive understanding of this supposed *remarkable* era.

[56] In the case of the Taschen books (Fiell and Fiell, 2000) for example, there is often only the merest contextual placement. Fiell, (Fiell and Fiell, 2000) opens with Behrens AEG Sparbogenlampe from 1907 and then arrays a number of artefacts, first in a form of historical chronology; and then in a number of contexts - 'packaging' and 'designing for children', for example - and finally a number of case studies - 'the iron' and 'the typewriter', for example.

intellectual activity that might otherwise have been lost over time. *This is industrial design, say the histories of industrial design; is the process of humanisation not embodied in the interplay of the designer and the client, the form and the function, and played out to a conclusion in the beautiful artefact?*

3.2 **The problem of disembodied resolutions of the process of humanisation**
Artefacts, presented without people in industrial design histories, appear as resolutions of an invisible process of humanisation. The process of humanising technology is ahistorical.

Design texts are almost always illustrated liberally with artefacts serving as the resolved outcome of the intellectual activity of industrial designers and the various intellectual movements that have pervaded across the scope of the history. Because of this emphasis upon illustration, many sustaining narratives of industrial design do read rather like paper versions of a Design Museum, where the concrete 'stuff' of sustaining narratives of industrial design are presented as tangible relics arrayed in chronological or typological order, put out for display as mute exemplars of a typology, disconnected from the people who might complete the resolution.[57]

Sembach's 'into the thirties' (1972) is similar to other industrial design histories. Although ostensibly more scholarly, Sembach's text relies upon images of artefacts and buildings to tell his story. Sembach makes this technique explicit in the introduction. 'From the illustrations in this book there emerges a composite picture of a historical period, a picture that seems bright and unclouded, suggesting elegance, sophistication, urbanity, even a hint of classicism' (p. 7). Later, however, Sembach hints at something rather more subtle than the usual parade of beautiful objects: 'In the illustrations I have tried to give an *impression*[58] of the period ...' (p. 13). Sembach makes a rather interesting move when he begins to analyse the photographs themselves, claiming them to reveal as much, if not more, of the zeitgeist than the artefacts and buildings they capture.

[57] You are not invited to sit on the chairs in the London Design Museum; your intellectual engagement with the displays is limited to the visual and the intellectual. You can never experience the artefacts on display and are denied the opportunity to gain some sense of what it felt like to use then.

[58] Emphasis added.

> The precision we have already noticed in the artefacts themselves finds its counterpart in the manner in which they were observed. - Restraint, calm and laconicism pervade the photographs, enabling them to achieve a feeling of space. (p. 18)[59]

Sembach lets the pictures do the talking, but, unlike those who precede him and were to come later, he is conscious of the images as a means to a phenomological insight that goes beyond their representative 'iconic' exactitude.[60] In Pevsner (1936) the images of architecture and design, used to chart history, are absent spaces; they present rather ghostly visions of an abandoned world.[61] In Heskett (1980) the images are similarly used. Some workers are seen on the Ford production line (p. 67), some craftspeople are shown at work (p. 86), some smiling commuters pose at the door of a Dymaxion car (p. 123), a driver and fireman are shown at work on the flying Scotsman (p. 163), a lonely woman sits in an empty gleaming Braynzeel kitchen, unsullied by any hint of life (p. 77) and then, in a similarly bleak 1970s vision of domesticity, a woman who appears to be on the verge of suicide stands alone in a sterile kitchen, a poignant rose held to her (p. 181). The implication is that the process of humanisation is resolved in the absence of people. In Woodham (1997), a craftsman is shown at work (p. 207), a woman bends down to adjust a side table, presenting a rather unconvincing impression of real life (p. 125), some workers ride the products of their labours through the gates of the Piaggio factory (p. 110), a man poses smugly by his Chrysler car (p. 70) and some office workers sit frozen, like mannequins, in the Olivetti office *c.*1935 (p. 55). *Functionalist Design* (Marcus, 1995) and *The Machine Age in America* (Wilson, Pilgrim and Tashjian, 1986) are both texts that explicitly focus upon designers who were concerned with the close interaction of humans and technology and with a particular intellectual approach to the humanisation of technology, yet there are no people shown in these texts. The writing is infused with ideas concerning the mechanisation of mankind and the functional interrelatedness of body and technology or space, and yet the products shown appear remote and isolated as fully resolved containers of intellectual chaos.

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[59] Sembach reviews the photographs of Alfred Renger-Patzsch and Walter Peterhans and draws parallels to the photography of Cartier Bresson and across the broader spectrum of the concision and detachment of the artistic thrust of the time. 'The portraits of Man Ray and Herbert List are an example of this. Nothing appears in them direct, yet everything has the clarity of a waking dream. This approach combines detachment with intensity' (Sembach, 1972, p. 20)

[60] Sembach, while presenting design as artefacts, begins to explore something more ineffable and invites in the reader a sense of placement in the consciousness of the era concerned.

[61] The buildings presented by Pevsner are empty. The streets appear abandoned too, save for a few scattered figures who populate the streets surrounding them and appear utterly lost and alone.

Images in sustaining narratives of industrial design are often contemporaneous with the era in which the artefact was first manufactured. In consequence, artefacts appear gleaming and new, unsullied by the wear and tear of time. Photographs of artefacts rephotographed in a contemporary context in their aged condition or captured in use are very rare. Products are almost never dirty, never scuffed or worn through use. Instead, they are presented in pristine condition, most often isolated and seen in an empty space, without context. However, in Bürdek (2005) a shift is discernible. In other similar design texts, utilising images constructed from the late 1980s onward, almost every technological artefact is represented in use, albeit sometimes in a rather stilted and posed manner. It seems from looking at industrial design histories as if people have only recently become an important component in the representation and understanding of technologies. There have been no attempts to reimagine the past in this manner; only recent designs are represented with any hint of the human being as a component in the process of the artefact.

Sustaining narratives of industrial design are similar in their scope and form. Perhaps in an attempt to find some means of historicising an otherwise fluid institution, their authors have retrieved a trajectory of artefacts. There is no attempt to find a history of the process of humanisation, nor for that matter to deal in any meaningful way with the human engagement with technology. This history, perhaps buried by centuries of traditions of scholarship, is glimpsed only in moments when the makers of artefacts are discussed in terms of their ontological struggle with what it is to be human and to use technology or to own artefacts.

3.3 The strategic lacunae and impact of the technological artefact-based histories on the inclusion of culture

In part because they have tended to be of lower social standing, the voice of the makers of artefacts have tended to be occluded from history.

Industrial design might merely be the current terminology for a rather more venerable intellectual process of humanisation, applied to a particular method of 'industrial' production. It might imply, too, that the process of humanisation is reimagined in a particular era and in the condition of industry; this is a subtle but profound implication. In the former view, the process of humanisation remains a constant that must be inculcated into the process of the production of artefacts. In the latter view, the production of industrialised artefacts could be understood to demand a revised model of the process of humanisation. Industrial design histories present a trajectory of the process of humanising technology through orthodox Western models of development. It is a matter of evidence that almost every artefact displayed in industrial design histories originates from a manufacturing source in the Western world. When they posit technology as an emergent consequence of the directed agency of designers working through a model of production and consumption, then it is difficult for industrial design histories to engage with processes of humanisation interaction that are not Western in origin nor necessarily resolved in a industrially manufactured artefact. The connection of industrial design to a particular period of industrialisation in a particular region of the world has enabled it to be historicised in parallel with other histories of the West. The emphasis thrown upon the process of manufacture is, however, at the expense of the process of humanisation that is evident in the artefact. The process of humanisation then becomes a lost history.

Histories of a community, constructed from within that community, tend, understandably, to self-reference and to hegemonic and normative modes of construction. In the case of industrial design histories there is a tendency to draw heavily upon images of artefacts produced within a frame of manufacturing and consumption. The Design History Society appears to accept and reinforce this impression:

> The Society encourages liberal and inclusive definitions of design history and its methods, approaches and resources. These encompass the function, form and materials of artefacts of the pre-industrial and industrial periods, up to and including the present day, their production, dissemination and consumption as well as their cultural, economic and social meanings. (Design History Society, 2006)

Artefacts serve as both the subject of analysis in design histories and the means to that analysis.[62] This is not necessarily a linear process. In *Towards Post-Modernism*, M. Collins (1987) demonstrates a history of industrial design that allows for an emergence of postmodernism with antecedence deep into the twentieth century. Through a story of a new formalistic movement, Collins makes it possible for a history to connect across other linear

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[62] In industrial design histories, as in Banham, (1955) artefacts are positioned around the book such that they serve to both illustrate and reinforce the description and analysis within the text.

histories.[63] This history is told nevertheless through artefacts that are presented as the resolution of the complex process of humanisation that has taken place. This process is largely unaccounted for, except as insomuch as it is resolved in the artefact. Heskett's *Industrial Design* (1980) and Woodham's *Twentieth Century Design* (1997) tell remarkably similar stories and utilise an approach to the telling of history that maintains a linear chronology while contextualising 'issues'. Topical chapters such as 'Commerce, Consumerism and Design' and 'Design and Social Responsibility' (Woodham) or 'Standardisation and Rationalisation' and 'Mass Production and Individual Choice' (Heskett) are presented as if industrial design history could be divided into neat movements. Both Woodham and Heskett demonstrate this change in emphasis through illustrations of artefacts presented as resolutions. Wilson, Pilgrim Grey and Tashjian's *The Machine Age in America* (1986), while covering a similar era to Banham's work, places more emphasis upon small artefacts and less upon architecture.[64] In an attempt to get deeper beneath the skin of the motive forces of the early machine age, the emphasis is placed firmly upon an analysis through artefact qualities, but nevertheless artefacts appear fully resolved. Schaefer's *The Roots of Modern Design* (1970) places a focus upon change from craft to manufacture. The story is told through the products of those processes, without any significant reflection upon their drives and consequences other than to prioritise the story of manufacturing by examining the emergence of a 'formal' language of simplicity that emerged from a practical response to the needs of industry. Marcus's *Functionalist Design: An Ongoing History* (1995) is somewhat similar; it enriches this story, using many of the artefacts that occur in other histories. Marcus tracks one story of the emergence of a formalistic functionalist style and its pervasive rationale in more contemporary design, arguing that this aesthetic is maintained, despite its apparent fall from critical fashion.

Industrial design histories, and by extension many other histories of technology, largely ignore artefacts that emerge in cultures outside a Western model of production and consumption. It is a matter of evidence, too, that almost every artefact displayed in an orthodox industrial design history originates from a manufacturing source in the West. Artefacts that originate

[63] Collins (1987) relates late-twentieth-century postmodernism with the grammar of ornamentation (Owen Jones) and with Pugin and Bell, weaving a connected history.

[64] This is a scholarly text, although liberally illustrated. While it remains an insightful and intelligent authority, it tells a strikingly similar story to Banham (1955).

from beyond the scope of the orthodox industrial design community are categorised as being 'vernacular', a term that is used to imply a form of design that emerges from outside the intellectual integrity of the institutionalised community. In recent years yet another new kind of design (vernacular design) has been proposed, which allows for the inclusion of artefacts from beyond the formal institutionalised discourse of industrial design - see, for example, the following abstract from a paper exploring the usefulness of the community of practice as a means to understand design formation:

> The concept of vernacular design allows for the understanding and the appreciation of designs created without recourse to institutional qualifications in the field of design. A study was undertaken of how North Alaska Inuit (Eskimo)[65] women learn design, based on observations, interviews with seamstresses, and authorial participation in designing and sewing in conformity with North Alaska Inuit tradition. (Reitan, 2006)

However, even those who espouse 'vernacular design' must illuminate by their use of that very term how design has come to be imagined as an institutionalised activity located about a particular part of the world and manufacturing process. Design in this view is disconnected from an activity common to humanity and reified into the practice of a few distinct individuals who *discover* and validate the vernacular. Design processes originating outside the Western world of production and consumption are largely ignored by orthodox industrial design histories except where they intersect with Western thought. In discussions of the vernacular, it is hard not to sense that the terms of debate are patronising, although it is important to note that a significant shift is taking place in discussions of the vernacular in terms of sustainability and environmental adaptation.

> Climate responsive design: Hi Praveen, FJS puts it abstractly as Vernacular and I agree completely. There has been a New Age wave of environmental/green/eco-design that has come with the caring sharing 90's, and of course, since the 90's were so high tech, then the solution had to be high tech also, so most of the climatic responses of buildings followed relatively complex systems involving metal moving parts and computer chips. Fine. But vernacular architecture is usually technologically advanced, it's just because it has been around for centuries that people want something new. Well it has been around for so long for the simple reason that it WORKS. There are few architects out there who have been able to continue the incremental evolution of their

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[65] The parentheses in the quotation are for an apparently unnecessary and inappropriate explanation of the term Inuit. They are not added here and in any case describe two entirely different cultural constructs.

local vernacular technologies, they have done great work with it and I'm sure you will stumble upon them on this site. I strongly suggest you look them up. Good Luck. Yahia Shawkat, October 17, 2006 (ARCHNET, 2006) [66]

However, even in this example, the vernacular is still posited as somehow being without intellectual intent and as an expedient response to conditioning. The Western response to climate change is vernacular too, but merely framed within a different institution. The institutional expedients that form design outside the Western industrial model are never discussed, and so the vernacular can only ever be considered in terms of its Western counterpart. In the past the terminology of intellectual engagements with the vernacular could be institutionally racist. For example, African design appears most frequently in Western design histories through the influence of the Fauvists upon the Western modernist designers. The association of African design with the 'wild' (Fauve) is racist, but it also points to the rather subtle reinforcement of the vernacular as beyond the bounds of the civilising institution.[67] Contemporary cultural theorists are alert to accusations of imperialism and racism, but they continue to struggle to understand the vernacular other than from institutional terms. Western historians who have drawn superficial comparison between the forms emanating from African designers with those of the Western modernists have recognised a vector of influence but have most often missed the opportunity to understand this design in more advanced terms. The lost history of the process of humanisation makes it difficult to understand any synergistic similarity in the process of design emerging from a non-industrial construct.

In industrial design histories we learn much about the Western designer and the influence of African forms upon them, but we learn very little about the intellectual drivers of African design and the intent of its design community and so the Eurocentric inference that design is a scholarly and Western invention of the industrial age is reinforced. For example, a Western material and social cultural analysis attempting to understand African design as an artefact in the form of mask can only draw upon a discussion in terms of identity where the mask

[66] I have cleaned up the spelling without changing the context in this quotation taken from a live discussion forum where editing prior to publication was not a priority.

[67] There is no doubt that designers of those times had different sensibilities from our own, but nonetheless the term can be found in contemporary accounts and employed without criticism. Similarly, terms such as 'tribal art' and notions of an all-encompassing African or Asian design aesthetic appear.

> functions as a concealer (and paradoxically as a revealer) of identities. Both the mask wearer and the community on behalf of whom it is worn are momentarily at least transformed sharing in another's identity so as to understand something of one's own identity. (Vanterpool, 1997)

We can understand this. This is how we in the Western and industrialised world use masks in drama or at Halloween. It fits with our conception of identity formation and with our storybook and movie impressions of tribal culture. But if we take a view that the hidden history of the engagement with technology extends to the whole of humanity, then African design, being human, is likely to be an intellectual endeavour with as much rigour, vigour and potential as anything emerging from the histories we tell. African design tells us something about the human activity we call design, but it tells us in a way we may find difficult to comprehend. When attempting to describe the same mask by reiterating what he has learned from those with an African perspective, Vanterpool struggles to come to terms with the mask's intention as a 'non-face':

> is unreal, but it does not represent nothingness: it stands for an imagery of existence in-human-spirit-relation behind which there is a felt sense of transcendental value-laden realities. (Vanterpool 1997)

What is this non-face, and how does it relate to a history of industrial design? That Vanterpool struggles to find the words should not surprise us; this seems beyond what we are led to believe codifies design. This is an insight into something that is beyond the terminology of industrial design history. It represents a glimpse into something that is lost from the histories of industrial design and points to a kind of anomie that one would not expect to find in an industrial design history. The intense ritualistic and interactional role of the African mask cannot be explored, because no precedent exists for such a narrative, but the artefact itself is an advanced technological response to a particular condition. What might then be learned from this artefact is then lost, as is the historical account of why fauvism might have appealed to designers as anything other than a stylistic and material aesthetic fancy. Industrial design histories can only reinforce the idea that the industrial design community is a Western material invention, rooted in values of consumption and production. If it is not an emergent consequence of Western industrial design's institutional discourse, technology becomes consigned to the vernacular, and so any particular insight that design might bring becomes lost, thereby weakening the rich potential of design analysis.

Not all artefacts that have been made throughout human history have emerged in consequence of some process that can be claimed to be part of the trajectory of industrial design. It has been argued that artefacts can emerge through intellectual engagement in the vernacular. The products of industrial design emerge as the consequence of a particular institutionalised discourse. They reflect the complexity of their times but carry with them the echo of ancient and uncertain histories of artefacts made of stone, wood and metals, shaped into the civilising tools of agriculture, war and worship. Understood in this light, the African mask and the 'i-pod' share some common (if ahistorical) trajectory, although they have appeared on the planet in very different circumstances. This common trajectory might lie in the fellowship of those who set about the task of making these artefacts. Both are products of a dominant discourse and a mode of understanding human technology relationships that is determined by an intellectual view of the universe and the place of the human in that universe. It is arguable, then, that the differences between the intellectual location of the designer of the mask and the designers of the 'i-pod', for example, are retrospective values that are a matter of cultural interpretation rather than intellectual sophistication. One view is that the artefacts emerge as a logical response to a set of needs. This may be true, but they also emerge in consequence of intellectual conventions and stylistic constraints imposed by organising institutions. The mask is an advanced technological response to a given understanding of the operation of the universe that is imposed by its own institutionalised convention; one cannot understand the mask unless one understands its institutional imperative. Design histories are then perhaps better understood as a sustaining narrative of a particular iteration of a human intellectual process.

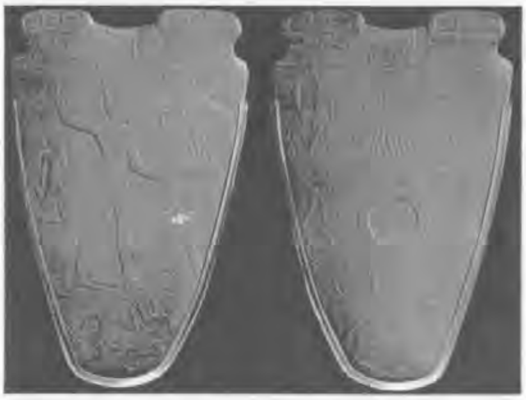
It is important to separate the history of industrial design from the idea of a sustaining narrative, because, although designers have called upon history, they can no longer rely upon it as an absolute authority. Hayden White (White. 1973, 1980) argued some four decades ago that history is best understood as a narrative, and more recently, Jordenova (2006), for example, has argued that the delineation of histories into narratives has itself become open to challenge. The sustaining narrative that design histories have maintained may have crumbled, but that in itself provides an opportunity to factor in other actors into the narrative, to help designers understand it in different ways and thereby to provide other alternative, sustaining natrratives. There is then an opportunity to revisit the foundations of industrial design in order to produce a new sustainable narrative.

When industrial design histories are understood in this light, it becomes possible to see how they constrain the sustaining narrative within rather fixed bounds. It would be a matter of conjecture to suggest that those who crafted the artefacts of ancient times could be thought of as part of a community that might be recognisable to industrial designers today. There is no evidence to suggest that ideas of how to shape and improve technologies were shared through anything other than an ad hoc community of people who shared something of a common conversation. Paleoarchaeology suggests that the sudden adoption of tools is in part a consequence of the sharing of ideas among early communities (see, for example, Schick and Toth, 1993). In order for this to happen it would have been necessary for some formal means of technical communication to develop. This language would have had to be more than a purely *natural* conversation and rather closer to an *object language* in order to direct the crafting of stone and bone.[68] There is, of course, no discernible record whatsoever of these

[68] However, the role of the community in this respect may have greater precedence than is perhaps imagined. Schick and Toth, (Co-directors of the Centre for Research into the Anthropological Foundations of Technology, Indiana University, Bloomington) study early hominid and human technology (Schick and Toth, 1993). Evidence from archaeological records suggests that the earliest anatomically modern humans did not make dramatic technological changes in their way of life until about 40,000 years ago. At this time there was a sudden explosion of tool development, environmental modification and aesthetic application to spaces and artefacts. Schick and Toth propose three possibilities to explain the global explosion of technological artefacts: (i) It is possible that the humans at this time were not 'human' as we understand it in terms of their brain structure. (ii) It could be that improvements in technology prior to that date are undetectable but just as significant, or that at this point - some 40,000 years ago - accumulated

conversations, but there is certainly evidence at sites such as Grimes Graves that some sophisticated decisions were made to produce early tools on an industrial scale, and these represent the earliest known evidence of makers of artefacts that were not intended for personal use. The stone tools of Grimes Graves were not made for a known client and have been found in Neolithic sites spread right across Europe. In order to be as successful as this, the stone toolmakers of Grimes Graves would have had to have anticipated some process of design. They presumably also knew which tools were popular and which were not. The archaeology they left behind them is perhaps an example of an ur-form of industrial design (see, for example, Barber, Field and Topping, 1999).[69]

Venus of Willendorf,
Paleolithic Europe,
30000-15000 BCN.



Palette of Narmer, Egypt, approx 3000 BCN.

What we cannot know is how the artefacts we find embody in some way the lost history of the intellectual process of humanisation that has gone into their formation. Some artefacts remain a mystery. The Venus of Willendorf's function, for example, is conjectural, except as in so much it bears a resemblance to a doll or statuette. The Palette of Narmer, while appearing to have some function, can only be categorised by archaeology as a work of art. Artefacts reveal the centrality of the human in human thought. Sometimes those thoughts are expressed as representations of the human that we can recognise, sometimes as reflections of shadows of

knowledge reached a threshold whereby it was somehow able to explode across the world. (iii) It is possible that it was only with the development of modern language and the availability of the hypothetical, or the future, tense that human societies were able to communicate plans and ideas effectively.

[69] Some techniques of making can be tracked historically and bear a direct resonance on contemporary production methodologies. It is a fairly safe guess that a contemporary industrial designer could study an artefact from almost any period in history and remake it.

the human intervention in the world, but also in ways that are tied to imaginings of the human in the universe.

Coolley (1988) has suggested that the term 'design' in its various European forms emerged during the sixteenth century, coincident with an intellectual need to describe the mechanical arts in higher tones. Cooley suggests that design was raised in this way as an activity in its own right and separate from processes of production, partly in consequence of a need for 'scientific' experimentation.[70] It is possible that this coincides with an emergent scientific transformation in the understanding of the human as biology rather than holy vessel. Nothing of this history is reflected in the sustaining narratives of industrial design, however. When read at face value, they present a largely consensual picture of a trajectory of artefacts. For the most part this trajectory is contextualised as evidence of industrialisation. Superficially this would seem to be axiomatic. After all, the matter of concern is *industrial* design. Stamm, however, has claimed the term "industrial design' originated only as recently as 1948. Hirdana (1988), reflecting on this, suggests that, rather than nascence, this should imply the institutionalisation of the term as a means of codifying an existing practice as a significant stakeholder during a period of post-war reconstruction and the rebuilding of markets (Hirdana, 1988).

Other attempts have been made to find a starting point for industrial design's history. Bertram (1938) placed Eastlake's *Hints on Household Taste* at the nascence of design. Eastlake had claimed his publication as the first to address design 'in a manner sufficiently practical and familiar to ensure the attention of the general public' (Eastlake, 1869, cited in Bertram, 1938, p. 11).[71] In *300 years of Industrial Design* Heath, Heath and Lund Jensen (2000, p. 11) commence their history in the eighteen century – a period they describe to be defined by the

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[70] Design would now come to stand for 'the conceptual part of work from the labour process. Above all, the term indicated that designing was separated from doing' (Cooley, 1988, p. 197). As the intellectual thrust of the enlightenment gained in strength, so design came to be seen as an increasingly worthy and intellectual persuit. Darnton suggests that the mechanical arts 'constituted the most extensive and original part' of Diderot's (1713-84) *Encyclopédie* (see Schwab, 1984, p.198). Vasari's description of *desegno* (see Bürdek, 2004) points to the identification of a particular process somehow remote from the activity of making.

[71] The choice of Eastlake is deliberate, because Bertram sees himself at the far end of that story opening with Eastlake. Bertram's book resides in the twilight of a period when designers were fixated with aesthetics of ornamentation and the role of hand skills and craft, and were subject instead to a new light of aesthetic concerns with the language of the power and range of modernity. Herbert Read, writing in the 1950s, reiterates this focus: 'We need to create a new consciousness of aesthetic form. We must put an end to the inculcation of false and supernatural ideals of beauty – ideals which are largely superficial "taste", a cultural veneer inherited from other ages' (Read, 1953, p. 41).

'large quantities of handmade items produced in the workshop and home ... with largely direct sale'.[72] The intellectual intent of this text appears to be to imply that sixteenth-century ambition to break the connection between craft and production, and between method and intent, is a continuing process. Heskett's history of industrial design reiterates this limited trajectory. His history opens with a chapter 'From Traditional Crafts to Industrial Art' (Heskett, 1980). Bürdek (2005) does make a brief reference to Vitruvius' *De Architectura Libri Decem* (Ten Books on Architecture) but then leaps across the mechanical arts straight to Paxton's building for the Great Exhibition (1851) via a brief mention of Ruskin. Perhaps this history is too subtle for industrial design's discourse. But perhaps too its exclusion from the formal sustaining narrative of industrial design points to it problematic highlighting of a continuing discourse that extends beyond the scope of orthodox industrial design considerations and points to a tacit recognition among industrial designers that they deal with abstract and philosophical ideas.

One reason why industrial design might have chosen not to historicise its intellectual engagement with technology other than through a series of resolved artefacts is that the intellectual tradition in which the institutions of industrial design reside have only a recent history of scholarship. In Ancient Greece thought resided in coterminous intellectual realms: *in extremis* the thoughtful and reflective *episteme* and the lived *doxa.* Although episteme has come to stand today for a category of thought (Foucault) or perhaps a paradigm (Kuhn), in ancient Greece the term stood for conceptually constructed, ordered and considered knowledge that could be placed somewhat in opposition to Doxa standing for opinion and intuition. (Bell, Devidi, and Solomon, 2001, p. 134). Whereas *episteme* was contemplative and rarefied, *doxa* was played out in daily life in the street and in commerce (see Rhodes, 2005).[73]

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[72] Positing in the process a highly materialistic view of industrial design, they attempt to extract industrial design as a process of replication emerging from the handmade crafts and transformed by the industrial revolution, while acknowledging that 'the craftsman designer is the most natural of them all and has roots reaching right back into pre-industrial history'. This association is fractured by the assertion that 'the industrial designer is very different from the craftsman ...' (Heath et al., 2000, p. 12).

[73] The ancient Greeks would struggle perhaps to comprehend how a civilised society could give such prescedence to *doxalogical* analysis and such authority to scientific sociological analysis of the human. Ancient philosophers were not concerned with the construction of cultural and social meta-realities they contemplated the essences of being. These essences were considered in relationship to any number of other phenomena and reflected the human struggle of those with the time on their hands to comprehend a purpose in being. On the street, in the fields and among the ranks of the military the concerns were more immediate; popular and common opinion shaped the understanding of the meaning of life. (In Roman terms this was the Vox Populi, literally the voice of the people.) The artefacts of history provide snapshots of this voice.

Those who made the goods for sale in the *agra* (the public space or market) were of low status and, we are told (although it would be doubtful if there were evidence to support this), endured the intellectual contempt of the very same people who valued their products. In classical times the slave classes engaged in the production of the everyday goods of the *agra* were of lowly status. Outside any institutionalised discourse, their vernacular network was considered a matter of *doxa* and hence not worthy of inclusion in the authority of an account. Given the lack of any recorded evidence of their expertise and the conversations formed through experience and on the hoof that they generated, we can only guess at the deep intellectual skills of the makers of the items traded in the *agra*.

Even in later scholarship the mechanical arts, while a vital component of power and social cohesion of the Middle Ages,[74] were considered a lowly art. The liberal arts trivium (grammar, rhetoric and dialectic) and the quadrivium (arithmetic, geometry, astronomy and music) maintain a far higher status than the rude mechanical arts, projecting an impression of the smoke and dust of the workshop and not the contemplation of the academe.[75] The mechanical arts encompassed a range of activities we might recognise as the domain of the contemporary industrial designer.[76] Included among the mechanical arts is the creation of carts, pots, shoes, architectural joinery,[77] as well as other less material activities such as navigation, pharmacy or animal husbandry. Despite the intimacy with which the products of designers, artisans or the rude crafts were accepted into life, the means behind their manifestation is not worthy of medieval scholarship, being constructed by 'most mechanical and dirty hand' (*2 Henry IV*, Act 5, scene v)[78] and not conceived among the higher academic arts and philosophies (see, particularly, Walton, 2003). Bürdek (2005, p. 13) reiterates how Leonardo Da Vinci is popularly

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[74] Where would kings have been without a lowly cup, or armies without swords?

[75] The contributions of Archimedes to the development of mathematics through practical means was largely forgotten, (the defence of Syracuse for example), immediately after his death to emerge in prominence during the Renaissance.

[76] It should not be inferred that the industrial design community as it is understood today extends back into these times, but there is much that contemporary designers would find in common with the mechanical artist. They would almost certainly discover that much of their object language is common. Contemporary designers can still read the plans and annotated sketches of their medieval counterparts. The process of commission between the tenth or fourteenth centuries, if it is anything like that of architecture, was similar to contemporary processes. (See, for example, Shelby's study (1976) of the commissioning of a monastic building.)

[77] It is simply a mistake to imagine prefabrication to be an invention of industrialisation.

[78] It is, of course the 'Rude Mechanicals', the tinker, the bellows maker and the joiner, who ruin the magic of *A Midsummer Night's Dream.*

claimed as the *first* designer; [79] this is unlikely to be the case. Nevertheless, Leonardo is emblematic of the concept of modern design as something transcending modern, industrial production. Leonardo was one of many who practised the mechanical arts. His *Book of Patterns of Machine Elements* is preserved perhaps because so few other working drawings of that era survive. The preserved 'patterns' provide evidence of the striking similarity in the approach to the active working practices of the mechanical artists to that of contemporary designers, but it is unlikely that Leonardo would have *invented* this process. Notwithstanding the iconic status of Leonardo, there remains a sense, however, of low status and an abiding lack of self-esteem that goes with an exclusion from higher philosophical attention and from scholarly validation that still resonates in the industrial design community. One of the missions of ICSID remains to 'further the profession of design, its *status* in society, and the protection of intellectual property rights' (ICSID, 2006). ICSID does this by promoting industrial design to the world as a tool of commerce. ICSID does not seek to connect the contemporary discourse of industrial designers with a longer intellectual history.

Somewhat hidden within an alternative and occult history of the mechanical arts, there is evidence of some of the ontological dynamics of the philosophical struggle with the process of humanisation. The mechanical arts negotiated the worldly concerns of materiality, commerce and needful use, on the one hand, and, on the other, a subtle ontological negotiation of aesthetic beauty, hand skills and spiritual transgression. Mechanical artists subverted the materiality of God's world for the sake of human vanities. Medieval scholars argued over the virtues of aesthetics. If beauty were a sin, then that which drove the craftsman to such levels of indulgence must corrupt. But, the counter-argument ran, was the hand of the craftsman not guided by God to reveal such beauty?[80] Contemporary designers remain as interlocutors between man and the physics of the world and as negotiators of the value of aesthetics and function. McInerny (2005) suggests that Hugh of St Victor included the mechanical arts within philosophy, because the mechanical arts were necessary to 'heal the wound sin has opened between man and nature ...' (McInerny, 2005). While it is suggested that this task is

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[79] 'From a historical perspective, it is popular to regard Leonardo da Vinci as the first designer' (Bürdek, 2005., p. 13).

[80] Rather like the practice of a sin eater, the service of craftsmen was valued for their feats of great architectural engineering knowledge, the subtle development of tools and techniques and their fine workmanship, and yet they themselves were condemned. While the medieval architects knew the secrets of how to hold stone in the air, directing God's will to the ground through pillar and buttress, the subversion of mechanical artists was not so dramatic or demonstrable.

'subservient' to the higher arts,[81] the task of healing the wound between man and the God nature reveals too something of a prototype of design's intellectual task in reconciling what it is to be human with the world. Industrial designers may not be aware of this, but it may go some way to explain why craft discussions, more centred on the skill and material quality of artefacts than on their philosophical problematic, are excluded from their sustaining narratives. The mechanical arts may appear to be part of a trajectory of the crafts, because their philosophical centrality has been occluded from histories of knowledge.

[81] Bertram, writing of industrial design in the mid-twentieth century, seems to describe a practice that stretches deep into history and not just to the dawn of the industrial revolution. Designers are needed, suggests Bertram (1938, p. 18), because the world 'need[s] a special body of men trained in aesthetics and having sufficient knowledge of technical processes, familiar with the history of visual art as a whole, and capable of imparting their knowledge and ideas'.

Chapter four

The artefact as a mutable consequence of culture

4.1 **The 'resolved' technological artefact and the role of cultural networks**
Artefacts are used to codify society and culture in material terms.

4.2 **Cultural networks and the deficit of reductivist methodologies**
Designers suppose that, if artefacts can be interrogated to examine how they might contain a cultural signification or might reflect the Zeitgeist of times past, then it seems reasonable enough to trade upon these cultural values and build them into the design of contemporary artefacts.

4.3 **The strategic lacunae and impact of agency complexity and autopoiesis**
Artefacts are better understood as an emergent and temporary form of supercomplex forces.

4.1 The 'resolved' technological artefact and the role of cultural networks

Artefacts are used to codify society and culture in material terms.

Industrial designers have begun to understand that their outputs emerge from within the culture in which they are themselves placed. The uncertain variability of the terms this process demands requires a familiarity with techniques of analysis that are themselves as complex as those they are designed to unpick. It is, then, not surprising that industrial design academics have struggled to explain the complexities that give rise to a particular technological artefact. Bijker has made a thorough study of this (see, for example, Bijker et al., 1989). Bijker's more recent *Of Bicycles, Bakelites, and* Bulbs (1997) is a more complete attempt to reveal the social origination of technologies and thereby an attempt to open its development to processes of democracy. Bijker encounters similar difficulties as Molotch, who in *Where Stuff Comes From* (2005) attempts to unpick 'how toasters, toilets, cars, computers and many other things come to be as they are'. Molotch presents a robust attempt to reveal the hidden forces at play in the emergence of artefacts. However, in summing up the text on the book jacket, Petroski suggests that this is an almost endless task.

> Molotch tells us what design is, who designers are, where design happens and society, culture, geography, the marketplace, and *just about everything* [82] else imaginable contribute to making things look and work the way they do. (Molotch, 2005)

Molotch attempts to build a picture of the forces of humanisation and positions the designer as an orchestrating agent in this complexity. It is not surprising then that industrial designers struggle to manage the possibilities of orchestrating infinite complexity. In 1979 Gregory Bateson, describing how we might build an artificial intelligence, wrote:

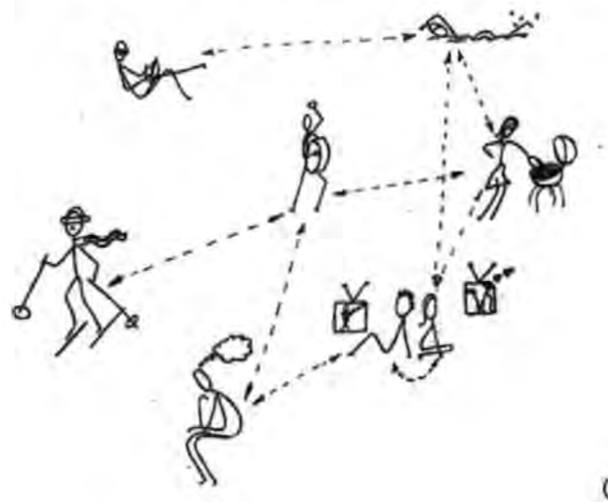
> Fifty years ago, we would have assumed that the best procedures for such a task would have been either logical or quantitative, or both. But we shall see as every schoolboy ought to know that logic is precisely unable to deal with recursive circuits without generating paradox and that quantities are precisely not the stuff of complex communicating systems. (Bateson, 2002)

Designers' attempts to extract the process of humanisation from the artefact must deal with the problem of recursive circuits too. The complexity of the task of unpicking the

[82] Emphasis added.

supercomplex forces of history and culture that go into the formation of an artefact makes it almost impossible to be certain of any pathway. There have been, in recent times, a plethora of attempts to understand what design is by distilling it as a process from the complex forces that create what is taken to be *human* culture. Many of these attempts are sited in the present and place their attention upon particular artefacts as a form of semiotic witness to culture. In this methodology, *culture* becomes the scene of humanity - that is, the place where humanity resides and can be accounted for. For example, a domestic washing machine is posited as a site revealing the gendered nature of technology (Graves, 1996), while material possessions are mirrors of social change (Hardiment, 1988), a means of revealing the nature of selfhood (Dittmar, 1992) or, simply, a means of exploring everyday life (Attfield, 2000; see also Dormer, 1990). To understand culture, this logic suggests, is to understand what it is to be human and ergo the process of humanisation. Harman (2002) has argued that, the richer and more inclusive and 'biodiverse' the understanding of culture held, the richer human species will be.

Much of recent scholarship in industrial design has focused its attention on how artefacts have become what they are and how this process can be reversed by understanding and orchestrating the cultural forces shaping them. Designers cannot reasonably be expected to be cognisant with the full complexity of the process they are engaging with, but are impelled by the ICSID to intervene nonetheless. The emerging brand of 'Social Design' has this claim at its heart. The DESIGN 21, Social Design Network, is an explicit attempt to bring together 'members of the design community, socially conscious individuals, local governments, businesses and non-profit organizations' in order to identify social problems. Social designers (another new design term) 'create smart solutions through design' (Design21, 2006). One problem with design attempts at social networking is that designers are not drawn from a particularly broad spectrum of society. It has been argued previously in this thesis that designers are 'placed' (Buchanan, 2002). There is a significant risk in social design interventions that designers will understand culture and society from a perspective determined by their own class and social placement. For example, research by members of Hewlett Packard Labs and Google investigating social networks demonstrates how networks can be read in behaviourist terms and as reflections of the social location of individual designers within the intellectual community. The network they identify is Western, somewhat middle class and essentially a younger professional and educated network of kinship (see Adamic et al., 2005). While the claim is made that the research 'observed and measured social network phenomena such as the small world effect, clustering, and the strength of weak ties' (Adamic et al., 2005), the evidence base is drawn from a tightly constrained social situation. In the illustration that accompanies the article, it can be seen that the network seems preoccupied with activities of leisure that are drawn from a very narrow social spectrum.



(Adamic et al., 2005)

This image illustrates the danger of social intervention by designers who might assume that deviation from the behaviour anticipated in the network is abnormal: 'we found correlations between a user's personality and their other attributes, as well as interesting correspondences between how users perceive themselves and how they are perceived by others' (Adamic et al., 2005).The notion of the 'human' then has become something of a meta-conceptual 'value': to be human is to imply something inherently good, rich and complex or even to accept Western cultural behaviours to be inherently human.

For the most part the human relationships, passions, laughter and tears that go to make up the rich complexity of individual lives are memories. But our memories are not yet durable. In order to build a picture of the rich complexity of past lives, archaeologists must scrape away mud in the hope of revealing something that has endured. Archaeologists can read histories, of course, but these can provide only a limited political and mythological memory. Archaeologists look for more tangible evidence of fire, wear on a rock, or the particular mineral content of a soil sample, for example, and claim these as a more solid memory of human life. An artefact, which in archaeology is something crafted with human purpose, is a particularly special find.[83] In archaeology, artefacts can be isolated from the place they are discovered; they are a portable and enduring evidence of real lives lived.[84] This is the process of archaeology: walls must be conjecturally reconstructed into buildings, pots and pans into meals and rituals. Just as skeletons are conjectured into people, archaeologists transform muddy artefacts into a memory of people situated in a life in another remote time.

Artefacts have an important role to play in our culture. Their use as some kind of evidential and solid folk memory is inculcated in us at an early age. As children we see artefacts in our picture books; artefacts are displayed for us to see in visits to museums. When analysed, artefacts can reveal something about the people who made them, but, since they cannot speak for themselves, any analysis is subjective. Archaeological analysis is subject to the beliefs and prejudices of the culture in which the analysis takes place. Rosenzweig and Thelan (1988) suggest that the past is imagined in terms of the present, Harraway has, in another context, written of how it is necessary to extract prevailing racism and sexism from primatology (see Harraway's *Primate Visions* (1989))[85] and industrial designers should not consider themselves immune from this prejudice. The analysis of any artefact is conditioned by the placement of the viewer and by any institutional discourse. There are some who see in displays of artefacts a subtle conspiracy to shape understandings of the world; one contributor to a discussion thread on a conspiracy website describes museums as 'brainwashing stations for the youth' (ATS, 2006). Another contributor responds to this:

> When I was young we went to museums. I saw greek and roman anphores [*sic*], coins. I saw dinosaurs, I saw equipment from the 1st and 2nd World War, I saw old cars and planes. I saw old books, old paintings. I don't think I have been brainwashed. Educated, yes. (ATS, 2006)

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[83] In archaeology, material without evidence of deliberate human intent is not classified as an artefact.

[84] Archaeology draws comparison between what is known with what is not known. Sometimes these comparisons are drawn with evidence that is close in age or culture to that of the artefact in question; a shoe, for example, we can guess might have been used in a similar fashion to its contemporary counterpart. On other occasions, the comparison is made with a generalised or specific understanding of human nature or culture; for example, there is a broad cultural assumption that children play with toys.

[85] Of course, archaeology is not immune from the truism that facts are true only until they become falsified by scientific proof, or because culture shifts, such that a new, more plausible, explanation becomes possible for the form of an artefact.

It is surprising perhaps that we should find such a discussion on a conspiracy website. These correspondents, should they trouble themselves to reflect upon some of the discussions that have occupied the discourse of museum studies, would find their discussion to be a matter of vigorous academic debate there. Bearman (1992, p. 9) has suggested that museums reflect the impetus to 'collect and preserve artefacts from around the world ...' as an extension of imperialist assumptions of the supremacy of Western civilisation and the logic of a scientifically constructed world. Until quite recently, museums made little effort to understand the artefacts they displayed, particularly when they emerged from cultures that were not Western. Those industrial design correspondents who argue rather vaguely about conspiracies to deceive echo these debates, but, while the subtle message contained within the choice of artefacts and their explanation have received much attention, the display of artefacts themselves as a means of containing a folk memory is accepted without question. Be it dinosaurs, equipment from the First and Second World Wars, old cars or ceramic pots, it is an accepted truism that the world can be understood by looking at its artefact traces. Those who design museum exhibitions recognise they must be conscious of their stance with respect to the arrangement and display of artefacts and the context of their placement in relation to one another (see Barringer, 2002). Only careful and critical curation and skilful information design can contextualise artefacts on display.[86]

> Over the years museums have changed a great deal. Today, while museums are diverse, as are their aims, it can safely be said that they are primarily in the business of dissemination of information rather than artefacts. The advantage to thinking in terms of information is that it validates the collection of intangibles ... as well as actual artefacts ... (Bearman, 1992)

The artefacts and animals collected from faraway lands were strange to behold when brought back into the Western world of the eighteenth and nineteenth centuries. Disconnected from their particular narratives, they appeared in many cases to be beyond comprehension. Buchli

[86] The Freakatoria (see Freakatorium, 2005) of the Victorian museum presented a field of wonderment, with collections of artefacts unalloyed by information - rather like the design picture books; they allowed viewers to wander at will and to delight in what they found in their own terms. Contemporary museums run the risk of the accusation that the informational context in which artefacts are placed constrains the imagination used in their interpretation (Greenblatt, 1991). Information - as Foucault alerts us - comes complete with its own structures of power and its own hidden determinants. Drawing a comparison with how Derrida alerts us to textual analysis - if museums focus upon a single linear story, as in a thematic exhibition, care must be taken not to exclude from validity the personal resonances that visitors might hold. We must remain alert to the knowledge that the choice and prominence of a particular artefact displayed in a museum (or an industrial design history for that matter) and isolated from its temporal determinants tell us rather more about our own times than we sometimes care to admit.

(2002, p. 12) has described the exotic displays of the eighteenth and nineteenth centuries to be an attempt to 'mediate between two worlds, one known (Western) and one not known and invisible (non-Western), that could be comprehended through these mediating artefacts we call material culture'. A significant discourse has emerged from this tradition of collecting and from the impetus to understand artefacts. The trajectory of this analysis has attempted to connect artefacts directly to the cultures from which they emerged. 'Material culture as we understand it is a direct consequence of the collecting traditions of the nineteenth century ...' (Buchli, 2002, p. 16). Over the years material cultural analysis has developed a sophisticated toolkit that understands artefacts to be indicators of the culture of those who made them. Methods of material analysis, devised in part in reaction to uncritical and subvert imperialist eighteenth- and nineteenth-century notions of display, have become firmly established in scholarship, to an extent that, arguably, they now shape almost every analysis to some extent.[87]

The idea that the things that humans use everyday carry with them, in some codified form, the cultural narratives through which human lives are formed is accepted largely without challenge. This is reflected in industrial design analysis and is given impetus by Csikszentmihalyi's ideas of *Material Possession Attachment* (Csikszentmihalyi and Roshber-Halton, 1981). Schultz and Baker's review (2004) of material Possession attachment is often cited by designers claiming 'Goods have the property of indexicality, as they provide tangible, palpable proof of life events'. Belk (1991) describes goods as 'magical vessels' of meaning connecting us to 'deeper, less understood, and unarticulated aspects of life''. It seems reasonable enough then to suggest a methodical and forensic deconstruction of artefacts in history might be open to critical analysis and hence to reveal some impression of the mythological (Barthes, 1989) nature of human-technological relationships. In comparison to the relatively linear stories weaved by Pevsner and Banham, more recent sustaining narratives of industrial design are thematic. These texts tell a story predicated upon the idea that artefacts hold the potential to reveal some common thread running through culture. These texts suggest that artefacts can be read as a kind of obscure linguistic evidence. Selle suggested in 1973 that 'one can speak of a product language to the extent that design

[87] It is arguable that many attempts at material and cultural analysis have such a degree of self-reference that they have become something of a dogma.

artefacts are not only carriers of function, but always carriers of information as well' (cited in Bürdek, 2005).[88]

Artefacts, however, appear to be fixed in time and place and to be solid. They become museum worthy because their material form is enduring and can be preserved and isolated for posterity and put on display. This should not mean that they are a prerequisite for analysis in texts where their physical presence is not a necessity. However, in the majority of industrial design histories, the visual, material cultural analysis used as a means of analysing a social and technological history of the nineteenth and twentieth centuries is centred about the images of artefacts. The sustaining narratives of industrial design sometimes present unusual or spectacular artefacts without critical or informational insight, but for the most part design literatures present artefacts as the means to track some kind of historical trajectory. Artefacts are presented as if they can reveal, in some special and necessary way, something of the unfolding story of technological development. There are, however, many versions of the material cultural analysis of static and fully resolved artefacts. The process of humanisation may be encrypted in their shape and form, but any explicit analysis of its immaterial trajectory is absent from the text. There are no significant histories of the trajectory of the use of technology.

4.2 Cultural networks and the deficit of reductivist methodologies

Designers suppose that, if artefacts can be interrogated to examine how they might contain a cultural signification or might reflect the Zeitgeist of times past, then it seems reasonable enough to trade upon these cultural values and build them into the design of contemporary artefacts.

The link between design and culture and the analysis of design as a cultural indicator is made explicit in Sparke's *An Introduction to Design and Culture: 1900 to the Present* (2000). Sparke moves away from the telling of the story of industrial development and draws a more direct

[88] The archaeologist retrieves artefacts from the ground and attempts to give them names. Artefacts, if they cannot be identified and named, or if they bear no reference to any device in contemporary use, can appear to be utterly bewildering when viewed with contemporary eyes. These artefacts, when they are first retrieved from the ground, appear to be intended in some way for human use, but are disconnected from, or obscured from traces of, the processes of human intervention that they embody. There is nothing necessarily inherent in the artefact to reveal its purpose, unless a corresponding reference remains at play in the times in which it is analysed. In archaeology an artefact can be studied and inference made from its form, but this process must remain somewhat conjectural. For example, the alignment of Stonehenge with the sun might seem to provide some insight, but it is widely accepted within archaeological scholarship that the imperative of Stonehenge can never be known for certain, and so theories of necropolis, grain store, astronomical calculator and temple can be found among the academic discourse surrounding Stonehenge, to say nothing of the many fringe theories.

focus upon the 'cultural concept called design visible in the context of consumption . . .' (p. 179). Sparke lists in her bibliography a vast array of more recent texts placing emphasis upon material and cultural analysis. As Sparke herself puts it, 'much of the work in the areas of design history and material culture undertaken since the 1980s has adopted a cultural slant' (p. 254).

> an enormous body of theoretical work ... [from] cultural studies, sociology, consumption theory, anthropology, social psychology, literary studies and cultural geography - has had a dramatic impact upon the way in which work on the subjects of design and material culture has been undertaken. (Sparke, 2000, p. 255)

Sparke recognises the growth of material cultural analysis through the 1980s and 1990s. 'Many books deal with the relationship between consumer culture, material culture and modernity' (Sparke, 2000, p. 256). She provides a comprehensive bibliography for industrial designers seeking a sense of their history through cultural readings, and her work is likely to appear in any university school of industrial design reading list. The study of material culture is now a wide and established field, which is often recognised in industrial design as building upon Marxist ideas of capital commodity, and also Veblan's classic study (1899) of consumption among the leisure classes. Twentieth-century analysis is significant for a proliferation of attempts to reveal hidden power structures within culture, and industrial design has not proved immune to this drive. Woodham (1997) provides a relatively recent and scholarly account of industrial designers' intellectual interventions, infused with visual, material cultural analysis, reflecting a discernible shift towards cultural studies in more recent design narratives. In a chapter 'Pop to Post-Modernism: Changing Values', Woodham (1997, p. 183) describes a 'discernible shift of emphasis from production towards consumption ...'. A significant body of work has been undertaken in the industrial design community in recent years attempting to analyse hidden structures within human culture and society and to connect this in an industrial design context to the development of technological forms. Design theorists such as Buckley (1986) Hillman Chartrand (1990) and Boradkar (2006) have constructed a commodity discourse around industrial design and have called upon Adorno, Horkheimer, Marcuse, Haug and other members of the 'Frankfurt Left' and also the French theorist Lefebvre (1991) in order to bring revisionist forms of Marxist analysis to industrial design. These theorists use the artefacts of industrial design to reveal evidence of power, politic, gender and patronage in cultures.

Reading material cultural analysis, one might think it quite plausible to acquire the material things needed to become whoever one wishes, detaching "oneself into another time and place, or to become part of an off-the-shelf, collective identity (Sudjic, 1985). Redhead (1999) suggests that 'the products that surround us provide an instant cultural history, a mirror in which our own preoccupations are vividly reflected' (p. 8): 'We design them. They reflect us' (p. 9). Redhead divides his history into five chapters: (i) Basics; a style for the 1990s, (ii) More; the proliferation of stuff, (iii) Control: the illusion of power, (iv) Identity: who do you think you are, and (vi) Crisis: the shape of uncertainty. It could be said that Redhead presents a fairly bleak view of industrial design, reducing it to a kind of freak show, hopeless and shallow. However Redhead reflects the output of industrial design, his presentation is constructed entirely of artefacts, presented as reflections of rather obvious cultural determinants. Such a notion, of course, is not lost on designers or marketing departments. It seems perfectly reasonable, then, for designers to reverse this process and to implicate artefacts with cultural meaning. In Woodham (1997), for example, a 1986 Dyson vacuum cleaner (p. 185) is compared with a 1957 range of Kitchen Machines from Braun (p. 155): 'Unlike the [Braun] kitchen appliances ... this design is redolent with imagery and associations.' This negates the imagery that the Braun product carries within its own times. Material analysis has provided what has appeared to industrial designers to be a productive means to understand how artefacts come to be as they appear in their histories. The interrogation of artefacts in such a manner as to reveal the culture that they contain has become an established practice in itself. Recent sustaining narratives of industrial design such as Woodward (1997) are similar in their analytical approach to more explicit explorations of material cultural analysis such as Miller (1987) or Buchli (2002).

Outside technical conversations, the analysis provided by contemporary histories and material cultural texts provides a means for working and student industrial designers to theorise their practice. This was not always the case, however; for most of the twentieth century industrial designers had relied upon variations of what came to be called the 'doctrine functionalism' (Moles, 1967). This doctrine broadly held that the products of industrial design should be designed in a manner such that they were first and foremost functional without unnecessary form, and were expressive of their function. The dictum of 'Form Follows Function' (FFF) was extracted from Sullivan's article of 1896, 'The Tall Office Building'.[89] Sullivan was influenced by Emerson's and Greenhough's Hegelian ideas of the metaphysical interpretation of architecture ((see particularly Lloyd Wright, in Jones, 1961) and also (Menocal, 1981.)) Although Sullivan might be read as a kind of prescient *chaos theory*, the dictum 'form follows function' can be tracked through industrial design histories, so as to seem an entirely materialistic and utilitarian reduction. 'Form follows function' came to be described as 'an empty jingle' by Banham (19655, in part because it seemed as if the utilitarian reduction of so-called brutalist architectures singularly failed to account for the invisible and more metaphysical qualities necessary for the support of rich human lives. Because these buildings appeared to take no accont of a complexity other than their own necessity, they were almost entirely inutile and were subsequently demolished. At the end of the 1960s Moles recognised that functionalism must give way as a maxim in the face of the acceptance of cultural plurality and an emerging consumer culture that demanded individually styled products. The shift from function to meaning reflects a shift in industrial designers' perceptions of their practice from a necessarily unconsciousness of culture, to a more problematic and confusing awareness of their need to be conscious of the need to be self-consciously unconscious of culture. Industrial designers seem to be aware that they need to recognise that their artefacts have a consequence in culture but find their attempts to intervene directly in, or to anticipate, culture to be fraught with problems.

This emerging culture had coincided with the proliferation of a number of new domestic, electronic artefacts. These new electronic artefacts could take their form without any particular aesthetic imperative that drew upon their function (Moles, 1967).[90] Designers who steadfastly held to functionalist principles in the 1960s and 1970s found that electronics denied any sense of their functionality in the form of the product.[91] Holding to functionalist principles,

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[89] 'Whether it be the sweeping eagle in his flight or the open apple-blossom, the toiling work-horse, the blithe swan, the branching oak, the winding stream at its base, the drifting clouds, over all the coursing sun, form ever follows function, and this is the law ... It is the pervading law of all things organic and inorganic, of all things physical and metaphysical, of all things human and all things superhuman, of all true manifestations of the head, of the heart, of the soul, that life is recognizable in its expression, that form ever follows function' (Sullivan, 1896).

[90] There is little in the material presence of electronic technologies that avails itself of the functional aesthetic; take an electronic device apart and it is indistinguishable from any other electronic device.

[91] The materiality of 'eff-eff-eff' as we came to know it through our teaching as student designers appeared to refer entirely to the material and visible qualities of technology. While Sullivan himself seemed to open the space for metaphysical engagement, 'eff-eff-eff' appeared to industrial designers during the 1980s to present a kind of imperialist constraint. Some student industrial designers attempted

designers found themselves creating indistinguishable artefacts in almost identical black boxes, with perhaps a single illuminating diode to indicate activity. Moles and others had identified that the industrial design community sensed an emerging pressure to develop aesthetic difference for marketing and brand-identity purposes in the products they designed. It appears to be an orthodoxy that artefacts are fixed, static and complete in themselves and present the resolved outcome of a process of humanisation that can be unpicked by means of material and cultural analysis. It seems reasonable enough for industrial designers to ask whether they might perhaps reverse this process: to anticipate the cultural forces that come together in the formation of artefacts and to build them into their designs. Industrial designers have become highly skilled at extracting the resonances established artefacts carry with them, and then re-embedding their cultural resonance into the design of new products. Some of these attempts can be analysed so that they reveal some of the problems with material culture as a mode of analysis - for example, the new 'Mini' (Design: Frank Stephenson) manufactured and sold by BMW.

The Mini old and new.

The design team of the new Mini has successfully reconnected its product with the original Mini from some forty years previously. The cult car of the 1960s has been captured in the new design through the skilful application of resonant styling cues:

> The new Mini is ... instantly recognisable ... it retains the short stubby configuration of the first-generation car, although it is in fact a much larger vehicle ... The unique

a radical breakout, a kind of Punk rebellion from its strictures and in keeping with the mood of the times; the phrase 'form follows fuck-all' became a clarion call of a generation of young designers who recognised that the packaging of electronics in identical black boxes - a consequence of modernist logic - presented little future for industrial design. In retrospect, this might have been a mistake, founded in ignorance of Sullivan's true implication.

heritage of the Mini sees it pull off a remarkable double act, cutting across a large generation gap. Appeal[ing] to the young and the young at heart. Rebels with a cause, you might say. (2005: www.cartorque.co.za.)

It is quite possible, of course, that potential customers of the new Mini might be unfamiliar with the classic Mini. The design of the new Mini is not enough to sell it alone, and sales have been supported by a skilful marketing campaign that has built a mythology reconnecting the new car with its supposed forebear.[92] In the light of BMWs skilful advertising and marketing campaign, it is difficult to remain po-faced when confronted with the playfulness of the retro-styling of the new BMW-Mini, and it is undoubtedly a popular and successful product as well as a hugely skilful manipulation of referent styling cues. The new product references the old product and has a functional similarity. The referent, however, is a fragile entity; it can become stretched over time to the extent that its narrative can be lost. This appears to be particularly problematic if applied to a product that has no functional connection to the culture it apes. A good example of a product that makes both of these mistakes is Nokia's 7260 series mobile telephone (Design: Frank Nuovo).

Nokia 7260 (left) and 7700 (right) series mobile phones

Nokia describe this artefact by suggesting it draws 'inspiration from the refinement and mystery of the golden age of glamour, and combined with old world elegance with modernity... each phone is a pure reflection of the inspirational 20s ... a distinct twist of

[92] The 2003 remake (director F Gary Gray) of the 1969 film *The Italian Job* (director P Collinson), coinciding with the launch of the new design, can arguably be understood as a device reconnecting the material culture of two generations of an artefact across time. It is possible that the inferior nature of the new film played a large part in ensuring the cult status of the original film, thereby projecting the Mini it featured forward as an intact referent.

modern art deco' (Nokia, 2005). Old world elegance failed to strike any resonance in Nokia's youthful market and even a casual search could throw up many references to Nokia's weird, strange and bizarre designs.

> given the Finnish company's penchant for coming up with some pretty bizarre designs of late, it's no surprise that the new Nokia looks more like a fancy address book or a lady's compact than a communications device. (2005. www.star-techcentral.com)

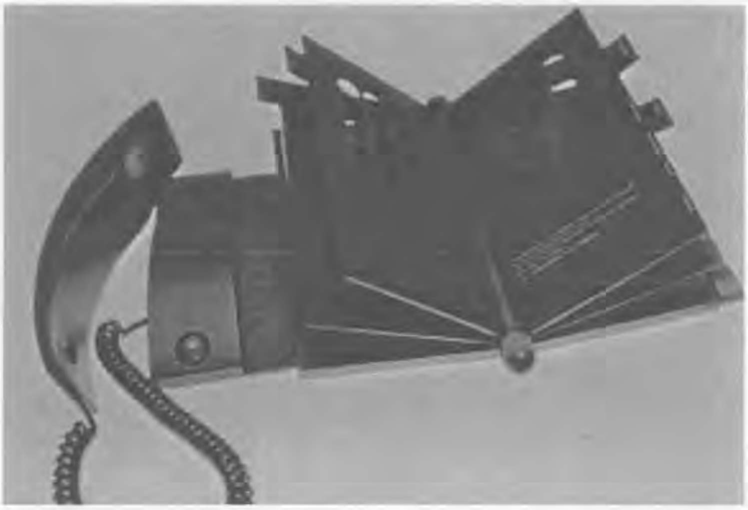
While artefacts can appear to tell us something of the times and situations in which they appeared, the reverse engineering of material culture is at the very least problematic and at worst confusing. Whereas the Mini builds upon some trace remaining of a cultural value, Nuovo's flirtation with the 1920s is fraught with problems. There simply is no referent to the 1920s in the function of the mobile phone, and so its form can be compared only to quite incomparable products. As one contributor to a mobile phone design forum says: 'I just don't see the point in this "phone", if that's what it is. It's so novelty [*sic*] it's unbelievable, I'll be surprised if they sell even one of these. Nokia have really lost the plot this time' (Mobileburn, 2005). While the material culture embodied in an artefact goes some way to explain it, there is clearly something important in the functionality of the referent: in this case the phone has no functional precedent in the 1920s to fit its trajectory. The function of the technology is disconnected from its own imposed cultural narrative; at the best it can appear to be a novelty, at the worst it simply seems like any other artefact dislocated from its context - like the Venus of Willendorf, for example.

When Moles (1967) recognised there was a crisis in the doctrine of functionalism, there appeared to be nowhere for industrial design to turn except towards a new form of narrative design (see Dormer, 1990). The drive to create meaningful form for electronic technologies emerged particularly as a consensual doctrine in the industrial design community during the 1980s as a methodology drawing heavily upon an interpretation of linguistic analysis. Described more fully in Krippendorf and Butter's 'The Semantics of Form' (Krippendorf and Butter, 1984) 'Design Semantics' was picked up as a paradigm by industrial designers (see, e.g., Philips's 'Design Strategy of Expressive Forms' (Kirchner, 1987, cited in Bürdek, 2005). Dormer describes Krohn and Viemeister's competition-winning telephone answering machine, utilising 'a book format with the pages serving as switches for different functions' (Forme

Finlandia, 1987. Design: Lisa Krohn and Tucker Viemeister). This artefact is perhaps one of the best-known and most often cited examples of design semantics. Dormer compares the answering machine with kitsch from the 1950s; although careful to recognise the intellectual intent behind Krohn's design, he points to the manner in which the design is 'clear in its vocabulary and therefore will be understood by a lot of people very easily' (Dormer, 1990, p. 28). The design of this answering machine relies upon a metaphor of page turning carried over from a pre-electronic paper telephone book. This is a materialisation of the immaterial electronic and plays with the idea that 'we live between two worlds: our physical environment and digital space' (Dunne, 1999, p. 123). Dunne, however, finds this form of narrative design problematic. This he claims is an example of 'the material equivalent of one liners. Once the viewer grasps the connection, there is little else to engage with' (Dunne, 1999, p. 124). Like the flag man walking in front of the motor car, making technology familiar can be shown to limit its potential; if referent design tells, or worse still demands, a mode of operation, it can trap us in its narrative structure.

> While the rise of semiotics in the 1960's was advantages [*sic*] in that it provided for the extension of linguistic research into other domains, any of which could be treated as a semiotic system, this extension took place at the expense of subordinating the artefact qualities of things to their word-like properties. (Miller, 1987)

And, in any case, what happened to the telephone answering machine? A decade after Krohn's design proposal, the answering machine puffed into evanescence. The artefact 'answering machine' has now become a service adjunct to a contract and is lost to artefact archaeology. The semiotic resonance of the telephone book has become reduced to an icon on a mobile telephone. For many younger users we can guess that even the phonebook icon itself has no resonance in something they have ever used.



Telephone Answering Machine and phone directory, 1987. Design: Lisa Krohn and Tucker Viemeister

This form of referent semiotics, when understood as an attempt to build upon the capacity for technologies to have a cultural and social value, must place emphasis upon the extraction of technology from culture as a material and visual snapshot, unless it attaches to it in an act of mimicry a mythological and synthetic history. Referent semiotics, attempting to ape this process, becomes a pastiche or simulacra of that which it mimics; more often than not it requires a massive investment in a supporting narrative that can carry cultural resonance across time.

4.3 The strategic lacunae and impact of agency complexity and autopoiesis

Artefacts are better understood as an emergent and temporary form of supercomplex forces.

Time can play tricks and archaeologists must take care to note in precise terms the location of any artefact they uncover. Archaeologists know that they need to be absolutely certain of the precise chronological location of artefacts. When artefacts are presented as reified objects, subsequent cultural developments can inflect their own influence upon the analysis. For example, in *Products of Our Time* Redhead (1999) presents a set of photographic illustrations of Constantin Boym's *Souvenirs for the End of the Century.* These 'six pewter models of buildings of disaster' include the 'Una Bomber Shack' and the 'Chernobyl Power Plant' and significantly the 'Twin Towers of the World Trade Center'. *Products of Our Time*, it is worth noting, was published in 2000, one year prior to the 9/11 airborne attacks but somewhat after the first, and now largely forgotten, attack upon the World Trade Center by means of an explosive device in an underground car park. The twin towers of the World Trade Center were perhaps intended by Boym as an icon of a global economic disaster, or a wry comment upon the institutions of corporate finance. Of course, subsequent events have projected the image of the twin towers into international significance, in a manner quite unforeseen by both Redhead and Boym and likely to be misread by future scholars. These objects may well one day find themselves in a museum of our times, entirely out of time with their chronology and presented as a memorial to the September 11 attack. The misreading of the image of the twin towers in this instance is unfortunate but hardly consequential. However, in his revised 1960 introduction to *Theory and Design in the First Machine Age*, Banham (1955, p. 10) looks back upon what he terms to be the 'naivety' of the early twentieth-century technology pioneers. He enquires how one might reconcile the 'enthusiasm that stirred the futurists' with the 'creaking fabric-covered aircraft, enormous and complex radios or cart-sprung automobiles' of those times and wonders how such archaic machines could have 'offered, the effortless conquest of time and space?' (Banham, 1960, p. 10) Banham's reflection upon technologies of earlier times and the 'naïve' response of those who engaged with them is a moment of arrogance, born not necessarily of a personality flaw, but of a methodology of analysis, which cannot get to grips with the full complexity of its terms.

Any picture may appear to present a final and fixed reality; however, more recent approaches to material cultural analysis, such as De Landa (2000), have argued that it is possible to understand artefacts as moments of apparent materiality and stillness in an otherwise fluid turmoil of dynamic forces.[93] Artefacts in this new kind of understanding are formed in moments of intense energy or slowly deposited over time and in the manner that strata are twisted and reformed, shattered and broken, worn down, erased and smoothed off over time by the cultural forces acting on them (see De Landa, 1997). This new knd of theorisation suggests that artefacts should not be accounted for out of their time to the exclusion of the forces that give rise to their emergence and subsequent development. Neither should we

[93] This will be discussed more fully later in this chapter and in the following chapter.

exclude artefacts from a recognition that they are in the process of becoming other subsequent forms.[94]

We must take care not to think of this forming and wearing-down in terms of a simple linear chronology. Although he is less prominent today, the popular science writer James Burke was at one time a familiar face on television. Burke's current project, the 'Knowledge Web',[95] extends the thesis of his popular science publications (Burke, 1985, 1995 and 1996). During the 1970s and early 1980s Burke developed a model of history that seemed to be quite at odds with the climate of the time. Burke is largely categorised today as a popular writer, but his methodology still has much to offer the scholar. If sustaining narratives of industrial design limit their scope of attention and in so doing limit the scope of imagination, then Burke alerts us to the connective nature and intellectually playful and creatively illuminating possibilities of history. For example, Burke extends his histories as far back in time as evidence will allow, and then through progressive steps arrives at a contemporary instance of a given technology.[96] For example, we can compare the history of the computer, as it is told by Shurkin in *Engines of the Mind* (1996), with that of Burke.

Shurkin (1996) opens his history with the 'invention' of counting and calculation and the particular need quickly to calculate the logarithm. His history then charts a trajectory that includes Pascal, Babbage and on to ENIAC and the desktop personal computer. This is a logical enough history; it seems to make good sense. There is logic to its focus on developments in the late twentieth century, a period in which the desktop computer proliferated. Shurkin

[94] Even in our own times, the realisation that much of the resonating rhetoric of cyberspace was constructed in an era of dial-up modems and computers, which by the standards of today might seem achingly slow, surely points to this problem. Technologies and the cognitive ideas they shape, and are shaped by, flow; they are not static and not readily analysed in isolation. The material manifestation of technologies is at best an inadequate means of exploring the excitement and promise of the age in which they appeared. Perhaps another illustration might lie in the disbelief of contemporary conspiracy theorists that the crude technology of the 1960s could propel a man to the moon and return him alive.

[95] The Knowledge Web (http://www.k-web.org) does not constrain the imagination of linear histories; it invites exploration and is described thus: 'The Knowledge Web today is an activity rather than a web site—an expedition in time, space, and technology to map the interior landscape of human thought and experience. Thanks to the work of a team of dedicated volunteers, it will soon be an interactive space on the web where students, teachers, and other knowledge seekers can explore information in a highly interconnected, holistic way that allows for an almost infinite number of paths of exploration among people, places, things, and events' (Knowledge Web, 2006).

[96] One can guess that these 'connections' are constructed in reverse and in so when written as a narrative in chronological order the histories become intriguing stories with something of the resonance of a whodunit mystery as each step unfolds. Burke alerts us to the denouement as he opens his story, then – rather in the style of an episode of 'Colombo' where the answer is known – the reader joins Burke in the unravelling of a complex story.

constructs a good history; it works as a narrative, building slowly and accelerating as we might expect into a tumble of developments in close chronology. Shurkin provides an authoritative reinforcement of the canonic history of computing and provides a good source of names and dates and a chronology of development that seems coherent. His history reinforces the notion we might hold of the computer as a calculating machine. Burke, on the other hand, does not focus upon computation and the switching of integers to arrive at complex mathematical solutions; his focus is upon prediction. Burke (1995, p. 117) opens his history with the development of astrology, focusing upon the potential of the computer to hold 'the future within it'. For Burke the power of computation lies in is ability to simulate in advance of reality. War games are played out in massive simulation; crashes and engineering tolerances are simulated; texts are simulated, re-simulated and then made real in the printing. Burke (1995) delights with stories of Arab astronomers (p. 114) and Christian adaptations of zodiacal systems (p. 119), unpacking the potentials and possibilities of prediction. The story resolves in the industrial era and through to the simulation and predictive softwares of production. In this way we come to understand the computer in a manner that opens it up to the imagination as a materialisation of an enduring aspect of human sensibility.

Whereas Shurkin confirms our sense of development, Burke reminds us that any artefact has an almost infinite history of determining forces. While Burke may be a popular science historian, Gallagher and Greenblatt's *Practicing New Historicism* (2001) provides a more authoritative text in this field. Their approach, although oestensibly more scholarly than Burke's, is not that dissimilar. For example, Gallagher and Greenblatt draw upon ideas of transubstantiation, not something one might reasonably expect to find in a history of the potato, but entirely coherent in their analysis of 'The Potato and the Materialist Imagination'). Although scholarly, Gallagher and Greenblatt are playful, and their histories are the richer for it.[97] Histories such as those of Gallagher and Greenblatt and Burke invite speculative enquiry; they demonstrate how artefacts as they appear in a moment of history have emerged in consequence of the collusion of many other histories. Stafford (2001) presents a similarly playful and scholarly approach when she constructs histories through analogy. Stafford finds resonance with contemporary artefacts and technological conditions in deep histories that go

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[97] Industrial design histories, however, appear to become ever more intense retellings of the same story - industrialisation made manifest by its products as a reflection of the culture of their times.

far further than orthodox interpretations built around linear trajectories of technological development. Stafford values the interconnected, self-generating nature of history and the reoccurrence of thematic human imaginations that are independent of technological circumstances. She demonstrates, for example, that the art of connecting and the impetus to take multiple views, evident in contemporary immersive virtual reality, is evident throughout the history of art and not suddenly shifted into potentiality by the particular technological conditions afforded by the paraphernalia of virtual reality.

Roe Smith and Marx argue in *Does Technology Drive History* (1994) that the success of a given technology is determined by the cultural forces that pull it into the imagination, and thenceforth into adoption and usefulness.[98] They demonstrate a gap between the initial development of a technology and its subsequent adoption into use. There is some evidence to suggest that attempts by marketing strategies to sell technologies fail if no cultural imperative exists. A good example of this is the seemingly endless attempts to sell mobile video by the ability to see 'Goals on Your Mobile' for example,the 24-7 Football service (24-7 Football, 2007). At some point, perhaps, a tipping point [99] will be reached, and mobile video, or the urgent need to see goals, will become apparent, and the technology will be pulled into use. Punt (2000) has identified a problem with deterministic models of technological development that construct a story of invention by 'great men' and then chart the supposed impact of the invention upon the world. Punt argues that the concept of spontaneous invention deludes. Roe Smith and Marx also suggest that technologies do not appear spontaneously as a consequence

[98] It can appear self-evident that technologies play a part in the shaping of culture: 'What made our modern world? Laws, politicians, kings and queens? Or the diesel, the computer, penicillin and the gun?' (Science Museum, 2005). For the most part the artefacts that appear in industrial design histories and in our museums are inert collections of metal and plastics brought together to act in some way that is useful. Artefacts, not being intelligent and sentient, have no active voice in human culture other than their reflection in human commentary. It is an assumption often made, however, in popular conversation that technologies *do* have the potential to act in the world at their own behest. While few would intend this as a literal fact, it is not uncommon to read alarming and deterministic claims that the television set is to blame for almost every social ill, from tabloid claims of the destruction of children's eyesight to academic texts such as Merrin's, for example, which claims television to be 'killing the art of symbolic exchange' (Merrin, 1999). Roe Smith and Marx (1994) alert us to the dangers of imagining in this way that technologies appear spontaneously as matters of invention and then intervene in human culture; their argument against technological determinism is founded in a rejection of the agency of technology and against the notion of victim-hood among passive consumers.

[99] The tipping point was outlined by Granovetter's 'threshold model of collective behaviour'. (Granovetter, 1978). Granovetter suggests a technology becomes usefully drawn into culture when sufficient factors in the interaction come into play. Other terms such as the *killer-app* widely coined in software design, point to the manner in which usefulness is a key factor in the interactive process. In the conversation that goes around the killer-app, the spreadsheet is widely held to be *the* killer-app that made the desktop computer useful. There is no simple non-computational equivalent of the spreadsheet and its usefulness was such that it drew the PC onto the desk of many businesses. This is a rather simplistic model. It will be argued later that models of the world such as Actor Network Theory illuminate the continuity of technologies in many forms. The spreadsheet has a non-computational counterpart in 'accounts clerks'.

of a flash of inspiration, but rather emerge as a consequence of a collective network of co-developers that are often not made visible in accounts of their trajectory. This is certainly not the case in sustaining narratives of industrial design where artefacts are posited frequently as evidence of the genius of individual designers. When Heskett describes Buckminster Fuller's design for the Dymaxion car, he recognises the forces of culture exerted upon it and cites the unwillingness of the public to accept its radical form. 'Fuller's sweeping reappraisal of both form and structure was too extreme for the American auto industry, however committed it was to a concept of mass production that depended upon judging the willingness of the public to accept innovation' (Heskett, 1980 p. 122). While stories of invention appearing again and again in popular histories and in industrial design histories can seem undeniable, their repetition consolidates the concept of spontaneous invention as a perfectly reasonable means of understanding technological development. In any case, instantaneous invention or design discounts the complexity of the placement of the inventor or designer in society.[100]

Artefacts are best understood, not as simple illustrations of cultures, but as the emergent consequence of an intensely complex interaction of determining forces, and they are best considered in terms of their use. For example, the artefact we call the 'wheeled suitcase' is better understood as a functional answer to the problem of carrying heavy suitcases. This problem could be, rather naively, understood as wholly contained within the wheeled suitcase. The wheeled suitcase, however, relies upon the smooth flooring of the travel terminus, the emergence of air travel and its new terminus, and its effect upon train travel and the redevelopment of its rather more elderly terminus. The wheeled suitcase depends too upon the demise of the porter and the social democratisation of travel. There are histories and trajectories here of changing architectures, the development of new materials and new modes of travel, changes in social and economic imperatives and any number of other social, cultural, tectonic and functional forces.

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[100] The late-medieval 'invention' of the printing press in Europe, for example, denies both the obvious nature of its function to transfer and replicate images that had existed for thousands of years prior to Guttenberg. If the press appeared in a moment of brilliance, how we might ask could the idea of printing not have occurred prior to this date? We leave prints in the soil when we walk, children intuitively print with their hands. Gutenberg's press as it appeared in 1447 drew upon the many previous crafts and its extended heritage of prior development some several thousand years earlier in other parts of the world. In the logic of Roe-Smith and Marx, the press may have simply become the killer-app of a burgeoning popular literacy, part of a complex story in a period of social change after the Black Death and in a changing intellectual climate of reformation. The determinist argues that the press brought literacy to the Western world. The argument against suggests that the irresistible demand for literacy made the press viable.

Trunki Suitcase. (Image: http://www.disabledhands.com/trunki_kids.jpg)

The industrial designer Ezio Manzini (1992), hinting at this complexity, has described the artefact as the 'materialisation of cultural contexts, of organisational forms, of technical systems, of economic interests and the will of projectionists and groups of designers, business people and the productive sectors' (cited in translation in Jiménez Narváez, 2000, p. 46). Manzini here suggests that the artefact is a somewhat, although not entirely, stable indication of otherwise subjective and fluid notions of the human condition, its institutions and the processes that go to form the cultures by which we can understand ourselves. The artefact then is only that part of a complex intersection of forces and functions that can be seen and held. It has special status because of this, but to imagine that the artefact terminates at the apparent boundary of that which is visually and materially accountable is to exclude its full complexity.

For the anthropologist Gell (1998), the understanding of artefacts resides in the placement of the observer who cannot separate his or her location in a cultural matrix from the analysis they construct. As the philosopher Derrida alerts us to the residence of meaning in a text, so Gell is among those who alert us to the necessity for a more subtle mode of analysis, which can engage with the distributed nature of determinants in a form. In a discussion of the form of Polynesian canoes,[101] Gell (1998, pp. 69-72) argues that the vessel as it appears in any moment is a static state of an emergent form. This emergent form is captured in that moment as a particular coincidence of any number of dynamic factors in which the designer or artist is but one vector; the canoe itself is in the continual process of becoming another form. The

[101] A popular reference in mid-twentieth-century anthropology.

process of humanisation, when understood in the light of Gell's insight, is not stable and resolved in the form of artefacts, but rather the artefact appears as a snapshot of an emergent and continual process. Like a snapshot, the artefact is merely the momentary solidification of a trajectory shaped by a distributed agency set in a complex and potentially infinite field of forces.

Trobriand Island canoe

The contemporary form of the canoe, sometimes constructed of fibreglass and powered by an outboard motor, is as much part of a continuing cultural history and not indicative of the erasure of one culture by another. Gell (1998) is concerned that simplistic modes of material analysis, such as those in industrial design histories, disconnect artefacts from the full complexity of the human agency they embody.

This complexity is not always recognised by designers. Dormer (1990, p. 181) has suggested that one of the most important things a designer can do is symbolise community and reflect, both in the form and in the materials and processes used to shape the design ... to argue for the importance of ensuring familiarity in design - and of employing the moral imagination'. It would be unrealistic to imagine that industrial designers can be familiar with the full complexity of the culture into which their artefacts are thrust, but this in itself may not be a problem. Gell alerts us that attempts to identify imperialist interventions can themselves provide a means to exclude the subject of observation from the authority of its own developmental trajectory. The fibreglass canoe powered by an outboard motor is part of a trajectory that cannot be undone. Relating this to industrial design, Jiménez Narváez (2000) suggests: 'Design's own knowledge is the result of this relationship between human beings and artefacts, foremost from the observation of the world and the multiple perceptions generated by this observation'. However, by presenting a picture of a somewhat focused intellectual endeavour, the stories contained within sustaining narratives of industrial design develop the notion that industrial design has maintained itself as a producer of material artefacts in a culture of Western manufacturing. Understandings of the complex interaction of forces is thus constrained to determining processes of manufacture and has become disconnected from the kinds of analysis that find artefacts to be an emergent solidification of complex social and cultural forces.

When the artefact is tied to a history of production and consumption and is understood as a determining agent, it runs up against fluctuations in value perceptions of what constitutes a valid human cultural value. The problem, of course, is that one cannot be certain any more as to what constitutes this human value. Profound cultural, political and ethical problems emerge when humanity is tied to a particular set of cultural values, although of course attempts have been made by the United Nations to establish a basic set of human rights, and designers have made some attempt to tie their practice to these.

> An idea claiming all human beings are equal and free has evolved as basic human rights today, and design has been questioned whether it is able to build happiness or what is happiness in people's life. (Ekuan, 2003)

One problem with this is that the role of 'champion of human rights' hardly sets design apart as an activity. Why should designers alone be responsible? Ekuan's call would be just as apposite were the word 'designer' replaced with 'sports', 'business' or any other discretely identified activity.[102] The Design Council also recognises this problem in its own definition:

[102] It is arguable that this is a claim more suitable for all humankind, a problem so vast it would seem beyond the scope of design alone. Designers recognise that the world is a very complex place with lots of

> One definition, aired by designer Richard Seymour during the Design Council's Design in Business Week 2002, is 'making things better for people'. It emphasises that design activity is focused first and foremost on human behaviour and quality of life, not factors like distributor preferences. But nurses or road sweepers could say they, too, 'make things better for people'. (Design Council, 2006)

Elsewhere Bürdek (2005) has suggested that an ideologically cemented concept of design is no longer plausible. Bürdek is one of many designers who give a voice to a sense that designers, as a key component in the profligate and largely unchecked development technology, might somehow carry with them some responsibility for the state of the human world.[103] With a rising awareness of ecological and social implications, the sense that industrial design has of its social, cultural and ethical responsibility in the world has grown considerably in recent years. There is a subtle implication that the role of the industrial designer has shifted towards that of an interventionist.

> We've allowed too long the idea that the world is 'out of control' - be it our cities, the economy, or technology. We've filled the world with complex systems and technologies that are indeed hard to understand, let alone shape or redirect. But we are people not ants. We have culture, and language, and the ability to understand and share knowledge about abstract phenomena. Ants don't have that. Neither do they have a tool, design, with which to shape them. We do. (Thackara, 2006, p. 225)

Thackara's suggestion is that industrial design can modify culture and that designers must take responsibility for this. In many ways this view of design as a social intervention can be read as reaction to a perceived modernist imperative. Huxley's novel of 1932, *Brave New World* presents a dystopian model of a supposedly dehumanised future. In this view, inhumanity is

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people in it who want to be happy/fit/fulfilled, etc., and so it tries to organise things so that they are, while operating in whatever economic model pertains. Who would not share this ambition?

[103] The sense that industrial design has of its social, cultural and ethical responsibility in the world has grown considerably during the period in which this research was constructed. With the almost ubiquitous acceptance of global warming and the burgeoning potential of the 'war on terror', the chatter in the industrial design community has reflected the many published and informal discussions with regard to the role of design in proliferating waste, energy consumption and international tension. Conversations within the industrial design community among those concerned with the idea and values of humanity have become more sophisticated in recent years, but are no closer to a resolved sense of what humanisation might mean. The intention of this thesis is not to add particularly to this debate, nor to undermine it, but rather to propose a new direction the conversation might take that connects future designers with their forebears. It is hoped that by making this move industrial design might learn from its past experiences with technology. It will be argued here that the process of humanising technology is not a new concern but rather the intellectual impetus underpinning design.

tied to rigid social classification, the erasure of emotion and the replacement of cultural and intellectual pleasure by artificially mediated somatic and sensory pleasures. Humanity in *Brave New World* is tied to the intellect and to the richness and variety of culture and to the recognition of instability or fluidity. The implication of this rhetoric is that technology threatens to erase this instability and must therefore be resisted. The process of humanising technology then becomes an act of resistance. The immediate assumption of members of the industrial design community who resist technology might be to place themselves within a notion of human culture in order to stand in opposition to unrestrained technological development.

In Hopi, the word *Naqoyqatsi* means life as war, and was adopted by Godfrey Reggio as the title of the third film in a documentary trilogy exploring the relationship between mankind, technology and nature. Reggio argued that it was not useful to understand humanity and technology as separate epistemic relations, but essential to understand technology as an essential facet of humanity. Only then, it is argued through the series, can humanity over the impact of technology upon the world. (That life should be a war will be shown to be an important construct in Western traditions.) There is a deliberate tautology here: technology, posited both as a human essence and as a force for ill in planetary terms, sets humanity up for war with itself - *Naqoyqatsi*.

> human beings do not use technology as a tool (the popular point-of-view), but rather we live technology as a way of life. Technology is the big force and like oxygen it is always there, a necessity that we cannot live without. Because its appetite is seemly infinite, it is consuming the finite world of nature. It is in this sense that technology is NAQOYQATSI, a sanctioned aggression against the force of life itself - war life, a total - war beyond the wars of the battlefield. (Naqoyqatsi, 2005)

The logic of the *Naqoyqatsi* series is that human life can be sustained only through recognising this conflict and by finding a means to reconciliation and peace. In *In the Bubble* Thackara (2006) posits design as a potential orchestrating agent in this endeavour. Thackara argues that, by attempting to break problems down into logical and linear steps and then constructing a solution without regard to the complexity of their agency in the world, design has driven a wedge into the human condition. Thackara invites a concern for 'lightness', 'flow', 'space' and 'situation' as fields of complexity, returning design to its own more 'natural' instincts. He reflects back upon itself Van Doesburg's rather famous treatise (1923) on modernism as an organising agency, and then projects for a new age as a force that invites disorder.[104] Thackara cites the philosopher Castells (2000), who has described a way of thinking about the world as a series of flows. 'Flows are not just one element of social organisation, they are the expression of the processes dominating our economic, social and symbolic life' (Castells, 1996, p. 412, cited in Thakara, 2006, p. 212). If designers can no longer stand on the outside of culture, then they must accept that they are part of a complex and interactive system. 'Design is evolving from its position of relative insignificance within business (and the larger envelope of nature), to become the biggest project of all' (Mau, 2004, p. 16). Industrial design, of course ,is not unique in the ambition to make the world a better place, but it lacks many of the political and philosophical tools fully to enact its ambitions. Industrial design has not been noted particularly for its spiritual authority, nor for its political sophistication according to its historical trajectory. It is responsible for the design of the things people use everyday in the construction of their lives. This is not always recognised in descriptions of itself. Mau, for example, has described design as an exercise in invisibility:

> in fact the secret ambition of design is to become invisible, to be taken up into culture, absorbed into the background. The highest order for design is to achieve ubiquity, to become banal. (Mau, 2004, p. 2)

This appears to run almost entirely counter to the proud histories of industrial design and goes against the instinctive, historical representation of industrial design as a means of realising technology in the form of artefacts.

Manuel De Landa, a biologist, takes a broad view of history and culture that runs counter to notions of the possibility of an orchestrated, overarching dynamic that designers might imagine. De Landa suggests that artefacts can be thought of as one might living systems to be momentary hardenings of processes of self-emergence. De Landa, of course, is allied to social and cultural analysis, 'account[ing] for this [society] systematically as an emergent property of

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104 From Blueprint and plan to sense and respond
From high concept to deep context
From top-down design to seeding edge effects
From blank sheets of paper to smart recombination
From science fiction to social fiction
From designing for people to designing with us
From design as project to design as service (Thakara, 2006. p.213)

some dynamical process' (De Landa, 2000, p. 270). However, to understand De Landa more fully, it is perhaps best to start from his biological view of the world. It would be a mistake to imagine a flock of birds or a school of fish as being orchestrated (see Partridge, 1982) by some kind of dominant and leading animal, rather than the emergent consequence of an intense and complex interaction that can be simulated (see, for example, Reynolds, 2006):

> Each bird flies its own path but knows about all the other birds (e.g. their positions and velocities). From its own position, the other birds' positions and velocities and the collected information about the environment, each bird then 'computes' its next position. (Lorek and White, 1993, Abstract)

De Landa is suspicious of accounts of society as extensions of individual behaviours and suggests that perceptions of culture as being open to orchestration are similarly delusional. However, while others such as Gallagher and Greenblatt (2001) and to some extent Burke (1985, 1995 and 1996) can be read so as to suggest to us that artefacts emerge from intensely variable, dynamic and complex determinants,[105] De Landa's approach is to find similarity in processes that give rise to other apparently organised biological and geological systems. This view is supported by research indicating that human institutions and cultural constructs appear to be open to the same methods of simulation as those that are used to understand flocking or schooling in animal behaviour (for example, Zhou and Zhou, 2004). For De Landa, history, in keeping with other planetary systems, is a non-linear story of self-directing, (autopoietic) processes that gives rise to a 'living' entity we call cultural history. De Landa (2000) uses the term 'stuff' as a neutral term for the product of autopoietic processes (p. 259); these processes comprise 'information, ideas, memes, money and other "stuff"' (p. 260). Rather than considering the 'stuff' of culture and institution from the top down to reveal some truth or other about the culture from which they emerged, De Landa invites a view of history whereby the complex interactions that give rise to design are recognised and accounted at their genesis. For De Landa the artefact, and its appearance in the present instant, emerge from many coincident consequences of complex interactions in human history and culture that suggest a condition of constant morphagenic flow.

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[105] These will be considered more fully later in a discussion of attempts by design to reverse engineer cultural history.

De Landa uses a geological model of human history. Geology is shown to pervade human histories, not merely as a topographical and tectonic player in the development of geographical movements but also as a model of the flows of tangible energy and matter that shape history. De Landa suggests that less effable, but no less material, morphogenetic forces form human history and are solidified momentarily in 'stuff'. De Landa's allusion to geology reinforces the idea of how the stuff of history, emerging from processes of self-organisation, as life itself, connects human history to that of the planet as a single self-organising entity. De Landa (2000) suggests that self-organisation is not limited to living species:

> In the eyes of many human beings, life appears to be a unique and special phenomenon. There is of course some truth to this belief, since no other planet is known to bear a rich and complex biosphere. However, this view betrays an 'organic chauvinism' that leads us to underestimate the vitality of the processes of self-organisation in other spheres of reality. (De Landa. 2000. pp.103-4)

Artefacts in De Landa's analysis are self-organising but momentary solidifications of flows, determined but always in the process of becoming something else. Artefacts are ground down and reconsolidated by the geological forces of culture, but cannot be reduced to give a picture of any moment without account being taken of the complexity of self-organisation in the system as a whole. Artefacts are part of the planet; they become something with it rather than merely operate as a superficial event upon it. The stuff of history - 'the source of every stable structure that we cherish and value (or, on the contrary, that oppresses or enslaves us) (De Landa, 2000, p. 261) - is considered to have arisen in consequence of flow and hardening in complex mixes, and is shown to be subject to continuous morphology and not usefully considered as a permanent tectonic.

The term 'ecology' (from the Greek for 'household') is held to originate in its employ, as we might understand it today with Haeckel who saw ecology as a new science of relationships between species and also between species and the world. The ecology movement emerged partly in response to understandings of 'super-organisms' - that is, the recognition that some, most commonly insect, species appear to function as distributed units and not as one consolidated body. The superspecies alerted biology to the idea that species cannot necessarily be considered in terms of autonomy and posited the idea of interactive eco-systems comprised of individual plants and animals acting together. While the idea of the super-organism has not entirely gone away, particularly in respect of any colonies or beehives, for example, it is now generally understood and accepted that life can be understood as 'communit[ies] of organisms and their physical environment interacting as an ecological unit.' (see Lincoln et al, 1998). Human ecology emerged as an independent discipline during the 1980s (see, for example, Buttel, 1986) and is intellectually located somewhere between ecology and sociology. In the last quarter of the twentieth century the human ecologists, most famously Canton and Dunlap (1978), moved against the sociological explanation of human society and culture towards an understanding of the human as both a cultural and a biological construction, 'stating that nature matters means the material surroundings (including biophysical nature) are constant elements in the fabric of social life' (Lidskog, 2001, p. 17). Broadly speaking, human ecologists view our species, not as a phenomenon to be considered in isolation from other species, but as part of the planetary ecosystem. Some, such as Canton (one of those who moved against the sociological paradigm) use human ecology to explain geopolitical conflict and political change (see Canton 1982). De Landa is, of course, an example of this approach too. In human ecology, culture and its artefacts are understood to emerge from an ecological process that includes biology and geography and not merely from other prior cultural processes.

> When approaching the relation between ... the natural and social world, it is obvious that social life and human societies in a fundamental sense are dependent on processes in the natural world. 'There can be no social praxis without breathing' as Beck (Beck, 1996. p.50) puts it. At the same time society is irreducible to (or emergent from) the processes studied by natural science. (Lidskog, 2001, p. 16)

Human ecologists situate the human in the world; nevertheless they recognise that humans alone appear to be in the position to contemplate the consequences of their activity within the ecosystem. Human ecologists argue that the protection of the biosphere is not merely an ethical nicety but a necessary imperative given the dependence of both physiological and psychological aspects of human life upon the health of the planet as a single autopoieteic mechanism. Environmental ethics is an emerging branch of philosophy that attempts to make sense of the moral complexity of human relationships with the planet and with other species. Human ecology, together with environmental ethics, can be understood in terms of a radical departure from popular understandings of environmentalism. Environmental ethiticians argue that orthodox environmentalism has become so commoditised as to be just another aspect of consumerist culture.

> The vast majority of Americans claim to be environmentalists while buying ever more SUVs, leaf-blowers, and uncountable plastic consumer goods ... a matter of buying Audubon memberships, Ansel Adams calendars, and 'biodegradable' plastic bags with one's Sierra Club credit card. (De Luca, 2005)

De Luca describes an emerging tension in environmental ethics. He argues that the environmental movement must shift its focus away from activism and individualised reactive interventions to protect and preserve. Rather than commodifying the environment in this way and artefactualising it, De Luca (2005) argues that humanity must be placed in a holistic and ecosystemic picture that incorporates a synthetic approach to the connective and interactive role of the human as a species.[106] This view is extended by members of the deep ecology movement such as Daniel Botkin (1990) or Alan Drengson and Yuichi Inoue (1996). In the deep ecological thesis, the environment becomes another actor in a network of actors. As Wheeler (2005) puts it, 'one might be moved to claim that the ethical matters in question are exhaustively delineated by those moral relations existing between individual human beings, or between groups of human beings, in which the non-human natural environment figures'. The human cannot be extracted as an individual species from this complex interaction.[107]

Mechanistic thinking has been de-estabilished over the course of the twentieth century by the emergence of relativism, uncertainty, duality and chaos in physics (see Peat, 2002). This has necessitated an approach to analysis that can engage with complexity and eschews reduction

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[106] We can guess, but not know it for certain of course, that a species other than our own has a concept of the environment. In human terms other species act individually in the ecosystem, they do not picture or understand themselves to be part of a complex interaction with other species but act from self interest. Environmental ethics takes as its starting point the concept that no species other than the human takes a view on the eco-system and considers its actions from an ethical perspective to consider its impact on the broader environment. Environmental ethics argues that this understanding must be at the heart of any ethical position. This view is somewhat at odds with more traditional views of environmentalism that start from the assumption that the non-human world has some status in its own right: 'then one might be moved to claim that ethical matters involving the environment are best cashed out in terms of the duties and responsibilities that human beings have ...' (Wheeler, 2005).

[107] McLaughlin (1993) has pointed to the political implications of an approach that suggests technologies can no longer be understood as an ethical impingement upon the natural world but part of its evolutionary trajectory. Deep ecology argues that humans bear responsibility for their actions in the ecosystem but only insomuch as humans have developed a wider ethical position in respect to themselves and to the world.

to incomplete assumptions. Contemporary environmental ethicists such as De Luca and Wheeler take the view of a growing number of scientists who call for an approach to analysis that deals with the whole rather than the parts alone. These scientists argue that linear and reductive modes of science are not sufficient to engage with complex questioning of the manner in which human beings understand themselves and the world, an inadequacy particularly evident in relation to the things humans make in order to interact in the world.[108] The International Society for the Systems Sciences (ISSS) reflects a contemporary trend towards interconnected and interactive thought. 'ONE - WHOLE: The First International Electronic Seminar on Wholeness' in 2000 brought together members of the society in an online forum with the theme of inter-connectivity and oneness (see ISSS, 2000). Capra is among a number of exponents of an approach to understanding the world by combining the rigour of science with philosophy and spiritual approaches to systems analysis. In *The Web of Life* Capra (1996) argues that the tension within science resides in the fixation with attention to the parts in the context of the whole. This tension emerges when various attempts are made in science to analyse each in respect of the other. Capra argues that Humanist separations that reduce man to an entity in antagonistic relation to the world are identified as an inhibition to the development of a sustainable ecological apprehension of interconnectivity.

> My thesis has been that a theory of living systems consistent with the philosophical framework of deep ecology, including an appropriate mathematical language, and implying a non-mechanistic, post-Cartesian understanding of life, is now emerging. (Capra 1996)

In Aristotelian logic, things appear through a process of self-realisation (Entelechy) or self-completion and always in a condition of development. 'Matter and form are two sides of this process, separable only through abstraction' (Capra, 1996, p. 18). Aristotelian modes of thought were 'destroyed' (Capra, 1996, p. 18) by the scientific logic of 'Cartesian Mechanism'; 'in the sixteenth and seventeenth centuries the medieval worldview ... was replaced by that of the world as a machine, and the world machine became the dominant metaphor of the modern era' (Capra, 1996, p. 19). Capra describes the change in the study of life sciences, from

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[108] Rather venerable modes of Aristotelian or preindustrial thinking valuing connectivity and sympathetic relationships appear to be gaining ground at the expense of more reductive models of thought. These models can be best summed up perhaps as indicative as a move away from a mechanical model of the planet towards models that reflect its biological nature. Synthetic analysis is one methodological outcome of this approach as to some extent is De Landa's argument for an autopoietic approach to analysis.

mechanistic and reductive analysis to the ecological. Ten subsections outline movements in thought that describe the swing of a pendulum sometimes violent and at other times modulated (Capra, 1996, p. 17). Recalling Gregory Bateson (1972, 449): 'Do you ask what it's made of - earth, fire water etc? Or do you ask' What is its pattern? Capra (1996, p. 18) suggests that the tension between mechanistic reduction and the holistic is a replaying of 'the ancient dichotomy between substance (matter, structure, quantity) and form (pattern order, quality)'.

Capra outlines a holistic approach to ecological thinking, which he describes as a paradigm shift away from the primacy of physics towards the life sciences. 'The Web of `Life' is a call for a return to pre-scientific intuition, albeit with the added benefits of the scientific method. Capra argues for a form of synthetic analysis describing an approach to understanding that takes a view of the whole with attention paid to the reductive analysis of the nano. In a chapter entitled 'From the parts to the Whole' Capra (1996, pp. 17-35) argues that reduction, while a good method for understanding how things function, ultimately obscures a view of the true, connective, nature of things. Furthermore, because of the way the scientific method has come to dominate thinking, it is now imagined that it provides the only effective model by which the world can be understood.[109] Zukav (1979, p. 65) for example:

> The next time you are awed by something, let the feeling flow freely through you and do not try to understand it. You will find that you do understand, but in a way you will not be able to put into words. You are perceiving intuitively through your right hemisphere. It has not atrophied from lack of use, but our skill in listening to it has been dulled by three centuries of neglect.

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[109] Capra's brief history of thinking suggests that there have been swings between reductive mechanistic methods and holistic connective methods of thinking. The twentieth century has seen these swings of the pendulum (Capra uses this metaphor), begin to reduce in amplitude. Particularly in the light of the recently emerging realisation, born of quantum physics, that 'the world appears to be a complicated tissue of events, in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole' (Heisenberg, 2000, p. 107), Capra tells a story of how Heisenberg, realising the monumental shift in understanding necessary, called his 1971 autobiography 'The Part and the Whole' only to find it re-titled by his publishers as 'Physics and Beyond'. The publishers failed to comprehend the importance and significance of the original title (see Capra, 1996, p. 31). Berkson (1974) tells this story rather comprehensively. Charting the development of physics from Faraday to Einstein, Berkson describes the development of the particular form of science that pervaded twentieth-century physics, focusing upon the problems that lead to developing interpretations and a gradual shift towards field views of reality. Similarly, Peat (2002) tells a story of the collapse of the certainty of mechanistic science into the acceptance of holistic uncertainty as a principal of reality. Coincident with the early stage of development of a holistic physics, the Gestalt movement emerged in Germany in the early part of the twentieth century. Gestalt - literally 'organic form' - is a description of the form that life takes rather than the static form of objects. Gestalt arguments take the view that humanity can be best understood through the shape of its reasoning and not through a series of reductions. Many of the social and distributed models of humanity as well as the deep ecology movement can be understood to have emerged from within the intellectual climate of the Gestalt movement.

An approach to thinking eschewing reduction (such as that of ecological logic) reveals how patterns and systems are played out at every level extending from the planetary whole to the individual activity of cellular components. The process of autopoiesis, for example, appears to be replicated at every scale from the planetary to the cellular in every facet of life. Life, then, is an emergent condition that operates across many levels of analytical attention. Deep ecology suggests that human life must be understood in this frame as a transitional and holistic condition, evident across a range from the scale of planetary tectoncs scale to the cellular level.

As a means of establishing some means of analysing this shifting form, De Landa (2000, p. 264) employs the term 'meshworks'. In meshworks, relationships can be found but never isolated. Meshworks are not a particularly useful device, if they are imagined, as a designer might be inclined to do, as a material entity. A mesh of some material or other such as steel or plastic, although essentially flat, is contorted into shape, creating an impression of solid and indestructible lines of force tied in place and constrained. De Landa is a biologist; he imagines a more fibrous material that is a dynamic, continually metamorphosing, flowing infinite and dynamic set of relations - a contorting topological surface that has emerged through a process of chaotic growth rather than any directed human purpose:

> an autopoietic system is self-contained and cannot be described by using dimensions that define another space. When we refer to our interactions with a concrete autopoietic system, however, we project this system on the space of our manipulations and make a description of this projection. (Maturana and Varela, 1973, p. 89)

Autopoiesis (for autopoiesis here, see Mingers, 1994, and also Livingston 2005) provides a vital and emergent model and a mode of thought that understands systems to be self-emergent (as we see in the division of cells, or in the apparently chaotic shifting of stock exchanges) rather than imposed (that is, planned or intelligently designed). Industrial design, being a biological community, is then itself an emergent practice (see Capra, 2006).[110] Self-

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[110] Although we imagine other species not to have a culture like our own, they leave evidence of their presence and construct what might be mistaken for a kind of artefact endeavour. These artefacts too can be demonstrated to emerge largely in consequence of algorithmic determinations (Blass and Gurevich, 2003) arising from the autopoietic process (Dyke, 1988). An algorithm (at least in the sense it will be

organisation, it is suggested, is not unique to humanity; it is a pervasive condition of the planet. Hemelrijk (2005) illustrates the pervasive nature of autopoiesis in planetary systems and illustrates examples ranging from the complexities of biology and mathematics, animal and human behaviours, to its appearance in human systems that are thought of as being almost entirely designed and directed, such as democracy and language. Human design intervention is in this account part of a rather larger autopoietic system. Any design intervention then must be understood to be only part of a more complex story.

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employed here) is a simple mathematical underpinning of an event in the world. In autopoietic theories, biological algorithms interact to determine super-complex, self-determining and chaotic processes. In human terms, algorithms often appear as events that obscure their mathematical foundation. Granovetter (1973) demonstrates how these rather slight moments in everyday life have a profound effect when acting in a larger system. However much of our lives may be determined by the autopoietic processes that underpin them, people do have what they take to be a degree of self-determination and free-will. 'Human networks of activity, like many of the dynamical subsystems of an ecosystem, are not strictly space-time localized' (Bogh Andersen et al., 2000). Autopoiesis may suggest that algorithmic determinants shape human life. Blass and Gurevich (2003) have shown how the notion of *an* algorithm at the centre of everything is a misnomer. They demonstrate that algorithms themselves emerge from subsystems that are themselves complex, indeterminate and interactive. When viewed in this light, the rather constrained and linear histories of industrial design can appear to be almost entirely out of step with an emerging intellectual climate of supercomplexity.

Chapter five

Reconnecting the human and the technological: a speculative historiography

5.1 **Topological domains and 'Machine Age'**

A speculative historiography showing how it could be imagined in terms of organic life in sympathy with broader intellectual understandings of the world.

5.2 **From landscape to ecology**

A speculative historiography showing how it could be imagined in humanist terms as a techtonic landscape in sympathy with broader intellectual understandings of the world.

5.3 **From corporeality to culture**

A speculative historiography showing how it could be imagined in terms of organic life in sympathy with broader intellectual understandings of the world.

5.1 **Topological domains and 'Machine Age'**

A speculative historiography showing how it could be imagined in terms of organic life in sympathy with broader intellectual understandings of the world.

The topological domain is used in this thesis to outline a conceptual spatial understanding of the world, which avoids the need to reduce concepts to essentialist isolation and to accept and recognise continuity without necessarily dealing with the infinite. In mathematics such a condition is expressed as:

$$X = \dots X \dots$$

It can come as a surprise to discover that such variability can be accounted for and that a discrete field of mathematics has emerged to deal specifically with this problem. Domain theory (see Abramski et al., 1994) is a qualitative means of understanding the world. It is used in mathematics as a means of dealing with degrees of complexity, often mirroring the ways in which people construct a natural conception of the world. We can, for example, talk about 'the world' as a broad concept without necessarily describing it in its near infinite complexity. When we talk about 'the world', however, we do not discount this complexity but rather put it to one side in order to build a functional concept. The idea of the topological domain, borrowed from biology, extends this to the understanding of spatial relations. It is used here as a conceptual logic and is not intended to be a strictly applied logic. The topological domain connects this variation in terms to spatial logic. Without going too deep into the specifics of the topology in mathematics, it can be understood as a means of understanding how logic is tied to spatial conceptions, to scale and to location in a degree of play and extent. De Landa's logic has its intellectual foundation in the science of cellular biology, and the topological domains must be imagined in that respect as a semi-permeable cell, organism or ecosystem (Maturana and Varela, 1973). The topological domain is an analytical convenience of sorts that invites a closed analysis without losing sight of the openness of the extended complexity. No autopoetic system can be isolated from the rather larger system in which it is itself acting. Even cells that might appear to have a clearly defined topological domain are subject to osmosis.

> An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components which: (i)

> through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network. (Maturana and Varela, 1973, p. 78)

A waterfall is a topological domain, a means of conveniently describing something that appears to have a clear formation in the world. The waterfall has a name because it appears to be something in the world, but on closer inspection there is no plausible way to define where the waterfall begins and ends; at what moment does river become waterfall, or water become mist, for example. We cannot operate in the world without some sense of the topological domain. But we cannot undertake proper analysis when we imagine these domains to be anything other than matters of convenience. It is essential to remain aware that the topological domain is a largely notional border; it does not describe an actual reality. Within a toplological domain, it becomes possible to account for the many tiny interactions that take place within it; by understanding these interactions in a larger picture of interacting domains, a picture can be built of the larger complexity. This is a rather well-established tactic in science: a dust cloud can be understood to be not an entity in itself but the interaction of individual specks of dust; a waterfall can be understood as an interaction of individual atoms, molecules and ultimately droplets of water. Each of these droplets traces an individual path; billions of individual droplets interacting in complex ways create the waterfall.

The philosophers Deleuze and Guattari[111] have attempted to find a means to account for the fluid reality of the apparently solid and material world. Their instinct is to take an approach to analysis that eschews 'conditions' or 'things'. Their analysis seeks

> not a scene, a place, or even a support upon which something comes to pass ... not space, nor is it in space; it is a matter that occupies space to a given degree - to the degree corresponding to the intensities produced. (Deleuze and Guattari, 1987)

One way a designer might understand this could be to imagine that Deleuze and Guattari are discussing a table situated between two people. In their analysis, the intensity of the table

[111] It is said that there is something in Deleuze and Guattari for everyone, but you have to know what you want to find. It can seem as if Deleuze and Guattari's proposition of the 'Body without Organs' is open to a degree of variation so as to make it a plausible tool of almost any scholar.

fluxes between them depending upon the way it is used. The table is revealed subjectively as 'a matter that occupies space to a given degree - to the degree corresponding to the intensities produced' (Deleuze and Guattari, 1987)

- A table for a meal perhaps where its materiality is critical, is it big enough? Is it the right height? - Does it wobble?
- A table for a meeting perhaps, where it is less critical, just something to rest papers, a laptop perhaps or ones feet.
- Perhaps the table is a nominal architectural plane occupying a void between two people talking, helping them feel at ease; a conceptual border perhaps.

It is possible then to take a view that industrial design should seek not to account for objects as solid signs to be encountered and negotiated, but to build a means of understanding the world as a continuum of moments of intensity in human activity. The presentation of history through static and isolated artefacts provides a snapshot archive of history, but, like static skeletons, these artefacts lack the full texture of their place in the world. Artefacts appear out of their time and are excluded from most of the flows that give rise to their emergence and deny their subsequent development. Attempts to reconstruct the past in the present frequently fail, or demand the infrastructural support of a marketing campaign in order to re-embed them into culture. Material cultural analysis, positing the human as a cultural construct, is an attempt to reduce the complexity. The upshot of this is that artefacts become reified and separated from their role in the formation of what it is to be human and to live among and use them. In the next chapter a number of modes of analysis will be examined that attempt to reintegrate artefacts into a construction of the human. If material cultural analysis separates and isolates the artefact, then these approaches to analysis can be understood to be integrative. Nevertheless, they are not without their problems. If artefacts are to be understood as intensities or topological domains, as mutable and unfixed, rather than resolved and bounded tectonics, then we must be sure of our terms. Where Deleuze and Guattari's idea of the fluxating intensity can perhaps be imagined from the outside as a kind of density, the topological domain must be imagined as a kind of porous but somehow bounded field of concern. De Landa borrows the term topological domains from the field of cognitive linguistics. In 1948 Jean Piaget and Bärbel Inhelder demonstrated that concepts are constructed from simple spatial and topological terms (Piaget and Inhelder 1956).

Talmyb(1983) has argued that spatial understandings can be broadly tracked in a wide variety of human concepts as they are expressed in language. It is now widely accepted in the field of cognitive linguistics that spatial relations 'correspond to elements of our neurocognition' (Landau and Jackendoff, 1993, paraphrased by Levinson and Meira, 2007). Topology is not always recognised when we talk about the world. Artefact mutability, while it might be considered in terms of shifts in topological attention, is often mistaken for tectonic transformations of materiality.

In *The Fourth Discontinuity*(Mazlish (1993) argued that human understanding has developed such that it has gradually eliminated epstemic discontinuities. Mazlish picks up on a widely recognised view that Copernicus broke the intellectual discontinuity between understandings of the materiality of the world and the physicality of the Universe, Darwin; the intellectual discontinuity between mankind and other species, and Freud; the intellectual discontinuity between the rational and the irrational. Mazlish suggests that a fourth discontinuity remains to be breached: discontinuity between the understanding of the human and that of the machine.

> My first thesis is that humans are on the threshold of decisively breaking the discontinuity between themselves and machines ... they now perceive their evolution as inextricably interwoven with their use and development of tools ... (p. 6)

Mazlish, however, anticipates that the breach of the fourth discontinuity will take place at a molecular level:

> the discontinuity is being bridged because humans now perceive that the same scientific concepts help explain the workings of themselves and their machines and that matter evolves - from the basic building blocks of hydrogen, turning into helium in the distant stars, then fusing into carbon nuclei and on up to iron, and then exploding into space, which has resulted in our solar system - developing on earth its intricate patterns into the structure of organic life, and now into the architecture of our thinking machines. (p. 6)

Industrial design histories, - for example, Heskett's *Industrial Design* (1980) and Woodham's *Twentieth Century Design* (1997) - tend to read as a sucession of artefacts, while the intellectual process involved in their consolidation remains obscured. It should not be implied that all sustaining narratives of industrial design display artefacts in chronology without critical analysis. Nonetheless there is a palpable absence of any serious critical analysis of the design process as a means of humanising technology from outside the community, and as a consequence sustaining narratives of industrial design tend to be intra-historical. There is no extra-historical history of industrial design, except as insomuch as its products are played out in other human affairs. Philosophers of technology, - for example, Mumford (1963), Mitcham (1994) and Armstrong (1998) - largely fail to include the intellectual history of industrial design in their accounts. It is understandable, then, that industrial designers should rely upon hegemonic forms of curatorial approach in their histories. However, judging by the lack of critical debate in this respect, the community appears to be unconcerned by any potential consequence of this mode of history telling.[112]

Many artefacts reoccur in sustaining narratives of industrial design.[113] However, given its domesticity and proliferation, the consistent absence of radio from the discussion of technology might appear surprising. Where radio does appear it does so through an artefact manifestation only at the extremes of its broadcast (the transmission tower) and reception (the domestic set). While some attention is paid in sustaining narratives of industrial design to the wooden sets of the inter-war period or to later transistor radios in some histories - in Heath, Heath and Lund Jensen's *300 Years of Industrial Design* (Heath, Heath and Lund Jensen, 2000), for example - there is no inclusion of wireless or radio technology whatsoever in an otherwise fairly comprehensive catalogue. Radio and other exemplars of the invisible nature of some phenomena have slipped from histories of industrial design. This may simply be because an attempt to illustrate the invisible would probably demand a wordy and textual chapter devoid of images in an otherwise image-driven text. However, the ontological and philosophical implications of terms such as radio-space, virtuality or the sense that people might be

[112] This is not to imply that a radical new history of industrial design is required. In any case, a future history of industrial design will most likely find it necessary to retain fellowship with the heritage of the community it addresses, and, given the hegemonic dominance of design histories, it will be a difficult task to avoid reference to the artefact.

[113] An encounter with images of the Crystal Palace, the Turbine Hall, a Parisian Metro entrance, the Barcelona Chair - or perhaps the De Stijl chair, the streamlined train, the spitfire, the great American automobile, the atom clock, the Braun razor, the Memphis jug, the Starke juicer, or the i-pod - should come as no surprise to the reader of an industrial design history. To have an artefact included in this collection is perhaps a secret desire of many industrial designers. It is an indication that one is recognised and inscribed into significance in history,- a reasonable enough claim; after all, these artefacts are what industrial design is. However, the hegemonic nature of industrial design histories is revealed by some surprising absences from the list of artefacts one encounters. The American and Russian space race and its associated icons such as the Soyuz, the Saturn Five or the Shuttle are entirely absent from orthodox industrial design histories. Exquisitely designed components such as pumps or engine housings are also absent,and medical products are rarely mentioned and seldom ever displayed. Radio is one such absent technology.

'immersed in technology' (Moser and McLeod, 1995) or might dwell in a 'technological landscape' (Rogers, 1999) are similarly absent topics of discussion in sustaining narratives of industrial design. There is evidently something missing in the conception of industrial design. When the process of humanising technology can be resolved in an artefact, then there appears to be no problem in including it into history, although these narratives are often rather selective in the choice of exemplars. However, when the technology does not resolve in an artefact, then industrial design struggles, and often fails, to include the outcomes of the humanising process into its history. There are some attempts to engage with the broader social imperative of radio as a specific consequence of design. Heskett (1980), for example, includes the transistor radio as an indication of the drive towards miniaturisation and increasing portability. Conran (1996, pp. 224-5) includes a Sony Mini-Disc Walkman as a signifier of travel, and the Classic Roberts radio to connote 'traditional design'. Rather intriguingly, both these examples are placed in a chapter that sets out to explore the notion of 'time' as an industrial design concern. Not only is this chapter almost devoid of illustrations, an exception in an otherwise profusely illustrated book; it makes almost no attempt to engage with any sense of time as a subject of ontological complexity except to posit the artefact as an indication of a social condition - the portable radio for a culture on the move, for example. In the 1950s and 1960s there was some enthusiastic discussion of the idea that we might be entering a new 'space age' and that this age might come to define humanity in the same terms as the 'stone age' or the 'iron age'. This is, of course, a problematic and entirely artificial delineation of trajectory into discernible shifts. Historical ages are artificial and can delude the reader into imagining that trajectories - or morphagenic flows, for that matter - can be neatly subdivided into discrete moments when some condition or other prevailed. The shifts between historical ages have no meaning in their times but can perhaps point on reflection towards a sense that some intellectual Zeitgeist can be identified that is somehow no longer prevalent.

Dividing the trajectory of human history into discrete ages seems to make sense as a means of delineating shifts in technological cultures (see, for example, Benjamin, 2003). There appears to be no particular agreement as to what defines, sequences or delineates a particular technological age other than that it seems to align to a general shift in the way in which technologies are foregrounded in the imagination. The sustaining narratives have done much to encourage industrial designers to imagine their intellectual heritage divided into what they refer to as the 'machine ages'. The 'machine age' is an idea rooted in industrial designers' culture, thanks in no small part to Banham's influential design history (1955). Like other historical ages, the machine age is, of course, an entirely artificial delineation. In a reflection of the general uncertainty, there is no clear idea as to how these ages might be codified. Brose (2004), for example, talks of *the* machine age and uses it to define a period in history prior to and including the First World War. Nevertheless, the idea that industrial design might be described through a series of 'machine ages' is well established. This was Banham's premiss (1955), and it is repeated often and widely as a way of dividing up sustaining narratives of industrial design into discrete sections. Pawley's supposed 'sequel' to Banham, for example, is directed at a second machine age (Pawley, 1990).

> [Banham] ... introduced the notion of what constitutes a 'Machine Age' within the more general processes and periods of industrialisation and modernisation. The point that Banham was making is that the architecture and design of a period reflect and express - indeed, are formed by - the Machine Age in which they occur. And, to some extent, the design itself helps to define the period. Values and assumptions of the Age underpin our attitude to design and so it is to our advantage to analyse what it is that makes each Machine Age distinctive. Banham defined the characteristics of only the First and Second Machine Ages ... (Whitely, 2005)

Banham's descriptions (1955) of the first and second machine ages were constructed retrospectively, sometime after the times they describe. This retrospective view of the machine age suggests that they can be understood as a means of coming to terms with paradigm shifts in the understandings of technological conditions. Stiegler (1999) has suggested that it is the tool that invents the human, and Cooley (1987), for example, argued that technology goes some way to inform the culture of how people organise themselves. Where Stiegler argued that the human invents itself by inventing the tool, Cooley suggested that technology shapes perception; reflecting upon the electronic media technologies that were emerging about him in the late 1960s, Cooley called for similarly networked and a contingent understanding of systems that eschewed top-down systemic organisation. It is possible, then, that De Landa's biological analysis of the way in which we might understand material culture is another in a long trajectory of imaginings that place the latest science at the centre of their allusion. This might suggest that machine ages in sustaining narratives of industrial design mark out changes in the conception of what it is to be human as much as they may appear to describe changes in the material nature of technology. In the forward to Dunne's *Hertzian Tales* (1999, p. 2), Crampton-Smith reflects conversations going around that the first machine age is characterised by particular 'heroic machines' in an age of 'monumental' technology. The monumental or heroic age is rather easily described in those terms, perhaps because it is characterised by large technologies that are somehow adventurous and emergent, 'naive' machines such as beam engines, for example. This era maps somewhat onto what Mumford (1963, pp. 22-211) described as 'The Paleotechnic Phase' implying a form of technology that would subsequently resolve more fully into the the awesome space of the machine halls of late-eighteenth- and nineteenth-century machine culture. Banham's description (1955) of the second machine age is delineated by an era of domestic machines, which then emerges as a consequence of the massive production potentials of the first machine age disseminated into wider domestic life. The machines characterising this second age are the motor vehicles, fridges and washing machines that came to fill the homes of the Western world.

While Banham's machine ages were reflective, there has in recent times been a tendency to anticipate machine ages. Banham himself anticipated the emergence of a third machine age. In 'The Triumph of Software' Banham (1961, p. 136) suggested that an era of electronic and media technologies would became as much about systems as materials.[114] There continues to be some life still in the idea that industrial design history can be divided up in this manner. There is, however, some disagreement and no certain intellectual codification as to how we might describe contemporary times. Whitely (2001) and Michael (2002), for example, suggest the emergence of a fourth machine age in need of some new kind of theorisation. Brutton, it has been claimed, goes further and makes the claim for a fifth 'cyborg' machine age (see Whitely, 2001, p. 98).[115] Whitely suggests that this new machine age is to be an age of pervasive computing, characterised by a realisation on the part of humanity that it finds itself immersed in an environment of many dispersed and seemingly invisible technologies. This emerging machine age, it is suggested, is delineated by an invasive host of systemic technologies that appear to be ubiquitiously distributed.

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[114] On closer inspection, this third machine age appears itself to be an accelerated microcosm of the broader development of technology, having its own paleotechnic phase during the time of the mechanical brains and the centralised computers of the 1940s, 1950s and 1960s and its own domestic phase, during the time of simple consumer electronics. This age has accelerated to become an emerging era of connective and supposedly intelligent systems functioning as an increasingly invisible and pervasive substrate that is now supposed to delineate the fourth machine age.

[115] This reference, being uncited, may be anecdotal.

> Picture being able to scatter hundreds of tiny sensors around a building to monitor temperature or humidity. Or deploying, like pixie dust, a network of minuscule, remote sensor chips to track enemy movements in a military operation. 'Smart dust' devices are tiny wireless micro-electromechanical sensors (MEMS) that can detect everything from light to vibrations. (Hoffman, 2003)

Before we proclaim another new emergent age of the biotechnological machine, we might reflect for a moment whether machine ages are truly delineated, determined even, by changes in the form of technology or whether some more subtle process of intellectual imagination might be at play. Some shift in scale and distribution appears to be built into the imagination of this new machine age. 'Ubiquitous computing has as its goal enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user' (Weiser, 1993). This machine age is posited as presenting a paradigm shift in how understandings of human technology relationships will be formed: 'some are calling it a new nature ... Nature has become technoculture' (Rogers, 1999, p. 9). In Moser and McLeod (1995) this new machine age is imagined[116] as a human-directed and active habitat, in which the active technologies are not necessarily discernible by the senses. This, of course, should include a range of rather more familiar technologies, such as broadcast radio. Broadcast radio, being some century old, is not normally associated with more emergent ubiquitous technologies. The chronological sequence in the development of technologies such as broadcast radio suggests that the machine ages should not imply the description of a chronological trajectory. This chronological slip is not reflected in histories of industrial design or of technology. The machine ages in sustaining narratives of industrial design are not periods defined by complete change in the practice of industrial design. The design and construction of heroic machines like the space shuttle or the oilrig, , for example, continue to this day. However, in sustaining narratives of industrial design the machine ages appear to delineate moments when it somehow becomes no longer viable to include certain forms of technology. A subsequent machine age then should not necessarily herald the end of industrial design as an active intervention in the humanisation of the technologies that provided a prior focus of attention, but rather as another imagining. If they mean anything, the machine ages in the trajectory of the narratives of industrial design can be understood broadly to define thematic understandings and evidence of a trigger of new intellectual styles.

[116] It will be argued that the idea of a human-directed and active habitat reiterates an interpretation from the dawn of the machine age. We might describe Moser and McLeod (1995) as a reimagining.

The machine ages appear most coherent in histories when they are recognised as retrospective reflections of moments when prevailing epistemologies shifted industrial designers' understanding of their particular role in the world. If humanising technology is at the core of the industrial design community's schematic understanding of its intellectual endeavour, then a new machine age could point to a moment where some new insight is brought to bear upon the fluidity in the terms of what constitutes humanity in relationship to technology.

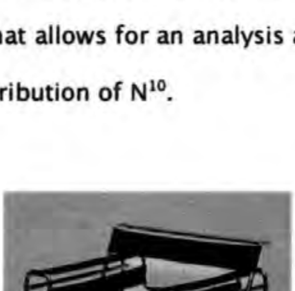
> The Second Machine Age was a kind of designer-Utopia and we recognise in it attitudes to design similar to those which we live amongst today, with design museums flourishing, and 'designer objects' as fashionable and sought-after as ever. This serves to remind us that Machine Ages contain continuities as well as differences: a new Machine Age does not signal the replacement of the previous one, but a displacement in that some new factor may occur which significantly changes the character of the Age and provides a new frame of reference, new expectations, almost a new consciousness. (Whiteley, 2005)

If the industrial design community's intellectual process of humanising technology had developed in an even and linear manner, then it would be likely that the story of industrial design would be written as a continuum and not as a series of fractured machine ages. It is possible, then, that the machine ages appear in sustaining narratives of industrial design because they represent moments of shock when industrial design found its intellectual location to be inappropriate in a given understanding of human technology relationships.

Members of the industrial design community, it has been argued, imagine the trajectory of their history through artefacts. With each successive machine age, the artefact can be shown to be reimagined at a smaller scale and at a greater degree of distribution. The first machine age suggests an imagining of technology as artefacts at a scale and degree of distribution that has resonance with the monumental and is represented as a series of independent, one-off, constructions of very large and very heavy machines.

Artefact imagined in a topological domain at the scale of N^1 and at a degree of distribution of N^1.

If artefacts in sustaining narratives of industrial design are imagined at a notional monumental scale, we could call this a topological domain at the notional scale N to the power of one (N^1) and at a notional degree of distribution of N to the power of one (N^1). This topological domain is big: it understands and analyses technology in terms of large singular and monumental artefacts that are dense and massive and isolated. In the imagining of the second machine age the artefacts in sustaining narratives of industrial design (for example, Banham, 1955) appear to be smaller, and more distributed. Artefacts of the second machine age can be understood in terms of a topological domain that allows for an analysis at something approximating the scale of N^{10} and at a degree of distribution of N^{10}.



Artefact imagined in a topological domain at the scale of N^{10} and at a degree of distribution of N^{10}.

For an imagination of the third machine age we can refer again to Banham, who projected this age in terms of the previous ages he had described (see Banham, 1961) as a proliferation of very many artefacts, imagined as part of a complex distribution and interacting system.

Artefact imagined in a topological domain at the scale of N^{100} and at a degree of distribution of N^{100}.

If the emergence of a fourth machine age is imagined in terms of another topological domain, as, for example, in Whitely (2001) and Hoffman (2003), it is typified by a further acceleration towards distributed ubiquity. This machine age is posited as special, because it will be determined by the emergence of hundreds of millions of tiny machines. It may also indicate that a further shift has occurred in broader intellectual imagination.

Artefact imagined in a in a topological domain at the scale of N^{100000} and at a degree of distribution of N^{100000}.

If the DNA computation and other biotechnologies were to be considered as somehow determining yet another, fifth, machine age, then it would probably present artefacts that are as evanescent and almost infinitely distributed as atoms in the universe.

Artefact imagined in a in a topological domain at the potential scale of $N^{\infty}$and at a degree of potential distribution of N^{∞}.

If a view of the machine ages is taken in terms of materiality, it is possible to understand how shifts in the scale of topological domains brings attention to history as it is consolidated in smaller and smaller material artefacts. The presentation of these artefacts shifts from the massive and noetically obvious, towards microscopic evanescence and eventual anoetic invisibility. In the trajectory technology also comes to be understood in increasingly ubiquitous terms. The materiality of technology becomes increasingly porous to life, increasingly interconnected and interdependent. With each successive machine age the artefact becomes less open to resolution through focused critical engagement that relies upon epistemic differentiation, and it becomes increasingly difficult, in simple material terms, to sift the technological apart from the human. This is a problem for industrial design, because, with each successive shift of the materiality of technology towards evanescence, there is less that can be used to represent the material quality of the technological artefact and to tie the artefact into noetic analysis. With each successive shift there is less differentiation between the human and the technological too, and so the process of noetic analysis becomes increasingly finite and complex.

In orthodox readings of the sustaining narratives of industrial design the concern with the singular architecture of the monumental artefacts is accelerated in each subsequent machine age by attention to smaller more numerous artefacts. The attention to the monumental becomes distributed into a focus on the domestic artefact, although, of course, technologies at the monumental scale continue to be produced. In turn, the intellectual means of engaging with these proliferating domestic artefacts comes to be challenged by a third machine age characterised by electronic artefacts where the artefact appears to becomes smaller and more distributed still. In the fourth age, it has been suggested, this distribution and miniaturisation to the point of almost infinite evanescence becomes the focus of attention. It may seem rather obvious that there is something in the nature of technological development that leads to its diminishing material presence. This would appear to be the logic of the machine ages. Technology would seem to be taking an undeniable trajectory from the massive to the evanescent and from intense materiality to immateriality. Whitely (2005) takes this to imply that it is shifting materiality that determines and drives the intellectual shifts that describe each successive machine age. The materiality of technology seems to force industrial designers to rethink their understanding of the world and constantly reminds them of the inadequacy of their imagination. It is quite possible, however, to take a view that increasingly complex understandings of the world invite closer topological analysis. This would seem to make sense; it would go some way to explain why technologies appear out of sequence in industrial design histories. They have slipped outside the topological domain of a prevailing analysis.

For example, the electromagnetic geography of 'Hertzian space' (see Dunne, 1997) is now becoming a legitimate topic of design and cultural analysis and a creative space for design intervention. This emerging focus is significantly out of step, however, with technological development.[117] Hertzian space is not by any means a new phenomenon, but for most of the twentieth century it has been almost entirely ignored by industrial design. For some reason it would seem as if radio has become a viable focus of concern. Radio, for some reason, has become an important facet of the noetic world and is no longer peripheral and anoetic. Radio, at least in Dunne's terms, of course has done nothing whatsoever to drive this analysis. It functions today just as it always has, but now we speak of Hertzian space in architectural and design terms as if it were a new phenomenon. In a material context the machine ages then might be read as a tracking of a series of moments of shock. In each track technologies appear to have moved closer to a condition of evanescence only because industrial design has found the means to materialise the artefact at a more finite degree that is coherent with prevailing attention of analysis in terms of the scale of topological domain. More importantly in this context, the machine ages could be understood to define eras when it becomes intellectually legitimate to consider changed degrees of materiality as a concern of industrial

[117] There is nothing to suggest any sense of disjuncture or shift within the design community from when Fessenden first sent his crackling message. Although the application of radio was immediately obvious, industrial design was at that point locked into a mode of analysis that understood human technology relations at a different degree of granularity. Radio, having no apparent form at that level of granular analysis, presented no problematic, and radio became occluded from consideration, except as it materialised in orthodox terms.

design. The response by the industrial design community to that shift in topological domain then comes to define a particular machine age.

In the industrial design histories about which the community is consolidated, the ages of the machine are presented as describing a clearly discernible and apparent trajectory of technological artefacts that shift material form from the solid, dense and intensely perceptible towards dispersing evanescence, invisibility and ineffability. It would be easy, although deterministic, to imagine that, as they come to terms with each successive artefact age, industrial designers have found it necessary to reimagine the world. But this would suggest that somehow technology has a life of its own and can determine human imagintion. Since industrial design sets out to humanise technology, it is possible that technology is represented in shifting material terms because there is some shift in the topological understanding of the process of humanising technology. Deleuze and Guattari (1987) point to a flux in materiality when the world is a lived experience. If this is extended into wider understandings of the world, then in industrial design terms it is possible that the process of humanisation might be subject to a similar flux. If it is tied to some intellectual coming-to-terms with shifts in the topological understandings of the human and the technological, the process of humanisation might be subject to similar flux. This would provide a subtle means of finding some continuation in the trajectory of industrial design and would detach that process from the necessary need for a fixed noetic engagement. In the accounts of their own history, industrial designers might find that a series of shifts in the intellectual comprehension of the human and the technological in their community are mirrored in the way they represent artefacts. Each machine age would then present a further shift in the understanding of the materiality of technology constructed so as to account for the revised topological domain. This would appear to demand a form of inverted reading of sustaining narratives of industrial design. Designers would need to understand that technological artefacts appear only as complex as prevailing understandings of the human and the technological. In simple terms, whether they know it or not, the sophistication of their intellect and knowledge drives the manner in which industrial designers represent the artefacts they create. In order to look for evidence of this revised intellectual stance, it would be necessary to return to, and to re-examine, the more established accounts of the trajectory of technological development.

In Giedion (1948), for example, the story of technology is described as a trajectory of human understandings and it attitudinal stance. Giedion ties the developing story of humanity to a more subtle story of human machine integration and the merging of human and machine values. 'We shall therefore open with the question: What happens when mechanisation meets an organic substance? And we shall close by inquiring into the attitude of our culture to itself' (p. 6).The machine ages in sustaining narratives of industrial design would be likely to follow a similar trajectory. It is possible to track in the machine ages a series of transformations in the understanding of human technology relations, from a detached notion of human nature as somehow transcendent from the world, to a dramatic inclusion of the artefact in the imagining of the human.

5.2 From landscape to ecology

A speculative historiography showing how it could be imagined in humanist terms as a techtonic landscape in sympathy with broader intellectual understandings of the world.

There is some evidence of design behaviour in the Paleolithic that has resonance in our own times. Technology does not appear to be a recent invention of human culture but would rather seem to be an eternal verity and intrinsic to intelligence as a contingent reaction to the environment. Reflections upon the directed, intellectual engagement with the form and meaning of technology reside in a much less extensive history. Despite their centrality to intelligence, the design and construction of technological forms (the mechanical arts) seem, at least in Western traditions, not to have been particularly worthy of scholarship. In classical literature the 'mechanical arts' are merely an unwelcome gift given by Mercury to his bride as something of an afterthought. Augustine found little to recommend in the study of the mechanical arts. If this is something closer to the nascence of the directed, intellectual consideration of technology, then it is inauspicious: 'among the other teachings to be found among the pagans ... including the theory of the useful mechanical arts, I consider nothing to be useful' (Augustine, *De Doctrina Christiana*; see Walton, 2003). Technological development was left to a class of people who had for generations been forced to work.

The Seven Liberal Arts. (Arte de Prudencia, 2007)

Perhaps it is no coincidence that many histories of directed intellectual consideration place the start of their narrative approximately with the end of the enslavement of African people and the emergence of steam engines. It has been suggested (for example, by Sachs, 1933) that the industrial revolution was delayed by slavery.[118] While it may appear superficially as if there is some logic in this assumption, slavery actually made little impact upon English agriculture and manufacturing and could not have provided the impetus to the industrial revolution. It is doubtful whether the ending of slavery was needed to enable the proliferation of machinery other than to signal a shift to a more egalitarian intellectual climate and the emergence of the intellectually brilliant but unscholarly engineer. As Giedion demonstrates, there was little strategic or philosophical interest in the development of technology among the educated elite, and there is no evidence that engineers such as Watt and his fellows had any wider intellectual concern other than to get things built and working.

> At the time when the physiocrats J. J. Rouseau and Adam Smith were at work, and the Encyclopédie, 1751-72, was slowly being brought forth volume by volume despite strong opposition, a few poor handicraftsmen of Lancashire, men of the lowest social

[118] Sachs suggests that inventors saw, with the Somerset case and the end of slavery in England, a massive potential to replace human energy with machines.

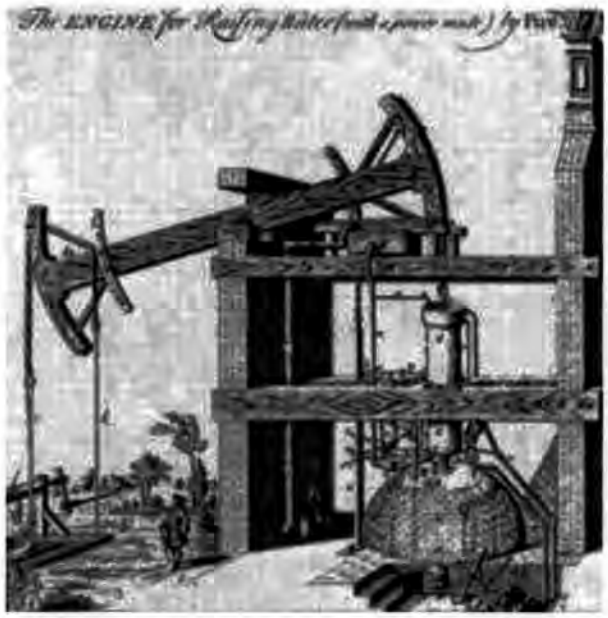
class, were devising apparatus for mechanical spinning and James Watt was completing the invention of a workable steam engine. (Giedion, 1948 p. 138)

The world of the early industrial revolution was understood in terms of sublime scales (see, for example, Hope-Nicolson, 1959). Although at first few and far between, the technologies of the heroic or monumental age were imagined and presented by their builders as objects of wonder, an essential component of an age of revolution and romantic awe. In keeping with their times, technologies carry with them the imagination of the awesome; their footprint is massive; they obscure views, fill and transform landscapes. The scale by which they are intellectually analysed is also immense; in contemporary molecular terms, these technologies represent a dense collation of molecules held together in tight electron bonds in structures that can withstand enormous forces. In an age of molecular physics and microscopic technology we could picture these technologies, not as monuments, but as flows and bonded collations of energy. Of course, we do not do this in our histories of technology; we are more likely to understand them at the same scale and in the same granular terms in which they were first imagined.

Given what we know of the intellectual climate of their times, the early developers of so-called monumental technologies did not picture themselves as subverting God.[119] But they understood well enough how they were revolutionising man's relationship with the world. At the time of their development these technologies were imagined in humanist terms as a sublime nature, a reconstructed great techtonic mass, extrinsic to humanity and as belonging to the fabric of the world. The fruit of human intellect, when imagined in the same terms as the world itself, albeit tamed, intellectually ordered and self-contained, is likely to be represented as a new artefact landscape. Perhaps their massive architecture reflected much of classicism, not because the new machines aped architecture, but because in these artefact landscapes scholars found testament to the power of the intellect and rational logic and the realisation of a new technê breaking irrevocably the link between man and nature and liberating humanity from the shackles of the temporal rhythms of pre-scientific times. Artefact landscapes appear as a new kind of controlled nature. They are frequently represented in

[119] It is arguable that this imagination was tied to a self-conscious taming of those forces that had in the Middle Ages been the domain of God. The developers of these machines had emerged from the same class as the medieval mechanical artists, but they came without the baggage of scholastic guilt. Watt and his fellows worked in a climate of self-conscious humanist vision, tempered by a more efficient non-conformist theology.

terms of the landscape. Humans stand and admire them from a distance, as one might admire a picturesque view or some other natural phenomenon.



'The ENGINE for raising water (with a power made) by FIRE.'

1711 illustration of Newcome's mine engine.

Reuleaux (1875) suggested that the machine tames 'the unrestrained power of natural forces, acting and reacting in limitless freedom'. Understood as a rational 'ordering' of 'disorder' then, the artefact landscape provides some evidence of how the first machine age was the product of the pre-scientific world. The artefact landscape extends a humanist conception of the world and is imagined in terms of how the intellect might finally tame and transform nature. Artefact landscapes are imagined as transformed and transformative landscapes - a human triumph over an ancient and antipathetic relationship.[120] Landscape artefacts, like the natural volcanic and seismic upheavals of the planet itself, left indelible imprints and rendered the earth inhospitable. Landscape artefacts, like other dynamic geological phenomena,

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[120] Machines, of course, had one great advantage over the old and uncontrolled nature they replaced; machines did not demand the same rhythm of the seasons as the agrarian world. In place of the rhythm of old nature, the machine presented a controlled and predictable rhythm - as Heath and Boreham (1999, p. 25) put it, 'the monotonous clatter of a boundless mill'. This new nature would prove to be faster, stronger, more even and relentless than the old irrational world. The new nature stripped energy from the supposed chaos of the old nature and spewed out the old nature back onto itself and out of place. The chemical waste products of this transformation did not support the life in the way the old nature had. It produced a new sterile and lifeless place that was neither of the world nor alien to it. The gentle images of the machine in the agrarian world such as that of the illustration of Newcome's engine are replaced in imagination by the horror of life struggling to survive in the industrial city.

released the potential energy of the earth and rearranged geology. Landscape artefacts like other tectonic upheavals created piles of spoil and laid waste to fertile land.

The imagination and presentation of the monumental machine deny interaction. These machines, imagined as awesome, are constructed such that people are kept at a distance. In keeping with the sense that the machine has a tectonic presence, people are represented as insignificant in the presence of the artefact landscape. These are not monuments but artefacts imagined as a topological domain that understands the process of humanising technology in terms of a wider landscape. Artefacts appear monumental in contemporary material cultural terms. There is no need at first to consider how artefact landscapes might relate to people in any way other than the people represented in a picturesque landscape; the interactional necessities of loading fuel into their fires might prove a concern were the task not so low on a register of skills as to be beyond the scope of intellectual consideration. Negotiated or avoided, as one might avoid a dangerous chasm or a volcanic vent, artefact landscapes required people of an insignificant social standing to work them. That they were killed was not a particular intellectual concern. An intellectual crisis began to emerge, as artefact landscapes began to proliferate. It became clear that a new imagination would be required if life were to continue in a landscape that was fast becoming widely poisonous. There is evidence of a palpable shift in the way that technologies are imagined. The final moments prior to a shift away from the topology of the artefact landscape are marked by pollution and squalor. The pollution and hostility to biology of the artefact landscape appeared to demand a new kind of species that might occupy the new nature.

5.3 From corporeality to culture

A speculative historiography showing how it could be imagined in terms of organic life in sympathy with broader intellectual understandings of the world.

If technologies had hitherto been imagined in topological terms as a landscape that was human in conception, then, in this new imagining, technology would come to be imagined as the animals that occupied this humanly constructed landscape. The representations of the artefact, as singular and set in a landscape, are replaced by pictures of factories that, are themselves, set in the landscape. The inside of these factories are represented by architectural spaces full of much smaller artefacts. The artefact landscapes were contained within walls, but with smaller artefacts distributed around their architectural space, as animals in a stall.

Above: The factory in the landscape (engraving of the Eli Whitney Armoury Site by Van Slyke, *c.*1879). Below: Technological artefacts with workers distributed among them in architectural spaces arrayed as animals in a barn.

Just as the loom has existed for many centuries, we should remind ourselves that the great beam engines continued to operate despite this transformation in representation. What is postulated here is that technological form is continuous. Its representation, however, reflects a developing intellectual trajectory and a shifting topological field of focus. While the previous intellectual climate had imagined technology as a rationalisation of the antagonistic landscape machine and humans were largely considered in isolation of one another, anew intellectual position can be found in the representations of this time of technology as a hyper-efficient animalism. Technologies imagined as artefact animals are pictured on the scale of animals, in ranked stalls in buildings in the landscape. Imaginings of technology in terms of an artefact animal are realised in subtle assumptions that prevail even into our times. Consider, for example, the crude but powerful Oxen or Diesel engine pulling the heavy load without finesse or grace but with efficiency and torque, and compare the smoother, faster and more elegant horse or petrol engine powering the daily transport of the gentleman and lady.

Artefact animals were fed with fuel, They consumed their 'food' to produce the energy required for their relentless work and spewed and excreted their waste.[121] Just as people had cared for their animals, so the engineers nurtured and cared for their engines. But these comparisons are perhaps merely superficial. In 1637 Descartes had described the animal as a machine 'made by the hands of God, incomparably better ordered and more admirable in its movements than any of those that can be invented by men' (cited in Rabinbach, 1990 p. 1). The artefact animals driving the industrial age, while perhaps more rudely constructed, could be thought of as super-biologies, outstripping the performance of even the most technologically reared and bred organism. The seemingly unrelenting rhythm of the seasons that directed organic life did not trouble the artefact animal. Its rhythm was relentless, unaffected by the seasons or by cycles of birth and death. Where the rhythm of the seasons had once determined supply and demand, now the wind and the rain were insignificant determinants in a wider economy of trade. Where animals had produced wool or milk, or young to be butchered, the artefact animals produced cloth or engineering parts. Animal husbandry required a subtle interaction and sympathy for the needs of the animal and drew the farmer into a harmonic sympathy with animal rhythms. Artefact animals ran to a different rhythm. Too powerful to be hindered by the weather, not regulated by the seasons or cycles of birth and death, or even day and night, these 'animals' could work relentlessly.

[121] This was not a new idea, and this is not a linear history. The point worth reiterating is that it can appear linear in an orthodox historical projection.

An idealised farmyard (above) and the 'farmyard' of the artefact animal (below).

The rhythmic certainty of technology, imagined as an artefact animal, required a form of husbandry that was sympathetic to its needs. Just as in traditional husbandry, the farmers of the artefact animal found it necessary to adapt to a rhythm. From the start these farmers were required to be as reliable, accurate, unfeeling and unemotional as the artefact animal under their charge. A new kind of farmer was required. These new farmers depended for their livelihood upon the walled landscape of the factory, and its particular skills and trades, just as their forebears had once depended on the farm set in an agrarian landscape. The emergence of the conception of technology as an animal within its own landscape shifted the imagination of the artefact itself towards the topological domain considered at a scale that had some resonance in the scale of the animal. When the farmer and the animal were intellectually conceptualised within the same landscape, the artefact could no longer be imagined as an isolated monument that was encountered and extrinsic to the body. As this imagination progressed, technology became represented in artefact animals with a smaller material footprint. The imagining of the artefact animal, contained in a factory farm, demands a special kind of farmer who both understands his 'animals' and can live successfully within this new technological habitat. The farmer is as intimately braided into the process of this new kind of farm production as into the agrarian model of pre-industrialisation.

After Darwin, it became necessary perhaps to understand humanity in similar terms to other species. This realisation had profound consequences for the intellectual climate of its times. It is quite feasible to suggest that the theorisation of technology was in some way implicated into this shift. For example, animals shift in status from something given to humanity for their use and exploitation to something that is in some way insinuated into a more extensive natural kingdom (see Preece and Fraser, 2000). Where once landscapes were considered from a distance, this new imagining invited a more complex model. Following Darwin and the intellectual shift from landscape to a wider concept of the 'natural world', technological landscapes could not be imagined without the animals that populated them. If people can be imagined in terms similar to other animals, and can be understood to occupy the same natural landscape as the animals, then it is a small intellectual step to imagine that people could be rationalised along the same lines as the artefact landscape had rationalised nature.

Left: Thomas Nast cartoon, *Harper's Weekly*, 19 August 1871.[122] *Right*: Darwin's sketch of evolutionary theory in his 'First Notebook on Transmutation of Species' (Darwin, 1837)

[122] "Victorian society was shocked by the publication in 1859 of Charles Darwin's Origin of Species and in 1871 of his Descent of Man, both of which seemed to indicate that man was descended from the apes. Here the artist puts all the dismay into the mouth of the "defrauded" ape." (Britannica 2007. Source: Encyclopaedia online: http://www.britannica.com

Armstrong (1998) has argued that during this period the human, which had provided the model *of* the machine, came in its turn to be modelled *on* the machine: 'it became increasingly possible in the nineteenth century to posit a general relation between bodies and machines in which the intentionality of making (the tool) is subsumed to a general logic' (Armstrong, 1998 p. 81).This view, however, does not account for the initial rationalist attempt to construct a new nature. It is possible, then, that it is the machine (or technology) that is imagined in terms of developing understandings of the human.[123] Steiner (2002) has suggested that attempts to find a new human that was symbiotic with the machine set the ground for the later emergence of an intellectual focus upon the paradoxical problem that technologies are constructed by humans but are intellectually understood in dissimilar terms from the human. This human technology paradox, the so-called technicity paradigm, would come to be understood to be at the core of human 'dis-ease' in the nineteenth and twentieth centuries. (The technicity paradigm is explored more fully in a subsequent chapter.) Steiner (2002, p. 213) calls upon Heidegger's realisation that 'we live in an epoch of technicity. At the root of the epoch of technicity lies a belief in rationality as a solution to almost every problem'.[124] However, it is plausible to understand this era in wider terms that include as symptomatic the separation of the artefact landscape from human schema and, by extension, the separation of humanity from technology.

It will be argued here that the human and the technological are an evolutionary ecological condition of the human species. Rather than the nineteenth century being seen as characterised by a more complex version of the artefact landscape (outside nature, such that any human who occupies that landscape must also be considered outside nature), the industrial age can be understood in terms of a more complex ecology. This ecology is bounded by the rationalist imagination, set in a landscape but separated from it by the walls of the factory, and the boundaries of the industrialised city. It is possible to understand how: 'Andrew Ure, to Marx's disgust, [could] describe the factory as a "vast automaton, composed of various mechanical and intellectual organs"' (Armstrong, 1998, p. 81). Though Ure may have been read by Marx as an attempt to demean the human to that of an organ, it may now

[123] We might think here of growing sophistication in understandings of artificial intelligence as it is driven by developing knowledge of human cognition.

[124] Steiner's argument suggests that this points to some deliberate attempt to control workers in an industrial setting. There is, of course, no evidence to suggest a widely orchestrated international conspiracy.

be read as an attempt to struggle towards the description of what we might now understand as an ecology.

Ecologies are energy systems (see Odum, Odum and Frankel, 1977), and an artefact ecology can be imagined in similar terms. Rabinbach (1990), again repeating the orthodox understanding of technicity, argues that a nineteenth-century belief in energy as a motivating force of modernisation led to parallels being drawn with machines that employed energy to such great effect (Rabinbach, 1990 pp. 2-5).[125] In De la Mettrie's *Man a Machine* (1748) there is an opportunity to reimagine the human soma in vitalistic terms, as a location of energy conversion and transformation within a wider system.

> Nourishment keeps up the movement which fever excites. Without food, the soul pines away, goes mad, and dies exhausted. The soul is a taper whose light flares up the moment before it goes out. But nourish the body, pour into its veins life-giving juices and strong liquors, and then the soul grows strong like them ... Thus a hot drink sets into stormy movement the blood, which a cold drink would have calmed. (De La Mettrie, 1748)

De La Mettrie can be interpreted as an attempt to connect the human with a wider ecology. However, this more vitalistic imagining was backgrounded in favour of interpretations of his treatise as a call for the rationalisation of the body. The orthodox argument suggests that attempts to understand and instrumentalise the body were brought about by economic imperatives, arising from a perception that workers appeared to be becoming increasingly languid. Reiterating the orthodox view, Doray (1988) has suggested that a perception of the dissociated loss of the body from the component of mechanisation was one of the drivers of modernism. The worker, suggests Doray (1988, p. 79), 'suffer[s] from the divorce between that part of his body which has been instrumentalised and calibrated and the remainder of his living personality'. This perceived separation, symptomatic in a new artificial disease (neurasthenia), can be posited as the underlying motivation of the modernist movement. Neurasthenia, a condition perceived to afflict the inhabitants of industrialised society, became a focus of intense study by nineteenth-century science.

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[125] Clarke and Dalrymple Henderson (2002) argue that information has come to replace energy in terms of representation of technology.

> The patient is pale and thin, without strength or courage, and always sad and dejected. He sees everything from the worst side. He rarely smiles. He goes along with his head down, avoiding the looks of others, his eyes languid and dull. He hardly dares look people in the face when he speaks to them, and the vagueness of his look is as it were a sign of powerlessness, an avowal of his moral strength. He always has the gait of a tired man; he is always very sensitive to the cold and is clothed in the summer almost as in the winter; his speech is slow, broken and trailing. (Proust and Ballet, 1902, p. 32)

Jean-Martin Charcot identified the condition as a product of the industrial age: 'a weakness of the will, or nervous system, that pathologically inhibited action' (see Rabinbach, 1990, p. 155). Perhaps one of the most widely known texts that engaged with neurasthenia was that of Adrian Proust.[126] Director of the French Ministry of Public Health. Rabinbach (1990, p. 157) suggests that Proust connected neurasthenia with the 'moral and intellectual pressures' of the age. Early twentieth-century modernism, then, would be driven by two apparently schizophrenic and divergent intellectual concerns: on the one hand, a move to bring the worker back into touch with his instrumentalised self, and, on the other hand, the drive to distance humanity from the corrosion and danger of the industrial condition. It is arguable that this paradox remains at the core of industrial design intellectual discourse, and it is perhaps no coincidence that it is at this intellectual juncture that most sustaining narratives of industrial design commence.

The Great Exhibition of 1851 provides the place in history where the majority of sustaining narratives of industrial design commence. The orthodox material cultural response to this shift is to claim that the exhibition marks a moment described by a sudden surge in demand for domestic technologies, tied to an apocryphal rise in domestic income (see, for example, Flanders, 2004). There is little, if any, economic evidence to suggest a sudden and dramatic change in the financial situation at the moment of the Great Exhibition, nor a sudden and visible cultural concern with domestication. If there is no material change at this moment, then it is perhaps more plausible to look for a shift in the intellectual dynamic that has led to a shift in the imagining of technology. The late nineteenth century is often characterised as a period in which those such as Jones (1856), Eastlake (1968) or Dresser (1873), and of course Morris (1877), (All can be found in Gorman, 2003) fought an ultimately futile battle to

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[126] The father of one of the most languid writers.

maintain the values of the agrarian world and handcrafts in the face of industrialisation and machine conformity. Most members of the industrial design community are familiar with the story that these designers would ultimately lose the intellectual argument to those such as Van de Velde (1897) and Veblan (1899), who are posited as the progenitors of the later modernists such as Lloyd Wright (1901) and, of course, Loos (1910) and who would drive ornamentation and the skill of the hand from the aesthetic of the modern.

> To me, and all the cultivated people, ornament does not increase the pleasures of life. If I want a piece of gingerbread I will choose one that is completely plain and not a piece that represents a baby in arms, or a horse-rider, a piece which is covered over and over with decorations. The man of the fifteenth century would not understand me. But modern people will. (Loos 1910)

One orthodox reading of this battle is a story of how designers, tied to emerging concepts of economic and sociological theorisations, found a simple, and efficient, aesthetic suitable for mechanical production. In this reading, the intellectual force of Lloyd Wright (1901) and Hoffmann and Moser (1905) swept away craft and craftiness and developed in its stead an efficient conformity of aesthetic that could be easily and efficiently reproduced. However, there is a more subtle ecological interpretation, missing from industrial design histories, that can be tied to a more subtle attempt to resolve the humanity-technology paradox. Where the preindustrial mechanical artist had struggled with greater ontological problems that tied the morality of his endeavour to the creation of the universe and to the substance of God, the designer of the artefact landscape, overcoming God, had sought to construct a humanistic model of nature that had eventually come to incorporate humanity into an inhuman condition. Then the shift in the representation of technology points to a reimagining that placed the individual human at the centre of the topological domain.

In 1905 Hoffmann and Moser wrote: 'The boundless evil, caused by shoddy mass produced goods and by the uncritical imitation of earlier styles, is like a tidal wave sweeping across the world' (p. 62). On a simplistic level, this looks like a simple condemnation of the shoddy. However, their explicit condemnations of the evil of an aesthetic that harks back to another age can be understood as a rejection of an ontological model that is unsustainable if it is reproduced without the intellectual location that accompanied its production. In Hoffmann and Moser we can sense a shift from a humanist rejection of theological, scholastic underpinnings of the imperative to form the technological artefact towards a new ecology that would place the human at the centre of things. However, the humanity-technology paradox prevailed. Hoffman and Moser, Lloyd Wright and the other designers could not accept technology as anything other than inhuman. In this new landscape the technology would henceforth be represented, not as an allegory of the universe, nor as a model of the world at large or of species upon it, but as an intimate prosthetic extension of humankind.

In sustaining narratives of industrial design, this machine age may appear to be a moment when the domestication of technology becomes a primary focus of design. But it is also delineated in sustaining narratives of industrial design by a dramatic distribution and a similarly dramatic shift in the scale of topological domain. Technological artefacts appear smaller, with less impact than in previous imaginings. Technological artefacts appear to have a diminished material footprint in comparison to their predecessors. These artefacts, being imagined at a more intense topological degree, are quieter, and their pollution is dissipated into more granular collations in exhausts or, in the case of new electrical motor, as intense locations of heat and noise distributed along wires. While the pollution of these individual artefacts adds up, individually they account for rather little. The technological artefacts in sustaining narratives of industrial design appear to be smaller; they have a scale that appears to be oriented about the familiar scale of humans beings.[127] Attempts to resolve the neurological disorder of life at the pace of the industrialised world shifted intellectual attention towards a view of people as nervous machines of subtle complexity. The focus of attention on neurological disorder can be understood to have provided the impetus to a significant shift in intellectual attention towards a multiplicity of interpretative and intimate conceptions of individualised experience. It is also worth noting that the understanding of the human in terms of nervous energy and electrical impulses precede the emergence of electrical technologies.

One untold story of the intellectual shift that brought about representations of technologies as limbs or extensions of the body is marked by a gradual retreat from the understanding of a new nature as a world in which the human might operate towards a realisation of the nature of

[127] We should be reminded here that this new imagining did not herald the end of large technologies, nor the machine shops of previous imaginings. It is also worth reminding ourselves that plenty of artefacts at this scale had existed in previous times, but are not included, or represented, in histories with the same enthusiasm as the monumental machines or the industrial landscape.

humanity itself as an operative and active soma with agency. Technology came to be understood less as the world brought under control, but as a limb or extension of human reach. Arguably this interpretation holds intellectual precedence to this day. In *Taming the Tiger* Rybczynski (1985, p. 89) argues that 'these prostheses don't fit well, they rub us raw, or itch'. This is, of course, a reiteration of Freud, who wrote in *Civilisation and its Discontents*:

> With every tool man is perfecting his own organs, whether motor or sensory, or is removing the limits of their functioning. Motor power places gigantic forces at his disposal which, like his muscles he can employ in any direction, thanks to ships and aircraft neither water nor air can hinder his movement; by means of spectacles he corrects defects in the lens of his own eye; by means of the telescope he sees into the far distance. Man has become as it were a kind of prosthetic God. When he puts on all his auxiliary organs he is truly magnificent; but these organs have not grown on him and they still give him much trouble at times. (Freud, 1961)

Foster's *Prosthetic Gods* (2004) is a relatively recent publication that explicitly connects the modernist movement with what might be termed a neurological focus of attention. Foster charts the emergence of the individual as a 'proper subject' in a chapter with that name. This story is characterised by concerns to connect the health in the industrialised world with honesty and purity, in the sense of simplicity. Foster suggests that the early modernists allied moral degradation to falsehood. This is an epoch marked by a concern to identify psychiatric truthfulness, of a bringing-out of repressed and hidden truths and the catharsis of simplicity and honesty. It is a widely held assumption in industrial design scholarship as a time of pragmatic, economic efficiency. When one considers the early twentieth century and the treatment of neurological disorder, one thinks, of course, of Freud. *Civilisation and its Discontents* was published in 1930, but one should not be mistaken in thinking that Freud's uncomfortable and prosthetic vision of mankind resided entirely in his imagination, nor that he would have the last word in this respect. Freud reiterates in essence the thesis of others such as Ernst Kapp (1877), who had suggested that tools had emerged as projections of human organs. Armstrong, citing Herf (1984), locates Kapp in an emergent German intellectual culture that 'set a pattern for subsequent [German] authors in placing technical advance in the realm of human anthropology...' (see Armstrong, 1998, p. 81). This should not be thought of as a chronological development, Paul made a similar argument in the late 1960s:

> The history of tools is a chronology of extension and articulation of human functions. Tools, originally conceived about two million years ago as crude adjuncts of the body to increase its power and efficacy, are passive participants in accomplishing work. (Paul, 1997, p. 133)

Sussman and Joseph have argued that evidence of the intellectual shift away from the humanist model towards a model of technology as prosthesis can be found in the writing of Dickens;

> In his comic and fantastic forms Dickens negotiates the limits, the boundaries, and the fusion of the human and the mechanical. Rather than accepting the Ruskinian opposition of the mechanical and the organic, he absorbed the reconstruction of the human in the machine age; the sense of the human machine splice formed and shaped his imagination. (Sussman and Joseph, 2004, p. 626)

Sussman and Joseph extend the ideas explored in Clayton (2003), who finds in Victorian English literature a suite of ideas that resonate in contemporary culture. This reminder that much contemporary posthumanist and cyber-thought has its origins some century and half ago, and indeed in many cases merely echoes arguments made in those times, is pertinent, but it should be no surprise. Sussman and Joseph, by exploring how some ideas that might appear to be quite contemporary are evident in Dickens's *Dombey and Son,* published some eighty years before Freud,[128] are part of an emerging intellectual attempt to reconnect the present with the past in less linear terms - see, for example, Hayles (1999) or Clarke and Dalrymple Henderson (2002).

Nevertheless, Sussman and Joseph go some way to illuminating a view of an intellectual climate, almost entirely invisible in industrial design histories, that appears to be a subtle, intellectual shift from the early humanist model of technology as an encapsulation of the world, towards more corporeal models. In *Dombey and Son* the character of Captain Cuttle has, in the way of literary sailors, a hook in replacement of an arm. This prosthesis both confines and liberates him.

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[128] It could be argued that Sussman and Joseph stretch their analysis rather thinly at times - for example, when they draw extended conclusions from a rather conjectural interpretation of a description of a character's teeth as being white as an indication that they were artificial.

Captain Cuttle.

Sussman and Joseph (2004, p. 619) make a rather more subtle suggestion of prosthesis in the character of Mrs Skewson:

> The novel-long joke about Mrs Skewton, her Dickensian verbal tick, is that while she prattles on about the decline of the *natural* and the rise of the *artificial* in modern society, she herself epitomises elaborate artifice not only socially but even more, materially, given this *Cleopatra's* infinite variety of bundled devices, the *pieces* that are regularly falling apart [Chapter 13], but which come together in their daily reassemblage [*sic*]. Of course ... there is no significant boundary between the naturalised organic body and its artificial extensions, between say, original hair and a wig.

Sussman and Joseph (2004, p. 626) collate and associate Dickens with Babbage, and with Ada Lovelace, who saw the imagination of the 'Difference Engine' as a living being that makes decisions for itself. It is significant, of course, that Dickens was a vociferous critic of life in industrialised society and the supposed dehumanised existence that the workers suffered. In Dickens, if Sussman and Joseph are correct, we can begin to find a form of emancipation that looks for a fulfilling life, not through the rejection of inhuman technology, but through prosthetic augmentation of the natural. Technology imagined as an artefact limb becomes imagined and represented in that topological domain and is represented in the company of, and in conjunction with, its organic counterparts. If this shift happened in consequence of a deterministic response to a change in the materiality of technology, as it is often supposed, then one would expect to find evidence of previous monumental forms finding their way into the scope of industrial design consideration. This does not happen. Instead we can find this shift of intellectual focus expressed through a particular fetishisation of technological artefacts in a topological domain that has resonance with the scale of the human body.[129]

Foster (2004, p. 110) emphasises, on the one hand, the rise of a new model of classicism, 'A Return to Order' and the imagination of the artefact landscape that 'proffered the nostalgic fiction of an intact body...' standing outside it, and, on the other hand, a reiteration of the humanity-technology claim of a 'machinic reaction to the very mechanisation of the modern body for a new principle of physical being'. Foster attempts to find a new complete human in the twentieth century focused upon understandings of the human as something made vital by the action of electrical impulses flowing through the nerves and the emergence of the psychoanalytical model of the human. But the topological domain was now fixed about the particular scale of the human body as it appeared in social and cultural understandings. The social and cultural imagining of the artefact owes much to a number of intellectual shifts that occurred during the second half of the twentieth century. Industrial design imaginings of technology in forms of the culturally determined have become somewhat submerged among the plethora of material engaging with the social shaping, and cultural reading, of technology. The body has come to be included in this discussion too, and its discussion has become somewhat confused with forms of social analysis. It is now difficult to discuss the human body without some reference to its meaning and value as a culturally and socially constructed object set at a particular material scale. See, for example, Brodwin's *Biotechnology and Culture* (2001) and also Scheper-Hughes and Wacquant's *Commodifying Bodies* (2002), in particular - which opens by reassuring the reader that in contemporary theory the body 'is generally treated as a text or a trope or as a metaphor that is "good to think" with, [while] in the larger society and in the global economy "the body" is generally viewed and treated as an object, albeit a highly fetishised one, and as a "commodity" that can be bartered, sold or stolen...' (p. 18). The emergence of socially constructed models of the human shifted the intellectual

[129] Prosthetic technicity retained as its starting point the idea that technologies are essentially inhuman. Machines were imagined either as extraordinary extensions of the human body or as devices of torture that made life uncomfortable. Foster (2004, p. 109) finds this troublesome: 'After McLuhan I will call this paradoxical view of technology as both extension and constriction of the body the double logic of prosthesis.' It is arguable that the paradoxical logic in the intellectual climate forced designers into aligning themselves either side of this logic, allied with one side or other of an intellectual schism. On the one hand, there were those who resisted technology and sought some kind of pre-technological utopia. On the other side, there were those who sought some form of post-natural form of humanity. These two positions are told in industrial design histories as rather separate events. Frequently industrial design histories deal with one story or another, rarely both. If both are considered, they are frequently represented as part of a logical and linear development and, in their true emergence, as simultaneous, irresolvable logics.

ground towards the body as a fixed and bounded topological domain set within a scene of social, economic or cultural narratives.

In more recent times humans have come to be imagined in social and cultural terms as collections of interacting groups working and playing together. In this climate designers have begun to understand technology in similar terms, as a constructed concept that extends way beyond the physicality to include, even in relatively pragmatic conversations, a concept of commodity as a metaphorically material construct. Industrial designers have found that terms such as materiality are no longer confined to hard materials such as wood, metal and plastics. See, for example, Herrmann et al. (1995) and the discussion of material flows in manufacturing where materials and commodities are both immaterial and material. To a degree the current machine age could be considered by a future generation as characterising a new machine age, itself characterised by a further acceleration of material dispersion and de-densification.

> In the Third Machine Age, the emphasis shifts from 'hardware' to 'software': from things to situations and events, with design facilitating experience and environment. (Whiteley, 2005)

In this new machine age, technologies, in keeping with the complexity of prevailing theorisation, are beginning to appear as tropes or as a means to understand social and cultural transformations. Society and culture must be read, and so imaginings of the human and the technological sidestep the prosthetic imagination of a previous age to become increasingly intimate and abstract constructions. Some sociologists, such as Latour (1998) and Law (see Callon and Law, 1995), have taken the metaphor further, to argue that social inventions carry many of the characteristics of materiality when they appear as institutions or as rigid codified constructions in the form of laws or social strictures. In engineering terms, this materiality is metaphorical or allegorical, except, as it has been argued here, as these social interactions are made material in artefacts, themselves fixed at a particular topological density. One reason for this shift can be tracked to the emergence in the late twentieth century of an intellectual resistance to much of the reductive nature of mid-century science.

These understandings of the human as a reductive psychology could owe much to the emergence of a resistance to behaviourist studies of the human mind. Wundt's late-nineteenth-century experiments at Leipzig University and also American research, particularly that of William James (2004), could be argued to have established the form and scope of psychology as it is understood in contemporary terms. These early psychologists can be understood in the context of their emergence in a climate where the human had become modelled on somewhat mechanistic models. Early psychology established the idea that human behaviour could be regulated.[130] These researches developed somewhat independently from the German and Austrian psychoanalytical methodologies. Behaviourism was understood by its exponents as a means to predict human behaviour and had some profound influence upon the development of design methodology. Cross (2001), for example, has argued that design, as we understand it today, is rooted in the scientific understanding of human behaviour. Cross recalls Van Doesburg's call for a new spirit in art and design and links this directly to the development of behaviourist models.

> Our epoch is hostile to every subjective speculation in art, science, technology, etc. The new spirit, which already governs almost all modern life, is opposed to animal spontaneity, to nature's domination, to artistic flummery. In order to construct a new object we need a method, that is to say an objective system. (Van Doesburg, 1922)

Others have suggested that behaviourism found application as a means to efficiency in various forms through its application in work system models. Behaviourism found a place in factories (see Hughes, 2004), and in offices through ideas of work efficiency and time and motion studies (see Gilbreth, in Price, 1990). Other Taylorist modes of scientific management were applied in advertising, marketing and market-led ideals of design aesthetics (see Kanigel, 1999). Arguably the challenge to behaviourism and the re-establishment of models of the human as a construction of the social and the cultural began in earnest in the 1960s. One stimulus of this is perhaps the inadvertent impetus of the American psychologist Burrhus Skinner. Skinner (1991), who had developed the 'Operant Conditioning Chamber' in which animals gained rewards by responding to learned stimuli, has been identified with attempts to broaden the application of behaviourism, and most particularly his attempts to establish a model of semantic behaviourism.[131]

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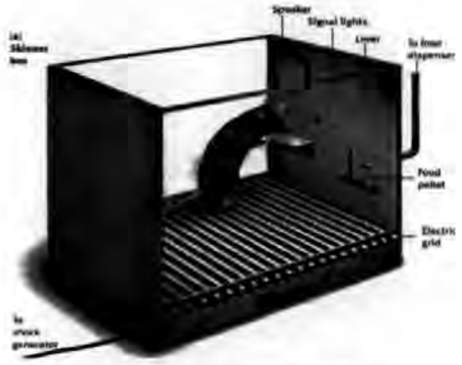
[130] Pavlov is perhaps the best known today among researchers who established the field of 'classical conditioning', which suggested that an entirely predictable and instrumental model of human behaviour and action might be eventually discovered and conditioned.

[131] There is some suggestion that it was this text that moved Noam Chomsky to public disagreement. It has been suggested that Chomsky misunderstood the subtlety of Skinner's thesis. Nevertheless it is now widely held that Chomsky's criticisms of Skinner can at the very least be seen to encapsulate an



Operant Conditioning Chamber or Skinner Box.

Skinner attempted to connect behaviourism to linguistic, mechanistic models of human understanding by suggesting that knowledge was externally acquired. For some, Skinner's work highlighted the reductive nature of the behaviourist model. Others, such as Chomsky had argued vociferously for a significantly more subtle coding of behaviour as a condition embodied in deep structures of socially innate behaviour, as a resistance to behaviourist models.

> it seems to me [to be an] appropriate form of social organisation for an advanced technological society, in which human beings do not have to be forced into the position of tools, of cogs in a machine. There is no longer any social necessity for human beings to be treated as mechanical elements in the productive process; that can be overcome, and we must overcome it, by a society of freedom and free association, in which the creative urge that I consider intrinsic to human nature will in fact be able to realise itself in whatever way it will ... (See Chomsky, 2006)

Chomsky can be understood in terms of the emergence of a resistance to behaviorism. His call for a social association has been widely adopted by designers. Technologies, although still seen and represented as extrinsic artefacts, are understood for their potential to inveigle their way into people's lives. Its domestication implies that technology has shifted in perception from that of a grand geographical entity or an animal, to something more intimate and culturally constructed. Human life no longer stands back from technology to admire it as a triumph of the intellect over the world, nor attempts to husband it by becoming symbiotic with it. Rather life begins to be understood to be a cultural construction, played out through

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intellectual move during the second half of the twentieth century, away from behaviourism and towards models of the human as a significantly more complex and embodied self-construction.

technology in the most intimate ways as an extension of the self. Designers have developed complex social and cultural flexibility in their models of technological intervention. Attempts to instrumentalise the human have continued to develop and can be found in recent attempts to reduce the human to a model in which all life is understood in rather deterministic terms as strings of code and predetermined genetic behaviours. Early psychodynamic models of the human, developed in response to a supposed neurasthenia, have developed from uncertain Freudian psychiatrical models, via behaviourism, into more contemporary developments in neuroscientific research. In the same terms, early models of the human rooted in the rhetoric of class-based models of taste and social behaviour have developed into more recent models of complex situated activity and actor network models. These developments have fed one another, transcended changes in politics, driven and responded to technological development and fed into wider conversation in the public consciousness as ideas that are now embedded in culture. Nonetheless, the human body remains a fluid construct, the subject of fashion and of much critical debate.

The body occupies a location that is both continuous (we can, for example, recognise our ancestors) and yet discontinuous. Bodies change scale and shape, as environmental and cultural determinant forces act upon it in the imagination. Humans modify their bodies. Sometimes this modification is transitory, such as in the shaping of the hair, and sometimes the changes are permanent, as in staining with ink, or scarring, or the consequence of some repeated activity or injury - deliberate or otherwise. The human in history has been shaped and scaled by diet, by posture, by fashion and by socially constructed behaviours and postures. Through a history of the chair, Cranz has demonstrated that the body is conditioned by posture, although it is often viewed as a fixed entity. While we can recognise human bodies in history and empathise with those who lived in those times, it can be shown that ideas of what it is to be comfortable are not fixed and without history (see Cranz, 2000). Demonstrably, comfort, which might appear to be an entirely physiological condition, is shaped by culture too. 'A family in republican Rome would dine together in the following hierarchy: the father would be served recumbent on a couch, the mother would sit nearby on a chair, while the children would sit on stools (as they did at school) ...' (Cranz, 2000, p. 15). The Visigoths, Cranz suggests, did not use furniture at all; they were most comfortable squatting and, despite the opportunity to adopt furniture from Roman culture, declined the prospect. The body is a political site, a fetishised, voyeuristic and sexualised minefield of complex discussion and rhetoric. However, in industrial design analysis, the body tends to occupy a more stable position in discussion, where it is represented in a manner that is somewhat fixed and empirical and imagined in the same topological terms as the artefacts with which industrial design populates its narratives.

It has been argued here that the artefact provides only a snapshot of culture and is imagined in topological terms that have resonance with imaginings of the human scale that brings it close to the scale of imagination. The body, though, is rather fixed in topological imagination. This inflects how it is imagined to operate in the world. For example, Verplank's description (2004) of design in an academic briefing as a process of creating artefacts for humans to 'sens[e] and displaying information (to all our senses)' provides only a limited conception of how humans function. In Verplank's description, the noetic is prioritised over the anoetic. Verplant finds a problem with the 'ambient', background or peripheral information, which, Verplank suggests, is more likely to be fuzzy or emotional than precise or definitive. For Verplank the problematic ambient can be made less problematic by making it available for people in a form they can readily understand. 'Tangible interactions involve explicit contact with hands and bodies not remote sensing and inference' (Verplank, 2004). This is a human body, and its sensing apparatus is imagined by a designer from an artefact standpoint. The imagination of the world as a series of resolved artefacts at a fixed topology now pervades thinking, even in attempts to imagine design in a broader more sensual and experiential frame. For example, Andrea Branzi, attempting to understand the role of the senses in design, suggests:

> Sensoriality is a very important component of design, because human beings always establish a complex relation with the artefacts that surround them. A relation in which sensorial experience, tactile and olfactory experience, has as much importance as aesthetic and functional qualities. (cited in Burkhardt and Morozzi, 1997, p. 78)

However, he returns immediately to a tactile, artefact imagining of sensuality:

> People like and choose artefacts for their weight, for their resemblance with other artefacts ... this kind of instinctive relationship that exists between man and man, man and artefact, is such that there will never exist sure-fire formulas for success in design. (cited in Burkhardt and Morozzi, 1997, p. 78)

Such a view depends upon an understanding of the human body as something as tangible as the media with which it interacts. This is a very limited view of the human body's sensorial engagement with the world. The artefact body is most frequently presented and considered in contemporary analysis as an artefact; its consideration is intellectually located with theories of the material, and in cultural terms at a given, and fixed, degree of granularity. The physical body is stable and provides a fixed locus in the imaginary conception of the artefact. Because technologies are imagined in terms of prosthetic extensions of the body, it has seemed reasonable enough to take the ineffable and to shift it to a granular scale that is commensurate with the imagined granular scale of the body.

Chapter six

Recovery towards autonomy: steps towards a fluid conception of human- technological relationships

6.1 **The opportunities that biotechnology offers to the conceptualisation of technology**
If artefacts are understood to be only as material as the complexity of their analysis, then it is possible to take a view that the biotechnology imperative is determined, not by the development of a new form of technology, but by an emergent intellectual understanding of the human as a molecular collusion.

6.2 **The imperative of valence: The material site of interaction**
The process of humanising technology can be understood in terms of a process in which valence is maintained between the intellectual logic of the world and its manifestation in the material artefact.

6.3 **Humanity and the enacted moment as a hybrid condition**
Actor-Network Theory: the materialisation of artefacts from the valence of hybrid social and cultural energies. Humanity can now no longer be considered as anything other than a hybrid condition.

6.1 The opportunities that biotechnology offers to the conceptualisation of technology

If artefacts are understood to be only as material as the complexity of their analysis, then it is possible to take a view that the biotechnology imperative is determined, not by the development of a new form of technology, but by an emergent intellectual understanding of the human as a molecular collusion.

It has been argued here that the nineteenth and twentieth centuries can be understood in terms of an intellectual shift from the relative simple imagining of technology as a landscape, towards an increasingly complex understanding of technology as a prosthetic, inhuman extension of humanity. This period in the trajectory of human knowledge can be understood as an imagining that gradually de-densified, from a solid, extrinsic imagining of the human as one who observed the landscape towards a view of the world as more intimately involved in the human. This shift tracks in many ways the scientific shift from large masses and planetary movements towards the atomic research of the late nineteenth century and shifts in the physics of energy management, from rather simple thermodynamics to more complex and subtle electromagnetics. Similar shifts can be found in politics and the move from grandiose imaginings of heroic nationalism towards more focused concerns with subtle politics and diplomacy. This broad intellectual shift is reflected too in understandings of the function of the human body and the meaning of what it is to be human in terms of the natural world. The machine ages have been claimed as indications of a series of moves from the general to the specific and shifts in a process of realignment in understandings of the interaction between humanity and technology. With each move, technology in a given form was no longer viable as a focus of consideration if its understanding moved out of step with a prevailing topological domain that provided the focus of intellectual imagination. For example, in a domain focusing upon the body as a location of nervous energy, the imagination of the machine as a monument was necessarily replaced by an intellectual imagining of technology as a prosthetic extension of the human body. Accordingly, the scale of technology became imagined at the scale of the human body, rather than at a more global scale.

These shifts, it has been argued, are visible in sustaining narratives of industrial design and are not chronologically connected or driven by the material manifestation of technology. Rather, this material manifestation is symptomatic of an intellectual shift. If the machine ages are reflexive and it takes time for the shift in intellectual positions to gain sufficient momentum to impact on the design community, then there must be some point at which the intellectual climate becomes irresistible to the design community and gains sufficient momentum in order to effect change. This delay may be caused, at least in part, by an established and historic distancing of industrial design from mainstream intellectual debate. This alienation suggests designers are likely to effect change within their own community only through the engagement with ideas in their own terms. We might think that a moment of intellectual shift refers to the moment of recognition, albeit in reflection, by the industrial design community that a topological domain change is required. It is only in the moment of recognition that the intellectual climate has reached an impasse with a particular manifestation of artefacts that a crisis becomes apparent to those, including industrial designers, who are responsible for their realisation. This would suggest, then, that designers can only refocus their attention upon the material artefact when the intellectual climate becomes meaningful in their terms. If the sustaining narratives of industrial design reinforce the idea that industrial design is described through changes in the material manifestation of technology, then it is not surprising that designers might assume that changes in form should determine intellectual reactions. However, if this were the case, then most of the machine ages should, by all accounts, have begun somewhat earlier, with the emergence of the technologies that characterise them. If a new machine age is prescient, then there should be some evidence of a prior intellectual shift in the topological domain. It is possible to suggest that biotechnology has become viable in consequence of a realigned focus at a more molecular scale.

The logic of a molecular domain invites a new imagining of the human. As this new imagining embeds, it is likely, if the trajectory of history is maintained, to give rise to a shift in the intellectual imagining of technology and to a further de-densification of the analysis of materiality. In keeping with the intellectual terms of the molecule, the artefacts of this age will be minuscule and almost infinitely dispersed. The artefacts of a future machine age will insinuate themselves into the fabric of everything because they will mirror the intellectual imagining of the molecular. When we speak of atoms and molecules, the ordinary logic of the world in terms of simple lumps of matter is replaced by an intellectual climate demanding an analysis of distributed and coextensive fields. This age may reside some way in the future, but its intellectual foundations are already well established. Industrial design appears to be out of step with the intellectual climate in which it finds itself, because it has not shifted its understanding of the artefact in line with developing intellectual understandings of the world. A molecular topology invites an understanding of the world at a degree of intense subtlety, such that it becomes almost impossible to imagine the human in terms of components rather than continuity. This suggests that, in this topological domain, the human cannot be isolated from the technological. One might choose to imagine this interaction as a finer and finer sifting of grains and to retain an intellectual stance maintaining the human and the technological in separate epistemes. However, at the molecular level the sifting takes place at such a degree of finite resolution that it becomes no longer plausible to separate epistemes than it is possible in physics to identify discrete boundaries between matter. This is true of any physical analysis and is also likely to apply in any emerging intellectual cultural and social analysis.

> We are now crossing the fourth discontinuity. No longer do we have to choose between the living or the mechanical because that distinction is no longer meaningful. Indeed, the most meaningful discoveries in this coming century are bound to those that celebrate, explore, and exploit the unified quality of technology and life ... As we make our machines and institutions more complex, we have to make them more biological in order to manage them ... As we shape technology, it shapes us. We are connecting everything to everything, and so our entire culture is migrating to a 'network culture' and a new network economics. (Kelly, 1995, ch6-g)

Given the fluidity of understandings of technology and humanity, surveys of histories suggest that the key intellectual task of those who orchestrate artefacts, most recently industrial designers, appears to be the maintenance of some kind of material logic in this relationship, in order that daily life appears coherent. Through this process, the essential value of the industrial designer's intellect is to ensure that human values are maintained, in so much as lives are meaningfully lived out through technologies materialised to a degree commensurate with intellectual imaginings of the world. It appears from a survey of histories that the machine ages are a reflective response by the industrial design community, which reimagines the artefact at a scale that maintains valence with prevailing topological domains. Given this trajectory, it is possible to anticipate that the focus of intellectual engagement with the biotechnological logic could manifest as a further shift. However, the comparative silence within the industrial design community indicates, either that this intellectual crisis has not yet occurred, and industrial designers are yet to comprehend the impact of a shift in the intellectual climate, or that industrial designers are aware of the shift but are not well placed intellectually to engage with the scale and subtlety of the analysis necessary.

The machine ages have demonstrated a consistent shift in the scale of intellectual understanding of the human and, by extension, human technology interaction towards increasingly finite and atomic resolution. Recent understandings have drawn attention towards understandings of the human as a complex and distributed social construction. Molecular logic appears, then, to demand a particular intellectual re-engagement. Industrial designers have demonstrated that they are able intellectually to engage with complex, distributed and social models of the human. If industrial designers can liberate their thinking from the constraints applied to their imagination by a narrative that enforces a trajectory of engagements with a particular form of materiality, then there is no reason to suggest they are not up to this task. Pehaps they will only be ready to engage with this when they turn their attention away from the deterministic idea that technological form drives the imagination. It is extraordinary that they should make this assumption, given that they themselves carry such a degree of responsibility for the formal logic of the artefact in the first place.

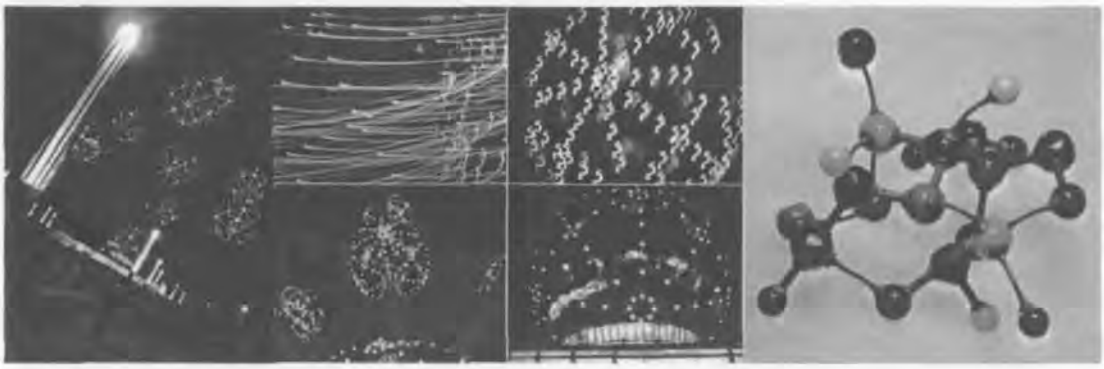
> Limiting our discussion to the field of Industrial Design, we can note that, in the face of the presumed dematerialisation of the world, its transformation into a virtual reality becomes ever more involving and convincing. The sense of satisfaction is delegated to the image and the illusion of what is virtual rather than to the material and multi-sensorial fruition of the physicality of things. What we perceive, however, is a distinct need for physicality, for recuperating a strong, sensorial quality. (Volsi, 2007)

Perhaps one way to start a more productive conversation might be to consider how those who deal with the world at the atomic scale make sense of their reality.

6.2 The imperative of valence: The material site of interaction

The process of humanising technology can be understood in terms of a process in which valence is maintained between the intellectual logic of the world and its manifestation in the material artefact.

In 1916 Gilbert N. Lewis published *The Atom and the Molecule* (Lewis, 1916), considered within the physics community to be the founding paper of a branch of physics called Valence Bond Theory (see Brown, 2006). Valence Bond Theory is, in essence, the scientific terminology for the study, at the risk of huge reduction, of what makes atoms and molecules *stick* together and why some are prone to do this and others are not (see Murrel et al., 1978).

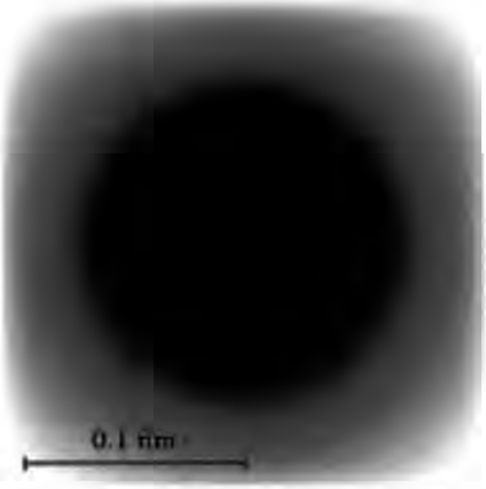


Pippa Wilson's[132] images of the Atomium (Architect, André Waterkeyn) and a familiar scientific demonstrational model of a molecule.

Lewis developed the means of representing valence by lines and dots. In models we are familiar with from school, valence is represented by the mysterious sticks that hold the balls together and apart in atomic models, or the corridors in the Atomium.[133] There are no sticks, of course, in an atom or a molecule, but they are necessary in the models and in the building, because there is no other, efficient, means of holding the spheres in place. In physics, as it is currently interpreted, valence is understood in terms that are more complex and subtle than the structural and determinant forces that were imagined when the stick models were developed.

[132] See: http://pippawilson.blogspot.com/2006_12_01_archive.html

[133] Lewis can be thought of as sitting somewhere between nineteenth-century mechanical models of bonding and later quantum models of wave bonding (see Murrel et al., 1978).



Quantum model. The shading indicates the probability of an electron in any position.

Physicists, who talk in terms of quanta, understand the atom, not as a rigid form, as the models and the Atomium might suggest, but as a field of probabilities. The determining forces that enact valence are related to the probability of a particle being in any given point in space. This probability forms atoms in a particular configuration in any particular quantum reality. The representation of the probability field presents a very different conception of materiality in which complex and fuzzy relations of probability, rather than rigid structures, prevail.

The designer Ben Fry (2004) is an information architect who builds 'visual representations of large bodies of information'. Fry produced 'Valence', a series of graphical representations of text sources as data that dynamically align words dependent upon their importance in a text and then join words together in order to form a kind of textual artefact.

> The premise is that the best way to understand a large body of information, whether it's a 200,000 word book, usage data from a web site, or financial transaction information between two multinational corporations, is to provide a feel for general trends and anomalies in the data, by providing a qualitative slice into how the information is structured. (Fry, 2004)

Fry applies a kind of nominal determinant force to the importance of complex data sets in order to construct a form of visually represented artefact. Fry's artefacts are very subtle. Images of them do not transfer well to print and are perhaps best viewed on Fry's MIT website (see Fry, 2004). The nominal force is determined by any number of vectors: frequency of occurrence, scale, and so on. Valence, then, is a determination that holds 'stuff' together. Fry demonstrates, in principle at least, how changes to the determinant construction can produce radically differing outcomes that appear to have a coherence of their own. The artefacts reproduced and used to drive the sustaining narratives of industrial design appear to be materiality suspended in time and space. The exact nature of valence is a matter of intense complexity and, being a probability, is subject to a significant degree of uncertainty. In physics, enormous intellectual and engineering efforts and a great deal of money have been spent on the concentrated attempts to discover and observe the fundamental interactions that underpin all phenomena.[134] Science suggests that the universe is, then, held together by an unimaginable, perhaps infinite, number of forces of infinite weakness. Anyone attempting to understand the forces holding culture together are likely, given quantum logic, to discover those forces to be similarly numerous and similarly weak. The isolation of these forces would seem likely to require an investment similar in scale to that employed by physics. Too many texts, however, claim one truth or another, when in reality almost any truth is possible, being only a matter of probability. De Landa, finding such a task too complex to be useful, sidesteps the need to think about what might actually construe the forces that make the 'stuff' of culture stick together, but takes a wider view and builds a picture of a self-emergent, autopoietic world. His argument is that culture bears a resonant similarity with the universal processes that give rise to life. That is life, of course, as a universal concept rather than as an evaluative social construct.

In scientific terms, if valence is too strong, matter (in terms of how it appears to us at least) implodes and compacts. At an ultimate degree of strong valence, this compaction forms a black hole. If valence is weak, matter flies apart. At an ultimate degree of weak valence, the universe retreats to entropy. This valence is determined by energy. In physics it has been proposed that fundamental energy is produced by 'strings'. By analogy to cultural analysis, the only place one can look for energy is in the analysis applied by humans. This appears to be an inverse process where unsubtle analysis produces robust but unsubtle artefacts, and the products of subtle analysis are prone to the ephemeral. To illustrate this, traction engines are made of atoms and rely upon complex thermodynamic energetic transformations, but in

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[134] These interactions are the 'Strong', Electromagnetic' and the 'Weak'. 'Gravity' is rather different to these interactions in that it is considerably weaker than the others. This weakness in turn has made it rather difficult to understand and despite much research the true nature of these determinant forces still eludes science.

industrial design history it is doubtful if we would speak of them in those terms. We might understand artefacts in energetic terms. The artefact 'plough' is a means to capture and redirect the forward momentum arising from the energy of the animal pulling it. The plough redirects this energy through angular momentum, into a determinant force sufficient to lift and turn soil. The soil itself has mass and density, and the plough must necessarily be constructed to have a greater density. Were the plough to have less density or insufficient mass, then it would itself be broken by the soil.

Today we understand energy as the fundamental principle underpinning all matter; density and mass are products of particular energetic conditions. The energy necessary for the plough to resist the soil must be put into the system, and this happens in the blacksmith's shop or in the carpenter's workshop. The plough has energetic density where it needs to be dense; wood is shaped to make the energetic connections between the farmer and the land and the animal. It is a mistake to talk about the plough as if it were an isolated entity, when it could be understood as a valent materialisation of physical and intellectual energy. The ploughman and the artefact are in effect a system that extends into flesh, wood, metal, soil and ultimately the infinite complexity of the universe. For example, we might consider the developing relationship between the cockpit, the control tower and the runway and an emergent history of automation and the social expectation of safety.

'The product' as a solely physical entity is an illusion of the mechanistic era which can no longer be sustained in an age preoccupied with information...' (Mitchell, 1988).

This history might consider the runway as an artefact in itself and its developing history, from a simple designation of grassland, to becoming a surfaced strip and more latterly a sophisticated assemblage of interacting navigation and lighting technologies.

6.3 **Humanity and the enacted moment as a hybrid condition**

Actor-Network Theory: The materialisation of artefacts from the valence of hybrid social and cultural energies. Humanity can now no longer be considered as anything other than a hybrid condition.

Sociology is one of the ways in which we can understand the forces that shape culture. In recent years there has been an intellectual move away from a view of human society and culture as somehow ordered and structured. In its place, a new view has emerged that reconnects humanity with other more universal systems of analysis that recognise systems that are emerging from supercomplex combinations of rather tiny effects. When analysed for subtle interactions, society and cultures are coming to be understood as comparable to swarming or flocking behaviour. Imagine that we might wish to *understand* rather than to admire the awesome spectacle of a swirling flock of starlings gathering in the autumn before migration. Broad analysis can recount only the overall dynamic of the flock; it can tell us little more than we can see with our own eyes. Broad analysis can account for the general behaviour of the flock, swirling around fixed geographies. These accounts can describe the scale of the flock but cannot predict its movement except in the most general terms. In physics the valence holding the fundamental particles of matter together is not a unidirectional force but is referred to as an 'interactional coupling' (see, for example, Griffiths, 1987). The notion of these interactions has provided some designers, particularly in the field of human computer interaction, with a metaphorical and strategic means to develop strategies enabling useful and stable systems. David Pinelle and Carl Gutwin at 'The Interaction Lab. University of Saskatchewan' (see Saskatchewan HCI. 2006), for example, use the concept of interactional couplings employed by a social and work group as a means to design a system for mobile workers (Pinelle and Gutwin, 2003). Pinelle and Gutwin refer to Orton and Weick's notion of coupled systems as a social management tool (see Orton and Weick, 1990) and extend the concept into the field of Computer Supported Cooperative Work. In a section where he discusses the granularity of interactions, Gedenryd (1998, pp. 131-2) describes how people 'check with the world' frequently and with varying degrees of interactional granularity.[135] In swarming or flocking behaviour this interactional force is referred to as chains of reaction:

> chains of reaction that bind us together as communities, ecosystems, societies, cultures. As we all strive to adapt to one another, only some self-consistent collective patterns are possible for the whole swarm. They are the patterns of emergent order and organization... (Bogh-Andersen et al., 2000)

Heidegger places the everyday engagement with technology at the centre of his analysis and reveals much of what an industrial designer might understand in a codified and productive, formal, philosophical analysis. Heidegger's writing is complex. His is the language of the philosopher and not of the designer. Nevertheless his concerns are intimately tied to those of design. Gorner (2005) has suggested that Heidegger wants to understand how technologies can be possible,[136] and this would seem to be something of the territory of the industrial designer. Gorner (2005) provides a particularly clear overview of Heidegger's enframed (see

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[135] Gedenryd, concerned with understanding the intellectual process of designing, cites an example of an everyday instructional conversation in order to demonstrate how interaction or coupling becomes increasingly intense, subtle and complex as it focuses. This should not surprise us; our postal addresses mirror this intensity. The early instructions deal with artefacts of larger scale, shops, streets, phone boxes. As the intensity and focus increase, the artefacts become smaller and smaller; a gate, a lock, a key. The geographic location and interaction space shrinks too, from large urban spaces down to intense interactions with small artefacts. The world is made up then of many interactions of varying and changing intensity. When we give directions to someone who is remote, we tend to be precise and linear. (1) Take the first left by the shop and then go right at the phone box and then left again into the gate. The person reading the instructions reacts to them; there is no interaction. However the same instructions in the context of a face-to -ace or verbal exchange via mobile phone are likely to be quite different. (1) Take the first left by the shop. (2) The sweet shop? (Person 2 has the opportunity to confirm instructions) (1) Yes, then go right at the phone box, OK? (Checks to see the instructions are understood) (2) OK (They confirm they understand) (1) Good, now go left into the gate. (2) What colour is the gate? (1) Black (2) Will it be locked (1) Oh yes, sorry. The key is under the flower pot.

[136] When confronted with a new project, an industrial designer must always enquire why an intervention is necessary at all; why design something new when the world has previously got on well enough without it.

Heidegger, 1962) [137] understanding of the human in the world and the role of technology in the processes that give rise to 'being'. Heidegger is not concerned to suggest that other ways of understanding people are not valid, and there is much to connect sociological views of humanity with the rather individualised scrutiny he employs. This is particularly important when Heidegger considers technology. While other philosophers take moral or linguistic approaches to understand what it is to be human, Heidegger's heritage resides in attempts to look at what in essence it is to be a human in the world, and he implicates technology intimately in this process. Heidegger distances the idea of being from the necessity to attach it to the world. His fundamental approach, employing the term *Dasein*, describes an entity that reflects upon, and understands, itself. *Dasein* is not necessarily human but a product of self-awareness.[138] The relationship designers might have with Heidegger is not without its tensions. In 'The Question Concerning Technology' Heidegger moves away from a rather broader phenomenological investigation of being to place rather closer attention upon the meaning of technology in the process of being. Heidegger suggests that technologies are constructed in a manner such that they obscure the true essence of *Dasein* and that life in a de-technologised world would somehow prove more invigorating. Heidegger argues that the drive of modernism forced technology into a condition where it became ready for use but not active in cognition (*bestanden*). Heidegger proposes that this drive was a dehumanising activity because it deluded*Dasein* into a false phenomenological perception of its true condition. This would seem to run counter to the success of industrial design in making the extraordinary ordinary, but it goes some way towards understanding the impetus behind social and cultural design. In this context the thrust driving industrial design to understand and orchestrate the cultural forces shaping the artefacts it produces can be understood as a response to critics of modernism who cite Heidegger's analysis of the erasure of narratives (indebtedness). Social design acts upon an assumption that it might be possible to create a richer experience of life by revealing some of the processes through which the 'stuff' of culture emerges. One example of this call is evident in McCullough's suggestion (2001) that

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[137] This *problem* of possibility is particularly evident in Heidegger's 1927 *Being and Time* (see Heidegger, 1962) and also, although somewhat differently, in his later lectures of 1956 'The Question Concerning Technology' (Heidegger, 1956). Between the two positions outlined in these lectures, Heidegger moved from a pure, phenomenological and philosophical analysis, which might have been rooted in almost any era, towards a more applied analysis of the emerging, technologised world of the second half of the twentieth century. The latter analysis is more complex and arguably more troubled. Heidegger's criticism of modernism in the former text is extended into the terrifying prospect of the nuclear era, and much of the earlier engagement with individualised being is lost.

[138] So Heidegger avoids being drawn into the increasingly debatable notion that humans alone, and not animals, possess self-awareness.

persistent conceptual models prevailing in the West stifle the means to deal with the environmental consequences of technological damage. Constructing an argument from a theological perspective, McCullough suggests that this understanding has emerged in consequence of late scholastic thought and in particular the emergence of scientific thought and the breaking from the Aristotelian logic of indebtedness. McCullough illustrates this by drawing upon Heidegger, with the example of a 'modern' central heating boiler compared to the wood stove, its 'pre-modern' counterpart. McCullough suggests that the wood stove draws upon its 'indebtedness' to the social and cultural systems that support it: 'the mother built the fire, the children kept the firebox filled, and the father cut the firewood, It provided for the entire family a regular and bodily engagement with the rhythm of the seasons ...'. The central heating boiler, on the other hand, hides its indebtedness, hidden within a metal shell, which is usually hidden in the basement of the house and powered by a source of which we are oblivious. The furnace reveals itself by means of a small control unit; it hides that to which it is indebted. In the case of the boiler, this is the network of energy supply and production without which it could not exist. The wood stove - as McCullough reiterates - brings its causes into the open. The boiler is *bestanden* (Heidegger, 1953); that is, it can be thought of only as something ready for use. Heidegger suggests that a machine such as the boiler erases the essence of being in the world and replaces it with the conformity and precision of 'disposition' - that is, a habit. McCullough's argument is that contemporary technology has somehow cut people off from their engagement with the world by erasing the complexity of the interaction with the technology in question. We must ask where one might stop this process of recovering erasure, or whether it is possible at all. For every debt that is revealed another debt is revealed further back into evolution. The boiler erases the debts of the wood stove, which has itself erased the debts of the fire.

What is often missed in this kind of discussion and in critiques of modernity is that technologies become *bestanden,* not by accident, but because they are designed and constructed that way. In the case of the boiler, a conscious intellectual decision is made to background the technology such that heat and comfort can be brought to the fore and the forces of cultural inclusion have drawn the boiler into usefulness because the grinding social process of gathering wood can be escaped. The wood stove is not some paragon of a picturesque ideal. That it erases the family engaged in the *struggle* to fight the cold in their home is not necessarily a bad thing. Arguably, that the struggle should have value could hint at something more politically sinister. The indebted heritage of the wood stove is a story of the grinding labour of the peasant, and not of the aristocrat who wakes to find his fire ablaze, quietly *self*-cleaning and always *bestanden.* The socialist underpinning of the Bauhaus and early modernism can be seen to be at odds with Heidegger's developing political tendencies. The evidence from more recently published sustaining narratives of industrial design is that the intellectual engagement with the ontology of the machine age is beginning to disappear from industrial design histories. Without this history, industrial design can appear as the lackey of industrialisation, modernism and a supposed malaevolent attempt to erase the *art* of lifes narratives. In that way the process of humanising technology is posited as a cultural restoration. The older histories such as Teague (1940) or Banham (1955) and more recently Wilson, Pilgrim, and Tashjian's more focused history (Wilson et al. 1986) demonstrate how the industrial designers of the early twentieth century realised that it would be both dishonest and uneconomic to do anything other than build an aesthetic of the age of the machine. This aesthetic cannot be understood as a mere stylistic surface decoration, but must rather be seen as an explicit attempt to find a form by which technology can draw upon a new sense of history and narrative contextualised in a progressive egalitarianism. Rather than aping a modality from an earlier age, where some historical and mystical narrative would be visible in the technology, the new machine age would find an entirely new aesthetic, built in the present and lived within the present. Adolf Loos (1910) thought decoration was a manifestation of the corruption of the humble in favour of the wealthy. 'My shoes are covered all over with ornaments, which result from notches and holes: work which the cobbler carried out and which he was not paid for'. Loos extends his argument in favour of simplicity. If a simple aesthetic style can be built, it will erase unnecessary ornamentation and thereby erase wasted labour. 'The Chinese carver works sixteen hours, the American labourer works eight hours. If I pay as much for a plain box as I would for an ornamented one, then the difference is in working hours' (Loos, 1910). The modern aesthetic, then, is imbued with the drive towards a poetic aesthetic of life in a new narrative of the machine age. To imply loss, as many do, is to run the risk of a retreat into nostalgia and some idealised condition where one imagines oneself in the rarefied world supported by the virtuous toil of others.

Roe Smith and Marx (1994) alert us that technologies are drawn into use by some obvious advantage that they afford. Today many people have both options available to them. An open fire may well act as a communal focus. A central heating boiler may erase this, but it opens space for other familial or community activities, one of which may be the occasional use of a wood stove. People are rather good at finding a balance that suits their lives. The ecstatic communion with nature in the process of gathering wood has become the ecstatic bringing of warmth to the body and the creative act of living out one's life without owing a debt to the cold. In a warm space, individual relationships and ecstatic happening can occur.[139] It is always possible, of course, to sell something by creating a fictional debt, as in the case of the new BMW Mini. Giedion (1948. pp. 188-201 examined the production of bread and points to the necessity of finding some value to promote other than the honesty and quality of its production.) It has been argued here that the BMW Mini requires an explicit campaign to support its semiotic reference to the past.

Industrial design has attempted to reveal indebtedness directly in the artefact itself. One way of understanding the doctrine of functionalism is as an explicit attempt to reveal the function and process to which mechanical technologies are indebted. In this logic, the boiler would, through some means, express its heat and the network to which it was indebted. With electronic artefacts this expression of indebteness necessarily shifted. In the example of Krohn's answering machine, cited above, then was an erroneous attempt to reveal both a previous technology and a social and cultural semiotic to which it was imagined the artefact was indebted. This was a mistake, because the machine Krohn designed had no real resonance in history; the device she designed was not a telephone book. Although it bore some superficial similarity, it had an entirely different human and social function. The boiler is not a version of the wood stove. It may bear some superficial simplicity, but its presence only as an insignificant ambience, makes it more akin to a device enabling a change in the weather. The ambient temperature is raised and the occupants of the room can get on with their lives, no richer and no poorer for the experience. The boiler is not humanised by connecting it back, out of *bestanden*, any more than one is dehumanised by a sudden turn to warmer weather.

[139] There may be some pleasure in gathering wood, but its necessity removes the opportunity for other acts of creativity. It may be the case that central heating generates an unsustainable expectation of constant warmth, produces unsustainable quantities of carbon dioxide and has removed the narratives associated with warm clothing, cold rooms and families gathered around the stove. It is another more political argument to suggest that the erasure of these narratives is problematical. It is a political stance to suggest that a sustainable life is made possible only by the reintroduction of narratives of suffering. This approach reverses engineers' design without heeding the forces shaping the design processes it analyses.

Sociologists have spent much of the second half of the twentieth century attempting to resolve the differing demands of their various methodologies. In recent years some sociologists, such as Latour and Callon, have criticised the impetus to account for the individual within a broader scope of structural analysis, which, they claim, characterised twentieth-century sociology. The work of Latour and Callon can be included among a number of recent moves in sociological thinking that look for connectivity rather than structural rigidity in relations. These new approaches look for networks of relations that can be cited simultaneously in both the individual and the wider social world as lived activities. Among these new approaches to sociology are a number of methodologies that are described as being 'material-semiotic' - that is, they analyse both the material and the semiotic simultaneously in any given situation. One particular form of material-semiotic analysis, the so-called Actor-Network Theory or ANT (Latour, 2005; see Law and Hassard, 1999), can be understood as an attempt to resolve a perceptual separation in sociological thinking between the world as it is non-human (artefact, technology, and so on) and conceptual (institutions, organisations, events, and so on) (see Latour, 2005). Because ANT bases its analysis upon the use of artefacts in culture, it resides very close to the analytical territory of the industrial designer. ANT also tends to be constructed in a rather accessible language.[140]

M. Michael's *Reconnecting Culture, Technology and Nature* (2000) demands neither a specialist engagement nor a familiarity with the terminology and method of sociology. Michael uses everyday artefacts as a means to extract the social relations at play in the activities with which they are associated. Michael focuses his attention upon a number of 'mundane technologies' such as the walking boot or the TV remote control. He makes no reference to the deliberate design intent that is embodied in these artefacts but rather plays the story backwards, as is the nature of ANT, to reveal something of the many factors that go into processes of utilisation and evaluation. ANT, it could be argued, is weakened by a failure to include the added complexity of the designer's intervention in its analysis. On the other hand, this absence focuses attention upon the lived consequences of the designer's intellectual interventions from the perspective of the active agency of the life in question. This is a rather different approach from sustaining narratives of industrial design, which focus attention,

[140] Where others, such as Lemke (1995), are difficult to understand without a sophisticated language of the sociologist, Latour writes with particular clarity, and his apparent concern to be as prosaic as possible makes his writing both charming and insightful.

naturally enough, upon positivist actions within broader social conditions. Where sustaining narratives of industrial design look for the broader sweep of forces giving rise to a particular form, ANT reveals to the industrial designer something of the subtle complexity of the artefact in direct utilisation and ownership. ANT involves people in a way that is largely absent in designers' own histories. Because it is not an explicitly design-centred analysis, ANT makes no attempt to project ideas forward into uncertainty, and cannot provide a means or a plan for action. ANT merely reaffirms the place of the designer; it does not provide a template. There have been attempts to construct actor networks from the ground up. Margolin's *The Politics of the Artificial* (2002) suggests that designers have the necessary skills to reconstruct culture and society.

In ANT's analysis artefacts are non-human retrievals of human activity. In 'Sociology of a Door' (Latour, 1992) Latour takes a simple everyday artefact and forensically examines it in order to reveal its hidden sociology. Latour's technique is to look for the so-called missing masses in artefacts, a rather subtle pun referring both to the replaced human labours an artefact affords and also to the absent sociological structures that have supposedly plagued orthodox sociology. Masses, in terms of physics, it must be remembered, are determined by the valent energy of strings. If, in sociology, masses are held together by intellectual ties, then, as in physics and in keeping with chaotic sensibilities, it should be possible to focus attention upon the tiniest interactions and to find larger truths.[141] Granovetter's *The Strength of Weak Ties* (1973) suggests that, in a personal and social construct, the effect of acquaintances (weak ties) upon personal development is stronger than family (strong ties). While it is sometimes possible to track the strong ties that direct the formation of an artefact and are reiterated in industrial design histories, the weak ties are often lost to time. For Latour (1992) sociological behaviour is an emergent phenomenon:

> According to some physicists there is not enough mass in the universe to balance the accounts that cosmologists make of it. They are looking everywhere for the 'missing mass' that could add up to the nice expected total. It is the same with sociologists. They are constantly looking, somewhat desperately, for social links sturdy enough to

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[141] De Landa (2000) reflects a recent shift in biological and physical science from reductivist and mechanistic approaches towards vitalistic and holistic considerations. Capra's *The Web of Life* (1996) for example, demonstrates the drift towards attempts to understand the infinite interconnected nature of everything.

> tie all of us together or for moral laws that would be inflexible enough to make us behave properly.

The door, argues Latour, is an invention allowing walls to be useful as anything other than as a grave or a prison. Latour argues that the hole, being an insufficient solution, can be modified by a door such that it makes viable the penetration of the space contained within the walls.[142] The door makes the penetration of walls viable by eliminating the need to employ builders to rebuild the wall after each occasion the wall is penetrated. Of course, a large plank of wood would do this too, but it would require several rather burly people to move it on each occasion. The solidity of the plank of wood is made useful by the hinge (replacing the burly people), and so the elimination of workers to be replaced by a 'non-human' is repeated. In ANT, non-humans are artefact conglomerations that act as the humans they replace.

> the hinge, which I will call a non-human. (Notice that I did not say 'inhuman' as so many bleeding hearts would do.) [143] ...As a more general descriptive rule, every time you want to know what a non-human does, simply imagine what other humans or other non-humans would have to do were this character not present. (Latour 1992)

Latour gives equal weight to the artefact and the human and sees them both as players (actors) in a larger and more complex social interaction. For example, an institution, such as a business, exists as an interplay of (i) the complex interaction of its employees, (ii) the non-humans (artefacts and networks) that enable it to function, (iii) the built architecture that bounds and directs its operation and (iv) the conceptual architecture of its strategies. Actor-Network Theory then connects humanity and technology together in an intimate interaction. Latour explicitly rejects the notion of technology as inhuman, but he cannot quite bring himself to accept that it is human. Instead, daily life is posited as a hybrid condition, a kind of compromise between humanity and technology. If technology is posited as non-human, it presents a problematic human-not-human paradox - a recursive circuit.

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[142] Writing from the perspective of the design of information systems, Levinson (1998) attempts to reiterate Latour's analysis but lacks the rigour of ANT. He describes a window and curtains as a means of modulating information.

[143] When Latour (1992) adds, as an aside, 'as so many bleeding hearts would do', he, of course, refers to contemporary writing that takes as its crux Lyotard's scepticism of technoscience (1991). Many of these texts fear the death of some admirable *humanity* in the face of cold inhuman technoscience. Thackara's *In the Bubble* (2006) provides an example of this drawn from a writer of some stature in the industrial design community. Thackara finds in bioscience a new and terrifying enemy that must be resisted.

Actor-Network Theory has been the subject of considerable criticism, even from Latour himself. In the same manner in which a car company might recall a model, Latour (1999) has suggested that ANT could be modified to take more account of the fluidity of its terms, actor, network and theory. Ashmore has demonstrated how ANT can be applied such that it can include rather unexpected actors in its network. In 'Behaviour Modification of a Catflap: A Contribution to the Sociology of Things' (Ashmore, 1993) the idea of the non-human is extended rather playfully to include a cat and its use of a catflap into an actor network. Ashmore demonstrates how ANT can be extended almost indefinitely as an ever-expanding network of actors. This criticism, of course, can serve to reinforce the notion of the artificiality of epistemic boundaries. Harraway (1994) has criticised the concept of the network, suggesting that it does not sufficiently account for the way in which relations are tied to one another. She has usefully suggested that the cat's cradle might provide a more appropriate model, as it provides a continuous connectivity between actors rather than connections and nodal points. More seriously, Star (1991) has suggested that studies of Actor-Network Theory have a tendency to explore rather obvious and established social generics and have tended, at least during the 1980s, to exclude minority groups or people who live lives that can be considered to be outside of expected or normalised social behaviour. Lee and Brown (1994) have reiterated some of these criticisms, suggesting that actor-network theorists have tended to position themselves outside and rather aloof from many of their studies and have tended to set up actors into relative notions of power and 'otherness'. Callon and Law (1995) have responded to some of the criticisms laid against Actor-Network Theory, particularly those that have accused it of normalising or centring behaviour into a single expectation of cultural norms. Law and Singleton (2000) have reiterated these arguments and have suggested that ANT should be considered as a series of performances in which life is played out, rather than as an analysis of social constructions. This defence turns the criticism of Button about. In 'The Curious Case of the Vanishing Technology' Button (1993) explored how Actor-Network Theory appears to include technologies rather arbitrarily into its analysis and calls into question the manner in which many accounts of ANT explore social processes rather than focusing upon the actions of individuals in technological situations. Law and Singleton (2000) have responded by highlighting the potentials of the analysis of performances as a means of understanding how life is lived. This would seem to be the strength of ANT rather than its weakness; performance, after all, implies an energetic imperative driven by human motive. Criticisms of Actor-Network Theory orient about accusations that it is reductive and post hoc and provides, in essence, an incomplete analysis. However, these criticisms can be understood to reflect a realisation that closure is no longer a viable objective and that the provisional is better accepted as a reality of analysis.

ANT makes it possible to understand how lives are played out. In their study of the United States Post Office's attempt to introduce a device to assist post delivery staff, the designers Engeström and Escalante (1994) have used ANT to understand why technologies that might appear in a sociological analysis to be likely to succeed have failed when they are deployed. ANT has made it possible for Engeström and Escalante to take a more subtle and unbounded view that accounts for interplay without seeking closure. This approach is broadly reflected in the arguments contained in this thesis. Some ideas may at first sight appear polemical, but can be understood as a version of the actor network that is designed to make it possible ultimately to identify a number of ideas that are paradigmatic of emerging directions in contemporary thought and useful in the industrial design context. That ANT is necessary at all is perhaps an indictment of the confusion in industrial design as it is played out in its histories. Sustaining narratives of industrial design reiterate and reinforce understandings of cultural theory that could be described as grandiose in that they attempt large-scale sweeps and are almost entirely disconnected from the anecdotal experiences of the subtle complexity of interactional valence. Understanding human culture to be a complex interaction of human and non-human actors reminds designers of what they already know, but have failed to give voice to in their own histories. This interaction is complex and subtle; life is lived as a multilayered, conceptual and tangible interaction of ideas and artefacts[144] that is not wholly described in a single artefact.

ANT does not make a distinction between subjects and objects; it situates life as an interplay of human intent and the 'matter' of the world. ANT provides a rather better way of analysing culture than the intertextuality of much contemporary analysis. It confronts supercomplexity but takes an approach that is not so localised and focused as we might expect in semiotic analysis, for example. ANT gets around problems of the dynamic, shifting and autopoietic nature of culture by localising its attention into individual moments of life. Nevertheless, the

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[144] I make a cup of tea, for example, pouring boiling water while half listening to the music on the radio and thinking endlessly about this thesis. I cannot be said to be doing any one of these things in exclusion of any other. I undertake a unique process that somehow involves listening, tea making and thesis writing. The kettle perhaps stands as an icon of this activity, but it describes only a fraction of it.

implication is clear. Artefacts appear in culture at the interplay of the biological and the social. They are tied to humanity as an uncertain and fluid part of the species. This uncertain nature of technological agency can be found at the heart of industrial design's struggle to understand human-technological relationships. This struggle is particularly evident in respect of the ethics of 'good design'.

Good design is a rather benign and banal topic of many design conversations. These conversations take a more grave turn in discussions of weaponry. For example, Heskett (1980, p. 195) cites a German fighter aircraft of the Second World War as an example of 'good design', feeling it necessary to declare that this quality can be judged, 'despite the policies for which it was used [which] were appalling in their goals and consequences'. Heskett struggles to detach a notion of *good design* from the necessity of ethical discussion. He suggests that, just because the German fighter kills, the 'criteria of judgement are not necessarily invalidated', when fighter aircraft are explicitly intended to kill. Heskett is alert to this. He recognises that

> 'good design', however defined in terms specific to an artefact or mechanism, cannot automatically be associated with beneficial ethical or political ideals; such juxtapositions are frequent but do not constitute an equation.

But this does little to clarify what constitutes good design, other than to suggest that it must be properly evaluated outside any socially and culturally constructed, ethical consideration. If this separation is uncertain in the case of the fighter aircraft, it becomes clearer when the object of killing is less overtly identifiable as a weapon of war. We might, for example, include the pen with which the authority for the Nazi death camps was signed, or the Schultz Calculating Engine put to such effective use in the organisation of the holocaust. The fighter is designed to kill; it does that well and has a kind of engineering beauty that makes for an uncomfortable evaluation of good design.[145] Attfield (1999) has undertaken a more forensic examination of the role of ethics in design and finds design histories to be predicated upon aesthetic considerations at the expense of other more complex concerns. Citing Forty's cry that 'the study of design and its history has suffered from a form of cultural lobotomy which has left design connected only to the eye and severed its connection to the brain and the

[145] This discomfort is perhaps most evident in a design analysis of the systemic architecture of I. G. Farben's mechanism of death in the final solution (see Bauman, 1991).

pocket' (Forty, 1986, p. 6), Attfield attempts to refine an ethical motivation for 'utility design' immediately after the Second World War. Attfield's focus is upon the association of 'fitness for purpose' with beauty. Like Heskett, Attfield struggles to reconcile this, for example, when reviewing Henry Strauss MP describing the beauty of the Bren gun in a DIA lecture: 'the intrinsic grace of perfection that is found in an object which fulfils its purpose with precision and economy...' (Strauss, cited in Attfield, 1999, p. 234). Attfield (1999, p. 234) can only complain:

> That blindness which could separate the intended use of the object from its economy and perceive it in terms of an abstract aesthetic could by the same logic have attributed beauty to the Nazi concentration camps designed to sort, separate and dispatch their victims with such efficiency. It may seem unfair to pick on this particular instance to suggest that the concept of 'fitness for purpose' was in any way referring to the intended use of a weapon.

This seems to be missing the point. Actor-Network Theory alerts us to the necessity of avoiding attempts to separate artefacts from their use. Attfield merely replaces one avoidance with another. Sterling (2005) argues that the gun itself can have no ethic: it is metal and inanimate, but becomes an agent of death in operation (p. 75). Sterling recognises that 'it is mentally easier to divide humans and objects than to understand them as a comprehensive and interdependent system: people are alive, objects are inert, people can think, objects just lie there' (p. 8). Sterling sets out to find a means of drawing a line between 'a technoculture of objects and a technoculture of machines' (p. 9).

In *Shaping Things* Sterling (2005) suggests that a problem with discussions separating artefacts from people is that it becomes necessary to place emphasis upon either the artefact (get rid of guns) or the people (let everyone own a gun) when it actually appears as if responsibility for the events resides in a complex network of responsibility. In this network artefacts are players but not necessarily proactive agents.[146] Sterling's histories are more

[146] Ethics can reside only in human thoughts and actions and in the foreseen consequence of those thoughts. An animal that kills is acting upon its instincts. It carries no ethic. An animal set upon someone is another matter. The ethic is not transferred into the beast; it resides in the trainer. Animals, we imagine, have no concept of human concerns. Similarly the tendons, muscles and bones that construct the mechanism of the finger that pulls the trigger are not implicated in the intellectual process of killing. If morality can not be identified to reside singularly in the hand that pours the zyklon-b into the gas chamber, then perhaps the architect of the chamber, nor in any individual actor in the greater nightmare can be exonerated too.

playful than academic. His polemic appears to be intended as a creative and provocative scholarship emphasising 'the interplay between objects and people (Sterling, 2005, p. 8) in a popular, although less rigorous and ultimately more confusing, retelling of ANT. Sterling's argument, like Latour's, boils down to an attempt to resolve the argument between the deterministic stance of the materialist, who locates agency in the artefact, and the ethical position of the sociologist, who discounts the artefact entirely.[147] Latour (1998 p. 6) argues:

> [the] dual mistake of the materialists and the sociologist is that they start with essences, either those of subjects or those of objects ... Either you give too much to the gun or too much to the gun-holder. Neither the subject nor the object, nor their goals are fixed forever. We have to shift our attention to this unknown X, this hybrid which can be truly said to act.

Latour (2005, p. 179) approaches this problem by attributing the status of an actor to both 'Which of them, the gun, or the citizen, is the actor in this situation? Someone else (a citizen gun, a gun-citizen) ... You are a different person with a gun in your hand.' Ihde (2002, p. 94) has termed this 'phenomenological interactivity', placing analysis in the experience of individuals in order to build a bigger picture of culture and society. Both Latour and Ihde suggest that understanding individual interactions can help construct a more complete picture of broader sociology without reducing it to its mere mechanical components. If human culture is compared to an emergent process such as flocking or swarming, then sustaining narratives of industrial design are revealed to speak only in general terms. When designers come to consider the humanisation of technology in the absence of this hybrid actor, they find themselves in a recursive circle and can be certain of nothing. It is little surprise they find themselves tied up in such rhetorical knots as Heskett and Attfield.

When the industrial design community speaks of humanising technology, it must do so today in the resonating echo of its nineteenth-century and early twentieth-century self. Industrial design, theorised in the face of the fear of mechanisation, and in consequence of its intellectual intervention in the mechanised and technological world in which we in the Western world dwell today, is so quotidian that we need to be reminded of its presence.

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[147] 'Guns don't kill people, rappers do!' (Goldie Lookin' Chain, 2004).

> The automobile, the freeway, the airplane, the cell phone, the air conditioner, the high-rise - all invented and developed first in the West, but fully adopted the world over - have achieved design nirvana. They are no longer considered unnatural. They are boring, even tedious. (Mau, 2004, p. 1)

Our lives are filled with the products of an industrialised culture.[148] Although people cannot be typified, most of us in the West share a world that is a mixed reality of the machine aesthetic and the crafts; of modernity, pre-modernity and post-modernity. We have things about us made by machines to look like crafts, and craft made things constructed to look as if they were machine made. That machines would make things alone without the human hand was once shocking: 'In form of machinery, the implement of labour become automatic, things moving and working independent of the workman' (Marx, 1867), but today it is an accepted facet of life. We do not share the urge of the early twentieth-century designers to find in our mechanical technology any particular urgency in the shaping of a transformation of the human spirit. The cars and machines, trains and aircraft, encountered are now merely an accepted part of life. Although they may excite us on occasion, they do not particularly shock, nor in the

[148] Let me for a moment contemplate my condition by briefly describing my situation. I am constructing this text using an Apple Powerbook. To my right, resting on the synthetic wooden desk, is my mobile phone, resting on an electronic diary and illuminated by the electric, halogen glow of a small black desk light. To my left are a flat screen, a keyboard and a mouse. A woollen hat is also close to hand - a consequence of an attempt to save oil by expending less heating energy in my study. Stacks of crisply printed books, a plastic beaker, a small aluminium fountain pen, an invoice from the garage where my car was recently serviced and bills from some service provider or other litter my space. A printer, of course, occupies a large part of this space, together with the piles of neatly cut A4 papers I have neatly stacked and ready for it. Several music compact discs litter the space; one of them is at work in my laptop. Something that sounds like Miles Davies - but cannot possible be anything other than a crisp verisimilitude - pervades the room. Adolf Loos (1910) and Christopher Dresser (1873) alike would be sceptical of my space, although there is much they would admire; Loos would surely delight in the way in which I have come to incorporate so many technologies into my study. He would be delighted to see that I have no curtains, just crisp, machined, slatted blinds to moderate the light and to conceal or reveal the room to the outside world. I have unadorned flat painted walls too - made incidentally in a factory and assembled on site to construct the study that extends what I consider to be an inconceivably small wood and stone cottage. The space we call the 'dining room' once housed an entire family. The cottage of course is complete with a wood stove in which Dresser, and we imagine Heidegger, would have delighted. My wood is delivered not collected by my children. They have no time for such narratives. Their free time is occupied by sport, sometimes outside with other human participants and at other times on screen with simulated computer opposition. The wood stove is unlit and the boiler hums gently in the utility room. Dresser would have shuddered perhaps to see the synthetic wood of my desk and would have mourned, perhaps, that no human hand had manufactured the crisply machined wooden blinds. But this is my world - the old and the new juxtaposed. I do not care to live in the stark modernity Loos or the later modernists might have imagined. I value the old and the decorative, but neither do I drench myself in it, as Dresser might have wished. I may not be typical, but my world seems to have some resonance with the world of my friends and my neighbours and the worlds I see on my television set. Occasionally I am given a glimpse of the world outside my world, of shanty towns and open sewers, and I am asked to donate money to turn that world into something like my own. What would Loos and Dresser make of my world? How would we - could we - know? Dresser and Loos were part of a community of designers who found themselves in a technological world we can scarcely remember. They spoke in their time and in their industrial design community and not in the community of today. Were they active today, their voice perhaps, although we can never know, would be different. Were Loos and Dresser alive today and part of the industrial design community, would they hold the same views? Probably not. Their world would be our world.

everyday account do they challenge our conception of ourselves as human. The industrial designer might, with some justification, claim responsibility for this world. Designers have found ways to make even the most extraordinary technologies seem quotidian. An industrial designer might argue that designers' intellectual endeavours to humanise technology have been so successful that it is now possible to feel complete, exhilarated even, when experiences are almost entirely mediated or enabled by technological means. We can find pleasure in the cold efficiency of mechanisation, just as we enjoy the supposedly warm-hearted qualities of the hand made.

The interplay of our lives with the technologies of mechanisation is a constructed orchestration of compromise. Industrial designers did not sweep everything away as the futurists might have had it, but neither did they sink into nostalgic sentimentality and resistance to technology nor hark back to a bygone agrarian age. Thanks in no small part to industrial design, precision and simplicity have come to stand in turn for both quality and efficiency and the inefficient uncertainty of craft has come to stand for luxury and inadequacy in equal measure. For the most part these old dichotomies are gone, as Moholy-Nagy (1948, p. 79) put it: 'In our industrial age, the distinction between art and non-art, between manual and craftsmanship and mechanical technology is no longer an absolute one' (cited in Naylor, 1985, p. 102). There was moment in industrial design history when Gropius demanded that his students should dress *conventionally* (Banham, 1955, p. 286). This event passed almost unnoticed but can stand to mark the end of the pioneering spirit of the early days of the machine age and the beginnings of a new era of commercial expediency. The days of experimentation and bold expressionist experiments were gone, and, in the minds of those creating a new kind of Bauhaus, had been consigned to history along with the 'old guard' such as Marcks, 'provincial expressionism' and the strident manifestos of the futurists (Banham, 1955, p. 287). The challenge of the machine age was past and now design had to get on with the task of being commercially viable. Gropius and those of his students who supported the move left the old Bauhaus in Weimar behind and began again in Dessau the process of building a new style of design. This new style would in time become truly international, acceptable to both consumers and producers alike. This new design, whilst uncompromising in its rigour, would carry with it the pleasure in the cold efficiency of mechanisation and would accept too the warm-hearted qualities of the hand made that we find in our world today.[149]

Van Doesburg, who at first opposed and then reluctantly accepted the new Bauhaus, had once proclaimed that the machine would become embodied in the aesthetic of the twentieth century, projecting the enlightenment forward into a socialist and mechanised age. He reiterated the conviction of the industrial designers of the early modern movement that a machine aesthetic would come to stand as a corollary with humanity as a whole and could project humanity forward towards the distantly imagined twentieth century. This was a time, described by Armstrong (1988) as a period of 'prosthetic modernism' , or by Foster (2004) as a time of 'prosthetic godliness', characterised by writers, artists and designers of whom some, such as Jacob Mohr, Max Ernst, Gerald Lee, Ernst Kapp or Wyndham Lewis, are now occluded from industrial design history. It is arguable that many of these contributions to the intellectual engagement with the machine age have more to offer for an understanding of how industrial design came to be formed than the usual parade of craftsmen and women of the Belle Époque that histories after Pevsner (1975) and previously Banham (1955) see fit to include in their accounts of that time. Where many of these craftspeople stood as a resistant defence against the machine age, others, such as the artists Marinetti (1909),[150] or Vertov (1929) for example, engaged with the potentials of a transformation in technological form and sought a new sense of humanity in it. Vertov and the other members of the 'Kinok' explored through their films - for example, *Man with a Movie Camera* (1929) - a new generative and phenomenological sense of being for the machine world and a new aesthetic sense. Brill (1989) has described *Man with a Movie Camera* as 'experimentation in the cinematic transmission of visual phenomena' and as an attempt at a new intellectual revolution, in response to the technological revolution, transferring romantic energy away from the symbols of nature towards a new technological construction of being. For Frank Lloyd Wright (1901),

[149] If we take another look around ourselves, we will find it still, in the form of the computers, telephones, lights and plain unadorned surfaces of the international style.

[150] 'We will sing of great crowds excited by work, by pleasure, and by riot; we will sing of the multi-coloured, polyphonic tides of revolution in the modern capitals; we will sing of the vibrant nightly fervour of arsenals and shipyards blazing with violent electric moons; greedy railway stations that devour smoke-plumed serpents; factories hung on clouds by crooked lines of their smoke; bridges that stride the rivers like giant gymnasts, flashing in the sun with a glitter of knives; adventurous steamers that sniff the horizon; deep-chested locomotives whose wheels paw the tracks like the hooves of enormous steel horses bridled by tubing; and seem to cheer like an enthusiastic crowd ...' (Marinetti, *A Futurist Manifesto*, 1909)

the Machine [151] would offer the means to elevate humanity onto a plane beyond previous measure. This would be a new era when the Machine, 'its function ultimately to emancipate human expression', could deliver human emancipation from Lloyd Wright's perception of a kind of vice in which culture had become mired. The Machine would sweep away the art of the old, which Lloyd Wright claimed idolised a 'structured necessity' founded upon traditional and pre-industrial modes of production towards a new age of remote production. While never replicating the old crafts, the Machine, Lloyd Wright suggested, would come to render them obsolete with rationalism.

> The new will weave for the necessities of mankind, which his Machine will have mastered, a robe of ideality no less truthful, but more poetical, with a rational freedom made possible by the machine, beside which the art of old will be as the sweet, plaintive wail of the pipe to the outpouring of the full orchestra. It will clothe Necessity with the living flesh of virile imagination, as the living flesh lends living grace to the hard and bony human skeleton. The new will pass from the possession of kings and classes to the every-day lives of all - from duration in point of time to immortality.

Lloyd Wright was hesitant to condemn those who had opposed mechanisation, although he damned Morris with feint praise, claiming he 'did his best' in another, earlier age of engines and dark satanic fears of subjugation. For Lloyd Wright "this new machine art would find a way to reconcile humanity with 'machine precision' rather than the spiritual art ..." (Naylor, 1985, p. 102)[152] and also to find a way to maintain some sense of humanity in the midst of industrialisation. In a stance bearing some comparison with those who feared the onset of industrialisation, Thakara (2006, p. 3) regards technological progress with some scepticism:

> telegraph, railway, electrification, radio, telephone, television, automobiles, air travel - [have] always been accompanied by a spectacular package of promises. A certain

[151] Frank Lloyd Wright used capitals, to emphasise the emerging eminence of the machine.

[152] What would Wright and his fellows have made of contemporary sex toys. They certainly employ 'machine precision' to strip sex of its 'spiritual art'. Sex toys offer many a mechanised, simple and intense onanism, an efficient route to orgasmic release without the necessity of uncertain and 'spiritual' although potentially 'unhygienic' encounters. Likewise, contemporary medications offer a efficient, mechanised route to emotional stability or to enhance the emotions, without the uncertain need to engage in a 'spiritual' enterprise. Wright and his fellows, of course, were reminded of efficiency in the age of the machine by the advent of mechanised killing in the trenches of Flanders, when Marinetti's rhetoric was realised *in extremis*. Although many of the particular manifestations of the machines Marinetti found are consigned to history in the strident enthusiastic extremism of the Futurists, it is still possible to sense the excitement of a new technological paradigm and the sense that something radical was required. That we now accept the efficiency of the mechanical artefact and blend it with our own spiritual needs and feel no loss in the orgasmic interaction with technology is testament to a century of industrial design.

naïveté is excusable for the inventors of these early technologies: They had no way of knowing about the unforeseen consequences of their innovations. Today, we don't have that alibi. We *know* that new technologies have unexpected consequences.

This betrays a kind of patronising belief that those who are there at the development of early technologies (by early we must presume Thackara means the eighteenth and nineteenth centuries and not the makers at Grimes Graves) were naive, and pushed ahead with the development of technologies without heed of the future. This view disconnects technology from the forces that historicise its emergence and posits it again as a reified object, but it is also an abdication of the values that would seem to be embedded, however poorly worked out, in industrial design. If contemporary designers are not willing to embrace the challenge of another intellectual shift to a revised (molecular) topological domain with same the vigour as their forebears, then future will be left to the science research institutions, pharmecutical companies and public policy negotiations. The future then will, as Thakara (2006, p. 228) fears, be designed in popular science and the media and without the abiding intellect, experience and aesthetic sensibility of the designer.[153] In recent times, the evidence of sustaining narratives of industrial design suggests that the process of making the extraordinary quotidian has become confused by attempts to separate the human and the technological into discrete epistemes. This, in turn, has disconnected contemporary industrial design from its prescedence in histories prior to industrialisation, and, by positing it as the design *of* rather than *in* industry, histories make it difficult for designers to find continuity in technological conditions. Nowhere is this more evident than in the rhetoric of cyborg theory.

It is now widely understood by social theorists such as Latour, Serres (see particularly Serres, 1982) and others such as Callon and Law (1995) that the human and the technological are implicated in one another to such a degree that they are best considered in a single conversation. Artefacts, rather than being seen as reified and fully resolved entities, are better understood as momentary solidifications of the human process of 'ordering and disordering complexity' (M. Michael, 2000, p. 22). In these terms the human and the technological distribute through one another and cannot be readily extracted, or sifted, into discrete

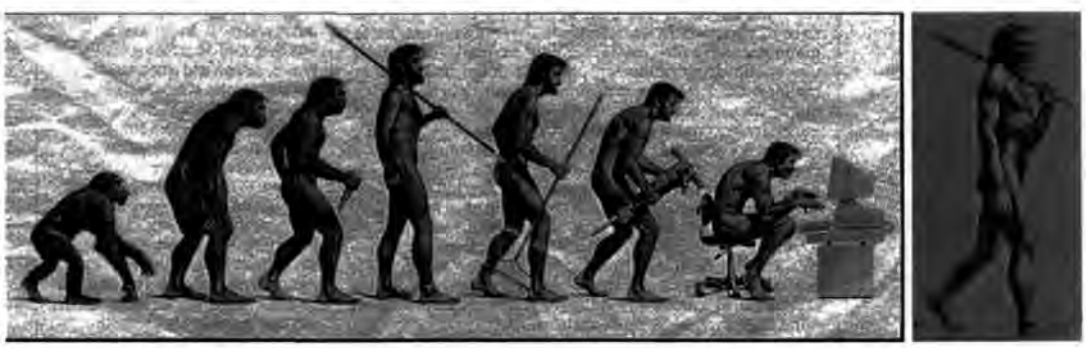
[153] There are some laboratory scientists who refer to themselves as "biodesigners' (see, for example, BioArizona, 2005, BioEden, 2005 and BioStanford, 2005). However, judging by their output and the autobiographical descriptions of their practice, they share neither the heritage nor the concerns of the industrial designer.

epistemes. Technology then appears not to have a meaning in itself other than when it is considered in the same terms as the human. Nevertheless, we are encouraged to talk of humans and technology as if they were somehow alien to one another. M. Michael (2000, pp. 18-44) provides a review of a number of social and cultural theories in which the human is understood to be a distributed construct. Placing emphasis upon the human as a social and cultural construction, Michael (2000, p. 1) echoes much contemporary theorisation but recognises humans to be 'fabricated - in language, through discursive formations, in their various liaisons with technological and natural actors, across networks that are themselves heterogeneously comprised of humans and non-humans who are themselves so comprised' (Michael, 2000, p. 1). Chartrand (2004) tells this story of fabrication, rather succinctly, and it becomes clear that the human has been constructed in consequence of a rather long and complex philosophical history.

Technology, on the other hand, is actually a surprisingly recent term. The *OED* locates its origin in the late nineteenth century and the collusion of art and science. For most of the twentieth century the focus of philosophical analysis (such as Mumford, 1967) has tended to emphasise the role of technology as a means for humanity to enact its will upon the world. Mitcham (1994, p. 247) provides a rather concise summation of some of the drifts of technology philosophy over the past century. Spengler (1932) and subsequently Ferre (1988) argued that technology has some evolutionary imperative as a means to enact some genomic instinct that drives a will to survive. Others, such as G. Grant (1969), reiterating the earlier thoughts of Zschimmer (1914) or Walker (1831), viewed technology as a means to escape the confines of existence and to find some greater freedom. Skolimowski (1966) posited an understanding of technology as a consequence of some evolutionary advantage in the human species to seek efficiency and to minimise effort, while Ortega has suggested that technology is a means to realise a self-concept in the individual (see Mitcham, 1994, p. 247). Polanyi (1962, p. 59) suggested that technologies are 'part of ourselves, the operating persons. We pour ourselves into them and assimilate them as parts of our own existence.'

Technology has become intimately connected with considerations of production and consumption, and so it is perhaps not surprising that Marxist and sociological thought has come to dominate technology philosophy and woven it into a tangled complexity. Technology philosophy reminds Farmum (2006) of hours spent cross-legged next to my grandfather untangling fishing line on the banks of one of the many lakes found on Colorado's Grand Mesa. Without a steady hand, the philosophical connections that bind Aristotle to Hegel to Lukács to Heidegger to Marcuse to Feenberg might read as a tangled mass of knots that appear impossible to pull apart. Like a fishing line, sometimes when you pull out one knot others form and the whole process can become extremely frustrating and overwhelming.

Throughout technology philosophy, an uncomfortable compromise is maintained. It is evident that human life is constructed by technological means, and yet, somehow, technology is maintained as an antagonistic force acting upon the human. The prevailing implication is that technology is utilised as a means to enact the will while simultaneously alienating humanity from its true self. There is a joke cartoon that is popular on the Internet. It intended to show (albeit in jest) the evolution of the human species, from a chimpanzee-like creature on the extreme left to contemporary man on the right. It is clear that the third creature in this line has bipedality and is carrying a stone tool yet in evolutionary terms is evidentially almost, although not quite, human. The joke is, of course, that humanity is retreating to some kind of shrunken ape-like, although static, posture.



Left: Internet cartoon, the 'De-evolution of man; right: Cro-Magnon (Wildercom.com, 2007).

The joke, ruined by analysis, relies upon a number of assumptions. The most upright of all the figures in the cartoon is replicated in scientific representations; he carries a spear on his shoulder, masculine and proud. He is in command of his technology.[154] This creature, one

[154] He is also very masculine, white and European, of course. It would be foolish to take a cartoon too seriously were it not, as Harraway alerts us, a view of humanity as essentially masculine and white that is also encoded into some anthroplogical representations. Harraway refers to this in *Primate Visions* (1989),

imagines, is intended to represent the apotheosis of humankind, a noble savage equipped with the weapons that give him, the hunter, mastery over the other species. Agrarian man is worn down with the burden of his labours and his concerns, mechanical man staggers grimly under the oppressive weight of his technology, and contemporary man is shrivelled and conditioned by the technology through which he thinks and looks out upon the world.[155] The humour, such as it is, resides in the truth we might sense of our condition and the reduction of our humanity to that of a victim.

The French theological philosopher Jean Brun has suggested that technology enacts the human urge to distribute. Brun (1992) is suspicious of ideas of technology as a component of an evolutionary imperative and trajectory. He holds out for an essential humanity that is made possible by the co-evolutionary track of technology as an inseparable facet of the species. The human urge to technology, Brun argues, is an enaction of a deeply held transcendental and spiritual nature, enabling the escape from the distinctions that people sense between what they suppose to be their subjectivity and the objective stability of the world. This direction is acknowledged by Mitcham, who sees evidence of a shift in technology philosophy away from ideas of the enaction of the will and the loss of true humanity towards a perception of some deeper drive. Technology 'grows out of [humanities'] ontological aspiration to merge subject and object' (Mitcham, 1994, p. 246). However, from the evidence of the fossil record, archaeology, written histories and our own experience, human evolution can be understood in terms of a process of continual and multifaceted distribution. In geographical terms, humanity has come to occupy almost every part of the landscape. It has penetrated the ocean and has begun to distribute itself beyond the planet into the wider universe. In intellectual terms, the history of humanity is of a distribution of shared ideas and cultures, or a distribution of decision making - for example, from centralised power to democratic and increasingly localised autonomy. Humans distribute themselves too. They leave deliberate traces. Marks left upon rocks distribute an individual consciousness across time; books do this better; paintings, wax and digital recordings refine and accelerate this distribution.

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and this is picked up by M. Michael (2000, p. 31). The Eurocentric and masculine construction of human evolution is in any case at odds with the intellectual stance of human ecology and with scientific evidence.

[155] Is this crouching man the last human in the drawing or does the computer represent the ultimate evolutionary paradigm, perhaps some kind of machine-human hybrid creature where, without a familiar body, machine and humanity become indistinguishable to such a degree that we might no longer recognise it as human.

A schematic drawing of the trajectory of human evolution might be better represented by an image like the one presented above. This image represents a trajectory in which the hybrid human has become an increasingly complex and distributed condition. While the social and cultural models of the human have become increasingly distributed and complex in their accounts, the manner of the theoretical construction of the physical human has, for the most part, remained fixed about an everyday perception of human form and has come out of valence with the scale and complexity of the topological subtlety of social and cultural analysis. Even the most complex social and cultural models are constructed about rather uncritical fixed and determined notions of human physical form. This may account for the attention that ANT's notion of hybridity is constructed about rather fixed and immutable artefacts. (A number of recent attempts to realise technology into a form that is fixed about a perceived scale with resonance with the familiar and everyday body will be discussed later in this thesis in terms of a hysterical attempt to fix the trajectory of industrial design.) One upshot of this is that, while humanity and technology can now no longer be considered as anything other than a hybrid condition in social and cultural analysis, the same cannot be said of attempts to understand the complete picture of humanity as an evolutionary species in material terms.

Chapter seven

Three problematic approaches to the distributed human and enaction

7.1 **Alienation**

Cyborg Theory: The process of humanisation as a process of the alienation of true humanity - making the ordinary traumatic.

7.2 **Technicity**

Outlining the term technicity and its projection of the logic of human, Exploring the idea that technology is part of the ecology of the whole species.

7.3 **Embodied interaction**

The body then cannot be discounted in any analysis of being in the world, and, more critically, it cannot be isolated from it either. The concept of embodied interaction extended into the context of design methodology.

7.1 Alienation

Cyborg Theory: The process of humanisation as a process of the alienation of true humanity - making the ordinary traumatic.

Cyborg (Gregory, 2006).

There is no one cyborg we can speak of. There is the cyborg of literature and of the movies, a creature-machine of fantasy and fetish, and the cyborg of scholarly trope. The cyborg, then, can appear as metaphor and phylum by degrees across a range of interpretation mixing the engineering fantastic with sado-masochism, fetish (Fernbach, 2002), progressive feminism and straightforward sexism in somewhat equal measure.[156] In essence there are two scholarly approaches to the concept of the cyborg; in one the cyborg is founded in the fascination of the human body invaded and replaced by technological forms. As Gregory (2006) suggests, this is not necessarily an emergent condition:

> The Matrix, Terminator, the Borg—are these visions of the intimate interface between humans and technology merely science-fantasy? NO! Human-technology symbiants - cybernetic organisms, cyborgs - are already among us.

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[156] A serious debate with respect to the cyborg must cast aside the cyborg of Hollywood or of the fantasy magazine adorning so many adolescent bedroom walls; it is a projection, fully formed and without integers and evolution. In projected fantasy there is no development line between the relatively uncertain implants of today and the sophisticated assimilations of systems and manipulations of the body architecture of the terminator or robo-cop.

The athlete Oscar Pistorius (left) (see Keim, 2007) might beg to differ when it is suggested that we might be something other than human because of our dental filling, our decorative piercing, our plastic heart valve or for that matter our shoes. There are those who take an initial proposition of Clynes and Kline (1961) and project a trajectory step by step towards some *ultimate* post-human, robo-sapiens-sapiens future (see, for example, Menzel and D'Aluisio, 2000). Many of these projections appear fully formed without the inconvenience of incremental development. One consequence is that the moment when the final trace of humanity is erased in the speculative trajectory towards the new, post-human species is absent. This moment is missing in texts such as that of Menzel and D'Aluisio, perhaps because it threatens to plunge an otherwise invigorating and exciting fantasy into the philosophical complexity of the other cyborg debate. This other, more-subtle and academic, discussion of the cyborg explores a claim of ourselves as a condition formed and shaped by technology. Harraway (1991) indicates that this is an incremental progression too and an emergent condition of lost humanity. She gives it a temporal location:

> By the late twentieth century, our time, a mythic time, we are all chimeras, theorized and fabricated hybrids of machine and organism; in short, we are cyborgs.[157] (p150)

When she positions the cyborg as a 'late-twentieth-century' condition Harraway (1991) implies that by some means the essential human condition has become somehow subverted from its true nature. This subversion is implicit in the engagement of human nature with an extrinsic engagement with the technological world in which it finds itself. While, on the other hand, this cyborg connects humanity and technology as a single architectural construct, its analysis proposes a condition that both belies the extent and range of technology throughout human history and, through its connection with the late twentieth century, condemns the

[157] Harraway continues: 'The cyborg is our ontology; it gives us our politics. The cyborg is a condensed image of both imagination and material reality, the two joined centres structuring any possibility of historical transformation. In the traditions of "Western" science and politics - the tradition of racist, male-dominant capitalism; the tradition of progress; the tradition of the appropriation of nature as resource for the productions of culture; the tradition of reproduction of the self from the reflections of the other - the relation between organism and machine has been a border war. The stakes in the border war have been the territories of production, reproduction, and imagination.'

machine-age world as some kind of dislocation from a supposed nature. The concept of the cyborg connects selfhood to a distributed technological architecture and extends this notion to suggest an ontology in which humanity and technology are inextricably coextensive, thereby recasting the human condition. If it is true that life has become an emergent condition, lived through technological means, then to some extent industrial design and its intellectual impetus to humanise technology must be implicated in the construction of the supposed 'cyborg ontology'.

H. R. Giger, *Birth Machine* (1967).

It is arguable that the cyborg is merely a voice in the hybrid debate representing just another archaeologically unpicking of much of the hidden intellect of the designers of the machine age. The work of H. R. Giger (see Giger, 1993) is perhaps the most obscure of the popular protagonists of the cyborg mythology. The *Birth Machine* (1967), an image of a technological firing of the cyborg into life, reveals a rather subtle recognition of how humanity and technology flow one into the other and distribute. Speyrer (2006) suggests that, from a deep psychological perspective, the birth machine emerges from Giger's recognition of his own traumatic technology-assisted birth. The suggestion here is that there is trauma in birth through technological means, and by extension that almost every facet of life (the preparation of food or daily transportation, for example) is likely to be a source of cyborg trauma.[158] Harraway (1991) writes of humanity *becoming* cyborg and of this process being progressive, such that 'by the late twentieth century ...' we found ourselves in a condition. This tiny but significant phraseology may be merely a rhetorical flourish, but it has profound implications for the process of humanising technology. If we have *become* cyborg, then by implication something has changed in the human condition. Technology has changed the nature of humanity, and we are now no longer human. If we are cyborgs, the logic extends, then our notion of what it is to be human has been jaded by a subjective view of the world, which we, in the Western world at least, see with cyborg eyes, sense with cyborg senses, and think about with cyborg minds. The logic of the cyborg makes it highly problematic then to separate the human from the technological condition in which the human is seen to operate and to take an objective and external view of things.

ANT makes it clear that 'the intermixing of the human and the non-human is intrinsic to human society... (M. Michael, 2000, p. 21). Latour (1992 p. 110) sets out chains of interaction and suggests that humans and non-humans can never be considered to be hetrogenerous.

> The proponents of ANT have long argued that humans and technological non-humans are thoroughly interwoven. ... take away the technologies - telephone, fax machine, computer, but also desk, chair, light - from a manager and they can no longer function in that role. To be human thus is a hybrid. (Michael, 2002 p. 25)

In the diminishing prospect of finding a group of humans naked and unequipped in the wilderness, there is almost no understanding of the world in which the human is not implicated in some way with a technological architecture. It is simply not plausible to extract the human from the world of the technological.

> We are cyborgs and have been for millennia. Cognitive integration with technology, extended cognition, our cyborg nature, is arguably what sets us apart from other terrestrial creatures. (Gregory, 2006)

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[3] From this it becomes possible to see just how much recent cyborg theorisation has set out to alert us to the trauma of technology in our everyday lives - a trauma we had perhaps not recognised and had better be alert to. It is always useful when one is told one is traumatised!

Other species may generate nests and such or collect about them manuports, but only homo-sapiens-sapiens has technology that sometimes hardens to enable particular human engagements with the world. The search for an elusive *something* that is unique about the human species and that ties it to this idea of technology has troubled human kind for millennia. In classical Greek mythology there is a quite well-known story of the dawn of humanity. Together with his brother Prometheus, the Titan Epimetheus was given the task of giving positive attributes to every species. By the time he got to humanity he had nothing left and in consequence it became necessary for his brother to furnish humanity with technology.[159] There are, of course, many aspects of contemporary Western understandings of the world that owe much to the thinking that evolved in Classical times. Classical logic is useful in many ways: not least it helps us to understand some of the terminology underpinning much later thought, as well as shedding light upon our own ideas. Myths can be constructed in their time to describe a particular intellectual position. These myths become familiar because they seem to fit a prevailing view that might hold in a particular intellectual climate. The story of the titans implicates technology as a negative essence, and any attempt to counter this stance will have the weight of philosophy against it.

7.2 **Technicity**

Outlining the term technicity and its projection of the logic of human, Exploring the idea that technology is part of the ecology of the whole species.

In 'Milieu et techniques' the paleoanthropologist André Leroi-Gourhan (1945) outlined a general theory of humanity as a species conditioned by technicity (see Stiegler, 1989). The term 'technicity', perhaps because it remains so close to intense philosophical analysis, has not yet been distilled into a concise concept. It is surprisingly rare in everyday language[160] and is also absent from industrial design analysis. Vallenilla's *Foundation of Meta-Technics* (2004) is typical of attempts to outline the concept of technicity more completely but demands familiarity with the complex tools of philosophy. Technicity remains at the centre of an intense philosophical debate and can be understood, in broad terms, to be both an essential trait of being human and (as the thrust of much contemporary analysis suggests) the cause of human

[159] Prometheus gave the knowledge of fire to mankind, having stolen it from Zeus. The myth suggests that the gift of the knowledge of the technological manipulation of the world gave human kind its power to enact its own will. That the story is familiar perhaps reflects the prominence of this philosophical stance over the course of the industrialisation of the West. After all, there is much political leverage in the projection of the concept of power through technologisation.

[160] The term 'technicity' does not even manage a Wikipedia entry.

alienation from itself. Stiegler's *Technics and Time, 1: The Fault of Epimetheus* (1998) focuses attention upon the emergence of humanity as a technological species. Steigler argues that the philosophers (Heidegger in particular) pay insufficient attention to the story of Epimetheus' neglect. While accepting the negative antagonism of technology as a given, Stiegler (1998 argues that technology can be considered in terms of an evolutionary ecology as a means to 'a new age of the spirit, a renewal of the life of the spirit'. While "the classic model of industrial society seems obsolete, this goal must be the ground for a political economy and industrial mind - which should also be an industrial ecology of the mind" (ArsIndustrialis, 2007). Ansell Pearson (1997), while accepting the notion of complex and distributed relations of the human, technology and society, cannot quite accept the coextensive nature of technology and humanity. For Ansell Pearson (1997 p. 123), technology is a human prosthesis, a softer version of the inhuman: 'originary technicity: technology is a constuitive prosthesis of the human animal, a dangerous supplement that enjoys an originary status.' De Kerckhove (1997) argues that technology must always remain 'a prosthesis', creating a revised and mutable sense of the self. Derrida and others positing technology as an inhuman counterpoint to humanity are forced, however, to accept that technology is tied intimately to human evolution. The concept of 'original technicity' can be understood as a somewhat begrudging acceptance of the challenge to alterity. The concept of original technicity suggests that technology alienates humanity from itself. If we accept, however, that technology is at least co-evolutionary with the species, then we must face the logical conclusion that humanity can have never truly known itself.

Beardsworth (1998) has argued for the extraction of technicity from the realms of metaphysics and 'continental philosophical thought's various articulations of the "other" of metaphysics in relation to the problematic ...'. However, the continental philosophy to which Beardsworth refers reappears as key texts in many attempts to engage with the concept of technicity (for example, Derrida, 1998, and Stiegler, 2001) Beardsworth suggests that an ethical approach to development can be found by appreciating how technology can be understood as an excess, and not as an other.[161] Beardsworth returns technicity to humanity as an essential, but largely

[161] A rhetorical stance, particularly in philosophy, that accepts something as originary and yet supplementary is extraordinary; it would seem to run counter to everything that evolutionary studies might tell us and posits humanity as some special case. It is arguable that much of the tortured consideration of technicity in contemporary philosophy is a sophistic attempt at self-justification, when actually technicity might point to a problem with the grounds upon which philosophies of alterity are constructed.

problematic, trait of the species. When interviewed and talking about drugs, Derrida (1993, p. 15) did appear willing to accept that alterity was problematic: 'The natural, originary body does not exist: technology has not simply added itself, from outside or after the fact, as a foreign body. Certainly, this foreign or dangerous supplement is "originarily" at work ...' (Derrida, 1993, p. 15). Mackenzie provides arguably one of the more useful additions to the growing number of considerations of technicity and its extraction from metaphysics. Mackenzie's *Transductions* (2002) focuses particularly upon velocity and time, placing technicity at the centre of his thesis. However, he too struggles to resolve the conflicting alterity of contemporary analysis with the nagging question of originality. Mackenzie accepts, drawing on Latour, that technology cannot be extracted from humanity (Mackenzie, 2002. p. 7) and is critical of Heidegger, (Mackenzie, 2002, p. 9), but presents another attempt to understand again how technology *changes* the essential qualities of being.

In Plato's *Symposium* (for a good translation see Gill, 2003) the conversation turns to the manner in which mortals seek immortality. The story is told, by Socrates, of a conversation with a woman of Mantinea called Diotima in which she describes her theory of the nature of *love* and knowledge. Socrates recalls this conversation and retells it to his fellows in the symposium. "Love" declares Diotima, " is a great spirit, Socrates. Everything classed as a spirit falls between god and human." (Plato, 2003. 201d-e p.38) Spirits suggests Diotima, are intermediaries, "...they fill the gap between [man and the Gods] and enable the universe to form an interconnected whole." (Gill, 2003. 201d-e p.39) Someone who is unable to communicate with these spirits and has wisdom in other areas of expertise and craftsmanship... [is] ...merely a mechanic" Diotima's theories place love at the centre of everything. Diotima's idea of love has been the subject of much scholarly debate but Gill suggests that it refers to some innate drive. (See Gill, 2003. p xxvii-xxxv) Gill understands this to be "the intense, emotional and (in some sense) 'erotic' drive that typically arises within interpersonal relationships." (Gill, 2003. p xxxv) This drive might also be understood to emerge as a human form of the genetic drive to reproduce in species. While other species share the drive to survive and reproduce, human intelligence, perhaps uniquely, seeks to reproduce not only in body but also in mind. "Reproduction provides the means through which mortal creatures can gain the immortality which is not otherwise available to them, and this is the underlying motive of sexual desire." (Gill's introduction to Plato, 2003. p xxxi) Sometimes mistakenly interpreted to mean the process of production and creation, or craft, the Greek term *poiesis* is perhaps best understood as this creative enaction (Bruner, 1966) of being in the world.

For the Greeks, the bringing into being of beauty defined the particular *poiesis* (love) that was characteristic of humanity. The bringing into being of another life, the attainment of heroic virtue and knowledge, are that for which mortals must strive (See Gill, 2003. 201a-212e p.36-50). *Poeisis*, then, describes a kind of ecstatic realisation of being in the world and can be understood as a rather superannuated concept of enacted cognition.

> Following the groundbreaking work of Varela, Thompson, and Rosch (1991), my understanding of spiritual knowing embraces an enactive paradigm of cognition: Spiritual knowing is not a mental representation of pregiven, independent spiritual objects, but an enaction, the bringing forth of a world or domain of distinctions co-created by the different elements involved in the participatory event. ... a dynamic and indeterminate spiritual power of inexhaustible creativity. (Ferrer, 2005)

Although sometimes considered to be similar to *poiesis*, *praxis* has been interpreted as the realisation of theory towards an end. There is a subtle yet significant difference between a knowing and applied realisation of an intellectual process and an ecstatic enaction of being in the world. *Praxis* is a human trait and the consequence of a human intellectual process. It has individualised intention, as, for example, in Cieszkowski's *Philosophy of Action* (see Mele, 1997), and implications for political power, as in Marx's rather famous and oft-quoted assertion that 'Knowledge is Power' (Marx and Engels, 1988, p. 121). *Poiesis*, on the other hand, is a more fundamental condition of being and is not necessarily known or enacted through the will.

Heidegger describes *poiesis* as 'the blooming of the blossom, the coming-out of a butterfly from a cocoon, the plummeting of a waterfall when the snow begins to melt' (McCullough, 2001).[162] The realisation of *poiesis* is not always easy. Human beings, lacking the supernatural

[162] Other species have their own particular ways of enacting in the world, "The [Osprey] in the Atlantic storm would be for the Greeks a poiesis-a-veritable production." (Christian and Grant, 1996. p.410) An Osprey seen through human eyes is understood through the singular and awesome ease with which it hunts and commands flight. In the terms of ancient Greece philosophy life is played out through a constant flow of poiesis realised. We can of course not be certain that our interpretation of the realisation

powers of the gods or the ineffable nature of the spirits, have ambitions of *poiesis* that go far beyond their biological characteristics. That mankind is forced to enact *poiesis* through the technic gift of the titans, which is considered something of a burden, resonates down the ages. Johnson (2006) has argued that *praxis* and *poiesis* differ only in their depth of engagement with reality. Johnson argues that *praxis* produces relatively simple 'codifiable objects', whereas *poiesis* produces objects of intense uncertainty and complexity. Johnson calls upon Heidegger's claim of poiesis as belonging to the artists and praxis to the craftsman. This view does seem to tally with the Greek conception but may have more to do with an echo of the dismissal of the intellectual worthiness of the mechanical artists and the conception of the crafts as a matter of skill and not intellect.[163] The impression we are left with is that, in ancient Greece, higher idealised life and the finer ambition of *poiesis* were confined to the realm of the episteme, that place of pure intellectual endeavour that was both a conceptual and a geographical place. If the philosophers occupied the episteme, then everyday life was played out in the *agra*. While also an intellectual and social place, the *agra* was concerned with matters of day-to-day life.[164] *Poiesis* for the ancient Greeks was a rather high ideal and easy to understand in terms of sculpture, painting, poetry or drama. The concept of *poiesis* in terms of the higher arts and not in terms of the products of the *agra* is inculcated in Western culture. The relationship of *poiesis* and *technê* must be extracted from social prejudice with some care (see Dorta, 1973). It may well be that part of the glory of the *Symposium* is that it can be read to suit the intellectual flavour of the reader and his or her time, but it does appear as if later analysis has little to do with the fundamental life-sciences notion of a condition that Diotima seems to describes in the *Symposium*. Humans are worthy of special consideration,

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of the Osprey's poiesis is that shared by the Osprey. We can be more certain about what poiesis might mean in human terms.

[163] An industrial designer might argue, as this thesis has, that they are conditioned to their lowly status.

[164] It has been argued here (see Section 1.3) that the industrial design community is located, in scholarship, firmly in the doxaical *agra*. Down in the doxa of everyday life, those who constructed the artefacts of the ancient world may well have been slaves or of lowly status, but, from industrial design's intellectual standpoint, a ploughed field, the harvest, the movement of goods or the death of an enemy are arguably as much an act of *poiesis* as any supposed *higher* ideal. Everyday life is a process of continual collusion of *praxis*, *technê* and *poiesis* (Smith, 2003). In the socially fluid world of the industrial designer, this collusion is no longer something that is necessarily confined to the rarefied world of the *episteme*. Take an activity such as ploughing, for example. The plough may have appeared to the *episteme* to be *doxaical*, merely mechanic and without *poiesis*. Clearly the plough is a consequence of *praxis* and craft. The activity of ploughing is essentially an anticipation of a fresh crop by realising the necessary conditions for planting. Tried for the first time, ploughing is a particular application of the theoretical knowledge of agriculture, applied through a practical endeavour. Over time, ploughing itself becomes recorded as an addition to *praxis* by shaping the theoretical process, and itself becomes the subject of its own theorisations. The plough is a theoretical intervention in the land, itself a theoretical readiness for the application of seed, itself a theoretical potential to become plant, and so it can be extended.

even in an ecological construct, because the self-conscious realisation of being, through *technê*, is, at least as humans understand it, a uniquely human condition. Other species may appear to intervene in the ecosystem in a way that bears some comparison to our use of tools, but other species do not employ *technê* in quite the manner that humans do in order to enact *their* particular realisation in the world.

It was recognised sometime before Darwin that humanity might be considered in similar terms to other species. 'I think Dr Franklin's definition of Man a good one; "a tool making animal"' (James Boswell; see Schick and Toth, 1994 p. 16). Mankind is not unique in this respect: in 1975 Edward Wilson published what remains a significantly complete and comprehensive list of non-human species that appear to utilise tools as part of their phylogeny (see Wilson, 2000).[165] Consideration of the human as one species among many in the ecosystem that can be demonstrated to employ a component of the world in this manner makes it difficult to separate the species from *technê*. Philosophy and ancient logic aside, the idea that technology is somehow inhuman is problematic in two accounts. In the first instance technology appears to be evident in some degree in other species, and, secondly, technology even as we understand it in the human context[166] appears to predate our species in our own phylogeny (see Relethford, 2002). Arguably some form of *technê* is not unique to the human but can be considered to begin in species prior to the emergence of homosapiens-sapiens-sapiens. 'The history of tools is a chronology of extension and articulation of human functions'. Tools, 'originally conceived about two million years ago as crude adjuncts of the body to increase its power and efficacy, are passive participants in accomplishing work' (D. Paul, 1987, p. 133).This phylogeny of the human begins before humanity in a progenitor Homo Hablis[167] that used tools with a degree of sophistication and distribution that might be compared to that of the modern chimpanzee. While it is possible that this similarity might suggest technology to be an emergent dynamic in an evolutionary trajectory, there is no evidence to support this. However, the co-evolution of technology in phylum other than our own points to

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[165] Phylogeny: evolutionary history.

[166] We can use the term *technê* here to define particularly sophisticated tool use, as we might understand it in the human context.

[167] 'The first glimmerings of the dawn of human technology can now be traced back to approximately 2.5 million years ago in Africa. At a superficial glance, these signs are not all that impressive; a few lumps and fragments of broken stone, often found with fossil bones and teeth of extinct forms of animals that lived during this time ... These shattered rocks bear witness to a new behaviour pattern among early hominids, the percussive flaking of rock, a behaviour that was to have profound consequences' (Schick and Toth, 1994, p. 18).

the wider evolutionary nature of technology and not to its origination as a unique consequence of human intelligence.

Homo Hablis (*National Geographic*, 2007; see http://donsmaps.com/dmanisi.html).

André Leroi-Gourhan suggested that tool use is a so-called Universal Tendency, an evolutionary phenomenon of the human species independent of culture.[168] Today there is a widely accepted idea that technology 'is inseperable from being human. Devices and machines are not things "out there" that invade life. We are intimate with them from birth, as were our ancestors for hundreds of generations' (Nye, 2006, p. ix).

The similarity between humanity and other species does not end with the physical manipulation of the world. Other species' patterns of behaviour appear to mirror human cultural interactions with technology. Chimpanzees have been observed to manufacture tools and to construct a form of culture about their use.[169] If chimpanzee behaviour can be understood to mirror that of our early ancestors (Homo Hablis), then:

> This is not just a biological story. Human evolution concerns not just physical change, but also behavioural transformations. Changes in our biology are perhaps easier to see ... Changes in our behaviour, however, even if many are strongly linked to our biology, are less easily visible but equally important. (Schick and Toth, 1994, p.17)

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[168] For Leroi-Gourhan the emergence of bipedality was critical to the evolutionary potential of technology. Bipedality, of course, predates homosapiens-sapiens by some millennia, and so humanity emerges with technology in place, and, if we accept this history, then technology is tied to the human condition as an evolutionary imperative.

[169] Schick and Toth (1994, p. 58) recall how the comedian Jay Leno once joked that 'if Chimpanzees were *really* like humans they would just *borrow* tools and not return them!' His joke has, it has turned out, proved to be prescient. Where particular rocks are scarce, chimpanzees sort out questions of 'ownership' and the 'authority' of use through complex social strategies.

Schick and Toth (1994) are concerned to emphasise the connection between tool use, technology and culture. Technology, they argue, is an emergent cultural condition and not necessarily human, which

> refer[s] to the system of rules and procedures prescribing how tools are made and used. In a broader sense, [technology] can be used for the systems of tool-related behaviour of nonhuman species as well. To have technology per se, there should be some agreed-upon ways of doing things in a social group - that is, there should be some learned, *cultural* aspect to the tool use or artefact manufacture. (Schick and Toth, 1994, p. 49)

Technê then appears to be a conditional phenomenon that emerges as a consequence of some component of intelligence and culture. If humans are to be considered a technological species, this must be taken to imply a species for whom technology is part of the genomic distinction and the evolutionary niche. If the concept of *poiesis* sets in train a line of thinking that understands life as a continual realisation of being, then for the human species this realisation is enacted through its own evolutionary imperative and *technê* becomes an essential component of the ecological construct. In the following chapter this idea is extended, and it is argued that technology can be understood to be a problematic obscuration of true humanity only if one rejects the notion of technology as the soma. This is not an artificial extension of the soma, as some would argue, but rather evidence of a distributing soma, made possible by the evolutionary trait of intelligence.

One way for designers to understand *poiesis* is to find a way to mainain its status as an enaction in the world, but to strip it of social status. *Poiesis*, as Doitima describes it, seems to be a fundamental evolutionary consequence of the particular intelligence of the species. *Poiesis* then can be considered as an enaction of our particular form of being. *Poiesis* in Greek terms is a mysterious spirit of creativity and is arguably among the most problematic of classical conceptions. It is difficult to grasp intellectually, because *poiesis* may be a product of our individual somatic systems and so deeply embedded in our conscious being that its consideration is a reflection of itself and beyond simplistic reduction. Freud's *Project for a Scientific Psychology* outlines the notion of cathexis (see Freud 1895). Cathexis is a somatic energy, the psychological excitement, panic or arousal that people experience in certain urgent, dangerous, sexual and creative activities. One way of understanding cathexis is as the biological response to enacted *poiesis*. One reason for the cathexic excitement of *poiesis* to be occluded in the formal and historical considerations of the mechanical world is that several millennia of Western philosophy have left us with no meaningful context for talking about the products of the *agra* as an arousing form of poetic love. Ploughing, for example, might be assumed an entirely mechanical act. Without crops the ancient farmer and his family would starve; ploughing, it is easy to assume, is an act of the will to survive. This is a pessimistic interpretation. There is pride in the craft of the farmer, and there is art in the ploughed field. 'We consider the art of ploughing to be highly important and a tradition to be actively encouraged if it is to survive' (MacIver, 2007). For the farmer this art is a vital and essential component in his being; the plough enables the farmer to enact this *poiesis*. While it may appear self-evident to contemporary designers that humanity and technology are heterogeneous, this must now be be understood to be determined by a fixed topological understanding. Though this enacted *poiesis* is ahistorical, there are any number of anecdotal accounts of human-technological relationships that can be called upon for evidence of a wider, more subtle engagement when technology and humanity appear to function as a continuity.

In a documentary film detailing the testing of a McLaren Formula One car, the racing driver Ayrton Senna comes into the pits and informs his mechanics that there is a problem with the engine. Senna (1991) describes how he can feel the engine fail inside himself. To the bemused incredulity of his mechanics, Senna suggests that he feels a particular friction. The engineers run diagnostic tests. They can detect nothing wrong with the engine, and send Senna out to drive again. The video narrative suggests that during a subsequent engine strip-down it was found that a piston ring had indeed broken. Racing engines fail often enough, and there is every chance of coincidence that would seem to point to a *rational* explanation; after all, it would seem occult in design terms to suggest that a driver could truly *feel* the pain of a failing engine. It was sometimes claimed by fighter pilots in the Second World War that they did not simply climb into a Spitfire; they wore it as a form of clothing (see, for example, *Spitfire*, 1998). Bond (1932) studied pilots and found that 'they commonly speak of the plane as if it were an extension of their own bodies' (see Bond, 1952, cited in Murphy and White, 1995, p. 32). These pilots may simply be describing the close-fitting nature of the cockpit or the struggle to clamber into its constrained space. A contemporary pilot feels rather more comfortable when she describes her experience of flight as a state of being in which she senses herself as a singular entity: 'you are flying using your brain and body but not your emotions, it is a single thing, you are a flying machine, you should be part of it' (Turkish Female Jet Fighter Pilot, 2006). Barthes found this condition to be problematic. Barthes's 'jet man' was dehumanised, having been stripped of his cultural persona. The jet man for Barthes (2000, pp. 71-7) 'knows no culture in adventure or destiny, but only a condition'. The jet man has no heroic humanity; he is one and the same as the jet. Whereas the contemporary fighter pilot, neurologically mapped into her cockpit with its vision tracking and advanced anticipatory computer systems, may feel some sense of herself as being directly connected to the aircraft, the Spitfire pilots' description of wearing their craft may point to the mechanical nature of their interaction. To describe oneself as being at one with the Spitfire might be to admit to an occult experience. This experience might be thought occult or a 'forbidden sensuality', because it refers to a largely unaccounted for and ahistorical description and projection of human-technological relations that appears to be confined to anecdotal accounts.

The rather famous poem 'High Flight' by Gillespie Magee, describing the ecstasy of the fighter pilot, betrays a delight in the potentiality of human consciousness to merge organic and inorganic and to call upon a soma that is not bounded or described by its organic or inorganic nature. Magee's poem is interesting because throughout it refers only to the ecstasy of flight as an act of consciousness, not of engineering, making only one brief reference to 'my eager craft'. The Spitfire is at best a liminal experience. The poem is joyous. It describes a human soaring, not the process of flying a machine.

Oh! I have slipped the surly bonds of earth
And danced the skies on laughter-silvered wings;
Sunward I've climbed, and joined the tumbling mirth
Of sun-split clouds - and done a hundred things
You have not dreamed of - wheeled and soared and swung
High in the sunlit silence. Hov'ring there
I've chased the shouting wind along, and flung
My eager craft through footless halls of air.
Up, up the long delirious, burning blue,
I've topped the windswept heights with easy grace
Where never lark, or even eagle flew
And, while with silent lifting mind I've trod
The high untresspassed sanctity of space,
Put out my hand and touched the face of God.

(Gillespie Magee, 'High Flight'. 1941)

In the Zone (Murphy and White, 1995)[170] is a wide-ranging collection of transcripted anecdotes of so-called 'Transcendent Experiences in Sports'. These experiences, it seems, are not understood to fit with orthodox science and are often described as being mystical - a notion reinforced on the cover description of the text: 'remarkable and mystical things happen to people during sports ...' (Murphy and White 1995. Jacket copy). In a chapter called 'Mystical Sensations' a motorcycle rider describes the experience of riding at considerable speed: 'you feel a calmness throughout your body, even though you know intellectually that you're right on the brink of disaster' (Murphy and White, 1995, p. 11). We know this sensation from personal experience, when we have perhaps hit a tennis ball cleanly, or struck a golf ball so that it flies straight and far. Murphy describes these experiences and points to how people describe this in a rather taciturn manner. Many of the interviewees, apparently embarrassed to admit a sensuality that appears to diminish their sense of themselves located about their bodies, describe their experience as if it had not really happened, but had simply felt as if it had.

Deleuze has described the 'machinic becoming'. A machinic becoming is a condition of being where the distinction of the human and technology becomes superseded:

> [a bicycle] obviously has no 'end' or intention. It only works when it is connected with another 'machine' such as the human body; and the production of these two machines can only be achieved through connection. The human body becomes a cyclist in connecting with the machine; the cycle becomes a vehicle. (Colebrook, 2002, p. 56)

In *Ways of the Hand* David Sudnow (1978) describes 'the organization of improvised conduct' in the experience and technique of jazz piano. In the preface (p. xi) Sudnow describes with incredulity the experience of watching his hands at work. 'If I watch my hands on a typewriter, I don't recognise their movements. I am startled by the looks of my hands while typing ... It's like witnessing an interior part of my body going through some business.' Sudnow describes in some depth the process of learning to become a jazz pianist from his earliest moments

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[170] This text, published by Arkana, is consigned among other 'new age' and 'spiritual' titles. Murphy is the co-founder of the Esalen Institute, and the book is couched in somewhat esoteric terms. It tends to find mysticism and to avoid scientific explanation.

when he 'knew how to place his fingers properly, how to engage in some manoeuvre once it was pointed out to me ... (p. 1) until the time when his hands could fly about the keyboard and he could 'sit down at the piano, gain an initial orientation with the merest touch "anywhere" on the field, then reach out and bring my finger precisely into the spot "two feet" off to my left, where a half inch off is a mistake, come back "seventeen inches" and hit another one, and go down "twenty three inches" and get there at a fast clip' (p. 13).[171] When Sudnow attempts to copy the movements of other pianists in order to attain their sound, he finds that the connection is not simply a matter of mechanical similarity. The posture and movement of the pianist seem to bear little relation to their sound.

> At live performances I had watched the very improvisational players whose records had served as my models, but their body idioms in no way seemed connected in detail to the nature of their melodies... [One] sat tightly hunched over the piano, playing furiously fast, but assuming that posture seemed to have no intrinsic relationship to getting my jazz to happen as his did. (p. 82)

Sudnow finds, however, that he can observe these musicians and then somehow his body finds its own shape; he can now make something closer to their own articular jazz. Sudnow describes a singular experience that is not described by physics or physiology alone. He suggests that no measurable account for the connection between human (musician) and machine (piano) is possible. In Sudnow's account, while there is no measurable account between the body and the music, there is nonetheless an unaccountable mystical connection. Counter to Murphy's hypothesis, however, it is doubtful that this connection is some strange ethereal gift of the muse, beyond the rationality of science.[172] There are many examples when

[171] I watch my own children with their Playstation. The Playstation is not my child. I have no emotional attachment to it. When it breaks, the loss my children feel is not that of mourning; it is more of frustration and impatience while they wait for its repair or replacement. And yet in that moment when they are engaged in its play there is no meaningful seperation between the systems that drive their bodies and the systems driving the Playstation. Their fingers flash about the controllers, their bodies swerve and bend with the information they take from the screen and absorb into their cognition.

[172] There is a branch of therapy called 'Esoteric Anatomy'. The most complete reference to this form of alternative medicine is *Esoteric Anatomy: The Body as Consciousness* by Bruce Burger (1998). In this comprehensive account of the practice, there is much that is tangential, much that appears highly unscientific, conjectural and founded in faith rather than evidence. Nevertheless, this is an intriguing book. It blends history with science with mythology and belief. If one is prepared not to take it entirely at face value but to understand it as shaping a way of understanding the body, it begins to make sense of where science might look to understand the phenomena. 'The Three Principals' and the 'Three Axes of the Body' describe attempts emanating from Eastern philosophy to understand how energy is dissipated and directed about the body (Burger, 1998, p. 221). The flow of energy through, within and without the body is an important consideration in Eastern philosophy. 'Oriental Wisdom' is not something that appears to feature explicitly in the Western scientific tradition, at least not in the way that industrial design encounters orthodox science. That these ideas might or might not come to be proven as science or myth is not a concern here. It is that a consideration such as Murphy's should be consigned to the fringe of science that should surprise us.

people appear to be in some way coextensive with technology, located firmly in the esoteric or considered so occult as to appear beyond rational conversation. The Ouija Board and the diving rod are examples of devices in which it is claimed the body becomes connected with some supposed externalised spirit or energetic force. Their use is explicitly paranormal; their discussion in rational conversation runs the risk of consigning the speaker to the fringe. In *The Illusion of Conscious Will*, Wegner (2002) describes a number of scientific 'explanations' of these phenomena. These explanations focus upon the nonconscious[173] function of the soma. Wegner suggests that the function of the soma cannot be entirely understood to be accountable in consciousness. Wegner (pp. 43-5) cites the work of the neurophysicist Benjamin Libet and colleagues and their experiments to test the timing between the commencement of somatic activity and the subsequent conscious willing of the movement. Wegner suggests that Libet's research presents a challenge to ideas we might have of somehow being in charge of our bodies and by extension of our free will. Wegner suggests that this unconscious functioning of the body may go some way to explain some of the occult experiences described above.[174] That a facet of life that is common to us all should be considered to be on the fringe of conversation is extraordinary. The piano in the process of making jazz does not diminish the humanity of the pianist; rather the piano and the pianist come together through a flowing of energies and intentions as an expression of humanity. We can find moments when people describe how any boundary between themselves and technology becomes meaningless. This does not necessarily imply a loss of humanity. Indeed the poetry of Magee implies quite the opposite: flight becomes a heightened moment of human ecstasy. A history of these experiences of being is largely absent from industrial design, and yet arguably this would seem to be a moment of supreme humanisation. However, the intellectual foundation of the process of humanising technology appears to imply quite the reverse. To remind ourselves:

> The boundary between humanity and machine is becoming progressively more blurred, and there are many willing to defend this development, regarding it as where

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[173] The nonconscious should not be confused with the unconscious, as a Freudian might understand it. The nonconscious refers to the functions of the soma that operate beyond human sensuality.

[174] Research has confirmed a gap of some fraction of a second between the bodiy's preparation for movement and the subsequent conscious decision to make an action.

our future lies. At stake this debate is our very conception of what it means to be human. (Sim, 2001, jacket copy)

It can appear natural in industrial design to engage in processes of analysis placing emphasis upon the resolution of difference, and so it becomes possible for terms such as 'interface' or 'interaction', prioritising modes of analysis reinforcing and then resolving differences between humanity and technology, to be accepted without question. 'Knowledge of the human body's structure, functions, size and strength is included in the first part of the course. In the second part, the human method of understanding, interpreting and dealing with information is studied. Students examine the boundaries between human and object' (UMEA, 2006). Thinking back to Deleuze's concept of machinic becoming, from the descriptions of the practice of industrial design history, it might seem as if designers intellect has been concerned only with the bicycle, its form and cultural value. The machinic becoming might, however, alert industrial designers to the realisation that Deleuze describes something that they know already and perhaps take for granted, but appear to have lost from their discourse and their history.

7.3 Embodied interaction

The body then cannot be discounted in any analysis of being in the world, and, more critically, it cannot be isolated from it either. The concept of embodied interaction extended into the context of design methodology.

'The human body is a machine which winds its own springs. It is the living image of perpetual movement'

(De la Mettrie, 1748).

Julien Offray De la Mettrie's *Man a Machine* (1748) is sometimes cited as an example of how science reduces the essence of humanity to that of a mere machine (see Cohen Rosenfield, 1940). While it may appear superficially[175] to make that claim, in *Man a Machine* De la Mettrie actually made a far more subtle proposition for the condition and experience of being alive to emerge from the enacted condition of being in the world. Far from suggesting that mankind was a zombified product of the mechanism of the body, De la Mettrie argued that the world is a product of human interpretation, which is itself conditioned by the world. In his own terms De la Mettrie was clear that humans had evolved to be in the world, and proposed, rather unpopularly in his time, that humanity was naturally inseparable from the world as a being of nature.

> Man's pre-eminent advantage is his organism. In vain all writers of books on morals fail to regard as praiseworthy those qualities that come by nature, esteeming only the talents gained by dint of reflection and industry. For whence come, I ask, skill, learning, and virtue, if not from a disposition that makes us fit to become skill-full, wise, and virtuous? And whence again, comes this disposition, if not from nature? Only through nature, do we have any good qualities; to her we owe all that we are. (De La Mettrie, 1748)

De la Mettrie argues that while the corpus is a form of machine, the human is more than the sum of its mechanistic parts. De la Mettrie argued that while the body and the soul [176] can be understood in isolation, no true picture of the human could be built unless they are considered as one whole. De la Mettrie returns our attention to energy; he suggested that it is the food necessary for the machine that can influence the soul, and courage or stupidity though considered to be essentially a matter of the soul and the domain of the philosopher, it could not be separated from the somatic influence:

> Nourishment keeps up the movement which fever excites. Without food, the soul pines away, goes mad, and dies exhausted. The soul is a taper whose light flares up the moment before it goes out. But nourish the body, pour into its veins life-giving juices and strong liquors, and then the soul grows strong like them, as if arming itself with a proud courage, and the soldier whom water would have made to flee, grows bold and runs joyously to death to the sound of drums. Thus a hot drink sets into

[175] Especially if one isolates this particular phrase from the entire text, as is frequently the case.

[176] Instead of soul, we might say *self, mind* or *consciousness.*

> stormy movement the blood which a cold drink would have calmed. (De La Mettrie, 1748)

For De la Mettrie it was impossible to reduce mankind to understand him. One can understand something of his nature and behaviour and something of his functioning but can never reduce him as one might a machine of his making.

> Man is so complicated a machine that it is impossible to get a clear idea of the machine beforehand, and hence impossible to define it. For this reason, all the investigations have been vain, which the greatest philosophers have made à priori, that is to say, in so far as they use, as it were, the wings of the spirit. Thus it is only à posteriori or by trying to disentangle the soul from the organs of the body, so to speak, that one can reach the highest probability concerning man's own nature, even though one can not discover with certainty what his nature is. (De La Mettrie, 1748)

In recent times there have been attempts to bring the intellectual impetus of cognitive science together with phenomenological philosophy. This is particularly evident in the work of Maurice Merleau-Ponty (2003) and to some extent in the earlier post-Hegelian ideas of Heidegger and Husserl. These philosophies deal with the 'embodied' experience of being in the world, rather than the constructed cultural conceptions humans build about themselves.

> There are strong indications that among the loose federation of sciences dealing with knowledge, and cognition - the cognitive sciences - there is a slowly growing conviction that [the Cartesian picture of formal, logical, well-defined units of knowledge] is upside down, that a radical paradigmatic or epistemological shift is rapidly developing. At the very center of this emerging view is the belief that the proper units of knowledge are primary concrete, embodied, incorporated, lived. (Varela, 1992)

Neuro-psychlogists such as Bermüdez et al, (1995), for example, have argued for some time that the body is the foundation of the sense of the self. In recent years, the works such as Lakoff and Johnson, *Philosophy in the Flesh* (1999) and also Varela, Thompson, and Rosch, *The Embodied Mind* (1999) have laid out an embodied approach to cognitive studies that attempts to understand what it means to be human in everyday, lived experience.

> If we examine the current situation today, with the exception of a few largely academic discussions cognitive science has virtually nothing to say about what it means to be human in everyday, lived situations. (Varela et al., 1999, p. xv)

Embodied approaches to understanding human cognition mark in some respects the intellectual drift toward connective, rather than reductive, thought. Emerging from what might be termed an orthodox scientific methodology, embodied understandings of cognition attempt to bring rigour to the subjectivity of lived experiences.

> On the other hand, those human traditions that have focused on the analysis, understanding, and possibilities for transformation of ordinary life need to be presented in a context that makes them available to science. (Varela et al., 1999, p. xv)

Varela, Thompson and Rosch's *The Embodied Mind* can be understood as an attempt to reconnect separations of mind, body and world and to bring these hitherto separate epistemes into one conversation. By understanding that the human experience of being (mindfulness) is inseparable from the physicality of the reality in which it is situated, an alternative is posited to representational models of cognition in which the world is understood as filtered through senses, rather as one might experience a gigantic and immersive picture show. Varela and his co-authors offer 'embodied' models where the world is 'enacted' through series of complex 'structural couplings' - that is, many[177] tiny connections of sense, experience, imagination, memory, knowledge and other somatic systems, interacting to form a meshwork of impressions of being in the world. If representational models suppose a fixed world that is experienced, then the world in embodied thinking is entirely constructed. Varela's concept of 'structural coupling' reflects, although differs from, Gibson's earlier model (1979), which, while similar in its rejection of representation, relied upon a largely visual model of the world, albeit one determined by species and habitat. In short, where Gibson recognises that the experience of the world is determined by the way in which a species is independently evolved in it, Varela and colleagues describe an 'enacted' concept that distributes the world into the species, and the species into the world. The world is then a lived experience enacted in somatic functions, and so humans must learn to be *in* the world. While some aspects of that world are constructed for some humans by others, this does not mean that these aspects

[177] How many billions of connections? It appears doubtful a number could be put to this with any degree of accuracy.

necessarily contain any truth about the world. Dennett (1993, pp. 206-7) sets out a neat and concise review of Varela's 'enactivist' approach in the context of previous purely 'cognitivist' approaches to cognition.

> Question 1: What is cognition?
> Cognitivist Answer: Information processing as symbolic computation-rule-based manipulation of symbols.
> Enactivist Answer: Enaction. A history of structural coupling that brings forth a world.
>
> Question 2: How does it work?
> Cognitivist Answer: Through any device that can support and manipulate discrete functional elements; the symbols. The system interacts only with the form of the symbols (their physical attributes), not their meaning.
> Enactivist Answer: Through a network consisting of multiple levels of interconnected, sensorimotor subnetworks.
>
> Question 3: How do I know when a cognitive system is functioning adequately?
> Cognitivist Answer: When the symbols appropriately represent some aspect of the real world, and the information processing leads to a successful solution to the problem given to the system.
> Enactivist Answer: When it becomes part of an ongoing existing world (as the young of every species do) or shapes a new one (as happens in evolutionary history)

This has profound consequences for the way in which we might understand industrial design's process of humanising technology. Taking each question in turn and looking at implications for design in the 'cognitivist' and 'enactivist' answers to each question it becomes possible to see how enacted or embodied approaches to cognition place a rather different emphasis upon the realisation of the self as a constructed (cognitivist) entity in seperation to technology or a self-enacted construct formed through complex coupling in which technology is understood to be coextensive with the soma. Perhaps the easiest way to emphasise the difference in these approaches might be to consider the act of speaking. A cognitivist approach might focus upon the meaning and construction of the words. How has a vocabulary been learned; what is the value of the words used; how are the words used differently in cultures and in changing contexts, for example. An enactivist approach might study the processes whereby the words are formed nonconsciously by the tongue in the palette; how this process is learned as a child; how words are assembled in the mind prior to their vocalisation and how in conversation their delivery is nuanced, seemingly without any thought being given to the process on the part of the speaker. The enactivist approach places the somatic system at the centre of the process.

Assuming the speaker does not speak from a predetermined script, many systems are at play in the formation of the conversation.[178] In design terms:

Question 1: What does design do when it humanises technology?

Cognitivist Implication: Design manipulates symbolic images by which people read the world so that they can make sense of and give value to technologies (semiotics).

Enactivist Implication: Design enables people to enact in the world by enabling potentiality of whole human. as a distributed soma (Holsomatic)

Question 2: How does design work?

Cognitivist Implication: Designers create the means to project simple or multiple and complex symbolic meanings. These symbols are primarily experienced by people in reference to a codified cultural understanding of referents.

Enactivist Implication: Designers intervene in the complex processes by which people form an experience of their world. Their task is to enable people to experience the world 'naturally' without necessarily needing to attach meaning to indvidualised interactions.

Question 3: How do I know when design is functioning adequately?

Cognitivist Implication: When people understand the symbols they encounter and react appropriately.[179]

Enactivist Implication: When people incorporate the designed world seamlessly as part of their experience of being.[180]

Dourish (2001) takes the concept of embodiment into the context of design. His primary concern is with the design of digital computer systems and artefacts. In *Where the Action Is* (2001) Dourish presents a model of 'embodied interaction' in seven chapters. 'A History of

[178] While the cognitivist searches for, and attempts to analyse, the supercomplex forces that construct the conversation, the enactivist understands conversation to be more akin to an autopoietic or emergent process.

[179] For example when people drive and see an oil light they understand this means they must stop the engine because they understand the value of the oil symbol in the context of the engine's function.

[180] For example, in Magee's 'High Flight' where the artefact is sublimated to the lived experience and becomes anoetic. We have some sense of this when we find we have driven safely down a motorway for some miles, without being aware that we have been driving.

Interaction' (pp. 1-23) presents a neat synopsis of the entire book. It opens with a straightforward story of how computers have been operated, moving through electrical switching, symbolic programming, graphical user interfaces (GUIs), to tangible and social computing, via Xerox Parc and Macintosh. The chapter concludes with an outline of Dourish's industrial design and artefact-oriented version of embodied interaction. Dourish draws heavily upon a number of the key figures in phenomenology he identifies as important to the development of embodied interaction: Husserl's phenomenology (1859-1938); Heidegger's hermeneutic phenomenology (1889-1976); Shultz's phenomenology of the social world (1899-1959) and Merleau-Ponty's phenomenology of perception (1962), for example. It appears that, in his choice of phenomenologist, Dourish is intent on positing embodied interaction as a methodology that resists genealogy in structuralist or cultural-theoretical method and thereby eschews the orthodox history of design, while accepting the trajectory of artefacts that the sustaining narratives project. He starts from his summation of embodied phenomena as 'those, which by their very nature occur in real time and real space'. Dourish (2001) proposes that:

> Embodiment is the property of our engagement with the world that allows us to make it meaningful. (p. 126)

He then locates his interpretation of embodiment in the physical. In a section entitled 'Getting in Touch' (pp. 25-53) Dourish locates industrial design in phenomenology by arguing that the physical experience of being-in-the-world cannot be separated from the 'reality of our bodys presence in the world' (p. 18), hence:

> Embodied Interaction is the creation, manipulation, and sharing of meaning through engaged interaction with artefacts. (p. 126)

Reflecting on industrial design history as it is written, Dourish suggests that the design of human technology interaction has shifted from a focus entirely in the machine foundation in protocols (switches, dials, etc.) towards tangible models of interaction that are distributed and intuitive. Examples are posited of digital systems that 'lend themselves naturally' (Dourish, 2001, p. 42, citing Gaver, 1991); these are interactions where people appear not to have to think to act. Dourish is rather uncritical in his concept of an action; he does not explore the difference between natural or tacit actions.[181] In 'Social Computing' (Dourish, 2001, pp. 55-97) Dourish outlines a concept of social computing and, reflecting the thinking that prevails in the industrial design community, argues that sociological approaches should underpin interaction methodologies.[182] Dourish describes how, after Suchman (1987), interaction can be understood as an activity system. In other words we have ways of behaving when we are engaged in activities that interaction designers would be wise to build upon. In 'Being-in-the-World: Embodied Interaction' (Dourish, 2001, pp. 99-126) Dourish suggests that tangible interaction and social interaction have much to offer one another, arguing that both aim to 'smooth interaction by exploiting a sense of familiarity with the everyday world' (p. 99). He calls upon the concept of metaphorical interaction (Lakoff and Johnson, 1999).Dourish, however, proposes that a collision of ideas of situatedness with ethnomethodological approaches will bring individual experience into the social frame. It is arguable that individual members of the industrial design community's adoption of embodiment as a socially conditioned situation takes it some way from Varela's concept of the 'structural coupling'. Dourish seems to be on the brink of a profound move, towards a distributed view of cognition and the soma, but then steps back, returning the design discourse into a more familiar forum. Arguably, then, rather than transforming the discourse, Dourish entrenches it in its methodology of analysis. A design methodology that calls for familiarity as its guiding principle is likely to find it difficult to progress, especially when the interaction is anoetic.

That any industrial design thesis should find itself attempting an extraction from socially and culturally constructed models is indicative perhaps of the degree to which those models have come to pervade the intellectual imagination of these times. Berger and Luckmann's *The Social Construction of Technology* (1975) is considered an important text, if only because it has been reinforced by such a significant body of scholarship during the last decade of the twentieth century and the opening years of the twenty-first century, attempting understandings of technology as a social construction (see, for example, Bijker, Hughes and Pinch, 1989, and, more recently, MacKenzie and Wajcman, 1999). That technology might emerge as a

[181] For example, there is no attempt to explore the somatic differentiation among supposedly natural actions like grasping with which we appear to be born; learned but apparently natural actions such as walking or talking; and the more specialist anoetic, but no less embodied actions, such as successfully wielding a tennis racquet.

[182] Social computing, as Dourish interprets it, interaction is reduced to activities and goals, a methodology that started out in computer science as a series of somewhat simplistic empirical studies and that, more recently, particularly after Suchman (1987), have taken a situated ethnomethodological (Garfinkle, 1967) approach. In social computing, interactions are learned and enculturated.

consequence of social forces has proved to be an accessible idea for designers. The enthusiastic engagement by the design community with social models of human-technological interaction has been necessitated by accelerated complexity in technic understandings of human-technological interaction to a degree of granularity that makes it difficult, if one assumes an epistemic difference between humanity and technology, to sift what is human from what is not. Designers have responded by constructing models of the design process that are themselves more granular, more fluid and less codified and mechanical than they might have once imagined (see, for example, Gedenryd's attempt (1998) to construct an intense granular and interactional non-linear design process). The emergence of socially constructed models of the human have shifted the intellectual imagining away from the human as a somatic architecture and a location of the ego, towards the body as a constructed and bounded locale to read in a social and networked model of humanity as a larger ethical construction. In this intellectual climate, humans are best not understood singularly but as collections of interacting groups and individuals, working and playing together. In this climate, designers began to understand technology as a similarly constructed concept that extends way beyond the physicality of materiality to include, even in relatively pragmatic conversations, a concept of commodity as a metaphorically material construct.

When designers construct new ideas, they do so with reference to history and established precedents. Schön and Schön (1991) described that process of conceptualisation as a kind of circulatory motion in which new ideas refer to the discourse they understand to be part of their genealogy. The implication here is that, in the context of their community, industrial designers are likely to interpret their history and discourse in terms of the community they understand and have embodied through the networks they have established with the places they have been trained or employed. Given that the industrial design community must draw upon its own histories in order to gain a sense of its precedence, it is not surprising that designers should gain a view of themselves as an intellectual intervention in the production of technological artefacts.

Chapter eight

Dissolving the problem in the recovered voice: strategies for the management of fluidity

8.1 **Granularity; a changed view of reality and not a changed reality**
Scale and extent are linked to the granular sophistication in the conceptual and technical models held.

8.2 **Artefactualising the body**
Joe and Josephine: The human body is understood by industrial design to be a resolved and material artefact, thus providing a form of hysterical continuity for industrial designers in the face of earlier, similarly hysterical attempts to understand the implications of holsomatic human.

8.3 **Designing with the 'Body without Organs'**
In order for industrial designers to find a way to engage with the anoetic, it will be necessary for them to find the means to artefactualise the enaction of the hybrid-human at a subtle degree of granular complexity. Such a granular logic will demand an understanding of the holsomatic human at a granular degree of complexity. At this scale and complexity it will become clear that no meaningful closure of the human is possible.

8.4 **Design Scenario**
Joey's ordinary life

8.1 Granularity; a changed view of reality and not a changed reality

Scale and extent are linked to the granular sophistication in the conceptual and technical models held.

In a short webcast on the 'Designinginteractions' (*sic*) web resource (see Designinginteractions, 2006) Durrell Bishop uses the example of coins and banknotes as 'abstract representations of value, and suggests that physical tags can be designed to represent any abstract item '. Bishop's frequently cited telephone answering machine (see Bishop, 2005) has no history to call upon other than the culturally constructed artefact. The answering machine draws upon a social networking model and creates an imagined scenario. Bishop then instigates[183] the materialisation of this scenario into an artefact. Briefly the device is imagined for a group of friends sharing a house,[184] its conceit being that it mixes real social and readily understood actions with the efficiency of electronic systems.

Durrell Bishop's Answering Machine.

The problem, of course, with Bishop's device is that it relies upon a particular, and very limited, social condition and, as with the previously cited answering machine of Krohn and Viemeister, appears to be presented as a resistance to the emergence of the mobile telephone and its associated, systematised personal voice mail system. There appears to be some drive to materialise an artefact, whereas the answerphone now functions rather successfully as an

[183] 'Forces' may be too strong a term to describe Bishop's intervention, although it can seem that way.

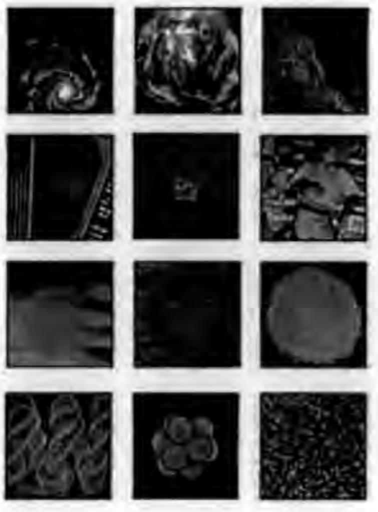
[184] The flat shared by friends is a social scenario close, of course, to the imagination of a Western design student, although the system could perhaps be applied to an office or family. When a caller leaves a message on the answering machine, it is held in the electronic memory but tagged to a small marble-like key. These keys are ejected from the machine, travel down a runway and collect in a pool moulded into the machine. When a member of the house/family/office arrives at the machine, he or she can listen to the message by picking up a key and placing it in a hollow; the message is played. If the message is for that person, he or she can then wipe the key by depositing it back into the answering machine. Should the message be for someone else, he or she can place the key in an appropriate saucer, pot or place such that the person for whom the message is intended can listen at his or her own convenience.

entirely immaterial device. During the mid- to late 1990s the world of tangible computing research particularly drew upon some of the pioneering research at the Royal College of Art in London. The research was characterised by experiments with the materialisation of data into solid (tangible) icons. This research was typical of a number of attempts to project the trajectory of industrial design history into an engagement with the supposedly immaterial nature of data, by replacing virtual information with solid matter. This matter was brought together into artefacts modelled at a scale with which designers are familiar from the narratives, which sustain their community. These artefacts, it was suggested, would act as material placeholders for informational events or as physical nodes for systems that appeared in these terms to be immaterial. Durrell Bishop's 1994 design for an answerphone (see, for example, Shaer et al, 2004), Natalie Jeremijenko's 'Live Wire' (Weiser and Brown, 1996) and Rob Strong's 'Feather, Scent and Shaker' (Strong and Gaver, 1996), for example, are often cited, both within and outside the industrial design community, as examples of this research. The material modes of historicisation underpinning industrial design analysis are, however, tied to a particular conception of materiality.

> a knowledge of scale gives us the perspective to see all things in terms of relative size. It gives us a sense of place in the universe and expands our thinking in non-linear ways. (Eames and Eames, 2005)

In 1977, the industrial designers Charles and Ray Eames produced the film *Powers of Ten* (Eames and Eames, 1977). Starting with a 1 metre square filled by the image of a couple in a park, the film zooms outwards at factors of 10 to the universal scale and then inwards at the same factorial to the atomic scale. *Powers of Ten* shifts understanding of the world through scales, revealing the earth as a microcosmic dot in the vastness of the universe. The human body is revealed to be a universe of its own, filled with atomic particles. At the atomic scale, the universe and all that is in it can be considered to be one continuous body of forces. The Eames film does little to enable this understanding; it eschews continuum and projects a series of discrete topological domains.[185]

[185] One of the problems with *Powers of Ten* is that, while it rather poetically reveals the relative scale of things, the film tends to lock these views into discrete taxonomies that are somehow isolated from one another. When looking at the universe, one sees and is encouraged to think of planets and stars and other gigantic bodies. That the universe is a vast collation of atoms becomes somewhat lost. Similarly in the perspective of the nano, cells are projected in isolation and the molecular and atomic nature of the human body is projected as being somehow contained within itself. The human-centric concept of the universe, where the human body and scale of understanding are the null point of view, is reiterated in the Eames's



Eames, *Powers of Ten* (Eames and Eames, 1977)

Pepperell (2003; see also Pepperell and Punt 2001 has sought to develop an extensionist mode of creative philosophy, finding no distinction in objects or between the mind, body and world. Pepperell (2003, p. 35) defines extensionism thus:

> Rather than regarding identifiable objects of 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 ...

An extensionist schema holds that no useful border can be found in objects or phenomena in so much as all 'objects' and 'properties' are considered formed as universal states of energy, evident as excitation or density. As such, this philosophy reflects that which we know to be the case from science. The radical shift in twentieth-century physics came with the demonstration that space and time can be considered as human conceptions without universal foundation. More recent Quantum logic has demonstrated that it is not even truly possible to observe anything with certainty. An extensionist philosophy suggests that such knowledge accepted as a facet of physics should be extended into more philosophical interpretations of

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film. It is not surprising, of course, that we understand the universe in relation to ourselves, but it a fallacy to imagine that the neatly contained borders we understand are reflections of reality.

being. That artefacts, like any other supposedly solid lump of matter in the imagination, should owe something to the perceived scale of the body is, of course, no surprise. And it should not be a surprise either to discover that humans have tended to construct the world about them in their own terms and bound about with their own terms of reference. Tis should not imply that 'matter' as humans understand it is a universal truism (see Davis and Gribben, 1992).

The topological domain defines a field of analysis. Some means is required of ensuring that topological domains are considered in terms that have some coherence in their terms. We can speak of a waterfall, for example, in terms of fluid dynamics and the path of any individual droplet or even molecule of water. We can also usefully talk of a waterfall in terms of its cultural resonance; we might give it a name - Niagara Falls, for example. But these are rather different, although entirely appropriate, conversations. They both provide fulsome descriptions of the waterfall but are not entirely coherent in each others' terms. We are, of course, used to talking about waterfalls in these terms. The problem we negotiate throughout our lives is how we determine which conversation might be appropriate at any given moment. In conversations we do this by negotiation. We construct institutions to frame our conversations. A conversation in a journal of fluid dynamics might possibly include a treatise on the romantic qualities of Niagara, but it is unlikely the journal's readers would consider it an appropriate scientific analysis. On the other hand, an overtly finite degree of analysis is hardly likely to lend itself to poetry - for example, the rather famous letter from Charles Babbage to Alfred Lord Tennyson:

> Sir: In your otherwise beautiful poem 'The Vision of Sin' there is a verse which reads: 'Every moment dies a man, every moment one is born'. It must be manifest that if this were true the population of the world would be at a standstill. I would suggest that in the next edition of your poem you have it read: 'Every moment dies a man, every moment one and one sixteenth is born. The actual figure is so long I cannot get it onto a line, but I believe the figure one and one sixteenth will be sufficiently accurate for poetry. (Paraphrase of a letter from Charles Babbage to Alfred Lord Tennyson.' (See ABC, 2002))

Babbage has been accused of being a pedant, but in his terms he was liberal with his figure and of course he was literally correct. In terms of the analysis of the topological domain, however, the difference in terminology is critical; one has to be certain of the coherence in terms. In data analysis it is recognised, of course, that the degree of inspection applied can determine widely varying outcomes. However, there is much to be gained by understanding how different degrees of analysis might relate to one another. To this end the mathematical science of 'extent analysis' has become a useful tool in the analysis of widely variant data fields (see Lisper and Collard, 1994). In the field of Biogeography it has become increasingly viable and necessary in recent years to undertake an analysis that brings fields of scientific study together. The correlation of the fields of analysis applied cannot necessarily be compared in everyday terms and are better understood in terms of spatial distributions - see, for example, Bickford and Laffan's study (2006) of plant diversity and health in terms of climate distributions. In studies of biology and ecology it is accepted that it is necessary to undertake a multi-extent analysis in order to build a functional picture of ecosystems that include species at widely differing scales, distribution and functional complexity.

> Many spatially complex environments are fractal, and consumers in these environments face scale-dependent trade-offs between encountering high densities of small resource patches versus low densities of large resource patches. (Ritchie, 1998)

Ritchie (1998) undertakes an analysis of species and finds evidence to suggest that the scale of species is linked, perhaps unsurprisingly, to the scale of the resources available to them. Ritchie, however, demonstrates that this relationship is a matter of fractal maths and fits with previous attempts to explain distributions in terms of consumer-led explanations. Ritchie looks for fractal repetition and describes this in terms of dimensionality. He demonstrates that, in broad terms, the spread of species within an ecosystem is coherent with itself at many degrees of resolution and that the distribution of species is determined by their scale in proportion to the scale of the domain under analysis.[186] Industrial designers, however, when they are attempting to analyse the process of humanising technology do not work with coherent fields of analysis.

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[186] 'The model predicts that, for a given density of resources, landscapes with greater extent and fractal dimension and that contain patchy (low fractal dimension) resources favour large foraging scales and specialization on a small proportion of resource patches. Fragmented (low fractal dimension) landscapes of small extent with dispersed (high fractal dimension) resources favour smaller foraging scales and generalists that use a large proportion of available resource patches ...This study thus places optimal foraging theory in a spatial contex t...' (Ritchie, 1998).

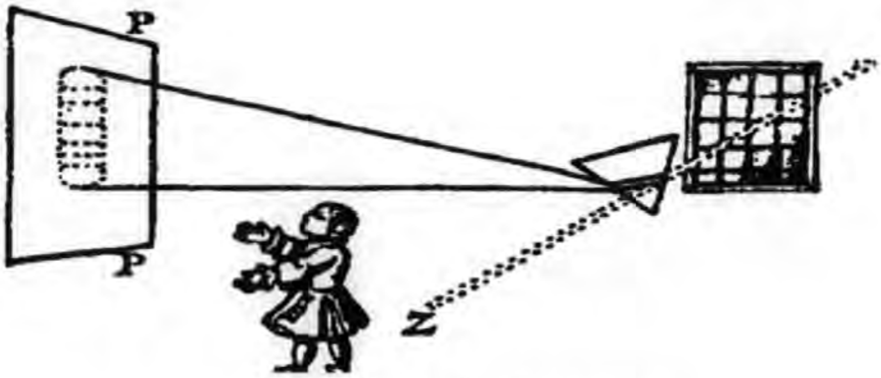
In fluid mechanics the 'Reynolds number' (See O. Reynolds, 1883) is a simple way of describing the difference we might experience moving through water or swimming through water. The Reynolds number is calculated as a ration of viscosity to the inertial forces applied to the moving object. In *Why Size Matters* the biologist John Bonner (2006) uses the example of the difference evident in whales and bacteria swimming in water. Bacteria live in a world of low Reynolds numbers; in comparison, the whale's world is one of high Reynolds numbers. Even though the viscosity of water is a constant in both cases, the whale's mass and size give it a far greater momentum than bacteria. The world of bacteria is very different from that of the whale and yet in human terms they appear to occupy identical media or space.

$$Re = \frac{\rho v_s^2/L}{\mu v_s/L^2} = \frac{\rho v_s L}{\mu} = \frac{v_s L}{\nu} = \frac{\text{Inertial forces}}{\text{Viscous forces}}$$

The Reynolds formula.

The difference between our world, the world of the whale and that of the bacteria is a matter of viscosity or density. Bonner demonstrates how the scale of species, their body typology and velocity of functioning are inextricably linked. Bonner demonstrates how the scale of species is directly linked to their velocity, their metabolic rate, intelligence, mass, structure and complexity. Species may appear to occupy the same world, but their engagement with it depends critically upon their scale. People have taken centuries to develop sophisticated ways of understanding the world that has some equilibrium with their understandings of their own densities. People have called this world the 'material'. That which appears to be anything other than material has proved to be much more problematic to explain in human terms. Fixations with the nature and problematic presented by supposedly ineffable phenomena such as the rainbow, spirits, pneumena,[187] vapours, miasmas, will-o-the-wisp or apparitions, for example, have come and gone. Some of these phenomena have maintained their status as being beyond understanding, but others have been included in the canon of science to become understood as refractions (Newton, for example, stripped the rainbow of its theology), gasses, electrostatics or mirages.

[187] The ancient Greeks had a term p*neuma*, which cannot easily be translated today except perhaps as soul or spirit or even breath: 'an underlying essence or life force which ran through all things and animated or illuminated them with Mind' (Ross, 1997).



God's mystery reduced to the spectrum.

Just as some terminologies have passed into history, other new terminologies, tied to more contemporary experiences, have emerged (for example, the virtual) but have proved no less elusive than the imaginations of the past. One of the ways in which people have come to include the ineffable into their existing understandings of material existence has been to extend their understanding of the complexity of the world.

Phenomena, which can appear to be beyond rational explanation or to rupture existing states of reality, do so only inasmuch as people are unable to accommodate them in their existing taxonomies. If reduction to taxonomy and differentiation is eschewed, phenomena can then be interpreted at a level of understanding that is more finite and complete in its own terms of reference.[188] For example, in the Eames's *Powers of Ten*, focus at each 'power' is placed upon a single, scaled, unit of attention; from the atomic, and ultimately to the universal, each scale appears as a discrete whole of its own and is disconnected from the other scales such that we see the cell, the body, the city and the solar system as self-contained entities. The Eames reveal their industrial design instincts in the production of the film. This is a film of artefacts, differently scaled, but nevertheless projected as entities that are coherent in their own terms. The Eames demonstrate that the artefactal world with which humans are familiar occupies but one scale of imagination. If a complete and connected universe is of such complexity and scope to be beyond human conception, then the Eames demonstrate how, by shifting attention across a number of scales, a more complete picture can emerge. They demonstrate how, as

[188] The rainbow, for example, can be understood as the action of particles of moisture on light. It can be more thoroughly understood as the deflection of photons by the more dense electromagnetic fields of collated water molecules.

designers, they can understand and cope with complexity and fluidity, by modifying their analysis appropriately to deal with larger, or smaller, units and then to analyse the interaction between these units of attention. This approach can be broadly described as a granular approach to analysis.

The essential concept of granularity is rather easy to understand. If boulders on a beach are an example of course grains, then pebbles represent a finer degree of granularity and grains of sand a finer degree again. Boulders, pebbles and grains reveal a surprising coherence in their form when they are viewed in scalar comparison. Without some other indication or analytical aid it is often difficult to tell an image of one from another.

It is a well-established concept of chaos theory that forms are repeated across degrees of granularity. There is similarity at differing degrees of inspection. For example, the shape of an individual rock pool frequently mirrors in miniature the stretch of coast where it is found, and the stretch of coast in mirrors the larger geographical outlines of the land masses it borders (see Green, 1995).

Rock pool (left) coastline (right)

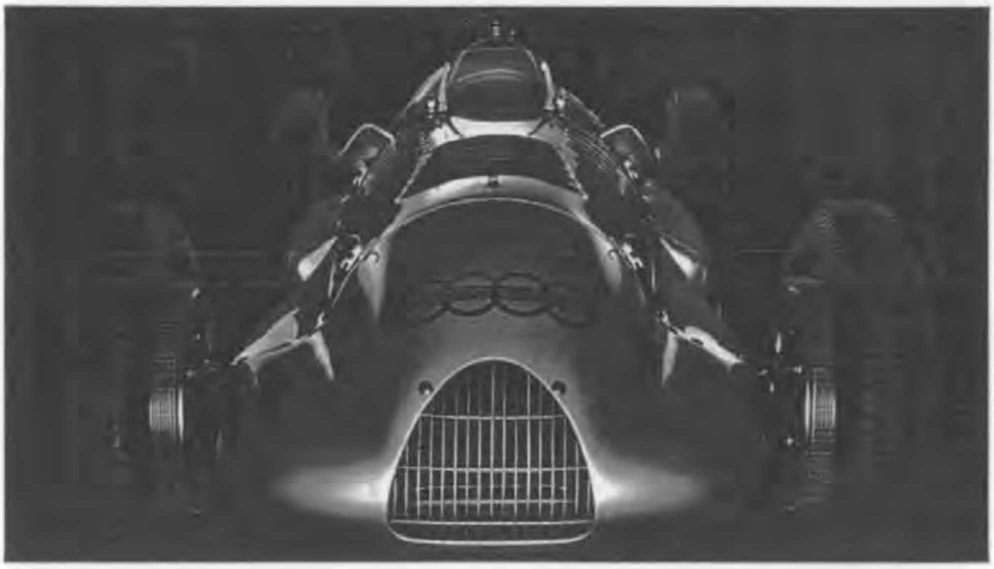
Similarity can be found in many occurrences. The illustration below could be of many, many things: a tree, a river delta, a data system, a family tree, a management system, a vascular system, a conceptual plan of animal phylum or a goods distribution system, for example.

In the field of information management, granularity is a term that is employed to refer to '.the degree of detail or precision contained in data' (Veryard, 2005). In this context granularity can be applied across several dimensions, time and space. In physics, granularity refers both to the scale of material under analysis and to the degree to which concepts are understood. In computation, granularity can refer to the size of data outputs and the degree to which a system communicates data. Granularity in financial conversation can mean the degree of risk associated with stocks; where talk is of 'perfect granularity', that is the perfect balance between risk and return (see Basel, 2006). The ultimate end of granularity in information systems analysis is referred to as atomic data - that is, the point at which data may no longer be broken down into smaller and useful constituents. Fodor (2007, pp. 9-10) points to the technique in science of explaining laws of nature by referring to the constituent laws that are basic to them:

> So, roughly, the laws about molecules explain the laws about liquidity; and the laws about atoms explain the laws about molecules ... and so on down, but not so on down for ever. Eventually, we get down to laws about whatever the smallest things are (or, perhaps, to laws about the fundamental structure of space time); and there we simply stop.

Fodor argues that much of the search for fundamental truth in science can be understood as a seemingly endless search for smaller and smaller detail. Successive generations of scientist, he suggests, proclaim that they have reached the ultimate truth until another generation breaks that into still more finite entities. Increased knowledge then leads to increasingly granular understandings of the whole. Granularity is not merely a rhetorical trope; it has a profound impact upon the way in which humans interact in the world, and has profound resonance in the designed world. For example, we can take two examples of an industrial design solution to high-specification car racing: an 'Auto Union' from before the Second World War and an almost contemporary 'McLaren MP4-21'. Both of these racing cars were considered in their times to be at the pinnacle of sporting potential and technological knowledge, particularly in the field of aerodynamics. The Auto Union was designed by those who had learned, largely by trial and error, in the early aircraft industry and demonstrated, in its time, evidence of an advanced knowledge of aerodynamics. It still bears some comparison with the contemporary knowledge of aerodynamics demonstrated in the McLaren. This car, in keeping with its times, is significantly more advanced than what seems in comparison to be the informed speculation of the Auto Union. Given the highly commercial and competitive climate of contemporary Formula One racing, it comes as little surprise to learn that a contemporary racing car is rather dispassionately designed and managed by a distributed cognition of dedicated and scientifically trained advanced engineering graduates working with the aid of simulation technologies and a computer-controlled wind tunnel equipped with sophisticated measuring and simulation equipment.

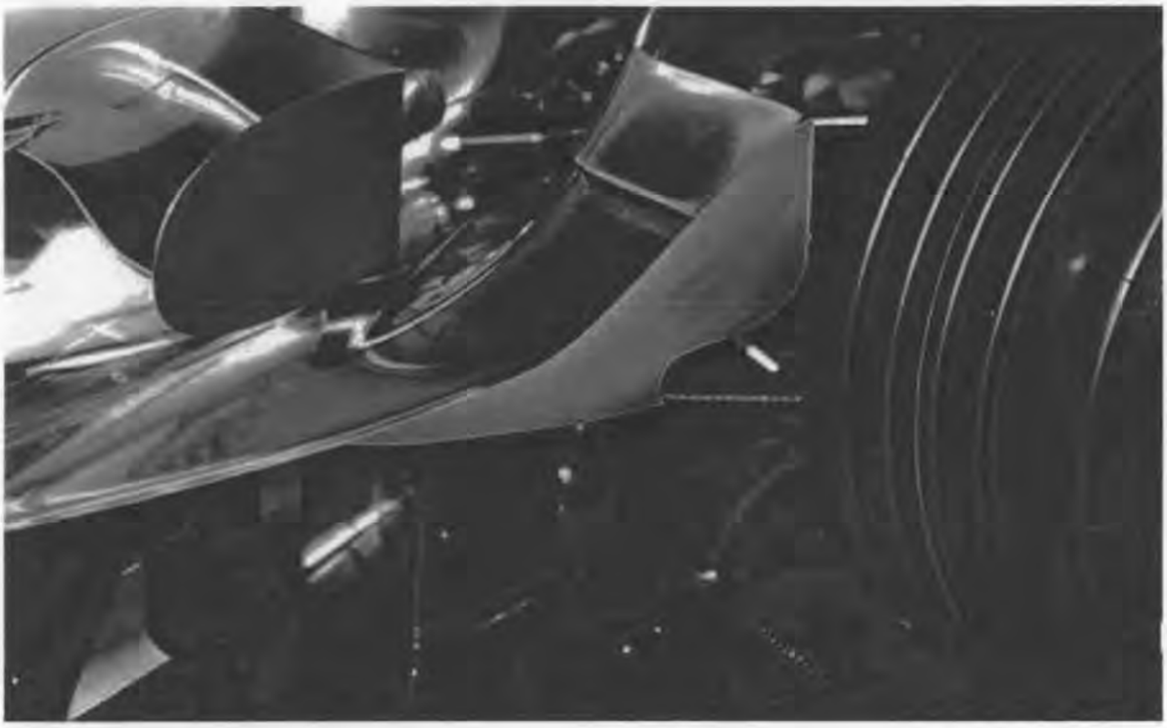
If these varying degrees of knowledge of aerodynamics are considered in terms of granularity, several things become apparent. The Auto Union is largely solid; its bodywork is smooth but coherent as a single mass. The contemporary Formula One car does not look like this. Its bodywork is fractured and distributed; the rear of the McLaren appears to be shattered, as if it were tearing off from the body of the car. The ambition of aerodynamics, of course, is to handle the flow of air either to provide as little resistance to it or to handle it to the dynamic advantage of the car. The dynamic advantage is exploited in order to force the car onto the road, for example, or to create a vortex of highly complex air at the cost of a following car. The McLaren demonstrates a significant degree of sophistication in this respect; the detailing in comparison with the Auto Union is intensely finite. Tiny winglets on the McLaren control the flow of air; the Auto Union merely allows its flow. In terms of aerodynamics, the McLaren is as complicated as the knowledge of aerodynamics that underpins its design



Auto Union Type C Racing Car, 1934.

McLaren MP4-21 Formula One racing car. 2006.

When the McLaren is considered as a functional object penetrating the air, the bodywork is coherent with the complexity of the air it encounters. The bodywork on the nose of the car is smooth and simple; it is not dissimilar to the Auto Union. The air encountered here is simple; it is probably relatively static. In terms of granularity it can be considered (at least in this example) as a single body of air. As the air flow across the body of the car is disturbed by the volume of the car and the necessary mechanical components of the suspension, the driver space, air inlets, brake ducts, radio aerials and rotating wheels, it becomes increasingly complex. The Auto Union reflects the complete absence of knowledge of this complexity. The McLaren engages with the complexity of the airflow and the bodywork is designed to match that complexity in its terms. The front of the McLaren is designed with still air in mind. Should the car encounter the complexity of the air in the vortex of another car, then the aerodynamic complexity overpowers the rather more simple front end of the McLaren.[189] Year on year, regulations allowing, this complexity increases and bodywork detailing and the winglets become smaller and smaller. Given the current trajectory, it is quite possible to imagine that air will eventually be handled at a molecular level.[190]



Rear and side winglets and ground effect diffuser. Note the tiny serrated edge on the floor diffuser, the purpose of which is purposely to trim the air to meet the grooves of the tyres.

In granularity there are some common threads: granularity implies that manifest complexity and uncertainty are a consequence of a particular degree of inspection. Granularity implies that there are many views possible of a particular condition or phenomena and that the complexity of understanding of that condition or phenomena is dependent upon the degree to which it is inspected.[191]

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[189] This is, of course, the cause of the problems Formula One racing has with the lack of the spectacle provided by overtaking.

[190] There are, even today, anecdotal rumours among the Formula One fraternity of the development of specialist aerodynamic and structured paints for just such an opportunity for advantage.

[191] This works with racing cars as well as with pebbles and sand, rocks and land masses, stock and shares, computer systems and, as it has been argued, complex systems such as gas clouds and flocks of birds.

As the relationship between humanity and technology is coming to be understood in a highly complex way, then the notion of the human and of technology, rather than being fluid, must be understood to be open to analysis at any number of degrees of granularity. In industrial design histories, technologies appear to demonstrate a striking similarity in form. The technological objects on display, contained within a very limited range of scale, demonstrate similar clarity of outline; they are of similar density. These technological objects are shown in a way that obscures the full complexity of their place in culture and the full complexity of their interaction. In racing-car terms, the apparent degree of complexity on display is out of step with the complexity of the 'intellectual air' they inhabit. Objects in industrial design are represented in a way that was designed to travel through the smoother metaphorical air of a far simpler logic. The Auto Union is designed to punch through the air. It does this by the force of its engine and by an attempt, as best it can, to minimise the resistance to the air. It could be argued that the Auto Union represents an early stage in development where it was realised that the best way to get a vehicle through the air was not simply to multiply the force against it, as earlier racing cars might have done, but to compromise with it. While the Auto Union must be forced through the air, its relatively unsophisticated aerodynamics allows a relatively easy passage around it; the bodywork works with the air to a degree. In the McLaren the bodywork and the air interact at an intensely finite resolution. The air passing across the surface of the McLaren works for, rather than against, the efficiency of the car.[192]

[192] Without its aerodynamic effect upon the air, the car could not transfer its torque to the road and would simply fly off the track as soon as an attempt was made to change direction.

The McLaren is complex because the understanding of aerodynamics is similarly complex; the form of the McLaren is coherent with the complexity of that understanding. Industrial design is now situated in an 'intellectual air' that is understood to be more complex than its projection and analysis technology as artefacts can allow. While designers now understand that artefacts are situated in, and emerge from, a complex dynamic meshwork of forces, their historical projections of the trajectory of the process of humanising technology cannot reflect that complexity. Sustaining narratives of industrial design project a limited trajectory of a particular form of technological artefact.

It is arguable, then, that designers have come to understand the human in artefact terms at a similar scale to the technological artefacts their histories project. The interaction of humans and technology as heterogeneous entities has appeared coherent when imagined at that scale as an interaction of material artefacts. When humans are considered as social and cultural constructions, they are considered at a degree of significantly greater complexity. In this analysis it becomes difficult not to think of humanity and technology in the same terms, and to be human has come to be considered a hybrid condition. This need not, however, be confined to the social and cultural model of the human.

A moment of active technicity - for example, such as using a cup to drink - may appear to be resolved because at first sight the cup must have a certain scale and granularity, otherwise it cannot function to hold water. But the logic of accelerated complexity and increased granularity holds. Cups are no longer made of lead, or for that matter the plastics they once were, because the complexity of their technicity has accelerated to include the analysis of the migration of the atoms of these cups into the water and thence into the human body. As cells and atoms are placed at the centre of our conception of the world, it follows that the instinct will be to focus our attention upon this degree of granularity in wider theorisation. A plastic cup may appear in an industrial design history as a resolved object, but the designer intent to put a particular design of cup into production must now consider it at the molecular level. Contemporary designers now think in terms of how materials might decay over time or be recycled. Where once the cup might have begun and ended at a suitable shape and material for function, the cup is now understood by industrial designers to extend into a degree of granularity that posits it as a focus of an interconnected complexity. The conversation has shifted away from the simplicity of the cup towards the migration potential of phthalate plasticizers (see, for example, BRPIA, 1998). Industrial design histories can only represent this complexity in a single consolidated cup that lacks the dynamic granularity necessary for its analysis. It is perhaps viable, then, that the designers of the future might graduate from emerging training institutions such as the Centre for Molecular Organisation and Assembly in Cells at the University of Warwick (See MOAC, 2007). These 'designers', however, do not yet benefit from the experience of twentieth-century industrial design's intellectual heritage.

The cup, we are now aware, is a container of the chaos of the determinant forces and interactional couplings that go about it. When considered as a focus of complex determinant forces, the cup is revealed as an unstable concept.[193] It might seem, too, that the cup is fixed across time as a realisation of technicity. Of course, in one respect this is the case. Cups contain liquid. They must have a certain physical characteristic in order to facilitate their purpose. At first sight and notwithstanding the chemical analysis described above, the cup seems to have a largely stable physical manifestation across history. When the full meshwork of determinant forces that go about the cup are included in its history, the artefact, the cup, becomes an increasingly unstable concept. We can see this in a trajectory of cups as valued commodities. The plastic vending-machine cup is used and then immediately thrown away or recycled. The plastic vending-machine cup is momentarily owned. It has almost no referent in *Vorhanden* and is instead almost entirely *Zuhanden*. It is picked and used in a manner almost that is entirely anoetic. The plastic vending-machine cup is lighter and uses less material in its construction than any of its ancestors. It just brings water to the mouth, a momentary coupling stripped almost entirely of its complexity in a manner that has closer historical

[193] This view holds true when the cup is considered as a totality of the complexity of its physical characteristics, as a particular collection of electromagnetic determinant forces and a coming-together of fundamental particles.

resonance with the cupped hand than with the chalice, the porcelain cup or the earthenware beaker.

Attempts to understand this developing transformation are almost always confined to an analysis of the determinant forces that drive the production and consumption of the cup, and it would be easy at this stage to assume the plastic cup to be the latest incarnation of this long history and to claim that it indicates some transformation in the social history of drinking. This might well be insightful and might tell some truth in itself. But this alternative reading alerts us to the potential for industrial designers readily to engage with prevailing intellectual shifts, even if they are not necessarily aware that they are making such a move. The process of humanising technology then should not imply that technology is changed to make it *more* human, but rather that technology is understood in a coherent manner with the degree of inspection and analysis that is applied to the technical understanding of the human in any given intellectual climate. Humanising technology can be understood as a process where coherence is maintained between prevailing degrees of granularity applied across an unbounded technical interaction and not merely set in an entirely cultural and social frame.

8.2 Artefactualising the body

Joe and Josephine: The human body is understood by industrial design to be a resolved and material artefact, thus providing a form of hysterical continuity for industrial designers in the face of earlier, similarly hysterical attempts to understand the implications of the holsomatic human.

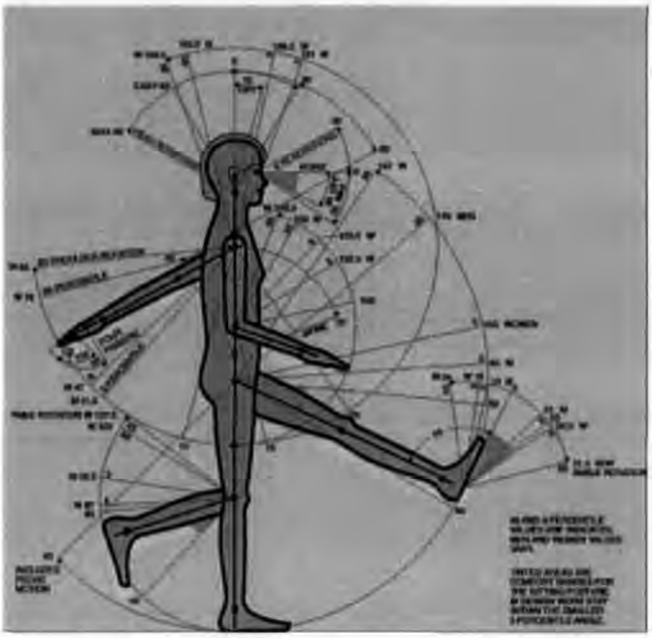
Perhaps the two greatest and most familiar members of the industrial design community are Joe and Josephine, introduced to the community and to the wider world by Henry Dreyfuss. Although industrial designers may not know their names, they are familiar with every dimension of Joe and Josephine's naked bodies. They are the archetypal humans that they use in the design of the material world.

> Joe and Josephine are austere line drawings ... [they] are not very romantic-looking, they remind us that everything we design is used by people, and that people come in many shapes and sizes and have varying physical attributes. (Dreyfuss, 2003, p. 26)

Joe and Josephine are drawn with hard outlines, demarcating the edges and borders of their bodies. A number of movable versions of their bodies were made, which designers could draw around in order to fit the human bodies they represented into the cars, aircraft seats or domestic setting they were constructing. Over time a number of additional Joes and Josephines emerged, fatter, thinner, older or disabled, to meet the empirical and physical demands of a diverse population. But this remains a contentious area, because Joe and Josephine are representations of a mean.

> The way they created Joe and Josephine was to make thousands of measurements of Americans and then simply come up with an average figure for everything from size to reach, strength to agility. At the time this was a great leap forward - actually designing objects around people was a novelty, with most machines designed by engineers more interested in what was easy to make rather than what was easy to use. But the process of designing for the middle, the average person, has driven mass marketing and mass consumerism ever since. (Miller et al., 2004)

Joe and Josephine were instrumental reductions of data and provided a strategic device by which Dreyfuss could construct a logic for design. Joe and Josephine were not entirely objective. Dreyfuss (2003, p. 27) describes them as having 'numerous allergies, inhibitions and obsessions'. While the anthropometric data that surrounded them provided an ostensibly empirical suite, Joe and Josephine remain subjective strategies too. They 'react strongly to touch that is not comfortable or unnatural; they are disturbed by glaring or insufficient light and by offensive colouring; they are sensitive to noise, and they shrink from disagreeable odour' Dreyfuss provides no empirical data in this respect, nor any real attempt to think about the implications of class and culture in such 'inhibitions and obsessions'.



A typical 'Joe and Josephine' type reference drawing.

There is a line in Dreyfuss's description (2003, p. 42) that demonstrates his awareness of the uncertainty of the human: '*it is apparent* that the industrial designer's task is twofold - to fit a client's wares to Joe and Josephine's anatomies', and to explore their psychology and try to lessen the mental strains of what Dreyfuss refers to as a 'pressure age'. Dreyfuss makes a tentative foray into the territory of life lived in the pressure age when he concludes by suggesting new problems to be 'emerging on the horizon'.

> Travellers in jet transports, where the speed is greater than the sound of the engine, say the quiet disturbs them. Accustomed to the interminable drone, they find they become uneasy at the *sensation of floating* noiselessly, vibrationlessly, through space. (p. 43)[194]

Joe and Josephine represent a model of how a potentially uncertain entity, such as the human body, can be made to fit into a defined system. Joe and Josephine stand as representatives of their time and as a model of humanity that remains useful. While even their critics recognise their value, Joe and Josephine have come to be seen as somewhat problematic. Myerson voices his critique in part because Joe and Josephine fix a normative model of humanity in the minds

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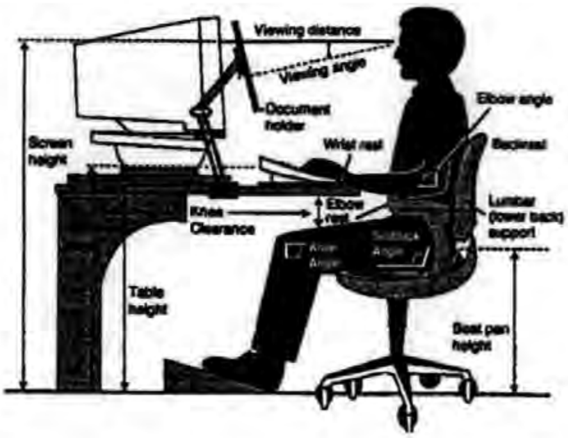
[194] Dreyfuss has no means whatsoever of accounting for this strange experience of flight; perhaps after fifty years it is time for industrial design to understand this mystery and to reconnect the relationships between the mechanical body and the psychology of being-in-the-technological-world.

of designers. This reiterates the claim made here that artefacts reinforce a normative model of materiality in the industrial design community. Joe and Josephine present a model that rather poorly represents the broad physiological spectrum of humanity. Joe and Josephine are rather poor at representing the scope of the disability and inclusive design community, for example. We recognise today the political implications of Joe and Josephine's narrow physiology.

Joe and Josephine cannot describe the human in full, and, of course, Dreyfuss himself points towards a view of humanity that is beyond the simple inscription of their 'austere line drawings'. Their carefully outlined bodies thrust attention onto the visible aspects of physiology. They can convey nothing of the social and cultural nature of humanity nor communicate anything of Dreyfuss's instincts when he talks (2003 p. 27) of the psychological discomfort in reference to their 'allergies'



The artefact model of human technology interaction. The design solution accounts only for the physical material interaction aspects.

Joe and Josephine could be thought of as a form of hysterical reaction on the part of industrial designers maintaining the sense that, while all about it swirls in fluid uncertainty, the human in physical terms as a body has remained stable. This stable model of the human body, however, is constrained by a view of it as bounded, outlined and limited architecturally in space, with an inside and an outside. This model is dualistic, being both located in physical dimensionality and having an entirely unaccounted mental dimension. Set in an emerging intellectual climate that appears to be increasingly familiar with a discussion of the human body at a genetic scale, the model of humanity presented to designers by Joe and Josephine becomes identified as being set as a particular, albeit everyday and easily understandable, scale. Acting, it might seem, on the suggestion of Paul Klee's Creative Credo for example, (1920), that art 'does not reproduce the visible; rather, it makes visible.' Tony Dunne and Fiona Raby create prototypes that demonstrate a degree of serendipity, inviting conversation rather than functional or commercial application. Dunne's Ph.D. thesis (1997) and his subsequent practice with Raby develop a form of 'critical design'[195] that explicitly attempts to make 'the invisible visible' (see Dunne and Raby, 2001, prologue). In *Hertzian Tales* Dunne (1999) describes a number of devices that illuminate the invisible world by transforming its supposedly insensible nature into sensible experience. Dunne's concern may appear to be an attempt to engage critically with the extent to which electronic artefacts extend beyond their materiality as data or energy, but he is constrained by his heritage. The concern to remain within the terms of orthodox design has led Dunne and Raby to feel it necessary to describe their outputs in terms that repeat the hegemony of the material artefact. Dunne, for example, has designed a number of items of furniture and artefacts for 'electrosensitives', highlighting or excluding the 'leaky' qualities of electronics and the pervasive qualities of so-called Hertzian (that is, electromagnetic radiation) technology (see Dunne and Raby, 2001). Perhaps acting in response to their perception of the confusing nature of the immaterial, Dunne and Raby are intent to highlight the blithe potential of the extensive nature of electronic products. 'Artefacts dematerialise not only into software in response to miniturisation and replacement by services, but literally dematerialise into radiation' (Dunne and Raby, 2001, p. 127).

> This table reminds you that electronic artefacts extend beyond their visible limits. The 25 compasses set into its surface twitch and spin when artefacts like mobile phones or laptop computers are placed on it. The twitching needles can be interpreted as being either sinister or charming, depending on the viewer's state of mind. When we designed the compass table, we wondered if a neat-freak might try to make all the needles line up, ignoring the architectural space of the room in favour of the Earth's magnetic field. (Dunne and Raby, 2001, p. 128)

When Dunne (1999, p. 62) suggests that 'all electronic products are hybrids of radiation and matter' , he reiterates the industrial designer C. Thomas Mitchell (1998, p. 213), who suggested: ' "The product" as a solely physical entity is an illusion of the mechanistic era

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[195] Critical design is an attempt to take a 'critical stance towards mainstream product design. While [those who engage in critical design] seem to keep their distance from the commercial design world, they use its mechanisms to ask questions about their own discipline, technology and society' (see http://www.worldchanging.com/archives/006344.html).

which can no longer be sustained in an age preoccupied with information ...'.However, whereas Mitchell (1988, p. 214) suggested that, in place of the solid product, there should emerge a means to facilitate 'a continuous and non-instrumental thought process, a creative act', Dunne and Raby can be read as an attempt to find a means of continuing the orthodox trajectory of industrial design. Dunne and Raby provide a kind of reflective indexicality for an unindexable world; they delight in the aesthetic potential of the invisible but their reference is explicitly to the material world; their 'designs noir' respond to the serendipity of electromagnetism to create enhanced material experiences of the invisible. 'Materialising unusual values in products is one way that design can be a very powerful form of social critique' (Dunne and Raby, 2001, p. 63). Dunne and Raby's work transcends the usual reductive terminology that is so frequently applied to new forms of design. Their attempts to realise the invisible in material artefacts can be compared in some respects to Krohn's attempts to realise the dematerialised telephone book by Lisa Krohn and Tucker Viemeister referred to here. If Krohn's answerphone with the formalistic allusion to the telephone book is an attempt to resolve the invisible functionality of electronics through cultural reference and to bring the metaphorical into material form, then Dunne and Raby can be read as an attempt to realise invisible and immaterial functionality through material form. Whereas Krohn relies upon a semiotic referent (which becomes lost over time), Dunne creates a new material cultural form. Dunne does not rely upon allusions to a prior cultural referent; he presents new forms, although they rely upon some degree of familiarity: they are tables, chairs or crutches, for example.[196] In sustaining narratives of industrial design, the intellectual endeavour in the development of technologies is made concrete in artefacts. Dunne and Raby can be included in this trajectory because their materialisation of the invisible reinforces schematic assumptions in which complexity is materialised into an artefact as a resolved projection of the culturally constructed human. The human in Dunne and Raby's analysis is not entirely a cultural construction, but it draws implicitly upon the model presented by Joe and Josephne. There is no model so well established in industrial design of the human body as that of Joe and Josephine, set at a supposed scale of materiality, but it is only one model, not a truth in itself. Joe and Josephine present one model, fixed in one topological domain that appears to be almost entirely out of valence with molecular analysis.

[196] One criticism that might be levelled at Dunne and Raby is that the objects they produce are almost entirely unnecessary other than as whimsical novelties. They are critical designs, of course, but present forms that could be regarded as toys for people who have the financial capacity to engage with the world in this way.

In 'Virtual Reality and the Tea Ceremony' Heim (1998) argues that the ceremony (rooted in this example in Buddhist tradition) is a technology for affirming nature, 'employ[ing] highly artificial means to return humans to a deeper intimacy with nature' (p. 163). Heim argues that the tea ceremony is a sophisticated technological intervention in the process by which the absent becomes immanent. Heim, however, can only imagine the human to be a fixed place of cognition. This is most evident when Heim describes the computer as a shrine, a place to enter a virtual world in which the body is largely redundant. This is a reoccurring theme in many engagements with virtuality. Towards the conclusion of a 1993 interview of Paul Virilio by Andreas Ruby (Ruby and Virilio, 1998) the discussion turns to the disparity between the world as it is perceived as 'relative' to mechanical experience and the 'absolute speed' of electronics. Ruby refers to the research of James Gibson citing his studies into dive-bomber pilots. Gibson's research (1950) is discussed as if it contradicted notions of space as a continuous occupation and instead posited the idea of perception as a sequence of discontinuous vistas. Virilio affirms this by linking the somatic need to blink with the perception of sequence.

> There is a sequentialisation [*sic*] taking place even in our gaze: twinkling with the eyes. If you cannot twinkle[197] you get mentally ill. Taking off the eyelids was a notorious torture in the old Chinese Empire. (Ruby and Virilio, 1998, p. 186)

Gibson's research serves Ruby and Virilio's conversation rather well and illuminates the potential for the role of the body in the formation of human experiences of space, time and place. The conversation, however, is based upon a view of a neuroscientific study from half a century ago it. It reduces the complex role of somatic systems to a reinforcement of the claim of perception as a series of sequential images. In *Polar Inertia* (Virilio, 2000) the body is similarly reduced to a static hub, a Husserlian 'zero' into which the world arrives and is processed through cognition. Virilio here refers to Husserl's attempts (1991, p. 315) to identify a 'zero-point orientation', which Husserl proposed would represent the point of origination of all experience, the point from which all accounting starts. Virilio sets the body up as something of a shell, a repository of information, opening space for a perceptual inhabitation of the external world. Virilio (2000, p. 125), extending a cyberspatial view of

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[197] (Sic) Twinkle is, I think, a mistranslation of 'blink'.

electronic mediation as a vista, claims that we no longer *occupy* space as Kant has led us to believe; we now *witness* it. This is an antiquated and limited notion of cognition tied about a notion of materiality to which the body seems bound. After all, William Gibson (1995) told us that, in cyberspace, 'the physical body [is] left abandoned, discarded and obsolete'. This points to an understanding of the body itself as a resolved and bounded artefact.

The enactivistic theories Dourish calls upon towards the conclusion of his argument broadly suggest that our understandings of the world are embodied in our social and cultural history. So, while ostensibly making an enactivist claim for the vitality of the body, by calling upon a cultural cognitive model of interaction Dourish diminishes the role of the soma. It is worth investigating why Dourish might be reluctant to make this move. It is arguable that Dourish reflects the politically conflicting attempts to resolve life in the industrialised society that shaped the intellectual thrust of the early to mid-twentieth century, which can be very broadly understood as a battle between 'a primarily Marxist project to *overcome* technological self-alienation dialectically and a potentially fascist desire to elevate this self-alienation into an absolute value of its own' (Foster, 2004, p. 114). There is, of course, much scholarship on both sides of this debate, but few attempt to connect the argument to more contemporary concerns. Foster (2004) provides a concise and scholarly account of attempts to connect this time with a new sense of corporeality. Morus (2002) and A. Mackenzie (2002) make some mention of this intellectual period in their analyses, too. Whereas Morus looks to that time as a nascence of cyborg theory, Mackenzie looks to it as a formative ideology that underpins the later poststructural thinking in more recent Deleuzian arguments. The enactivist argument that Dourish makes bears some comparison with the argument made for the 'new ego' by Percy Wyndam Lewis and the Vorticist movement. The Vorticists can be understood as a rather British compromise, neither Marxist nor fascist. The Vorticist movement presents a deliberate attempt at alienation sometimes associated with some rather intellectually illiberal ideas. One way of understanding Wyndham Lewis is as a form of 'essential humanist'. Like other humanists, Wyndham Lewis accepts, and welcomes, the idea that humans are antagonistically situated in nature. His short, somewhat tongue-in-cheek poem 'BLESS the HAIRDRESSER', published in 1914 in the Vorticist magazine *Blast*, provides some evidence of this.

BLESS the HAIRDRESSER

He attacks Mother Nature for a small fee.

Hourly he ploughs heads for sixpence,

Scours chins and lips for three pence.

He makes systematic mercenary war on the

WILDERNESS.

(Blast 1. published in 1914)

'BLESS the HAIRDRESSER' is playful of course, but there is some significance in Lewis's association of the neurologically inert soma with the extrinsic wilderness of nature. Foster paints Marinetti and the futurists and Lewis and the Vorticist movement in similar political colours. This is not entirely fair. Where Marinetti and the Futurists had glorified in the ultimate cleansing of the sensibility of humanity in the face of a new machinic existence,[198] Wyndham Lewis can be understood to be searching for something rather more subtle. For Wyndham Lewis, the human still exists but the corporeal materialisation of the body is a site of transformation. For Wyndham Lewis (1914), humanity transcends the 'actual human body':

[198] MANIFESTO OF FUTURISM: F. Marinetti, 1909. 1. We want to sing the love of danger, the habit of energy and rashness. 2. The essential elements of our poetry will be courage, audacity and revolt. 3. Literature has up to now magnified pensive immobility, ecstasy and slumber. We want to exalt movements of aggression, feverish sleeplessness, the double march, the perilous leap, the slap and the blow with the fist. 4. We declare that the splendour of the world has been enriched by a new beauty: the beauty of speed. A racing automobile with its bonnet adorned with great tubes like serpents with explosive breath ... a roaring motor car which seems to run on machine-gun fire, is more beautiful than the Victory of Samothrace. 5. We want to sing the man at the wheel, the ideal axis of which crosses the earth, itself hurled along its orbit. 6. The poet must spend himself with warmth, glamour and prodigality to increase the enthusiastic fervour of the primordial elements. 7. Beauty exists only in struggle. There is no masterpiece that has not an aggressive character. Poetry must be a violent assault on the forces of the unknown, to force them to bow before man. 8. We are on the extreme promontory of the centuries! What is the use of looking behind at the moment when we must open the mysterious shutters of the impossible? Time and Space died yesterday. We are already living in the absolute, since we have already created eternal, omnipresent speed. 9. We want to glorify war - the only cure for the world - militarism, patriotism, the destructive gesture of the anarchists, the beautiful ideas which kill, and contempt for woman. 10. We want to demolish museums and libraries, fight morality, feminism and all opportunist and utilitarian cowardice. 11. We will sing of the great crowds agitated by work, pleasure and revolt; the multi-coloured and polyphonic surf of revolutions in modern capitals: the nocturnal vibration of the arsenals and the workshops beneath their violent electric moons: the gluttonous railway stations devouring smoking serpents; factories suspended from the clouds by the thread of their smoke; bridges with the leap of gymnasts flung across the diabolic cutlery of sunny rivers: adventurous steamers sniffing the horizon; great-breasted locomotives, puffing on the rails like enormous steel horses with long tubes for bridle, and the gliding flight of aeroplanes whose propeller sounds like the flapping of a flag and the applause of enthusiastic crowds.

> The human form still runs, like a wave, through the texture or body of existence, and therefore art. But just as the old form of egotism is no longer fit for such conditions as now prevail, so the isolated human figure of most ancient Art is an anachronism. THE ACTUAL HUMAN BODY BECOMES OF LESS IMPORTANCE EVERY DAY. It now, literally, EXISTS much less.

Vorticism is widely understood to have emerged from the trajectory of British art, but stands in opposition to many of their contemporaries and to tradition.[199] Wyndham Lewis shared the Futurist sensibility in that he found in the machine age a beauty and excitement that most of those about him seemed intent either to ignore or to resist. In *Project for a Scientific Psychology* (see Freud, 2006) Freud had suggest that the ego is shocked by sudden shifts in the mechanisms by which it is bound and unbound from the body. The problem with life in industrialised society, Freud suggested, is that it is subject to continuous shock. Resistance to this shock merely numbs the ego, leading it to atrophy. Marinetti (1909) argued that technology had the potential to enable a new body 'endowed with surprising organs: organs adapted to the needs of a world of ceaseless shocks'. Marinetti foresaw humanity dissolving in this new age to become a new machinic reality. Where those artists and designers who allied themselves to the Futurists argued to overcome the stagnation of resistance to technological development that they detected in Marxist dialectic (or worse still the stagnation of bourgeois decoration), the Vorticists understood the intellectual concept of the ego as residing in the centre of a vortex of being. Wyndham Lewis was opposed to the erasure of humanity. He foresaw the human at the centre of an unbound being with an energised technological soma swirling around *his*[200] ego. This being would extend the human further and further into the universe, but always remaining centred on an essentially consolidated ego, bound in some fluid manner to the material body. Resistance to technology was understood as 'a vampire sucking the town's heart and as a gloomy circus. It stirs sentimental, nostalgic feelings which stifle the new generation' (*Blast*, 2006). The new ego would be a new sense of being that could thrive within a new machinic nature and can be understood as a nascent attempt to

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[199] In contemporary terms, Wyndham Lewis had been a Graphic Designer and a somewhat junior partner in a design agency, 'Omega Workshops', which he left somewhat acrimoniously to form his own studio, The Rebel Art Centre, which stood against the supposedly traditional and decorative values of Omega. The Omega Workshops was formed by the artist and critic Roger Fry and can be considered as part of the Bloomsbury set, designing many of their outputs and creating the aesthetic that typified Omega.

[200] Both Marinetti and Lewis were misogynistic and found the new condition to be essentially masculine, although Marinetti was more explicit in his hatred of women.

understand life as something that was embodied and enacted outwards, rather than resolved outside the body and transmitted to it via the senses. While Wyndham Lewis accepted the humanist notion of the separation of being from the world, he nonetheless set the ground for the understanding of the human as a construction of an embodied interaction.[201] Both Wyndham Lewis and Marinetti sought to extend the somatic potential of the body beyond its physical border and to unbind the ego from it. Marinetti (19109 saw in this unbinding a glorious destruction: 'Art is the need to destroy and scatter oneself.' The body had no meaning for either Marinetti and Wyndham Lewis. For Marinetti this was an optimistic sign of transcendence from the vileness of the biological organism. For Wyndham Lewis the loss of the evolutionary body pointed to an inhumanism that must be resisted. Foster suggests that Wyndham Lewis sought to retain his humanity in the new reality of the machine age. Like Dourish, this preservation resides in the protection of the self: 'It's myself I want to conserve' (Wyndham Lewis, cited in Foster, 2004, p. 118).

There are several ways in which the failure of both Marinetti's futurist interpretation and Wyndham Lewis's manifestos can be accounted for. Of course, other political circumstances diverted attention from their logic, and the horrific realities of total warfare rendered much of the posturing untenable. The futurist manifesto and the new Ego can also be understood to be a hysterical over-reaction. This hysteria is evident in industrial design too. On occasions, in the ideas of both Marinetti and Wyndham Lewis, the hysteria is played out in terms that have some broader resonance. In industrial design we can on occasion find an essential delight in mechanism - a truth to functionality and a stripped-down elemental minimalism. The form of the technological artefact during this phase takes on a primordial somatic quality that transcends all but the aesthetic rhetoric of decoration. These are elegant, beautiful but essentially functionalist comings-together of matter. Breuer (2005) spoke of his design for the Wassily chair, designed first in 1925, as 'my most extreme work ... the least artistic, the most logical, the least "cozy" and the most mechanical'.

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[201] That the age of the machine should in some way impact upon the nervous system was well established and for some the nervous system provided the model for how one might understand the new nature. The American writer Nathaniel Hawthorne (1851) wrote that 'it is a fact that by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point of time. Rather, the rough globe is a vast head, a brain, instinct with intelligence.' Freud's psychoanalytic method emerged from the European neurological research of the late nineteenth century. Freud's ideas of the excitation of the nervous system cathexis were set down in 1895 in *Project for a Scientific Psychology* Freud (2006) placed the energetic excitation of the body at the centre of his thesis. At the risk of huge reduction, Freud suggested that the ego, the essential residence of being, was held complete by states of neurological condition, binding (*Bindung*) and unbinding (*Entbindung*) itself from controlling forces. These forces are applied both from within the body and from outside it as sensory or mechanical interventions.

Breuer, Wassily Chair.

Although Marinetti would perhaps have found a weakness in the organism in the need to sit, this chair would surely have pleased him more than its decorative contemporaries. The organic body is suspended in space devoid of any apparent means, and the chair acts as a component of the skeleton, transmitting the weight of the human to the floor devoid of aesthetic, unbinding the ego from the necessity to situate the chair in any stagnant bourgeois association with decorative arts. This chair is a machine for sitting; it enables - what will much later come to be called, by Deleuze, a 'pure machinic becoming', a pure means to enact rest in the soma.

In the intellectual clamour following the Second World War and the fall of fascism as a viable philosophy, it became distinctly problematic to refer to its apologists in anything but the most distrustful terms. Heidegger's problematic association with Nazism (see Sluga, 1993) could be argued to have distanced his phenomenology from the intellectual mainstream, and similarly Marinetti's explicit and enthusiastic association with the Fascism consigned Futurism to a historical siding, appearing in sustaining narratives of industrial design as something of a footnote. The intellectual voice of the Futurists and their battle with ego has become lost from industrial design.[202] Marinetti constructed Futurism without the foresight of the extermination camps. His writing is undoubtably strident; its terminology was aggressive and often rather

[202] Even here in this thesis and in my apparent enthusiasm for the new ego I have found myself questioning my own politics. In speaking about the thesis, I sense a diffident hesitation, lest my argument becomes somehow associated with the extreme right and is imagined as reinvigoration of the Fascist ethic.

brutal in its apparent loathing of the feminine traits he deplored, but it is perhaps a mistake to dismiss his voice as that of a madman. Marinetti can be read as a voice of liberation and emancipation and a call for a new enacted life. In any case, Wyndham Lewis should not be counted among the Fascists. Munton (1997) has argued that Foster does not make this clear enough in his text and that it is wrong to collude Wyndam Lewis with the Futurists' movement. It is possible to suggest, then, that the ultimate defeat of Fascist Europe took with it, along with many million lives, the intellectual impetus of these movements. Wyndham Lewis (1914) took the view that technology, as an innate facet of humanity, could enable the immanent ego to distribute. This would be a process of continual distribution, a new reality that would enhance the quality of being: 'One feels the immanence of some REALITY more than any former human beings can have felt it.' The discussion of the ego in the technological soma has developed rather slightly in the period since the Second World War. (Certainly in comparison to the emphasis placed upon social and cultural understandings of the human and the technological.) The idea of a distributed immanent presence has become somewhat fixed in the hysterical rhetoric of its early discourse and has proved difficult for designers to realise, without resorting to the social and the cultural, where some understanding of distribution has now become an embedded aspect of theorisation. It is arguable, then, that the break in this intellectual trajectory has allowed the paradoxical discussion of modes of resistance to technological being to profligate. In recent theorisations, distributed immanence has become attached to the cultural and the social. It is rather easy now to accept that our lives are shared constructions played out through a meshwork of our friends and associates. Industrial designers, such as Durrell Bishop cited previously in this chapter, have attempted to intervene in this meshwork, calling upon the trajectory of materialised technology with which they are familiar from the narratives that have sustained their intellectual community. The artefacts they produce have tended to be unsuccessful, because they are not coherent across the terms of the understanding of the human as a distributed and enacted immanence - a holsomatic condition.

8.3 Designing with the 'Body without Organs'

In order for industrial designers to find a way to engage with the anoetic, it will be necessary for them to find the means to artefactualise the enaction of the hybrid-human at a subtle degree of granular complexity. Such a granular logic will demand an understanding of the holsomatic human at a granular degree of complexity. At this scale and complexity it will become clear that no meaningful closure of the human is possible.

'Body without Organs' (BwO) is a term taken from a 1947 radio play by Antonin Artaud. In *To Have Done with the Judgment of God* Artaud explored how the realm of the imagination or the spiritual might be considered as 'real' as the physical body. One way to understand Artaud's Body without Organs is as an exploration of an expression of emancipation from the tyranny of political subjectivity. Artaud saw this, in primarily social and cultural terms, as a raising of consciousness and an elimination of the anoetic.

> When you will have made him a body without organs, then you will have delivered him from all his automatic reactions and restored him to his true freedom. (Artaud, 1976, p. 571)

Body without Organs is used elsewhere to develop any number of differing theses ranging from the political and sociological to the cinematic, fetishistic and psychological. However, it is perhaps best known as Deleuze and Guattari's [203] search for a distributed and intensely finite and granular understanding of the body as a fluxating condition rather than a materiality. The term 'Body without Organs' (sometimes colloquially referred to as the BwO) is most commonly understood as it was outlined by Deleuze and Guattari, first in 1972 in *Anti-Oedipus* (see Deleuze and Guattari, 2004) and then expanded more completely in 1980 in *A Thousand Plateaus* (see Deleuze and Guattari, 1987). Deleuze and Guattari take a philosophical stance that views human existence as a distributed and intensely finite collation of singularities; this view extends to their analysis of society, politics, architecture and technology and demands an intellectually intense engagement. The analysis of the Body without Organs can appear almost blithe in its indifference to the confusion of the reader. In some accounts this confusion can arise in the literal translation from the technical language of French philosophy, into English.[204] However, the nature of the Body without Organs demands a subtle and unfamiliar terminology for dealing with ideas that attempt to transcend representation and to attempt to talk in coherent terms within a topological domain rather

[203] Deleuze and Guattari are social commentators, literary theorists, theorisers of cinema, philosophers, agents-provocateurs and the voice of a generation of architect philosophers. They appear rather infrequently in the context of industrial design, although Jamie Brassett (1996) must be considered as a notable exception in this respect.

[204] More recent translations have improved significantly in this respect.

than across scales. Rather than seeking to account for objects as solid signs to be encountered and negotiated, the Body without Organs constructs a bringing-together of the world and body as a continuum (singularity) of fluxating intensities, in terms coherent with their analysis of materiality, where artefacts are understood not as objects but as fluxating moments of intensity in human activity. 'A BwO is made in such a way that it can only be populated by intensities. Only intensities pass and circulate' (Deleuze and Guattari, 1987, p. 160).

'Max as the BwO', by Theo Humphries 2007

The Body without Organs is not simply a nominal philosophical trope, but provides a liberating means of understanding oneself as a distributed entity (A-life) and not as an objectified body. This imagining is possible because the body can be understood to be as complex as that which it negotiates. This is a new kind of body, a distributed and extensive dispersed 'body without an image' (Deleuze and Guattari, 2004, p. 6). To comprehend the implications of the Body without Organs more fully, it is necessary to understand life as a constantly uncertain and intangible self-activating system of infinite complexity. The difficulty then emerges as to how one might talk about non-representation without reference to analogy. The Body without Organs is described by Deleuze and Guattari (1967) as

> not a scene, a place, or even a support upon which something comes to pass ... It is not space, nor is it in space; it is a matter that occupies space to a given degree - to the degree corresponding to the intensities produced. (Deleuze and Guattari, 1987)

Body without Organs is not fixed. Its analysis and description imply a necessity to find a syntax that eschews the construct of the fixed entity at the centre of grammatical construction. Given that much of Western language is constructed in those terms (the term 'humanisation of technology', for example, becomes immediately problematic), the Body without Organs can appear to defy description and to appear as an unattainable condition. This condition is not merely rhetorical but provides an essential *poeisis* such that humans are in a state of becoming. 'You never reach the Body without Organs, you can't reach it, you are forever attaining it, it is a limit' (Deleuze and Guattari, 1987, p. 10). Deleuze and Guattari propose that the Body without Organs is a transcendental,anoetic and infinite condition and that its attainment is to be the true human urge: 'in other words, the unformed, unorganized, nonstratified, or destratified body and all its flows: subatomic and submolecular particles, pure intensities, prevital and prephysical free singularities' (Deleuze and Guattari, 1987, p. 43). The Body without Organs distributes the body into a theoretical condition as the residing host of all species conception of themselves in the universe.[205] If theories of embodiment can be summarised to suggest that human beings are at a loss to think in terms outside their embodied understanding, the Body without Organs reveals human understanding to emerge from an almost infinite organic and inorganic soma. The Body without Organs points to the delusion of imagining that the body is a self-contained and entirely organic object. It follows, then, that distinctions or borders between the objective body and objective technicity are merely matters of rhetorical convenience and a hindrance to the realisation of a truly human trajectory. Kendall and Michael (2001) remind us that the Body without Organs is a further iteration of attempts to understand human-technological relationships, but it could be argued that its implications are far more profound then those emerging from ANT. The Body without Organs eliminates the notion of a relationship between technology and humanity and posits a condition of an emergent becoming, more akin to that described by the pilots cited earlier in this thesis.

> one's nervous system becomes directly linked with the vehicle in a very basic way. If the driver decides to brake, the body performs a complex sequence of manoeuvres with the

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[205] Edwin Hutchins (1995) developed distributed cognition as a mode of cognitive psychology that could extend earlier approaches (such as those of Vygotsky and Piaget, for example) into a more focused concern with the interaction of people with complex systems. If a view is taken that cognition is distributed, it becomes possible to overcome the tendency to reduce people in complex systems to cognitive processing entities. Distributed cognition is not particularly useful as a means of understanding anoetic technologies, because it relies upon representation and metaphor, but it points to an emerging model of the soma as distributed.

brake, accelerator and steering wheel, all acting as sense-extensions. The vehicle becomes body like and responds in body-like fashion to the drivers' thoughts. (Paul, 1967, p. 131)

Paul suggests that the car becomes 'body like'. In terms of the Body without Organs, the self is enacted through the organic and inorganic soma, and no meaningful distinction is invited between the car and the driver. The activity in that analysis becomes a schematic intention and not a mediated interaction of isolated conditions that give a culturally determined delusion of extension.[206] Deleuze and Guattari recognise that people, as individuals, move through/about/within everyday in a way that seems to make sense for them. Deleuze and Guattari suggest that the body, as with other supposed material and discrete artefacts, has been overemphasised for its materiality and for its representative value as a container of chaos. An attempt by design to orchestrate representation is bound to the culture it represents or to the reading of that culture; representations are uncertain and continually shifting. Merrell (2003) has argued that lived and enacted experiences should provide the centre of analysis. He proposes a form of semiotic enaction.

Theorisations of the body and by extension the everyday understanding we might hold of the body are now dominated by representative materialism that attempts resolution across heterogeneity at the expense of the development of a theorisation that accounts for a distributed somatic potential. Deleuze and Guattari argue that the full somatic potential of the body remains unknowable, because so much of its terminology remains abstract and uncertain - a consequence of generations of the domination of materialist logic. In similar terms, Deleule (1992), a one-time colleague of Deleuze, has identified the mark left upon the modern era by the intellectual separation of mind from the body. Sustaining narratives of industrial design encourage a view of technology as a realised artefact that acts as an extrinsic actor with an activity system. It has seemed logical enough, then, for designers to imagine that they

[206] "The belief that one can drive an automobile unconsciously is widely held. A quick web search turned up a number of quotes attesting to this belief. Here are a few. "Have you ever been driving down a highway and all of a sudden snap out of a daydream only to briefly panic as you realize you've been driving unconsciously for quite awhile?" "The laughter faded with the memory as he realized he had been driving unconsciously." "When you drive a car for long periods, you tend to slip into this bicameral state and are actually driving unconsciously." Philosopher Peter Carruthers offers "absent-minded driving" as one example of a "non-conscious experience". Not everyone adheres to this belief. Dennett suggests describing the unconscious driving experience as "a case of rolling consciousness with swift memory loss" (Dennett, 1991. p. 137). ...The absence of enduring memory for such events can lead to the illusory retrospective impression that one has somehow been driving 'unconsciously' (1999)." ...on one's arriving at work, the driving experiences can't be recalled." (Franklin et al, 2004)

can intervene in this process in order to shape human social interaction through the form of the artefacts of technology they design. However, when, after Merleau-Ponty (2003) and others, life is understood to be a consequence of an intrinsic enaction in the world, the process of design is returned to a focus upon that individualised enaction and the distribution of the immanent self. The design process, rather than acting on an impulse to regard life as a structured response to extrinsic conditions, as much theory appears to accept, could turn its attention to, and place emphasis, in the process of humanisation upon individualised experience as an immanent condition of being. This would demand an understanding that is free of the limitations of representation and a revised molecular somatic understanding.

The artefact is situated in a complex meshwork of effable and anoetic relations. If its histories are to be believed, industrial design has limited its attention to the visible effable materiality of technology as it appears to be resolved in the form of artefacts. The engagement with that which is not visible and effable is ahistorical. The lack of critical tools for the analysis of the supposed *Immaterial* became a concern of the artist Yves Klein. In *Zones of Immaterial Pictorial Sensibility* Klein presented an empty space for exhibition: 'the artefact that creates the dialogue between the viewer and the exhibit is removed (i.e. the painting or sculpture). Instead, one must interact with the void and recognize that the elimination of artefacts is the thing that is on display' (J. Grant, 2006). Klein presented a deliberate attempt to grapple intellectually with the possibility of grasping the infinite complexity of culture without reduction to the artefact. One consequence of this presentation is that those who 'encountered' Klein's project were forced to attend to their own presence in the void. The histories the industrial design community constructs of itself generate a view of how the world can be analysed through material artefacts and project a schematic construct of the artefact as a resolution of wider cultural and social conditions. There is, then, no history of the humanisation of technologies that are in a condition of materiality outside the scope of the topological domain of the familiar artefact as it is manifest in orthodox analysis. It has been argued that this way of presenting a history reinforces the notion that industrial design engages with a particular degree and scale of solidity and visual materiality. Technologies that do not display this scale and solidity or density, such as radio, appear outside this scope and *appear* to demand a *new* kind of analysis.

While only a tiny proportion of the extraordinary extent of media studies and virtuality literature that has been published in the last twenty years of the twentieth century can be surveyed, the proliferation of those publications demonstrates how so much of the attention of cultural analysis has been focused on the struggle to engage with conditions of supposed invisibility tied to the materiality of these technologies. Digital media and radio technologies present an active, although apparently empty, space. Terms such as 'the virtual' and 'media' have sometimes been used to create a kind of semi-present metaphorical artefact that occupies otherwise orthodox artefact-free spaces. The virtual has appeared as a rich site for analysis. One way of understanding the virtual is as something 'other' than the artefact and something other than space. The otherness of virtuality brings with it a sense of alienation or marginalisation. Virtual space is mediated and controlled. It is politically loaded and mutable, mysterious, mythological and prone to a degree of subjectivity that renders its discussion complex and uncertain, and so much of its analysis reflects the supercomplexity of material cultural analysis with added political, psychoanalytical and conjectural logic framed about the uncertain (see, for example, Cambell, 2005). Many attempts at analysis set up the real and the virtual as a dichotomy of the material versus the immaterial. Since industrial design is understood to be located about materiality, it is understandable why those considerations of design that lack precedence in materiality or are explicit in their engagement with the immaterial might be regarded by industrial design theorisations as evidence of a critical shift or rupture in the orthodoxy.[207] It has been demonstrated, however, that it is possible to take a view that materiality is only a matter of the complexity of its analysis and that heterogeneric otherness is a rhetorical trope. When designers think like material cultural theorists and then find themselves confronted by technologies that have no apparent materiality, in those terms, they have nowhere to turn other than to alienating modes of analysis that the immaterial appears to demand.[208] Some designers, however, have contrived ways of realising the immaterial or the invisible by making it material and visible.

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[207] It is arguable, then, that the lack of designers' attempts to make immaterial technologies as quotidian as machine technology has played its part in the projection of these technologies as extraordinary and evidence of shifts and fractures in postmodern and post-industrial society. The fracturing that is widely felt and the mutability of cultural certainties may then be evidence of a lack of design's intervention.

[208] The struggle to come to terms with the immaterial nature of emerging technologies has, in its own lexicon, become a hyper-rhetorical ideology. The discussion of that which is not material abounds with confusion and disjunction, tangled further by so many academic texts striving to find a footing in the fractured face of the complexity of postmodern and uncertain times that are supposed to have emerged in consequence of technological change. While presenting a continually shifting and increasingly complex picture, a codified mode of analysis for an age of super-complexity has emerged that presents the

The 'Tangible Media Group', established in 1995 in the 'MIT Media Lab' (see Tangible Media Group, 2005), explores what might be learned in Human Computer Interaction (HCI) from the ways in which people interact with artefacts, the intention being 'to develop inquiry processes and to gradually build a repertoire of familiar devices and operating principles' (Brereton, 2001). This research can be thought of perhaps as something akin to the antithesis of the Body without Organs. The members of the Tangible Media Group are among the most widely published of researchers who purposefully set out to transgress reality and virtuality, the material and the informational. (See, for example, Fitzmorris et al., 1995; Ishii and Ullmer, 1997; Ullmer et al., 2000; Bellagas et al., 2003; Koleval et al., 2003; Klemmer et al., 2004.) This burgeoning field of research is concerned with the design of interactions *between* the human and the computer by building upon reference to the kinds of pre-existing models of interaction. These models are built upon an idea of the enaction of the human in the world through the interaction with the culturally familiar artefacts historicised through the trajectory of technology. These artefacts are imagined in a topological domain that reinforces a particular scale of physicality of the human soma. Taking the lead from Hiroshi Ishii, the Tangible Media Group set the 'immaterial' and the 'material' in separate worlds and focuses on the design of supposedly 'seamless couplings' between physicality and virtuality (Tangible Media Group, 2005). It seems as if its prime objective is to build upon the physical abilities of humans in order to 'empower collaboration, learning, and decision-making by using digital technology' (Ishii et al., 2004). The research is founded upon many of the hegemonic assumptions underpinning usability research. The Tangible Media Group misses the potential of the distributed soma, after all: 'if the interaction is not evident to us we are no more users [of technology] than we are the users of our eyes, ears, nerves and hormones' (Ascott, 1995, p. 23). The logic of the Tangible Media Group appears to rely upon a given and fixed assumption of physicality and materiality. This assumption of scale fixes concepts such as the material and the immaterial. Because scale is fixed, in this example apparently about the human body, tangibility is imagined at that scale and in consequence reiterates the material world at that scale. The problem with approaches to enaction such as this it that they discount the full range of somatic potentiality.

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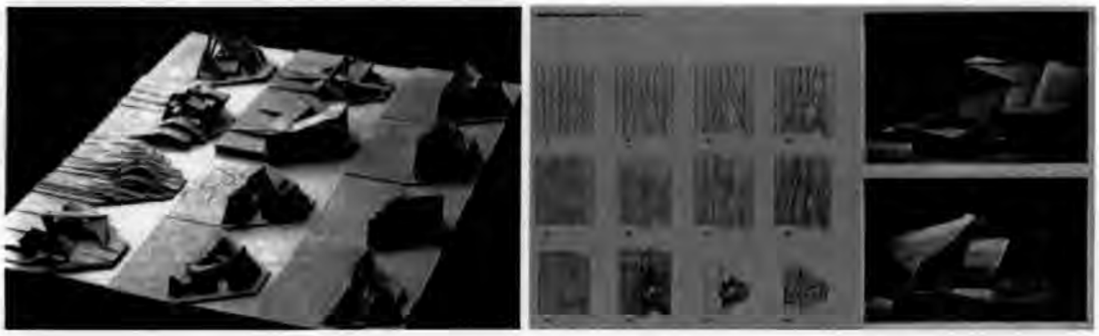
designer with little means of getting to grips with anything other than an understanding of these modes of analysis themselves. This kind of theory is fraught with claims of fracture and disjuncture.

Dunne and Raby's critical designs are read very much as cultural artefacts but they can be understood in terms of a wider analysis. Many of the artefacts in Dunne and Raby's publications (such as the Placebo screen) engage with the idea that the human body is subject to the electromagnetic radiation of electronic technologies, artefactualised as somatic shields. Dunne and Raby call these artefacts prosthetics, but they read more like skins.

Dunne and Raby, Placebo (domestic electromagnetic radiation shield).

The skin is porous. It provides no boundary, and Dunne and Raby's artefacts mimic this porosity but maintain an architectural void with the organic flesh. The shields come only so close to the human body as to be a place to sleep to be carried or sat upon. Dunne and Raby cannot bring themselves to understand fully the fluidity of terminology with which they play, and the electromagnetic remains schematic rather than material and their analysis. The representation of the full scope of materiality is, of course, a huge problem for design, especially when it is read only in terms of the familiar topological domain that defines the orthodox narrative reperesentation of the artefact. Fiona Raby has described the attempts of some who take a hyper-architectural view of materiality (see Puglisi, 1998, or Toy, 1998, 1999, for example) as 'a visual pornography of space denied, as yet, to biological material' (Dunne and Raby, 2001, p. 92). This, however, reveals a very particular view of the scale of biological materiality and posits the biological human as a rather fixed entity. It also singularly fails to understand how hyper-architecture merely represents an impression of its forms, rather than a literal reproduction. Raby projects a rather narrow understanding of architectural engagements with the scope of complexity. The architect Peter Eisenman's Rebstockpark Project, for example (see http://www.eisenmanarchitects.com) calls for a means of analysing the spatial world in a manner that avoids reduction 'to relations among distinct elements in a space-time parameter but which rather supposes a strange invisible groundless depth of intensive complexity' (Rajchman, 2000)



Peter Eisenman, architectural works.

In a description of *Urban Electronics* Rajchman (2000, p. 28) posits a Deleuzian approach as a means of analysing cities, not as the 'static urbanism' of fixed buildings set about cartographical plans, but as living, flowing places that acknowledge the flows of intensive complexity that construct a sense of place. The means to find solidity, however temporary in this architecture, Rajchman suggests (p. 29), is to draw upon the anoetic - in his terms, 'the layers of sense that exist prior to human cognition'. Rajchman proposes something much more fundamental and somatic in his analysis than Dunne and Raby; however, it remains an intellectual place that is difficult to describe in orthodox syntax. In consequence, the rhetoric of many hyper-architectural texts can be confusing and obscure, sometimes even vague. Many texts assume a familiarity with the broad scope of the philosophies that they call upon in the construction of their particular logic. For example, Isozaki and Asada, members of the Any Corporation, describe the experience of taking tea in a tearoom.

> Such an event intervenes in the flow of time, transferring the consciousness of the participant to the interiority of time. Time is that which according to Dogen 'comes flying'. In other words, an intervention in one instant draws the plural times flowing from different origins into one place. (Isozaki and Asada, 1999, p. 81)

While Isozaki and Asada cannot be claimed to condemn a genre, their writing appears, at first sight, to display the disconnected, poetic logic of many hyper-architectural texts, employing vague allusions to unexplained concepts. This kind of language make questions of being-in-the-world seem deeply mysterious, occult even, and beyond the intellectual scope of industrial designers, who by nature of their role in dealing with apparent and everyday problems are likely to think of themselves as pragmatic (Lawson, 1997) problem-solvers who are active-in-the-world. There is, then, an urgent need to humanise this logic; to transform it from the quixotic into the quotidian. This will be no simple task. Industrial designers might look to architects such as Vidler (2000) or the Any Corporation (Davidson, 1999) or Eisenmann (1999), who are not afraid to challenge established concepts or to introduce conceptually difficult and complex ideas that are unfamiliar to conventional design conversation. If they *are* to do this, industrial designers will need to braid ideas of space and time, consciousness, territoriality or topological mathematics, for example, into the terms of their intellectual community. These ideas will by necessity need to infuse one another in order that a subtle and complex field or fabric might be constructed. The particular intellectual trajectory and heritage of industrial design, described by generations of people who have taken complexity and brought it into the world as a series of forms, could be brought to bear upon emerging understandings of the world as a continuum. If designers were to eschew the tendency to define themselves by the nuances of their practice and instead to take a view of their expertise to reside within one topological domain or another, they could describe themselves in the terms of the scale of attention they give the world. They would then need to understand that the impetus to humanise technology implies that they should seek a condition of quotidian experience at any degree of granular attention by transforming complexity into the quotidian. There is not yet any answer as to how designers might take the potential of DNA computation and other biotechnologies, but at least they then might have something of the terminology required in order to construct a brief for the design of a future.

8.4 Design Scenario

Joey's ordinary life

Industrial designers have an essential autonomy that resides in their expertise. This expertise has tended to be traced in archaeology through artefacts that have a particular scale and materiality. However, design expertise is more vital than those objects suggest. Design logic has sustained the human species through tens of thousands of years. This thesis has attempted to reveal how that heritage can be connected to the future. This thesis has not attempted to create an operative language that will be for others who come after it. This concluding scenario sets out how some of the ideas discussed in this thesis might one day come together to form an operative design strategy. By narrating three very brief glimpses of the future, it shows how that trajectory might play out. These scenarios assume that designers have taken up the imperative set out in this thesis, have cast aside their concern with epistemic distinction of technicity, and have begun to engage with the human as an intense and granularly distributed soma.

The scenario describes how someone uses a technology that is not yet developed and that we can hardly imagine. It does this in order to lay out some of the issues industrial designers of the future will have to overcome in making this extraordinary technology seem quotidian. One way to approach this might have been to take an example of a future technology from a science-fiction novel and to deconstruct that for its design issues. However, we should remind ourselves that novels are a form of artistic endeavour, that their narrative has a particular dramatic strategy, and to take that apart is likely to produce a rather ludicrous outcome, bearing comparison perhaps with Babbage's reduction of Tennyson's poem cited previously here. Instead, the scenario described here *imagines* a technology of the future. This is chosen not for its spectacular science-fiction-like manifestation but because it is incomparable to any current technology and explicit in the way in which it throws into questions the epistemic differentiation that designers of our times have embedded in their schematic discourse. The technology may be a crazy pipedream, it may never be realised, it has certainly been very difficult to find a way to imagine it; but that is a particular characteristic of technological development. One imagines that the designers of the late nineteenth century might have had some idea of how the world of the early twenty-first-century might materialise, but they could almost certainly not have imagined how some of the extraordinary things that we use would work. They might have had difficultly in coming to terms with the prospect of life in our world as being entirely human; this is not something we sense, however, as we live out our lives. In this scenario, a future technology is proposed that enables people to retain the coherence of multiple conversations in what seems to them to be a form of real time. This technology has the means to enable the people who use it to operate conversation in similar terms to the way in which we can shift data about.

The scenario is set around a protagonist Joey (a homage both to Joey the Mechanical Boy and to Joe and Josephine) and moves through several stages. Joey lives some time hence, perhaps in an era where a century of design consideration has been given to a technological paradigm in which it has become necessary to think in terms of a holism that accounts for the human as a distributed and enacted life. The thesis has insisted that these designers will have learned to understand how their impetus to humanise technology implies that they should seek a condition of quotidian experience at any degree of granular attention. In order for designers to find a way to engage with the anoetic potentials of this emerging paradigm, the thesis has proposed that it will be necessary for them to find the means to artefactualise the enaction of the hybrid-human at a subtle degree of granular complexity. Such a granular logic will demand a holsomatic understanding at a range of granular degrees of complexity. At this scale and complexity it will become clear that no meaningful closure of the human is possible. It will be necessary then to go far further than John Thakara's new rules for design (2006, p. 213), which were imagined for a post-mechanical paradigm only insomuch as he recognised the socially constructed hybrid nature of the human. The new rules will necessarily incorporate the holsamatic human and will understand the potentiality of a topological domain that recognises the molecular potential of design. For example:

- from sense and respond to deep sensuality;
- from deep context to distributed context;
- from seeding edge effects to swarming possibilities;
- from smart recombination to enacting consciousness;
- from social fiction to somatic fact;
- from designing with us to us designing;
- from design as service to design as poetic possibility.

Before we can meet Joey we must understand slightly how that idea of the open unbordered and intensely complex understanding of the human will have given shape to the way in which technology is imagined in his time. We can do this by reimagining how Joey uses technology if designers maintain:

(a) *Reality insistence.* Industrial designers cannot come to terms with this new understanding and continue to project a material interactional model of human-technology relationships. Stability is maintained in the topological understanding of the human artefact and interaction is a noetic extension of that domain.

(b) *Virtuality insistence.* Industrial designers can come to terms with holsomasis but only as a social and cultural hybridity: semi-stability is maintained in the topological understanding of the human artefact. Interaction is quasi-anoetic but socially orchestrated such that the human artefact becomes conditioned by technological interaction.

(c) *Holsomatic insistence.* Industrial designers can come to terms with a complete and enacted model of the distributed holsomatic hybridity. Being human is reconditioned and interaction is anoetic and naturalistic.

Joey will be ordinary, unexceptional, as boring and as interesting as anyone. No more no less human than any of us. Some of the things Joey will take for granted will seem extraordinary to us. We will not, for example, be able to suggest a gender when we talk about Joey or say 'his' or 'her' without risking offence; after a century of fluid and open discourse, ideas of sexuality and gender will have been rendered as unviable as any other mechanical and dialectic vision of the world. We must be prepared to meet Joey in a condition of complete modesty. We must be humble and must recognise how we think about some of the attempts to presage our own times that were projected from the technic imagination of the nineteenth century. We must be prepared to assume that, should Joey or a contemporary ever come across this scenario in some archive or other, they will no doubt laugh at the naivety of these projections. Joey may be amused or astounded at the failure here to account for some other yet unforeseen occurrence that will render these ideas nonsensensical. When we understand technology as emerging as a momentary solidification of a great flowing complexity of dynamic forces, we must be aware that we cannot hope to account fully for the supercomplexity of that process. The most we can hope for is that this Joey of the future will understand this as an example of how the great developments of *his* time (there *he* is forced into gender by the limits of language) were made possible by the foresight of some who understood the necessity to reimagine technology in terms of the human. Let us assume that De Garis, like those who have made the same dire predictions before him, *was* wrong, that his prediction of an inter-species war has passed similarly into the realm of nostalgic fiction. Let us instead assume that human life, following the pattern of the previous twenty thousand years, has continued to be rich and creative and just as dull as it ever was by presenting a vision that is neither a utopian nor a dystopian and discounting the unaccountable complexity that goes about it. It is not a dream, a warning or a manifesto; it is just an idea.

'The Unknown Citizen' (W. H. Auden, 1940) is a poem of extraordinary simplicity in its subject and redolently quotidian in both its narrative and art. The poem is not quite funny or sad, it is neither bitter nor contemptuous, and, in keeping with its subject, it is just simply, skilfully and magnificently ordinary. It is ordinary and unexceptional. This is, of course, what makes it so extraordinary and exceptional.

He was found by the Bureau of Statistics to be
One against whom there was no official complaint,
And all the reports on his conduct agree
That, in the modern sense of an old-fashioned word, he was a saint,
For in everything he did he served the Greater Community.
Except for the War till the day he retired
He worked in a factory and never got fired
But satisfied his employers, Fudge Motors Inc.
Yet he wasn't a scab or odd in his views,
For his Union reports that he paid his dues,
(Our report on his Union shows it was sound)
And our Social Psychology workers found
That he was popular with his mates and liked a drink.
The Press are convinced that he bought a paper every day
And that his reactions to advertisements were normal in every way.
Policies taken out in his name prove that he was fully insured,
And his Health-card shows he was once in hospital but left it cured.
Both Producers Research and High-Grade Living declare
He was fully sensible to the advantages of the Instalment Plan
And had everything necessary to the Modern Man,
A phonograph, a radio, a car and a Frigidaire.
Our researchers into Public Opinion are content
That he held the proper opinions for the time of year;
When there was peace, he was for peace: when there was war, he went.
He was married and added five children to the population,
Which our Eugenist says was the right number for a parent of his generation.
And our teachers report that he never interfered with their education.
Was he free? Was he happy? The question is absurd:
Had anything been wrong, we should certainly have heard.

W. H. Auden, 'The Unknown Citizen'

The scenario must not assume that technology will drive cultural change but rather that it becomes solidified by the culture it facilitates. This is an important assumption, because it points to an essential stability in the experience of being human. We can recognise holsomatic hybridity just as easily in Auden's poem as we might in any DNA computational future. Arguably, as some facets of this hybridity have gained prominence, the 'researchers into Public Opinion' perhaps, so others facets have become less apparent. The work of the

Eugenist, for example, is played out in a more subtle and distributed and enacted interaction through IVF treatments and the interventions of intrauterine surgery. Although this is not at all his intention, Auden hints at the enacted hybridity of life that becomes solidified to a degree that shifts topological attention away from its distributed nature. Auden can describe 'everything necessary to the Modern Man, / A phonograph, a radio, a car and a Frigidaire', because these things make solid a complex meshwork of interacting systems that go about them. It might be just as viable, although not so convenient, to talk about how the people, materials and physical phenomena that interact in these meshworks but are made solid in the gramophone, which might also be essential to the modern man. Before we meet Joey, we must assume that, in the future, life continues to be enacted in a hybrid meshwork of possibilities.

The topological complexity and degree of granular attention must be carefully managed in the scenario. What aspects of the future will bear resonance with our own times and to what extent with the holsomatic, distributed, and semi-infinite granular imagining of the human have enabled an entirely fluid imagination. If Joey is to look like us and to have a certain tectonic physical presence in the world, then we must perhaps assume, for example, that he might own and rely upon some form of vehicle. Joey will need this in order to move minerals or foodstuffs about and to move his own tectonic self about on the tectonics of the planet. This imagination determines a Joey who continues to eat and owns a means to keep food fresh. We might then productively imagine a world that acts upon Joey's life very much as the world we know, with dust on futuristic bookshelves and leaves blocking futuristic drains. In that future, Joey sleeps, occasionally gets stung by a wasp and is forced to clear up after children. That is a very limited although perhaps realistic vision. We could, for example, imagine a Joey who is so granularly distributed as to be data or electromagnetic energy. This would be a plausible way to engage with the pragmatics of holsomasism but might not have resonance with the industrial-design problem of our time. That scenario would need to pay no particular attention to tectonics but would necessarily engage philosophically with an idea of humanity at a degree of metaphysical complexity that echoes with our own times only in the manner of a ghost. That scenario would describe a kind of will-o-the-wisp vision of humanity. That future may be the inevitable consequence of an increasingly granular and distributed understanding of the human that makes viable a valent degree of enacted interaction. We must be careful to place our Joey correctly as a step towards that future and to be mindful of what might make us human. This is an impossibly problematic task because almost any imagining is likely to be subjective and culturally inflected. Joey, like Auden's citizen, for example, might remain fully sensible to the advantages of the saving and investing by shifting values about, but could have no conception of coin or a note. Joey might be imagined to have never bought a newspaper; they will probably disappear very soon anyway. Knowing news, though, might be an important, if not essential, human trait, having continuity with our behaviour even in our most ancient history. Authenticity and neutrality might perhaps have returned to be a matter of consensus rather than political orchestration, because, in the holsomatic imagination, information will appear more as a field than as a directed stream. Joey will arrive at a truth through participatory discussion in a field of conversations. Like Auden's Unknown Citizen, our Joey is not unhappy; being human he might find joy in family life and ideas and in popularity. But of course these are cultural assumptions founded to a significant extent in the placement of the author who constructs and imagines this Joey. We might think about values of authorship and about the way in which skills are valued in others. Is this an important facet of being human? Will Joey find art in the music of others when that skill is universally distributed? Certainly musicians seem to be able to enjoy other musicians' music because they are atuned to the more subtle and granular differences they can discern. Perhaps that degree of topological subtlety in critical awareness will be a necessary facet of humanity too.

One thing we might think we can assert with confidence is that it will be important to Joey to know he is an individualised self. If self-awareness seems to be a fundamental facet of higher-order consciousness, then there is no reason to assume that an even higher order of consciousness might erase this facet of being human. It is more likely it will focus it into an intense but powerful singularity that remains core to a file of quantum probabilities, if that is the degree of granular attention we are dealing with. Can we assume that there can be no design without interacting selves or is that another rhetorical convenience born of an assumption of epistemic differentiation in individuals? For convenience sake, let us assume that this question is not yet necessary. This means that we have positioned Joey clearly as part of a continuous trajectory with the stories told in industrial design histories. That trajectory may continue to a point of an infinite human of interacting singularities, but the moment of the scenario presented here is not that remote.

Let us assume that one essential trait of feeling human and of retaining a sense of self in a quotidian field of holsomatic interaction resides in staying sane. Quite how one might retain one's sanity as a singularity is perhaps beyond the scope of what we need to achieve here, so let us imagine a projection of the trajectory in which we find ourselves today some time into the relatively near future. The skill of staying sane in the twenty-first century is not unlike what it was in the twentieth century or any time prior to that. One has to be good at managing the flux between individualised ideas of oneself as a complete entity and the wider understanding of oneself as part of a greater and hybrid whole. Design is one way in which we manage that flux. The skill of design is to enable us to know that we have achieved the things we do. Like the pilot in Magee's poem (cited previously), we soar and climb and dive. In an increasingly granular imagination, this fluxation may require a specialist body of psycho-engineers who manage how people do this and make it possible to retain a sense of sanity. Perhaps future designers will be imagined as those who give an aesthetic to psycho-engineering - those who make it attractive and desirable.

Conversation is one of the ways in which we believe ourselves to differ from other species. Being a technic species, we have hybridised conversation and, given skilful design, it is not extraordinary to us and today to talk at a great distance to a friend or colleague. This hybridity is an accepted quotidian facet of human life, an accelerated hybridity of the way that human beings have thought it a good idea to have conversations with people without being tied to tectonic time and place. One aspect of this human phenomenon is known as social media. A projected trajectory of social media sets up a possible technological application for the future that comes replete with its own engineering and design problems.

> You write a blog post. You tweet about it. It gets posted to your FriendFeed profile. You share it via Facebook. You save it to del.icio.us. Your friends, followers and colleagues comment on the blog. Or they say something nice via Twitter (where a conversation related to your post ensues). Or, they comment directly via your FriendFeed profile. Or they comment on your Facebook post. Or they save the post to their own del.icio.us account and add a comment there. Yes, you're highly connected with your audience. Yes, it's cool that each of your readers can view and respond in the social media outlet of their choice. But as a result, the conversation is broken. It's not threaded. It's discontinuous: lacking sequence and coherence. Is this a problem? I dunno. But I do think it's problem for the 'ideal' of social media: in a fractured comment sphere, individual voices can be too easily discounted or simply lost. (Defren, 2008)

We can imagine then a future technology that will overcome this fracturing, though we do not yet know in precise terms how this technology will be engineered. The idea of overcoming time may seem a matter of absolute fantasy, but only insomuch as time and duration are human conceptions. The problem of distance in communication might once have seemed insurmountable too. Distance and the problems of communication have one historical trajectory that can be understood as a series of eliminations of temporal discontinuity. The trajectory of communications and more recent telecommunications is a history of the elimination of waiting. The relay runner, the horse, the train, the telegraph have all hybridised this elimination of fracture. Delays that plagued early transatlantic voice conversations have been largely eliminated, and now digital media technologies appear to enable near instantaneous communication, just as Latour suggested the elimination of delay was tied to the elimination of 'mass'. In this historical trajectory direct human cognition has been increasingly eliminated from the wait. Temporal delay has been eliminated by shifting the conversation, by stretching it increasingly into a hybridised version of natural conversation. Just as once it might have seemed extraordinarily ambitious to call for the elimination of the wait for a letter to be answered, is it completely without possibility that all communication will become instantaneous and entirely ubiquitous. The first thing we must think about is how this ubiquity will be managed. Three short scenarios featuring Joey using this technology will be constructed. Each of these following scenarios will assume an intellectual position in regard to human-technology relationships. In reality no single position can be usefully isolated and presents as part of a continuum in the intellectual discourse in the industrial design community.

Joey 1. A designed future of material interaction

(a) *Reality insistence.* Industrial designers cannot come to terms with this new understanding and continue to project a material interactional model of human-technology relationships. Stability is maintained in the topological understanding of the human artefact, and interaction is a noetic extension of that domain.

In this scenario the device that Joey uses is imagined as a straightforward projection of an early twenty-first century portable electronic device. The device functions through the means of its seamless and instantaneous connectivity to a huge number of other devices, all of which possess huge quantum computational power. In the logic of orthodox industrial design, this device is imagined as a hand-held and personal node to a vast networked media substrate.

Joey sits in a café sipping a cappuccino talking out of time. Joey can hardly imagine how people coped without being able to store and repeat conversations, drop in and out of them at will, fracture and dissolve them, split them and share them and revisit them at will. Ideas of linearity in conversations are merely echoes of a time of mechanical allusions, when cause and effect were more important than fields and flows and before ideas swarmed. Does Joey 'talk' with people, or with ideas of people, or collations of ideas, or with a whole comprised of many-many hybridised ideas? It matters not, because the ideas to Joey are part of a rich swarming field of conversation that one can shape and direct, share with one other or with many or with none . . .

Joey speaks into a form of smart tool, which he holds in his hand. The electronics in this device utilise advanced computation and quantum logic processing that produce a functionality of jaw-dropping complexity. Joey's device is the most popular version. It is styled with a form of timeless classical beauty with a slightly retro aesthetic that recalls a look of some thirty years ago, which recalled a look of some sixty years prior to that. The design of the device bears striking similarity to the early portable electronic devices that typify the early twenty-first century. The insides of the devices have changed beyond comparison, of course, but human hands are still hands, the form and scale of any palm-held device, no matter how powerful or complex its computational power, is bound to be similar. The portable electronic device has now become as ergonomically fixed as the hammer or the cup. The industrial designers have still had some aesthetic role in the design of Joey's device. It is, for example, a testament to the designer of this artefact that it still looks good, even though Joey has owned it for many years. In that time, while Joey has gradually learned something of its potential, the device has worn with use and now carries with it some of the narrative that has made up Joey's life - that scratch when he dropped it in Samarkand, for example.

Left: Sterling Hammer Catalogue. (Sterling, 2008) Right: New Hammer design by ATOMdesign (ATOMdesign, 2007)

> ATOMdesign was asked by Vaughan & Bushnell to reimagine the classic hammer and the S2 is what they came up with. ATOMdesign didn't take the challenge lightly. [...] The Split-Head hammer offers many new features never seen before in the industry such as integrated overstrike plates, modular head construction, and elastomeric shockgaskets just to name a few. (ATOMdesign, 2007)

The design of the hammer is largely fixed about a topological domain that fixes it at a particular materiality, because the world with which it acts is fixed in that domain. The material and form of its construction may change minimally, but any change is likely to be superficial. The ATOMdesign seems to be a flim-flam, because it seems to achieve very little more than an ancient designer might have realised. The design logic of Joey's device imagines an extraordinary futuristic stone tool to be carried and wielded as a means of capturing, mediating and reconstructing the world. Unlike a mechanical tool, this device can process more data than perhaps all the computers of the twentieth century combined. Joey can now 'see' in detail places of extraordinary remoteness and 'hear' sounds from places far away, he can arrange these into any order he wishes, store and retrieve them, shift them about and reorder them. It takes a long time to learn how to do this, of course, because that function is one of many on the device. It is necessary to decide what you want to do and then to work through the information presented. The product designers have had very little to do, other than to design a stylish and ecologically legal box with a screen. Given that every computational device looks almost identical, this does not look like a very difficult job. In fact most artefacts are designed by other computer systems, which use data to anticipate the most practical ecological, attractive and desirable box for any given market situation. How one uses this thing was a job for the interaction architects. The device is voice operated and well conceived, but, rather in the manner one struggles with the 'interface' of any complex electronic device, Joey is left exhausted by the process of using it. Joey is forced into reading and understanding a complex mass of data and must manipulate software that cuts up and stores conversations rather in the manner one might already edit sounds or movies, only written with almost infinite complexity. Joey plays no part in the functioning of the device, but it is his cognition that must be used to read and understand what he sees and hears.

Actual illustration is TomTom leather carrying case for 'Go' satellite navigation device. (http://www.tomtom.com)

Because this device is a tool, it modifies the world. The data it presents are not reality but complex data-driven simulacra. While he sits in the café, Joey's bodily senses act as a conditioning force filtering an approximate microcosm of the world presented by the device. The device Joey carries acts as a convenient, reassuring mechanical reminder that a process of transformation has taken place. This device makes the real unreal and then converts it back into a form of unreal-reality; an approximated replication of that which it conveys. Joey's life is very complicated. This moment in the café offers a moment's respite. He has many similar devices at home and at work, all of which look almost identical, which talk together. Given the computing power and the artificial intelligence these devices possess, they sometimes feel as if they are conspiring against Joey, anticipating and second-guessing his needs, but getting it wrong almost all of the time. The power of these combined intelligences is extraordinary, and only a fraction of that power is revealed to Joey at any one moment. It is all he can cope with. Joey sits in the café and fiddles with the device, never quite understanding it, distracted from the 'real life' around him by it. Joey's world is a place of frustrated complexity. It is filled with ever-more complex gadgets that contain complexity and then leave it to people to sort out the mess into something meaningful.

ME AND MY VIDEO RECORDER
I once programmed a video-recorder -
Sat there for hours growing
Tetchy
And
Grumpy,
Melded mind with plastic machine,
Brain-cells with paper instructions,
Feelings with electricity and silicon junctions.
Finally broke through to
ENLIGHTENMENT
And found myself staring AGHAST and
FLABBERHASTED
At a remote
THAT SEEMED TO BE DOING ITS JOB!
Lost the battery the next week,
Week after that the video got kicked,
Week after that unplugged,
And then my kids pressed all the wrong buttons.
Now my buttons stay firmly UNPRESSED,
I will not rise to the bait of HOW EASY IT IS,
Nor will I describe in loving detail to my friends
HOW CONVENIENT IT'S MADE MY LIFE.
It sits there, sulking and glowering,
And I ignore it,
Best way to deal with
MACHINES THAT DON'T WANT TO FUNCTION!

Richard Macwilliam (2008)

Joey 2. A designed future of social and cultural hybridity

(b) *Virtuality insistence.* Industrial designers can come to terms with holsomasis but only as a social and cultural hybridity: semi-stability is maintained in the topological understanding of the human artefact. Interaction is quasi-anoetic but socially orchestrated such that the human artefact becomes conditioned by technological interaction.

In this scenario the system that Joey uses is imagined to function through an interaction of some form of technology implanted into the soma imagined with the orthodoxy of the artefactual body. The functionality of the system resides in the interaction of the devices implanted in Joey's body with the extended system. This scenario presents the first of two holsomatic alternatives. In this scenario the system enables a becoming. When Joey moves into a designated proximity, he becomes another conditional state. Where the first scenario described a state of being constrained about a cognitive interaction, this scenario describes a state of being defined by an activity location.

'Oh, who doesn't own an interositer these days?' says the scientist Dr Forrester in the 1955 science-fiction movie 'This Island Earth' (1955). The interositer: this alien (Metalunan) device plays an important role in the centre of the narrative. The interositer, realised by the film's art directors Alexander Golitzen and Richard Riedel, appears to be on something of a scale similar to a domestic appliance.

Essex (the alien) demonstrates the Interositer to his human passengers.

The full function of the Interositer is not explained. At first sight the device appears to have a considerably bulk. Its aesthetic is contemporary with atomic imaginings of the time of its design and art direction. Where once the Interositer might have stood for an advanced technology, today it might appear quaint and utterly out of step with the more complex understanding we have of the distributed and microelectronic nature of communication technologies. However, unlike the technology of much subsequent science fiction, in Golitzen and Riedal's design the artefactual construction of the device can be understood to act only as a theatrical placeholder. In the narrative of the movie the interositer appears to interact with the occupants of the spaceship through some form of mental connectivity. Its artefactual presence appears to be necessary merely to make it plausible to the movie's audience. The function is explicitly distributed between the alien species, the spaceship and the Universe itself.

The narrative necessity of the artefact in this case is an echo of the mechanical logic of the audience's intellectual placement. This is not so extraordinary as it might sound. The rather familiar experience of driving a car is a condition in which there is a kind of seamless flux between states of holsamasis and discretionary control. I may drive for miles as unaware of the car as I am of any other facet of my biological soma, but the mechanical presence of the car is essential because of its tectonic interaction with the world. It is difficult to imagine a world in which mechanical necessity does not provide the model by which things can be understood. There may be some weight behind the argument of tangible media designers that a form of mechanically imagined placeholder is necessary in order to facilitate the rich interaction with media technologies. Following the logic of Dunne and Raby, it is possible to suggest that Joey may find it necessary, like the occupants of the Metalunan spaceship, to have some artefactual resonance with an extension of his artefactual body. Joey must be reminded of the artificiality of the condition he becomes when he uses the system. When Joey puts the system on or rides it, the system distributed in the world begins to interact with the components placed inside Joey's body. These in turn interact with his nervous system, feeding directly into his cognition. There are no needs for screens or speakers.Joey hears and see information swarming and swimming before his eyes - then steps back out of the system and into the 'real' world.

As Joey moves closer to the zone its effect becomes more intense. An initial and intermittent zone of stuttering, half heard conversations and spectral forms shift and dissolve fades as the condition comes over Joey completely. Dissolved into the zone Joey can pause and resume *conversations without being aware of their temporal shift. That shifting is the killer-app that has overcome just talking and has made everyone want to get into the zone and get out of it. There are junkies of course, weak people who can't escape the awesome intensity of being simultaneously dissolved and mingled with a universe of possibilities. It's knowing when to get back to reality that counts.*

The zone is a socially defined place where a condition of hybridity can be orchestrated into a media-becoming. It generates questions of control and power. How does one access these places? Who determines whether access should be granted? Where are these places located? Are they public or private? Does one subscribe to a club of some kind? Is Joey some member of an elite social group? One thing that is certain in this scenario is that the system works. It has arrived in consequence of an intense developmental trajectory in which designers have worked to understand how the cognition can be orchestrated in the soma.

The question is not one of whether the bioengineering brief will make this possible but one of how it will be possible to retains one's sense of self when this condition of intense hybridity takes effect. The engineering will perhaps combine advanced network communications with an essential and microscopic materialist understanding of some of the processes by which cognitive linguistics is enabled in the human soma. This presents a dramatic shift from the way in which the interaction was conceived in the scenario in which Joey uses a hand-held device. In this scenario the suggestion of a design understanding of the subtle functioning of the evolved biological soma enables a more complete cognitive flow.

In the first scenario the quotidian was understood to reside in a mechanical model of 'hold and use'. In this scenario the quotidian is maintained by an awareness that one can move between conditions of reality and virtuality. In the first scenario the interaction is entirely noetic. In this scenario the interaction is quasi-anoetic, in that it is socially bounded, and artificiality is reinforced through social construction. The artificiality of the condition reinforces the need for social orchestration, which is codified in orthodox topological terms by the spatial geographical location of the event. The designer's brief will interact with that of the bioengineer at an intense degree of granularity. This granularity will demand a valent degree of materiality and complexity in the way in which the hybrid affordance of the technology is accounted. It is quite possible, of course, that the scenarios presented here are steps in a developmental continuum. The trajectory of this hybridity from noetic separation to located condition might ape that of the telephone. One history of the telephone can track a trajectory from a determined geographically located enaction, in a fixed point in space (the telephone box) towards an eventual migration in socially located situations and then to portability as a mobile activity. The manner of materialisation is momentary. There is every reason to suppose that that trajectory is not finished. It is quite plausible even in the early twenty-first century to predict how the mobile telephone will become more of an ubiquitous activity than a located activity.

Established ideas of the brain as an intrinsic processor of information have been largely overturned by cognitive science in favour of a condition of mind as an emergent and enacted facet of embodied cognition. The designer of the future must have a very clear and informed understanding of how the quotidian will arise. Will, for example, the quotidian be more likely to arise when the condition has resonances with the familiarity of location - the office or the bar as places of conversation, for example. However, it is equally plausible to suggest that the quotidian may be facilitated as a state of being through a form of interaction bearing comparison with pharmacological technologies for example. (I have used the example of the asthma medicine QVar.) This idea of anoetic holsomatic interaction is explored in the final scenario.

Joey 3. A designed future of enacted holsomasism

(c) *Holsomatic insistence.* Industrial designers can come to terms with a complete and enacted model of the distributed holsomatic hybridity. Being human is reconditioned and interaction is anoetic and naturalistic.

Humans are not linear and mechanical devices. The flux between states of consciousness is an essential psycho-evolutionary trait that makes communication possible. This shifting conditionality is not something people necessarily notice. Linguistic psychologists, such as

Zali Gurevitch (1989, for example, suggest that the evolved potential to flux plays an essential role in communication and particular vocal conversation.

> Whenever faces are engaged in a face-to-face conversation distance is evoked between them as a 'common dialogic space' that both connects and separates. This space must be dealt with in conversation. The habitual tendency is to cover it up by formulating a topic that is external to the immediate relation. Keeping the topic going 'holds' the separate parties together in an ongoing engagement. When the topic for some reason fails to hold, the gap between the participants is exposed and they fall embarrassedly into silence. There are, however, ways to give presence to distance and still contain it within the bounds of the conversation. What this calls for is a recognition of the speaking voice as an emergent self rather than an utterance subordinate to the external topic. (Gurevitch, 1989)

This ability to put oneself outside the voice in order to maintain stability in conversation appears to be an essential facet of the socialisation of the species. Most of us appear to be able to shift and deborder our voice without any particular awareness. The inability to do this can lead to ways of being that are described as being conditions of disability. Some of these disabilities appear to be tied to the temporality of speech. For example, a 'festinating' device (DAF) has been used to demonstrate improved functionality in patients with Parkinson's Disease (Downie et al., 1981). There are some implications as well in disorders such as schizophrenia, where one's own voice or remembered conversations are displaced and appear to be disembodied (Curio et al., 2000. Gurevitch, perhaps intent to separate conversation from social constructed analysis, does not talk about people but rather describes 'faces' as actors in a condition of conversation.

This third scenario is perhaps the most difficult to write, because it is unbound. This third scenario cannot talk about devices or places where conditions are enacted because it will describe a quotidian condition without disability. In this third scenario, Joey will just live, being able to do things with his cognition that we can do, but without the inabilities we take for granted. In *Middlemarch*, George Eliot identified an essential stupidity that made the human condition possible.

> If we had a keen vision and feeling of all ordinary human life, it would be like hearing the grass grow and the squirrel's heart beat, and we should die of that roar which lies

> on the other side of silence. As it is, the quickest of us walk about well wadded with stupidity.

The question for design is whether that stupidity is indeed essential. Should it be considered in the same light as fallacious assumptions of the effect of speed upon the human condition or the unnatural nature of human flight? Joey will be a species that lives in an evolutionary nature filled with interacting nanoparticulate DNA computers. This will be a kind of living, flowing physics. In *The Garden of Forking Paths* (2008) Jorge Louis Borges imagines the possibility of losing oneself in possibilities.

> Look, here - a beautiful poppy, yes? But some say that it has the power to unravel time. And here: yes, this narcissus-flecked pool. The locals contend that if you gaze into its depths too long, you are in danger of merging with your reflection and losing all sense of Self; for your image becomes that of all men. And there, a gallery of mirrors most enigmatic; and hanging here, by this coin: the skin of a most unusual tiger....

Joey will have learned to live in this world as a child. He will have played in it, learned and loved in it, and will perhaps find it to be an extraordinary and poetic place. That poetic ordinariness will owe much to the designers who came to understand how that world would be possible and who orchestrated and shaped its beauty.

Joey's ordinary life:

Was as ordinary as shaping flint.

Is as ordinary as drinking coffee at 30,000 feet above the Atlantic Ocean.

Will be as ordinary as flowing out into infinity and then back into the intense singularity of oneself.

Was as ordinary as reading.

Is as ordinary searching for and finding anything in an instant.

Will be as ordinary as knowing everything there is to know.

Was as ordinary as watching the world made real in paint.

Is as ordinary as finding oneself overtaken by ecstasy.

Will be as ordinary as sensing the joy and pain of others in emotional art.

Was as ordinary as the lens let the microbe dance.

Is as ordinary as playing with the calculation of atoms.

Will be as ordinary as diving one's consciousness deeper and deeper into the detail of the Universe.

Was as ordinary as listening entranced to the Shaman's journey.

Is as ordinary as finding oneself dissolved in the world of the club communion.

Will be as ordinary as allowing one's eyes to be shared.

Conclusion

Industrial designers have a vital expertise, which has given them an essential autonomy that has sustained the human species through tens of thousands of years and may yet continue that trajectory into a future we can hardly imagine. That is an exciting and awesome responsibility, and it suggested to me that industrial design should be more rigorous in its intellectual strategies. Industrial designers have had such a significant part to play in making life possible so far that any inability it senses to engage with the future must present a significant concern.

This thesis has focused upon Western European and American industrial design as a particular practice and discourse at a moment in time when the trajectory of technological development has thrown into doubt the certainty of understandings of the boundary between the human and the technological. That uncertainty might have given rise to a critical moment for the intellectual fellowship of industrial designers, as the insights they once relied upon when dealing with questions of the material formation of the technological world have begun to seem irrelevant in the formation of the future. Rather than applying an alien theory to industrial design, this exploration used its design instincts to draw upon a broad spectrum of ideas and then assembled them through a process of synergistic analysis. This process assembled ideas as if they were actors in a network of interacting conversations that gave form to a discursive conversation.

Rather than adding its voice to the many who have called for the end of industrial design, this thesis took as its impetus the opportunity for designers to reconsider the essential principles that have underpinned their intellectual community. Through a critical review of literature, it showed that, if industrial designers are to continue to talk in terms that have some continuity with the trajectory of the historical narratives that have sustained their intellectual community, a more subtle attention to the artefact than that provided by recent design theorisations was required. Rather, it showed that it was necessary to find a means to analyse the artefact without seeking closure through forms of material and representational analysis by acting upon a strategy that understood materiality to be tied to the complexity of analysis. That strategy revealed borders and epistemic heterogeneity to be matters of conceptual and rhetorical convenience, and so it became possible to discuss humanity and technology in a single conversation.

By calling upon the idea of the topological domain and by using a 'designerly' form of extent analysis, it became possible to establish a means to engage with ideas without necessarily calling upon orthodox and received understandings of the human *and* the technological as discrete encapsulations of terms in heterogeneous epistemic locations. By taking a more fluid view of human-technological relationships, it then became possible to insist that design processes of humanisation could be viably accounted across terms at any given degree of complexity and granular sophistication in the conceptual and technical models held in human-technological relationships. That allowed the thesis to explore how designers could understand questions of the human and the technological in a new way, which allowed for sufficient debordered and fluid granularity in terms. It was then possible to conclude that a sufficiently subtle understanding of the world, which will be coherent in its terms with the molecular complexity of future discussions, will demand the construction and incorporation of a form of 'designerly' extent analysis. In that way the thesis presented a reinvigoration of the industrial design community's discourse and maintained the centrality of its expertise with materiality, but in new terms of debate. To achieve this reinvigoration the thesis was divided into eight chapters, such that, proceeding from a definition of the discipline, it was possible to demonstrate in stages how the problematic it confronted lay in industrial design's own definition and not in some extrinsic determinant.

Chapter one opened the thesis by confronting industrial design and its particular autonomies. That strategy located the research, established a clear view of how industrial design could be identified. The chapter also interrogated the intellectual tactics that have given industrial design autonomy and the authority to act within its own terms and as a wider intellectual agent. The key claim made in this chapter was that industrial design could be usefully understood as an intellectual community. By establishing industrial design as an intellectual community, it was then possible to reveal its autonomy. Industrial design autonomy was shown to reside in its subtle management of fluidity in terms that go about a particular ambition founded upon a critical position not fully accounted in its discourse.

Before commencing a theoretical examination of industrial design, it was important to be sure about what was implied by that term. One problem with the term 'industrial design' was that it was difficult to define without excluding any number of other ways of describing the unique contribution it might have made to the world. Thinking about industrial design as an intellectual community provided a means of analysing the licence and scope that designers appear to accept when they define their own bounds and went some way towards an explanation of why industrial design seemed to have some coherent presence in the world. Although not regulated with the rigour of medicine or law, 'industrial design' was shown to be consolidated into a recognised profession by a number of affiliated institutions, loosely held together under the umbrella of a further official body consolidating other national design bodies. It was shown how one important institutionalising body, the International Council of Societies of Industrial Design (ICSID), has suggested in its description of industrial design that it was an intellectual means of 'humanising technology'. In making that claim, industrial designers were posited as being unique among other professions and practices. Once industrial design was painted as a kind of intellectual community, then it could be approached as a rather particular although fluid discourse that orbited a rather profound but uncritical claim made of itself as an intellectual means of humanising technology.

The impetus to humanise technology has, however, intellectually placed the human and the technological in oppositional epistemes. Individual members of the industrial design community, however, have found themselves having to work with a number of fluid terms when they have thought about how they might construct that process. While the 'human' and the 'technological' have been considered as discrete epistemes, they have remained terms that have been almost entirely fluid. This has made it difficult for the community to frame in precise terms what it has meant to humanise technology. However, being a creative and reflective community that has dealt with a discourse of abstractions, industrial designers have been well placed to explore how they might have constructed, with a degree of coherence, a process of humanising technology when the terms of reference were in constant flux. During the twentieth century the industrial design community humanised technology by making the extraordinary seem quotidian. Individual industrial designers have seemed to be able to communicate with a clarity that has belied the complexity of the forces that have shaped their intellectual community and the intellectual challenge in the process of humanising technology.

They do not have a formal tradition of accounting for this expertise, and, in consequence, industrial design has become established as an intellectual community founded in a fluidity that was not always aware of the full extent of the subtlety of its own enterprise. This chapter argued that, if a view was taken of industrial design, it was an intellectual community consolidated about an intellectual process founded in epistemic discretion. That opened the way for the thesis to explore with some authority how that process has become thrown into question by the disconnection and the progressive displacement of the human reference in technology. Accordingly, chapter two outlined how emergent technologies that have appeared unaccountable in orthodox material terms could be understood to have pointed towards a more critical, epistemological displacement of the human referent in understandings of technology. That understanding has enabled the claim to be made that rupture in the industrial design community's critical discourse was symptomatic of a schematic problem that could be resolved through a strategy of reconnection. This was an important move, because, while there remains much that individual members of the industrial design community could refer to that might have helped them to describe technology in material and cultural terms as a visual aesthetic, there remains little by way of a formal or technical language in Western culture or in readily available terminology to describe an aesthetic of use or enaction. That has lead to a prioritisation of the visual evaluation of the cultural values of technology over any other kind of aesthetic.

The significance of this problem of the prioritisation of the visual has been brought into sharp focus by the emergence of new technological forms. One recent emerging technology has lead to suggestions by some of the emergence of a new species of Artilects (artificial intellects). Projections of technology such as these, which have given rise to new paradigms of human and post-human existence, were demonstrated to be symptomatic of a critical problem in the understanding of the intimate relationship between humanity and technology and to imply a lacuna in the understanding of the process of humanisation. Those projections have resonance in some of the early twentieth-century fears of man-machines. Some erstwhile members of the industrial design community were shown to have responded to the intellectual challenge posed by the apparently immaterial nature of electronic and media technologies by inventing new forms of design practice. However, the inclination to give discrete names to these diverse, but intellectually similar, design practices has served to distance the intellectual heritage of the industrial design community from the intellectual capital it has generated in any discourse connecting the process of 'humanising' mechanical technologies. That inability to connect has caused the rupture in the community's intellectual discourse. Despite this, for a number of years industrial design has been promoted as an adjunct of successful business development and growth. The success of the industrial design community at finding clients among corporations and small manufacturers could have suggested that design intellect remained a vibrant focus of cultural, strategic and economic creativity. There remain any number of ways that the industrial design community might have progressed by overcoming the rupture in its intellectual discourse; however, these are not without pitfalls. While designers might embrace a form of limited continuity in a model of their practice as a fixed condition or as a means of overcoming ecological disaster, or might become a kind of fantastical imagineer, these developments would be likely to distance designers from a substantial part of their intellectual heritage. However, the industrial design community can now draw upon the model of continuity presented in this thesis. By understanding how the industrial designer has been projected and by showing how that has been responsible for rupture, the thesis could move to connect biotechnology and the other emerging technologies of the future to industrial design's intellectual trajectory. It has become possible to establish a vision of the future where a trajectory of biotechnological development, for example, could play out as a quotidian facet of future culture. Once the rupture in the industrial design community's critical discourse was understood to be symptomatic of a schematic problem, as was established in chapters one and two, then a necessary strategy of continuity founded in an aspect of discourse that had resonance in past practice and in some consolidating aspect of industrial design practice could be outlined. This opened the way for chapter three to explore more fully how the industrial design community could be understood to be formed around a sustaining narrative in which the artefact acted as the keystone of analysis. Particular focus was placed upon the causal link in the tendency to rupture in the industrial design community. This was revealed to emerge from a strategic lacuna in technological artefact-based histories, where the process of humanisation was regarded as ahistorical.

Further consideration of the 'artefact' revealed it to be defined by the evidence it has provided of the process of humanisation as a provision of a particular type of 'solid' evidence of human interventions into the world. A heritage populated by people of the lowest social standing was posited as evidence of a vernacular and informal construction underpinning the interchangeable theoretical and historical discourse models that have emerged from within the industrial design community. Together, design histories, repeating a similar story, have reinforced one another and have provided a consolidating narrative for the industrial design community. This consolidating narrative has become built around a coherent, although largely invariant and chronologically constrained, model of the industrial design community's trajectory - scholarly industrial design histories that are told through industrially produced artefacts largely drawn from the late nineteenth and twentieth centuries. Histories of the process of humanisation can then be accountable only in material cultural terms. Artefacts presented in that manner, in the absence of people and as fully resolved entities, belie any fluidity in their terms of analysis.

It became evident that industrial design could visibly connect its consolidating narrative with emerging technologies only if they were able to avail themselves of the orthodox accounts that were used to track the process of humanising technology. A more subtle attention to the rethinking of the artefact was provided in this thesis - a means of exploring how the process of humanising technology can be retrieved in industrial design narratives. In chapter four emerging understandings of cultural networks were used to interrogate how the 'resolved' technological artefact has informed and shaped understandings of the process of humanising technology. The strategic lacuna identified in chapter three was posited as an emergent consequence of a deficit in reductivist methodologies, which have paid insufficient attention to autopoietic cultural networks, and to the impact of agency and supercomplexity. However, by understanding the materiality of the artefact as an emergent consequence of autopoietic and flowing materialisations of intellectual forces, then it became possible for the thesis to show how the artefact at the locus of industrial design logic was connected to the developmental logic of biotechnology.

The consolidating narrative provided by industrial design histories could lead designers to suppose that artefacts could be interrogated to reveal something of the culture of the people who made them. However, the argument of this thesis has proposed that such linear histories of technology are unreliable. It has shown how histories of technology have been selective in their sources and have projected one among any number of possible trajectories for any given artefact. By taking account of how the enduring quality of the artefact cannot record the passions, laughter and tears that go to make up the rich complexity of individual lives, it became clear that the artefact can have provided only some fractional evidence of a process of humanisation and the full complexity of the forces that determined its appearance. A number of ideas were brought together in the thesis to show how artefacts are better understood as self-emergent (autopoietic) and flowing materialisations of supercomplex intellectual forces. When artefacts were understood in those terms, it became possible to see why attempts to 'reverse engineer' or to unpick supercomplexity might have been beyond the scope of human intellect. It was shown, therefore, that it was necessary to eschew closure in any productive understanding and revealed how orthodox presentations and analysis of the artefact are problematic. With this new account, a history of the process of humanising technology became possible where artefacts were understood as self-emergent (autopoietic) and flowing materialisations of supercomplex intellectual forces. History was freed from the constraints applied by deterministic shifts in materiality, because development could now be shown to be an intellectually imagined process. Shifts in materiality should be understood as an emergent consequence of paradigmatic shifts in intellectual understandings. The revelation opened up the possibility of constructing a more connective narrative for the industrial design community.

Once the ground had been set, chapter five then tested that reconnection. It extended the idea of the topological domain (an analytical tool of biology) in order to demonstrate how it could shape understanding of what it meant to humanise technology. The historical narratives that sustain the industrial design community were re-imagined through two speculative historiographies. These were specifically designed in order to demonstrate how the process of humanising technology could be tracked alongside developments in intellectual logic. Complexity in understandings of the human in the world were tracked through a trajectory that revealed how technology came to be understood and represented in terms that were tied to the complexity of understandings of the human. That developmental trajectory was tracked initially through humanist understandings of the man in an antagonistic landscape through to ecological understandings of interconnected species; and then through understandings of the human as a corporeal entity through to understandings of cultural construction. The virtue of incorporation of the topological domain into the thesis as a strategy revealed the world to be only as material as the complexity of the analysis applied to it. When the sustaining narratives of industrial design were reviewed utilising this strategy, the periodisational tactic of the 'machine ages', although problematic, was revealed to be a reflexive means of grouping, or collating, rather uncertainly codified ideas. (On occasion, the historical periodisation of the 'machine ages' was used here, but only when this was necessary as a colloquial term in reference when it was employed elsewhere.) In industrial design histories, the machine ages have represented changes in the way that artefacts have been consolidated in forms that have lost both scale and density. This was shown to be a linear process that has moved from the massive and noetically obviously monumental towards microscopic evanescence and only recently into anoesis. However, in recognising the 'machine ages' for their artificiality, it was possible to show them as providing evidence of shifts in the scope and extent of analysis (the topological domain) rather than physical materiality. The manner in which materiality was imagined could then be feasibly tied to broader philosophical understandings of the place of the human in the world. That broader understanding revealed how any supposed material reality was a cultural construction. This alternative history demonstrated how technology could be imagined in humanist terms as a tectonic landscape in sympathy with broader intellectual understandings of the world. Similarly, it demonstrated how technology could be imagined in terms of organic life. By extension, it then became possible to insist that materiality is now understood to be a fluid and mutable construct, because it is tied to the complexity and fluidity of contemporary analysis of the human. It was also possible to explain successfully why large monumental technologies were not discussed in these terms. Previously the intellectual location of the industrial design community has necessarily shifted in order to ensure that its process of humanisation has remained coherent in terms of pertaining topological domains. It also became possible to suggest that another shift in topological domain would make it possible for the industrial design community to regain its autonomy.

Once it had been established that technology comes to be understood and represented in terms that are tied to the complexity of understandings of the human, it became necessary to set out some steps to show how industrial design might recover its autonomy. That autonomy would be determined, not by the development of a new material form of technology, but by an emergent intellectual understanding, having resonance with the biotechnological understanding of the human. In chapter six a number of intellectual opportunities that biotechnology, for example, offers to the conceptualisation of technology were interrogated. That process, in which the human was understood in terms of enacted moments of a hybrid condition, revealed how the imperative of design could viably be understood as a process of the orchestration of valence at the material site of interaction. The chapter then showed that the humanisation of technology can be understood as an intellectual and creative process in which valence is maintained between prevailing understandings of the world and its manifestation in the material artefact. In those terms, it will become increasingly difficult to talk about the human and the technological in discrete terms. A model of actor network theory, drawn from sociology, was employed at this point in the thesis as a means takeoff taking a more fluid view of human-technological relationships. The criticisms of actor network theory were understood to reflect a realisation that closure has become a nonviable objective and that the provisional should be better accepted as a reality of an emergent holanthropic analysis of the human. Actor network theory made it possible to understand how lives are played out in cooperation with technologies and to take a more subtle and unbounded view that accounted for interplay without seeking closure but rather accounted for the materialisation of artefacts in terms of hybrid social and cultural energies.

Once a simple, viable model had been established, it was necessary to subject it to critical scrutiny and to ask why industrial design has not incorporated a process of the orchestration of valence at that material site of interaction into the terms of its analysis. Chapter seven took its lead from an anthropological understanding of technology as an evolutionary component of intelligence-given form and enacted through social and cultural processes. Attempts to resist a necessary inclusion of hybridity into analysis were reviewed. Ideas of alienation were shown to emerge from classical ideas of technicity, which have denied the evolution of the hybrid species. Dourish's previous attempt to understand enaction from a design standpoint was reviewed and shown to be limited by its failure to account fully for the distributed soma in its analysis. Many attempts to unpick the hybrid nature of the human condition have been founded upon ideas of an essential heterogeneity. Ideas such as that of cyborg theory have not fully accounted for hybrid holanthropic evolution and have been forced to imply that somehow people are alienated from their true selves by technology. Those theories have considered the human and the technological in degrees of differentiation and have frequently made the ordinary seem traumatic through their focus of attention upon technology as an alienating force, rather than a facet of a hybrid holanthropic condition. Industrial designers, lacking confidence in their intellectual heritage, have allied the process of humanisation to attempts to reverse that supposed alienation and to reconstruct a social narrative of the cyborg by intervening into social situations and by separating the human from the technological. Environmental scientists, reflecting other recent moves in scientific logic, have argued that linear and reductive modes of science are no longer sufficient to enable understandings. Classical ideas that have underpinned much Western logic and have reduced the human species to an entity in antagonistic relation to the world are now unsustainable in intellectual and ecological terms. Those assertions appear in any case to go against the way in which people have anecdotally described their lives. Holanthropic analysis understood technology as a component of intelligence tied to the evolutionary trajectory of the species and given form through social and cultural processes. When the thesis began to talk in terms of evolutionary biology, however, the soma could no longer be discounted nor isolated from any analysis of the world and invited a new form of holsomatic analysis. However, in industrial design discourse the theoretical construction of the physical human has, for the most part, remained fixed about a perceived materiality that has had resonance with the familiar and everyday body.

While humanity and technology can now no longer be considered as anything other than a hybrid holanthropic condition in social and cultural analysis, the same could not be said of attempts to understand the human soma. While it may have previously appeared self-evident to designers that humanity and technology were heterogeneous, cognitive scientists have come to recognise that cognition should be understood, not as a purely perceptual interpretation and analysis of the world, but in terms of an embodied and somatic engagement with the world. Some design-led approaches to embodied interaction have appeared to be entrenched in methods of analysis that have made it difficult to incorporate the full holsomatic account into design logic.

Reluctance to the idea of holsomasis in terms of coextensive experiences of human-technological interaction may be rooted in its association with previous more hysterical claims of the Futurists and of the 'New Ego'. Joe and Josephine, the familiar ergonomic line drawings of the human developed in the mid-twentieth century, have provided a bounded model of the human for designers and an attempt at stability by fixing the human body as a given artefactual form. While everything else may have appeared to be fluid, designers have been able to imagine that they could at least rely upon that model of the human as a fixed material entity. By fixing the human body as a resolved and material artefact, hysterical continuity has been provided for industrial designers, but that has made it impossible for them to account for the ways in which humanity could be considered as a hybrid holsomatic condition. In order to overcome these objections it was important to return to how granularity in analysis could provide a changed view of reality and not a changed reality. When human-technological relationships are considered through a form of extent analysis, valence must be maintained in terms. A number of attempts to maintain stability in terms have been made by members of the industrial design community, but these must be overcome if a form of extent analysis that accounts for holsomasis can be included in their discourse. The function of chapter eight in the thesis was to deal with this in order to provide a closing argument. In order for industrial designers to find a way to engage with the anoetic, it is necessary for them to find a means to 'artefactualise' the enaction of the hybrid-human at a subtle and intense degree of granular complexity. At this scale and complexity it has become clear that no meaningful closure of the human is possible and that, therefore, a means will be required for some kind of extent analysis to engage productively with a new-found holanthropy. The thesis concluded with a speculative scenario, which reviewed some of the ideas contained within the thesis, and set out three parameters for a future form of industrial design.

- Material scale and extent are linked to the granular sophistication in the conceptual and technical models that are applied to their analysis.
- An artefact is a collusion of many differing modes of analysis set about a range of topological domains.
- The humananthropic and holsomatic human must be understood in similar terms of granularity and complexity to the model of technology applied.

By eschewing the limited artefact models of the human that they have held, industrial designers can come to terms with this understanding. Then they will find their imagining of the artefact will have shifted to a scale coherent with emergent intellectual understandings of the world as a complex and unbound singularity. When artefacts are understood as a materialisation of some hybrid-human enaction, then the anoetic will point to a need for materiality to be understood in similarly complex and molecular terms. The particular intellectual trajectory and heritage of industrial design, described by generations of people who have taken complexity and brought it into the world as a series of forms, can thus be brought to bear upon emerging understandings of the world as a continuum.

Designers must eschew the tendency to define themselves by the nuances of their practice and must instead take a view of their expertise as residing within one topological domain or another. They can now productively describe themselves in the terms of the scale of attention they give the world. The impetus to humanise technology implies that designers should seek a condition of quotidian experience at any degree of granular attention by transforming complexity into the quotidian. In order for industrial designers to find a way to engage with the anoetic, they must artefactualise the enaction of the hybrid-human at a range of granular degrees of complexity. At the extreme, it is clear that no meaningful closure of the human is possible. In keeping with its holanthropy, the thesis has not attempted to provide any absolute answer or to provide any eternal verities as to how designers might take the potential of DNA computation and other biotechnologies, but has outlined a philosophical basis in order to construct a brief for the design of one kind of future.

I have demonstrated that the discourse of the community remains an essential human conversation that should be tied not to any particular material form of technology but to an ongoing engagement between the intellectual and experiential understanding of the world. My community's unique contribution to human development has been quite simply to make it seem quite quotidian to live one's life as a hybrid technological species. Industrial designers must stand up for that autonomy and must reject assumptions of technology as an alien intervention into human life. The convenient assumption that distance must be found between the human and the technological must be rejected, so that a sensible and intelligent conversation can start with respect to the design of a biotechnological future where no such distance will be found. This thesis has gone some way to make it possible for the industrial design community to continue that contribution to human culture. However, there is much scope for future research and the journey must continue.

There are two particular directions that might be taken on a subsequent research journey. One direction for research might be to take a pathway towards the development of a critical form of extent analysis in order to enable the development and activation of a technical language to describe an aesthetic of enaction. That research journey could explore more fully individual facets of the technic placement of the human outlined in this thesis and could deconstruct these in order to lay out a codifiable and applicable language for designers. That journey might produce something akin to Dreyfuss's Joe and Josephine, although any new model would necessarily be constricted in more open and complex terms. In the manner in which a good adventure story often starts with a mysterious clue, another direction the research might take after this thesis might be track back to the very start of this journey and think again about Ayrton Senna feeling the pain of an engine grinding itself to death. With the benefit of the connective logic of this thesis, the research could return and revisit some of the emerging discoveries of neuroscience regarding the autonomic and non-conscious mechanics of the soma. That research would build upon the design discourse I have outlined here and begin in earnest the task of understanding the soma as an engineering potential. It could start the journey towards a more subtle understanding of an aesthetic of enaction that would have resonance in consciousness studies and it might provide the basis of a quotidian but no less extraordinary future.

I believe that my research over the past years and embodied in this thesis has gone some way to continue the rich intellectual heritage of the industrial design community. This thesis is a small contribution to the continuation of the intellectual value of those industrial designers who have gone before and an important means of allowing that intellectual voracity to have a voice in the future of humankind.

Stephen Thompson : July 2008

Appendix 1

Coda: Joey the Mechanical Boy

Coda

Joey the Mechanical Boy

An allegory eschewing closure, showing how process of humanisation is tied to the intellectual coherence of the complexity and granular sophistication in the conceptual and technical models held of the artefact as a component of the whole human.

Joey **Introduction to the Coda**

The allegory

In this coda the story of Joey the Mechanical Boy is deconstructed in order to provide an allegory that illuminates how the process of humanisation can be understood to be tied to a process of intellectual coherence in the complexity and granular sophistication in the conceptual and technical models held of the artefact as a component of the whole human.

'Joey, when we began our work with him, was a mechanical boy.' (Bruno Bettelheim, 1959)

This story provided much of the impetus to the research and remains in the thesis because it provides a means to open out a number of ideas contained within the main thesis. After an introduction to Bruno Bettelheim's account of Joey the Mechanical Boy as it appeared in *Scientific American* in the mid-1950s (appearing at face value to be an account of trauma and therapy, this coda questions the process by which Joey is liberated from a particular and rather exceptional, technology-engendered psychosis. The story of Joey is sometimes used as an argument in favour of the cyborg nature of human existence and is claimed as evidence of the traumatic alienating effects of an imagining of the body in machinic terms. Joey's own voice has no part to play in the very few accounts that refer to his story nor in the narrative laid out by Bettelheim's narrative of trauma and cure, illustrated with Joey's own drawings. When it is read from a design perspective, the story invites a closer visual analysis of Joey's drawings. These are Joey's only voice; they provide his side of the story and can be understood by a designer, who is perhaps familiar with sketching and drawing as a conceptualisation process, to reveal much that appears to be unnoticed in other accounts. The analysis of these drawings from a design perspective makes it possible to observe, by allegory, how many orthodox readings of human-technological relationships might occlude or simply miss the opportunity to adopt an intellectual stance considering and testing how technology and humanity might reside in a single episteme and be considered coextensive. Rather than as an escape from his machinic self, Joey's therapy can be understood to reside in developing coherence in the conceptual and technical models he holds of himself and of technology. This process enables Joey's sense of self to emerge in a condition that accepted continuum rather than the resolution of heterogeneous entities. Broader ideas of granularity emerging from this interpretation of Joey's therapy are explored as a means to understand how changed views of reality do not necessarily reflect changed realities but may have consequences for the material scale of analysis. Joey's story could be understood as a means to an end in the development of this thesis. It might perhaps appear to make sense to treat this story as part of the sketch material or scaffolding of a process of research and to dispense with it. The prejudices that underpin the conception of therapy that Bettelheim describes can be understood to mirror many of the assumptions that can be understood to reside at the core of industrial design discourse, and so the story can function as an allegory of the problem and situation in which industrial design finds itself. Joey's cure (his humanisation) is imagined as residing in a process of therapy, which enables the emergence of a social model of his humanity from the cold and unfeeling realm of his technologised self such that he might become a resolved and complete human. The story of Joey the Mechanical Boy's therapy when it is reanalysed reveals how Joey realised his own therapy, through a process that enabled his selfhood as an emergent condition that accepts anoetic continuum rather than the resolution of heterogeneous entities. Joey's illustrations chart a developing granular sophistication in the conceptual and technical models he holds. This idea is extended to demonstrate, through the example of an industrially designed artefact, how the scale of materiality is tied to the complexity of its analysis. In other words, the more complex the analysis applied, the more granular the representation of materiality. The assumption that materiality determines the design process, underlying much orthodox analysis, is thereby inverted.

Joey.1 **Joey the Mechanical Boy: His Story**

Introducing Bruno Bettelheim's account of Joey the Mechanical Boy.

The account of Joey the Mechanical Boy and his supposed cure under the care of Dr Bruno Bettelheim, appeared in *Scientific American* in 1959. Given Bettelheim's subsequent reputation for embellishment and invention (see particularly Pollak, 1997 and Raines, 2002), the authenticity of the story of Joey the Mechanical Boy must be considered to be in some doubt, and it is perhaps best read, at least in part, as mythology. Although considered inadequate today as an account of psychological therapy, Bruno Bettelheim's account published in a late 1950s edition of *Scientific American* of a supposedly schizophrenic[210] child nevertheless continues to provide an illuminating insight into 'emotional development in a mechanised society' (Bettelheim, 1959, p. 117). To take Bettelheim's account at face value: when Joey was first admitted to the Sonia Shankman Orthogenic School at the University of Chicago, he displayed signs of serious trauma. Joey was a frail 9-year-old child who believed himself to be a machine.

According to Bettelheim, so complete was Joey in his machine behaviour that he was able to convince others who encountered him that he might be some remarkable, although obviously mechanical, android. For Joey the 'delusion' was complete. He would move from room to room stringing 'an imaginary wire from his "energy source", an imaginary electrical outlet, to the table. There he "insulated" himself with paper napkins and finally plugged himself in. Only then could Joey eat, for he firmly believed that the "current" ran his ingestive apparatus' (Bettelheim, 1959, p. 117. To their bemusement, the staff and the other children found themselves stepping over these 'imaginary' wires and being careful to avoid the other 'apparatus' with which he surrounded himself. Mostly Joey would hum along unnoticed like a domestic appliance, but on occasion he would suddenly 'shift noisily through a sequence of higher and higher gears until he exploded screaming "Crash, crash!"' (Bettelheim, 1959, p. 117). Joey would hurl his apparatus around the room; he was particularly fond of stealing light bulbs and, if any broke, would 'retire to mute, motionless non-existence' (Bettelheim, 1959, p. 117). In contemporary engineering terms, Joey seemed to imagine himself to be a form of

[210] Although described by Bettelheim as schizophrenic in 1959, Joey might be considered autistic by contemporary therapists, a fact noted by Bettelheim in a subsequent retelling of his story (see Bettelheim, 1976).

hybrid, a combination of electrical motors and internal combustion; while his wires connected him to his current, he breathed through a carburettor and exhaled through exhaust pipes.

In Bettelheim's account, Joey, being 9 at the time, displays a remarkable cognisance with mechanical complexities for such a young and disturbed child. We might wonder whether he was as much a product of the interpretation of the nurses who cared for him as a product of his own mind, although Joey certainly became something of an expert at taking apart and reconstructing machines at a very early age. Bettelheim speculates that this early fascination coupled with the inadequacies of remote and unloving parenting led him to develop 'preventions' protecting himself from the world, feeding through pipes. His pathological behaviour seemed the 'external expression of an overwhelming effort to remain almost nonexistent as a person' (Bettelheim, 1959, p. 119). Conversely, Joey gave biological names to his apparatus: his tubes 'bled' when cut, his machinery sometimes 'got sick'. On one occasion Joey bumped into a piece of the hospital apparatus; in rage he began to kick it, until restrained by a nurse, who explained that the hospital apparatus itself, being hard, would hurt his foot. Joey's response was to cry indignantly: 'That proves it. Machines are better than the body. They don't break; they're much harder and stronger' (Bettelheim, 1959, p. 120). When Joey demonstrated any human physical or intellectual frailty, he would demand that a limb or his brain should be hit to make it work, or torn off and replaced. Once, later in his treatment, when he was rebuffed by another child to whom he had formed something of an attachment, he cried, 'He broke my feelings' (Bettelheim, 1959, p. 120), as if his emotions had some kind of mechanical construction.

Joey's supposed restoration to 'humanity', Bettelheim informs us, was a gradual process. Joey progressed over the course of five years from a disturbed and isolated frail child to become human enough to escape Bettelheim's treatment. At the age of 12 Joey wrote a slogan on the hospital memorial day float: 'Feelings are more important than anything under the sun.' This was evidence enough for Bettelheim that his cure was effected. 'Feelings, Joey learned, are what make for humanity; their absence, for a mechanical existence. With this knowledge Joey entered the human condition' (Bettelheim, 1959, p. 127). Between the screaming machine and the emotional and cultured citizen, a story is told of a child emerging slowly from trauma under the patient and gentle care. Whether his story truly reflects some of the later more brutal accounts of life in the Orthogenic School or not, Joey's life appears to be an extraordinary and remarkable story. Bettelheim suggests that it is a story of its times. 'It is unlikely that Joey's calamity could befall a child in any time and culture but our own . . . our society of mechanised plenty' (Bettelheim, 1959, p. 126). Joey 'chose the machine and froze himself in its image' (Bettelheim, 1959, p. 117). It was constructed from the world as it was to hand, a mid-twentieth-century world, presumably close to a second great mechanised war, a time of the rapid proliferation of domestic appliances and motor transport, the apotheosis of a process begun a century before in the steam age and the nascence of a new era of electronic apparatus. Joey's condition, and his construction, mirrors his time, his hybrid nature of electricity and combustion reflecting the transformations that were taking place in the world about him, his behaviour both violent and mechanical and passively electric.

Joey.2 Joey the Mechanical Boy: The Orthodox Analysis

Joey's cure (his humanisation) is imagined to reside in a process of therapy, which enables the emergence of a social model of his humanity from the cold and unfeeling realm of his heterogeneous, technologised self through a process of social and cultural alienation.

Bettelheim imagines that Joey's cure resides in a process of the *humanisation* of the technologised self. Bettelheim suggests that his process of humanisation is undertaken by teaching Joey to repress the dread of his machine self and to come to terms with himself as an emotional and cultural human. In his lost humanity Joey is the ultimate, pathological cyborg. Only by refinding his humanity can he be expected to live at peace with himself. The story, as it is presented, suggests that Joey imagined himself as a technology in need of humanisation. In Bettelheim's analysis Joey presents a complex retraction from the world. The child is trapped in trauma, but is then gently freed from an all-consuming delusion. This delusion, Bettelheim reasons, is sustained by the world in which the child finds himself, conditioned internally in reaction to infantile events but determined by the times in which Joey lives. The child is brought both into the world and into himself. Joey's humanity is thus revealed as some form of soulful warmth buried beneath the cold hostility of his autistic defence: 'the body can operate without a human spirit, that body can exist without a soul' (Bettelheim, 1959, p. 117). In that moment when he recognises the necessity of feelings, and through a number of sensitive drawings that Joey makes of the world, the human is revealed. Joey is no longer a machine. He is evidentially a human being, because he has culture and emotion, and these define the terms of Bettelheim's imaginary conception of how we should measure our humanity. The centre of this therapy resides in the transformation from machine boy into a human being who *controls* machines.

For Bettelheim control represents an important aspect of the overcoming of trauma; he makes several references to it in his account of Joey's restoration. Toilet training, of course, and the control of his bowels are a focus for Bettelheim's scrutiny. Although it was not 'anal' in the Freudian sense, it is supposed that rigid toilet training had in some way mechanised Joey's behaviour. Joey overcomes fears that his 'whole body be sucked' out during defecation into a superior machine toilet. This, and his contradictory fear that the removal of his particular digestive 'prevention' tubes might lead to his body filling with faeces, 'leaving him no room to live' (Bettelheim, 1959, p. 122), seem to indicate an awareness of his organic nature even at the apotheosis of his mechanised trauma. Bettelheim is now considered to be wrong, even fraudulent, in his hypothesis that autism emerges in consequence of parental behaviour. Nonetheless, a lack of emotional attachment, as well as a mechanistic treatment by unloving parents (were these shown to be true), might be reasonable grounds to develop a defensive view of oneself isolated within a machine. Bettelheim charts the slow and painful retrieval from this isolation by tracking the expansion and dissolution of Joey's illustrated conceptions of his place in the world. Joey's first drawing describes the 'papoose', an 'artificial, mechanical womb . . . into which he locked himself' (Bettelheim, 1959, p. 127). Joey represented the papoose in drawings as an isolated box, strung on taught wires, suspended in an infinite void. Gradually over time and in the process of therapy, the papoose became more intimate and eventually more akin to a skin, closely contouring the organs of the body. In simultaneity with this intimate wrapping of the organs, the body itself became progressively less isolated, grew hands and acquired sensory organs. With the development of the means to engage with the 'outside' world, it became necessary for Joey to construct a new conception of his psychology. Joey began to draw the 'Carr'.

Three drawings of the Carr family.

The 'Carr' is a drawing of a machine in which Joey is able to undertake a psychological journey into the world. The 'Carr' may refer to Joey's childish misspelling of the 'Car' or the 'Autocar'. However, Bettelheim might be playing a rather subtle joke upon us, while simultaneously revealing something of the fictional or allegorical nature of the story of Joey that he tells. The term 'Carr' may hint at Joey's true name, or may be Bettelheim's subtle allusion to the Ancient Egyptian concept of the 'Kah' or 'Ka', somewhat uncertainly translated as the 'soul' or 'vital energy' or as the essential quality that defines our sense of self in the world. Joey's Carr is mechanically imagined, and Joey is a mechanical boy. The Ka is a means for the deity to travel into humanity, and the Carr is Joey's mechanical means to travel into the world of humanity (see Kemet, 2006). Bettelheim claims the Carr was designed by Joey to move and thus to provide a means of 'exploring the possibility of leaving the school . . .' (Bettelheim, 1959, p. 127). As the 'papoose' entered the 'Carr', it was at first a passenger, and then eventually took control of the vehicle. In taking control, Bettelheim argues, Joey became human. The logic of this argument is that machines are not human; they are controlled and extrinsic to conditions of humanity. By taking control of this extrinsic condition, Joey convinced Bettelheim of his cure, and, in making his final step into the human condition as a cultured American, with his contribution to the carnival float, he was allowed to leave the hospital.

For Bettelheim this is a story of therapy and the emergence of humanity from the soulless mechanism of the human body. That Bettelheim's *Scientific American* account was presented in an exhibition at Vancouver Art Gallery, entitled 'The Uncanny; Experiments in Cyborg Culture' (see Grenville, 2001),[211] is an indication that his story has taken on a late-twentieth-century resonance. For some, Joey's condition is evidence of the uncanny nature of the cyborg condition, a symptomatic response to an age in which humans have become machine. For Bruce Grenville, who collated the exhibition and edited the catalogue, the story represents his own feelings of dread, the same terror he felt when a mechanical lung sucked the air from his chest. If Bettelheim proposes a cure, a realisation by the child that he is not a machine, then Grenville argues that a repression of Joey's awareness of the machine nature of his body has occurred.

> My proposition is simple. The cyborg is an uncanny image that reflects our shared fascination and dread of the machine and its presence in modern culture. This proposition is rooted in Sigmund Freud's dictum that the uncanny 'is in reality nothing new or alien, but something familiar and old-established in the mind and which has become alienated from it only through the process of repression. (Grenville, 2001, p. 10)

[211] Bettelheim's *Scientific American* account is presented alongside Marcel Duchamp, Lee Bull, Donna Harraway, William Gibson and others, who reoccur as focuses of attention in cyborg literature.

Only by repressing the dread of the machine can Joey escape into something of a semblance of life in the mechanical age. Joey's trauma merely reveals the terror of life in his time. He must simply learn to forget, or at least to ignore, the oppressive nature of the technological and mechanised world in which he can live. Bettelheim uses the word 'uncanny' to describe his patient,[212] although he gives the term little weight. 'Uncanny' appears almost colloquially, perhaps as a figure of speech, perhaps unconsciously connecting Joey with a Freudian revelation. 'Perhaps [Joey was] so uncanny because [he] remind[s] us that the human body can operate without a human spirit, that body can exist without soul' (Bettelheim, 1959, p. 117). The body, in this logic, must be understood to be a machine for living in, and we are today now more familiar with the concept of a body, brain dead but breathing with the aid of apparatus. But nevertheless we are reminded at every turn that the body is never just a machine.[213] The body is warm, vital and generational; the machine, at least in Bettelheim's analysis, is cold, geological and transfixed in time. If the body is a machine, it occupies an extraordinarily intimate relationship with our sense of ourselves. Joey, however, is imagined as an artefact. He can be humanised only by denying the machine nature of his body and by learning to externalise his humanity as an emotionalised culture. On closer inspection, the drawings presented as evidence of the process of his therapy suggest that Joey comes to a broad understanding of the nature of the human condition, performs a necessary artifice to convince Bettelheim of his cure by completing the required normative expectation of himself as an American citizen, escapes the orthogenic hospital, journeys out into the world and melts into legend.

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[212] Bettelheim, of course, was almost certain to have been familiar with Freud's exploration of the uncanny (see Freud, 1917).

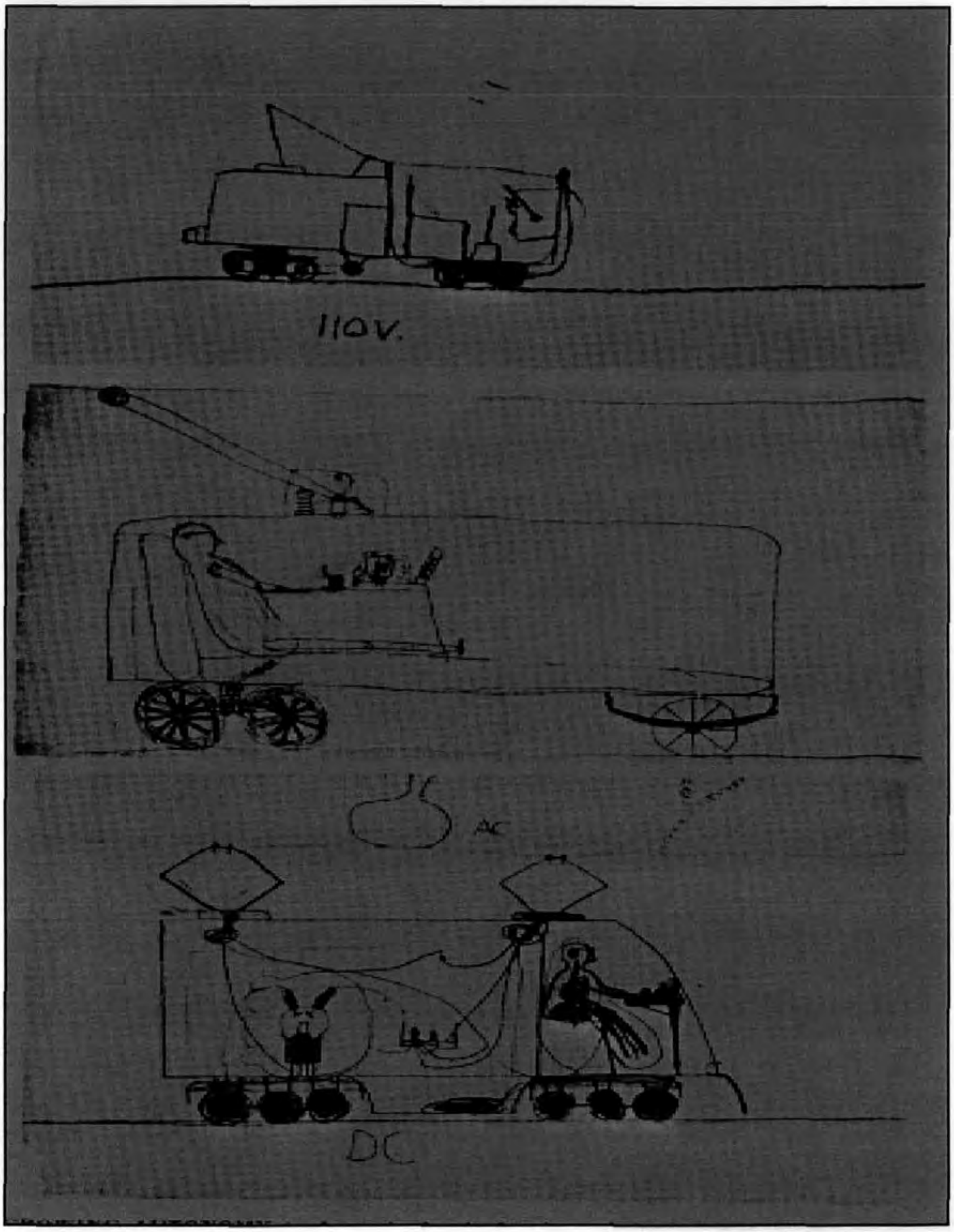
[213] For example, the moral outrage at the removal of organs from dead children in a Liverpool hospital without permission of the parents (Liverpool, BBC, 2005), the veneration of a saintly finger, or the recovery of our DNA from a stray hair all remind us of the totality of humanity in both the abstract and the material body.

Joey.3 **Joey the Mechanical Boy: An Unorthodox Analysis**

The story of Joey the Mechanical Boy's therapy as a design analysis, revealing how Joey realised his own therapy, through a process that enables his selfhood as an emergent condition that accepted continuum rather than the resolution of heterogeneous entities.

Bettelheim's treatment, enabling Joey to come to terms with the need to have emotions, seems to be both subtle and expert, and, in combination with the care and patience of the nursing staff, seems to have been effective. In Bettelheim's account, the hospital helped Joey to understand that emotions, connected to a social and cultural model of the world, are the essential terms of being human. This is not in question here. However, if the three drawings of the Carr family are subjected to a revised analysis, a rather different picture emerges. Joey's own voice has no part to play in the very few accounts that refer to his story, nor in the narrative laid out by Bettelheim's narrative of trauma and cure, illustrated with Joey's own drawings. Drawings are Joey's only voice from those times; they provide his side of the story and can be interpreted to reveal much that appears to be unnoticed in other accounts. The illustrations of the therapeutic journey through the Carr family, when viewed by a designer, and in the context of an investigation of the nature of the process of 'humanising technology', can be read in a manner rather different from that which Bettelheim describes from his perspective of the therapy. To remind ourselves of Bettelheim's analysis of the Carr family, it is presented as evidence of 'GROWING AUTONOMY' (Bettelheim, 1959 p. 124). The top illustration is supposed to show a Carr with no human in it. In the second illustration the figure rides within the Carr as a passenger, and in the bottom drawing the figure has taken control of the vehicle. These drawings, Bettelheim suggests, illustrate how Joey is at first a remote and isolated machine. Joey's humanity then emerges, first as an accomplice of the machine, and finally as the master.

But it is plausible, when one examines his drawings more closely, to take a view that Joey did not imagine himself to be a mechanical boy at all and was not cured. Rather than seeing the drawings as showing Joey learning to repress the machine nature of his body, it is quite possible to take a view that Joey realised his *own* therapy by discovering the full complexity of his humanity. In a design analysis, the 'papoose' and the 'Carr' family are evidence, not of the human gaining control of the machine, but of an emerging realisation of the hybrid nature of the human condition. Bettelheim could understand the machine only as something other than, and in opposition to, humanity. Joey's therapy, and by analogy the process of humanising technology, are then imagined as a transition between states (machine to boy) in which the technological machine of the body is repressed in favour of an externalised humanity that interacts with the body, rather as one might interact with an artefact. But this is not the evidence of the drawings.



The Carr Family

The top drawing certainly appears to be an empty and unoccupied machine. We can perhaps accept Bettelheim's analysis of the figure as a passenger in the second drawing, although, of course, many vehicles - railway engines, for example - are often driven from this position. The Carr certainly appears to have something of a resonance of the train in its wheel configurations and its pantograph. However, the third (bottom) drawing in the sequence is perhaps the most telling. Here the internal mechanism of the Carr and the internal mechanism of the figure are drawn with the same care and attention to detail. We can see the digestive system, the spinal chord and the brain as well as something that appears to be an electronic valve mechanism and the wheel bearings. Most tellingly, the Carr and the figure appear to be symbiotic. The brain and digestive system are not merely connected to the components of the Carr; they appear as part of a larger machine, part biological and part mechanical, connected together with energy as an essential motivation. The Carr, for example, functions because it draws power through the pantograph, but also by collecting excreta in a tank and drawing energy from it. The eyes and ears of the figure are directly 'tapped' into the system, in which electricity and energy flow about, powering the Carr.

The Carr then, as it appears in this drawing, is not *something* that is merely *controlled* by the human, but a complete and coextensive activity system, synthesising energy, cognition and mechanics into one entity. The third Carr family drawing appears to represent the Carr as an autopoietic system, a topological domain that is enclosed and self-directed, although active in the world. Isolated analysis of the non-human system (vehicle) and the human (the figure - can we be sure this is Joey?) is no longer meaningful. Rather than simply a vehicle in which to travel, the Carr is a complete system that realises Joey's humanity. Being human is an activity realised through a singular coextensive being that extends into every facet of the soma and into every facet of the technological world. There is no beginning and no end of Joey. He is a being embodied in a biological and technological machine. Is it possible that Joey's trauma is not that he thinks he is a machine, but is symptomatic of what happens when one so young comes to the realisation of the hybrid nature of the human condition? If the drawings of the Carr family are looked at from a design perspective, they appear to track a process of self-realisation that Bettelheim does not describe at all. From a close study of these drawings it becomes possible to suggest that Joey, rather than *emerging* from trauma, merely came to a more sophisticated understanding of his condition as he matured intellectually. This sophisticated understanding enabled Joey to function in the world as an apparently normal human being. When he was admitted to the hospital, Joey imagined that he himself was realised through machine processes that were childish and crude. The only model of the machine available to his intellect was the artefact, remote and resolved. Joey attempted to replicate himself as an artefact, remote and operated by radio control. He was a single entity isolated from other machines.

As Joey began to attach himself to an infrastructure of technology, he moved from isolated radio control to more direct connections with crude models of technological systems. Joey now understood himself to be part of a distributed system of machines. Joey's early attempts to realise himself as part of a distributed system were crude and metaphorical. He used string instead of wires and other ephemera he could purloin to stand in for machine components. Over time, Joey came to a more sophisticated understanding of machines as being comprised of many smaller components and networks of other components. In the process of his developing experience and knowledge of technology Joey came to realise that technologies are complex, and his knowledge extended to increasingly finite understandings of that complexity. The detail of the machine became increasingly intense and subtle as well as more literal, practical, less metaphorical and more realistic in engineering terms, and this is reflected in the drawings. When admitted to the hospital, Joey drew himself as a simple creature, outlined with shimmering lines, a simple box body and limbs that were hardly there. Over time Joey came to an increasingly complex understanding of the machine nature of his body. The detail of that machine becomes increasingly finite in each drawing, as Joey realised himself through more subtle and sophisticated machine processes. Joey came to represent his own body as a complex system of intestines, spinal chord, brain, skeleton and so on. This representation mirrors the developing sophistication in his understanding of machine as an increasingly finite series of interacting components. The symmetry in this developing sophistication and the granularity of attention paid to the component of the machine (body or technology) are evident. Joey the Mechanical Boy enacted and realised his therapy by accelerating the complexity of the understanding he held of his condition. In the developing Carr drawings we can track a gradual intellectual shift from a mechanical model of the self, towards more distributed and interactive understanding.

Joey's drawings suggest that throughout his therapy he continued to understand himself as a machine but realised that he must understand himself as a distributed system that did not rely upon metaphorical props to support his schema. Joey came to understand that his body and the technology distributed around him were functioning together to make him conscious. As he matured, the Carr drawings demonstrate how Joey developed an increasingly finite understanding of technology and of the machine nature of his body. Joey's drawings suggest that he realised he could not simply copy the machines he saw about him in isolation, any more than he could isolate and copy any of the components of his body. Rather than isolating the components of his soma, Joey realised they must be considered as a complete system. As the therapy enabled the development of a more sophisticated understanding of the human, Joey maintained coherence in his self-perception by accelerating the sophistication and complexity of his understanding of the machine. Joey realised that he *was* and *was not* a machine; the machine *was* and *was not* Joey; humans are machines and machines then are human.[214] This was the only plausible means for Joey to realise himself as being in the world in terms that could incorporate his being as a condition emerging from the systems that give rise to and support his being. Some of these systems, Joey understood, were built of organic tissue, others of metal and plastic; together these systems act as an extended soma. Joey's therapy came from this realisation. His drawings suggest that he did not suppress his machinic qualities but accelerated the complexity and subtlety of his understanding of the machine nature of the organic and inorganic soma, such that he was able to 'enter the human condition' (Bettelheim, 1959, p. 27) by understanding his humanity as residing in a rather special realisation of being. Coming to this rather sophisticated conclusion, we can perhaps speculate that, realising the futility of attempting to explain his realisation to Bettelheim, Joey painted a picture of a tree[215] and slipped into mythology.

The narrative of Joey the Mechanical Boy ends at the moment when Bettelheim considered him to be cured. There is no account of Joey's life after this period. He remains entirely anonymous, which suggests it is possible that the story is a fictitious colluding of several separate accounts. Even if this were the case, the termination of the story at this moment suggests that Bettelheim accepted a generalised view of the normal relation between humans

[214] In this account Joey would find the idea that one could humanise technology to be an oxymoron.
[215] A tree painting was one of Bettelheim's key indicators of Joey's humanity.

and technology. Joey's therapy appears to be complete when his relational positioning of his self and technology are placed in a relationship that is thought normal in everyday experience. Joey's drawings, however, suggest a rather different account of his therapy. We might ask whether Joey accepted the normalised view of human-technological relationships or whether he merely masked his true understanding in order to effect his liberation from Bettelheim's care. It is likely that we will never know the truth in this respect.

Bettelheim suggested that Joey the Mechanical Boy chose to be mechanical because the mechanical world about him had come to dominate his imagination. The more subtle reading is that Joey comes to an increasingly mature metaphysical understanding of the nature of the human condition as an emergent consequence of the soma. Joey understands his soma to be continuous in the organic and inorganic. Joey is not a machine, but he recognises that 'machines can be considered as organs of the human species' (Canguilhem, 1992, p. 55). His body then extends far beyond the biological artefact. This is a view that has much resonance in twentieth-century technology philosophy. Joey's drawings imply that he effected his own therapy by maintaining coherence between developing granularity in his knowledge of his own soma, with his growing understanding of the complexity of machines. We can find this coherence in the representation of his own soma concurrently with the inorganic soma of the Carr. As Joey becomes more sophisticated in his understanding of the inorganic components of the Carr, he develops his understanding of the organic components. Joey realises himself by finding a form of coherence in his understandings of himself as a machine. It could be argued then that, notwithstanding Bettelheim's direction and the expertise of the staff in the Orthagenic hospital, Joey realised his own therapy. This self-directed therapy could be understood to have occurred as Joey came to realise that his self-perception was insufficiently complex and could not be limited to a narrow conception of himself as a machine. Joey de-objectified himself, stripped his understandings of the world as a series of discretely ordered taxonomy, and came to realise himself as neither purely Boy nor Machine. By understanding his selfhood to be enacted through a distributed and extended soma, Joey could come to terms with his place in the human condition and could escape Bettelheim's regime. If Joey's trauma is understood as an analogy of the state in which industrial design finds itself, struggling to resolve a perceived difference between the fluid interpretation of the human and the objectified view of technology, then it is possible that Joey's therapy can provide an analogous model for industrial design too. The orthodox story of therapy that Bettelheim describes tells of Joey's gradual coming-to-terms with understandings of himself as culturally constructed. This model would seem to bear some similarity with contemporary industrial designers' attempts to reimagine the process of humanising technology in a cultural and social construct. The alternative model of Joey's therapy presented here invites a view of the process of humanisation as a coming-to-terms with continuum. Joey comes to understand that he is continuous with the machine, not because he is a bounded and fully resolved machine, but because he manages to understand his continuity at both the macro and micro scales. In one sweeping and material imagination Joey can sense his soma to be internalised organically and externalised mechanically as a continuum.

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