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Cyborg Urbanization: Complexity and Monstrosity in the Contemporary City

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Introduction

> She referred to the high-rise as if it were some kind of huge animate presence, brooding over them and keeping a magisterial eye on the events taking place. There was something in this feeling — the elevators pumping up and down the long shafts resembled pistons in the chamber of a heart. The residents moving along the corridors were the cells in a network of arteries, the lights in their apartments the neurones of a brain (J.G. Ballard, 1975: 40).

> Now, the boundaries between the organic and the inorganic, blurred by cybernetic and bio-technologies, seem less sharp; the body, itself invaded and re-shaped by technology, invades and permeates the space outside, even as this space takes on dimensions that themselves confuse the inner and the outer, visually, mentally and physically (Anthony Vidler, 1990: 37–8).

> The body-territory [*corpo-territorio*] poses a problematic form of corporeal identity that in becoming ever more routinized has tended to dissolve the distinctions that formerly existed between the organic and the inorganic (Tiziana Villani, 1995: 118).

As she tentatively begins to play the piano, the replicant, named Rachel, recalls that she once had lessons but cannot be sure whether these memories are her own or simply the implanted memories of someone else. In this poignant scene in Ridley Scott's *Blade Runner* (1982) we explore the possibility that human identities might be artificially created in order to produce advanced androids whose intelligence and sensitivity is comparable with that of their human creators. The figure of the cyborg, as represented in science fiction cinema, is not an automaton or robot but a sophisticated creation that seems to simultaneously extend but also threaten our understanding of what it means to be human. If we were to locate the cyborg as an idea, we could say that it is clearly linked to fantastical combinations of bodies and machines but is nonetheless a way of thinking about the world. It is, in other words, an ontological strategy for extending the limits to human knowledge as well as an apposite means of describing those phenomena that appear to reside outside conventional frameworks of understanding. If a cyborgian sensibility is explored within the context of the contemporary city, we find that it has developed out of several interconnecting strands of thought as a trope of critical reflection which uncovers a series of anomalies, fractures and tensions lurking within dominant modes of urban and architectural thinking.

Since the early 1960s the potential applications of the cyborg concept have proliferated to include developments such as whole organism cloning, in vitro

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fertilization, gene sequencing, advanced prosthetics and other sophisticated medical technologies. In tandem with these technological manifestations, the imaginative field of the cyborg has expanded through literature, cinema and the fantasy spaces of contemporary culture.[1] It is since the mid-1980s, however, that the idea of the cyborg has been associated with a more densely argued series of theoretical applications as a means to explore the interface between technology and the body. The key intervention here is Donna Haraway's article entitled 'A Cyborg Manifesto', first published in the *Socialist Review* in 1985, and later included in her influential collection of essays *Simians, Cyborgs and Women* where she writes in her introduction (1991a: 1):

> A cyborg is a hybrid creature, composed of organism and machine. But, cyborgs are compounded of special kinds of machines and special kinds of organisms appropriate to the late twentieth century. Cyborgs are post-Second World War hybrid entities made of, first, ourselves and other organic creatures in our unchosen "high-technological" guise as information systems, texts, and ergonomically controlled labouring, desiring, and reproducing systems. The second essential ingredient in cyborgs is machines in their guise, also, as communications systems, texts, and self-acting, ergonomically designed apparatuses.

This succinct and revealing definition reminds us that the idea of the cyborg, as originally elaborated by Haraway, is at root a political as well as an intellectual project, an idea which originated in and from the 'belly of the monster' (1991a: 4), that nexus of political and economic entanglements that we might term the 'first world' in distinction to the proliferating spaces of marginality that lie beyond.[2] Since its inception as a critical intellectual concept in the 1980s the cyborg metaphor has been deployed to challenge disembodied, dualistic, masculinist and teleological bodies of knowledge. It has infused science and technology studies with feminist epistemological strategies. It has opened up new possibilities for the understanding of relations between nature and culture. And it has facilitated greater sensitivity towards social and spatial complexity through its emphasis on 'situated knowledges'.

The idea of the cyborg shares an affinity with related concepts such as 'cyberspace', 'cybernetics' and 'cyberpunk'. Yet the contemporary use of the term 'cyborg' is different from these virtual, analytical and fictional constructs because it is grounded in the living and breathing flesh of the human body. Whilst the 'cyber-' metaphor has tended to be associated with various forms of virtuality, the idea of the cyborg is closely linked with

1 The word 'cyborg' is widely attributed to the NASA scientists Manfred E. Clynes and Nathan S. Kline who used the term in 1960 to describe a series of experiments that explored how the human body might be technologically enhanced in order to allow space travel. The etymological roots of the term 'cyborg' can be traced to the eighteenth-century word 'organism' (derived from the French *organisme*) and the more recent term 'cybernetics' introduced by the mathematician Norbert Wiener in the 1940s to describe the study of complex systems of control and communications in animals and machines. The literature on the cyborg ranges from conceptions of the cyborg as an ontological or epistemological strategy to explorations of specific manifestations of the cyborg in social and material practice. See, for example, Haraway (1984; 1991a; 1991b; 1992), Springer (1991), Alaimo (1994), Schroeder (1994), Dumit *et al.* (1995), Franklin (1995), Gabilondo (1995), Gray *et al.* (1995), Tomas (1995), Balsamo (1996), Lock (1996), Bostic (1998), Hacking (1998), Mitchell (1998), Picon (1998), Schaub (1998), Formenti (1999), Hayles (1999a), Fox (2000), Allison (2001), Tofts *et al.* (2002) and Zylinska (2002). For early accounts of the development and impact of cybernetics see, for example, the original contribution of Wiener (1948), Halacy (1965), Schöffer (1969; 1973) Lefebvre (1971), Delpech (1972), Negroponte (1975) and George (1977).

2 For greater detail on the geneology and impact of the 'cyborg manifesto' see Sofoulis (2002) who claims that the essay's most critical contribution was to challenge the prevalent essentialism within eco-feminist responses to science and technology. The earlier work of Haraway is perhaps best conceived in relation to the emerging post-Heideggerian critique of technology developed by, for example, Guattari (1993), Stabile (1994) and Lykke and Braidotti (1996), and in this sense provides a critical bridge between neo-Marxian political economy, feminist epistemologies of science and post-structuralist theory.

the corporeal experience of space.[3] In this sense the cyborg can be read as an alternative way of conceptualizing the growth and development of cities that serves to destabilize the pervasive narratives of dematerialization, spatial malleability and virtualization. The underlying materiality of the cyborg metaphor has acquired heightened significance now that the earlier polarity between virtual space and 'meat space' articulated in the first wave of cyber literature is losing its conceptual utility and now that the very idea of 'virtual reality' is itself imploding as it becomes either relocated in the context of a heightened dimension of the real (see, for example, Žižek, 2002) or simply derided as an inherently oxymoronic formulation (see Grosz, 2001).[4]

The emphasis of the cyborg on the material interface between the body and the city is perhaps most strikingly manifested in the physical infrastructure that links the human body to vast technological networks. If we understand the cyborg to be a cybernetic creation, a hybrid of machine and organism, then urban infrastructures can be conceptualized as a series of interconnecting life-support systems (see Swyngedouw, 1996; Marras, 1999; Gandy, 2002; Mitchell, 2003). The modern home, for example, has become a complex exoskeleton for the human body with its provision of water, warmth, light and other essential needs. The home can be conceived as 'prosthesis and prophylactic' in which modernist distinctions between nature and culture, and between the organic and the inorganic, become blurred (Vidler, 1990: 37). And beyond the boundaries of the home itself we find a vast interlinked system of networks, pipes and wires that enable the modern city to function. These interstitial spaces of connectivity within individual buildings extend through urban space to produce a multi-layered structure of extraordinary complexity and utility.

The figure of the cyborg is at root a spatial metaphor. But how does the idea of the cyborg intersect with spatial theory? In what ways does the cyborg reinforce or contradict other emerging strands of urban thought that also emphasize urban complexity and hybridity? Has the epistemological subtlety and political prescience of the cyborg, as originally formulated in the 1980s, been realized in practice or simply been diffused through the term's widening usage? And should we ultimately reject the idea of the cyborg as an anachronism derived from cold war science and the first generation of twentieth-century cyberpunk culture? In the rest of this article I will try to address these issues through an exploration of the somewhat haphazard presence of the cyborg in contemporary urban discourse. I will focus in particular on the example of urban infrastructure as a concrete manifestation of the cyborg idea in order to explore different facets of the relationship between the city, the body and the human subject. My aim is not to foreclose discussions surrounding the 'cyborg city' but to open up a series of dialogues in order to explore contemporary thinking around these questions.

Neo-organicism and the rhizomatic city

One of the principal difficulties with delineating the cyborg city as a clearly defined entity is derived from the entanglement of the cyborg idea with a variety of urban metaphors ranging from organicist conceptions of the nineteenth-century city to 'neo-organicist' representations of the post-industrial metropolis. In its classic nineteenth-

3 There is now a vast literature on cyberspace. Useful starting points include Benedikt (1991), Featherstone and Burrows (1995), Turkle (1995; 2002), Bingham (1996), Ludlow (1996), Woods (1996), Kitchen (1998), Lunenfeld (1999) and Wolmark (1999).

4 In the earlier phase of the digital revolution human consciousness was widely perceived as caught between what William Gibson referred to as the 'meat space' of the body and the disembodied subjectivity of the digital or virtual realm (see Stone, 1991; Greco, 1995; Hayles, 1999b; Downey, 2001; Mitchell, 2003; Thomas, 2003). Neil Leach (2002: 14), for example, insists on the use of the term 'digital realm' rather than virtual reality to better capture the interface between new technologies of representation and the evolving dynamics of urban space.

century form the organicist conception of the city emerged out of a functional analogy, originating within the medical sciences, wherein spatial differentiation corresponded with a distinctive arrangement of human organs. We find that Kantian notions of the self-organizational characteristics of animate matter were combined with new insights into the human vascular and arterial system and an emerging circulatory emphasis within the nascent science of political economy. In recent years, however, the organicist emphasis on the city as an integrated body with identifiable organs, which emerged in response to the nineteenth-century industrial city, has been increasingly displaced by the idea of urban space as a prosthetic extension to the human body. The body-city problematic has been reconceptualized in the context of post-Cartesian and post-positivist modes of thinking. The emphasis on the city as a self-contained body or machine has been challenged by a hybridized conception of space as a system of technological devices that enhances human productive and imaginative capabilities. The cyborg metaphor not only reworks the metabolic preoccupations of the nineteenth-century industrial city but also extends to a contemporary body of ideas that we can term 'neo-organicist' on account of the deployment of biophysical metaphors for the interpretation of social and spatial complexity.

In the neo-organicist city we encounter a shift of emphasis away from an anatomical conception of space as an assemblage of individual organs towards a neurological reading of space as a diffuse and interconnected realm of human interaction. The film maker Michael Burke, for example, director of *Cyborg City* (1999), describes how beneath the 'glass and concrete' of the future city there will be a 'humming mass of technology' acting as a central nervous system, 'constantly monitoring and controlling both its own functions and those of its citizens' (Burke, 1998).[5] The mechanical and hierarchical model of the relationship between the body and the city has been supplanted by a more complex and non-linear pattern of urban development in response to the spread of new information technologies (see Gille, 1986; Rabinbach, 1990; Akira, 2001). The organicist city of the modern era was founded on a clear separation between mind and body that enabled the city to be conceptualized as a coherent entity to be acted upon, disciplined, regulated and shaped according to human will. The emergence of the neo-organicist city, in contrast, is founded on the blurring of boundaries rather than their repeated delineation. At the same time, however, there remain important continuities between the kind of machine-based metaphors associated with the early twentieth-century futurism of figures such as Mario Chiattone, Filippo Tommaso Marinetti and Antoniono Sant'Elia and the elaborate computer-based metaphors deployed in the contemporary city (see Villani, 1995; Boyer, 1996; Schaub, 1998). Other significant continuities include, for example, the avant-garde bricolage of early cinema and the surrealist bodies depicted in the art of Hans Bellmer, Francis Picabia and other responses to 'a sterile and over rationalised technological realism' (Vidler, 1990: 42).[6] These interconnecting strands between cultural modernism and the emergence of the cyborg metaphor are significant because they underlie the centrality of corporeal metaphors for the critical interpretation of urban form. The current emphasis on corporeal and neurological analogies in the neo-organicist literature owes more to earlier developments than is widely acknowledged.

We can detect two principal dimensions to contemporary neo-organicist urban thought. A first strand, rooted in the bio-physical sciences, perceives the city to be a special kind of complex, yet intricately ordered system. This homeostatic perspective, which is inflected by ecological thinking and recent developments in evolutionary biology, has diffused through parts of the architectural literature and is only tangentially

5 Other cinematic representations of the cyborg besides Michael Burke's *Cyborg City* (1999) include, for example, Masayuki Akehi *Cyborg 009* (1980); Albert Pyun *Cyborg* (1989); Gianetto De Rossi *Cyborg: Il geuerriero d'acciaio* (1989); and Michael Schroeder *Cyborg*^{2} *Glass Shadow* (1993).

6 For further insights into the historical continuities in the idea of the human body as a cyborg form see, for example, Canguilheim (1992), Biro (1994), Sykora (1999) and Keller (2002).

linked with the epistemological challenge of cyborg theory.[7] A second and more intellectually significant development is represented by the convergence of ideas surrounding the 'thinking space' of the city and the indeterminacy of spatial forms. If the body-city nexus is conceptualized as a thinking machine then the analytical focus shifts towards the identification of those critical networks or 'neurones' that sustain the relationship between the body and the city (Kurokawa, 2001a). Though this dimension to the neo-organicist perspective shares important continuities with the technological preoccupations of early twentieth-century modernism, it extends its conceptual purview into different aspects of cultural modernism. The influential speculations of Gilles Deleuze and Felix Guattari, for example, develop Antonin Artaud's conception of the 'body without organs' to produce a philosophy of spatial complexity quite different from that associated with dominant modernist traditions (Deleuze and Guattari, 1986; 1987; Rajchman, 2000; Uno, 2001). Their philosophical challenge is to perceive space in the absence of any previously existent categories, hierarchies or systems as a form of 'anarchic non-identical proliferation' (Luckhurst, 1997: 128). The organic metaphor of the 'rhizome' is deployed in distinction to 'arborescent' conceptions of cities as hierarchical structures (Teysott, 1990; Akira, 2001; Kurokawa, 2001a). In addition to this emphasis on non-hierarchical structures of difference Deleuze and Guattari's conception of concrete space also seeks to incorporate the imaginary, libidinous and oneiric realms of human experience. From their 'neo-vitalist' perspective, which builds on the philosophical ideas of Henri Bergson, the virtual realm is not simply a mimesis or reflection of physical reality but an independent domain that generates new kinds of spaces and ideas. The political significance of the virtual realm lies in its experimental and emergent role as part of an envisioned space that has yet to be realized within the taken-for-granted realm of concrete reality (Boundas, 1996; Massumi, 2001). The role of the diagram or 'abstract machine' takes on special significance in this context as an attempt to give visual expression to new models of reality.[8] In the case of architecture, for example, there has been an intense dialogue between developments in building design and the speculative possibilities engendered by computer-aided simulations so that 'physical space increasingly resembles cyberspace' (Mitchell, 2003: 197). Some architectural practices have deployed so-called 'genetic algorithms' in order to generate a form of 'in vitro' architecture which derives its inspiration from nature yet remains autonomous from it as a purely digitized space of imaginative exploration (see Chu, 2002; De Landa, 2002).[9] Examples of architectural practice inflected by post-structuralist ideas which move beyond purely 'in vitro' speculations to fully realized projects include the work of Peter Eisenman, Frank Gehry and Bernard Tschumi, where sophisticated combinations of form, structure and materials have been achieved, which are quite at odds with modernist conceptions of architectural form.

A conceptual synthesis can be discerned in some of the recent literature between post-structuralist philosophies of space and Latourian conceptions of actor-network theory to produce a new kind of urban theorization which eschews the meta-narratives

7 Examples of this coalescence between neo-organicist ideas and ecological thought in architecture and urban studies include Jencks (1993), Papanek (1995), Sukopp *et al.* (1995), Slessor (1997), Poole (1998), Ruano (1999), Kurokawa (2001b), Pearson (2001), Gauzin-Müller (2002), Gans and Kuz (2003), Lalvani (2003) and Senosiain (2003). Key influences on the incorporation of natural forms in urban design include classic works such as Zevi (1950), Katavolos (1961), Häring (1962) and Alexander (1964). Other important inputs into what one might term 'organic' architecture also include the designs of Alvar Aalto, Hans Scharoun and Bruno Zevi and also the influential metabolist manifesto of Kisho Kurokawa (see Kurokawa, 2001a; Frampton, 2003; Gandy, 2004a).

8 See, for example, Deleuze (1988; 1993), de Vries (1993), Wigley (1993), De Landa (1994; 1998a; 1998b; 2002), Robbins (1998); Bostic (1998), Kinnard (1998), Lynn (1998; 1999), van Berkel and Bos (1998), Coyne (1999) and Di Cristina (2001).

9 Examples of so-called 'parallel' or virtual architectural practices include Asymptote, UN Studio and AMO.

associated with neo-Marxian approaches. Building on the insights of Deleuze and Guattari these approaches have sought to remove all the extrinsic or foundational aspects to urban theory and pare analysis down to the movements and interactions that constitute 'the city' as a particular kind of spatial form or activity that is independent of conventional accounts of scale, structure or order.[10] The brain or 'thinking space' of the city persists yet is dispersed through innumerable nodes and networks in contrast with the embodied cyborg citizen to be found in the more technophile literature. We can trace these developments back to the emerging critique of architectural modernism in the 1970s and 1980s that increasingly drew on the theoretical ontologies of post-structuralism in order to advance a radically unplanned built form.[11] From this perspective the role of 'chaos', for example, takes on a very different significance from that associated with the modernist city and is perceived as a field of evolutionary and radical experimentation. Chaos is no longer seen as an anomalous dimension to the urban experience to be problematized or excluded from analysis but a rich vein of social and spatial interaction through which we may perceive signs of alternative or hitherto overlooked urban forms. Chaos may also be characterized as a more sophisticated, resilient and adaptable form of order as Rem Koolhaas has suggested with respect to the dynamics of West African urbanism (Koolhaas *et al.*, 2001; Koolhaas, 2002). The theoretical novelty of such a perspective sits sharply at odds, however, with the capacity for what one might term 'avant-garde urbanism' to actually explicate any substantial dimensions to urban change (see, for example, Rauterberg, 2002; Gandy, 2004b). We can detect within urban and architectural discourse an emerging counter current to post-structuralist and avant-garde urbanism led by a combination of formal, technical and political critiques (see Frampton, 1996; van Berkel and Bos, 1998). Though the post-structuralism of Deleuze and Guattari seeks to make explicit linkages between the 'real' and the 'virtual', and is in this respect a significant advance on the flattening and one-dimensional simulacra of Jean Baudrillard, there is a persistent difficulty in articulating any kind of cogent political critique of the cyborg city. The emphasis on the fluid characteristics of urban space risks overlooking the particular combinations of fixed capital and human expertise that enable specific nodes within the global urban system to play enhanced roles in the arena of cultural and economic production. The disavowal of structure hampers the evaluation of the theoretical and practical significance of these insights despite the potentially fertile coalescence between Deleuzian post-structuralism and a cyborg sensibility towards the mutual entanglement of the real and the virtual. We are left with an ironic continuity between the functionalist reading of the industrial city and a 'neo-organicist' preoccupation with the design of space that resides quite comfortably alongside reworked formalist idioms in architectural criticism.

From endo-colonization to the cyborg citizen

The emerging depiction of the human-machine interface as a technological monstrosity is strongly associated with nineteenth-century romanticism: anxieties over uncontrollable science and technology, for example, form part of a long-standing counter discourse to modernist teleologies of technological progress (Clayton, 1996; Tsouvalis, 2003). In recent years, however, the trope of technological monsters has tended to divide between a Haraway-Latour axis of new affinities towards excluded others on the one

10 See, for example, Thrift (1999; 2000a; 2004), Amin and Thrift (2002), Doel and Hubbard (2002), Thrift and French (2002) and Smith (2003a; 2003b). We should note, however, that Deleuze resisted the categorization of his work as post-structuralist (see Rajchman, 2000: 146).

11 For greater detail on the impact of deconstructive and post-structuralist ideas within architecture see, for example, Wigley (1993). An emerging emphasis on 'anti-planning' can be found in, for example, Koolhaas (1990; 1995). See also Hughes and Sadler (2000).

hand, and the persistence of fears towards technology and its 'malevolent autonomy' on the other hand (Waldby, 2002: 28). The appearance of the cyborg has engendered a new wave of fear and trepidation towards the invasion of the body by strange technologies that threaten to eliminate or overwhelm the human subject. In the writings of Paul Virilio, for example, we move beyond the romantic and Heideggerian critique of technology towards a political economy of technology and its intersection with the human body. Virilio sees the colonization of the body by new technologies as a 'revolution of transplantations' that marks the critical 'third wave' of modernity following the earlier revolutions in transportation and communications technologies (Virilio, 1997: 6). Virilio charts the advance of a 'neo-eugenics' in which the power of military-scientific imperialism leads towards an 'endo-colonization' of the human body itself so that we no longer talk of the body in the city but of the 'city in the body' (see Virilio, 1995; 1997). The cyborg figure becomes a symbol for the militarization of society: we are no longer dealing with a cold war astronaut but with the technologically enhanced soldier of the twenty-first century peering around the corner of buildings in defence of prosperous nations and their corporate sponsors.[12] The hygienist discourses of the past have been radically extended by new technologies of surveillance and control in order to construct the *cordons sanitaires* of the twenty-first century. New defensive structures have developed that combine long-standing mechanisms of social exclusion such as housing markets with enhanced forms of social control through a mix of architectural, ideological and intelligence-gathering processes. The growing significance of urban warfare in particular is now leading towards military strategies which specifically target the destruction of essential technological networks such as water and power in order to subdue civilian populations and eradicate sources of political resistance (Graham, 2003; 2004). A deliberate process of decoupling modern societies from urban technological networks or 'decyborgization' to use Timothy Luke's (1996) expression is reducing marginalized communities to a state of biological subsistence so that they are no longer political subjects but mere inhabitants struggling for existence (see also Agamben, 1998; Bauman, 2004). Through a process of deliberate disenfranchisement from modernity whole societies face the prospect of annihilation through a combination of disease, impoverishment and overt acts of violence.

Ranged against the more fearful readings of technology we can discern an emphasis on the cyborg as a means of becoming 'post human' in order to liberate the human body from the illusory boundaries of the autonomous self.[13] In the work of William J. Mitchell, for example, we can trace a lineage from 'Vitruvian man', through the phenomenological experience of space, to the contemporary networked urban citizen as 'a spatially extended cyborg' (Mitchell, 2003: 39). 'For millennia', writes Mitchell (1998: 173), 'architects have been concerned with the skin-bounded body and its immediate sensory environment . . . now they must contemplate electronically augmented, reconfigurable, virtual bodies that can sense and act at a distance but that also remain partially anchored in their immediate surroundings'. In this sense Mitchell builds on the technologically inflected historicism of earlier writers such as Reyner Banham, Sigfreid Giedion and Pierre Naville who depicted modernity as a series of revolutionary technical innovations. Focusing on wireless infrastructures Mitchell explores the extraordinary technological potentialities of the cyber city and the increasing interaction of digital code with virtually every sphere of human activity (Mitchell, 2003). Yet this is a strangely undifferentiated future in which the polarities and exclusions of space are largely overlooked. Mitchell (2003: 5) claims, for example, that we are witnessing 'the shift from a world structured by boundaries and enclosures to a world dominated, at every scale, by connections, networks, and flows' but he ignores

12 On the future development of military technologies see, for example, Gray (1997), Virilio (1997) and Der Derian (2001).

13 On the post-human subject see, for example, Grosz (1992), Halberstam and Livingston (1995), Wood (1998), Hayles (1999a), Feenberg (2000) and Murdoch (2001).

the devastating disparities between the mobility of capital and labour that condemn much of humanity to economic serfdom. In the final instance his perspective is so heavily driven by technological change that it begins to assume the role of an independent variable in his analysis.

Agency, hybridity and distributed cognition

The blurring of boundaries between the body and the city raises complexities in relation to our understanding of the human subject and the changing characteristics of human agency. An extended conception of human agency would include, for instance, the role of biophysical processes and socio-cultural technological systems that impact upon the social production of space. Bruno Latour, for example, has emphasized different scales of analysis to allow the extension of our conception of agency to include those objects, forms, structures and non-human elements that have been systematically excluded from both positivist and materialist epistemological traditions (Latour, 1993; 2004).[14] Whereas the work of Haraway has tended to emphasize the affinities between human and non-human nature the practical import of Latour has been the mapping or delineation of 'cascading micro-decisions' linking between different kinds of networks or structures (Zitouni, 2004). The cyborg can be conceived in a Latourian sense as both a new kind of social interaction with space but also a disordered concept to be conceived in opposition to the purified realm of modernist urban thought. Yet a Latourian public realm, with its hybridized conceptions of agency, is quite different from that envisaged within Habermasian philosophical traditions because of the radical extension of human agency to encompass those technical and organizational systems which the Frankfurt School philosophers sought to specifically exclude from the realm of ethical and political judgment.

The concept of hybridity also entails its own spatiality, its own geometries of power between its constituent elements. The idea of the cyborg as a hybrid can be conceived as a problematic re-inscription of technical discourses derived from core locales or some overarching teleological template for urban change but it can also entail a reverse flow of ideas and developments from the margin to the centre. The complexities of colonial and post-colonial urbanism, for example, can be explored in terms of locally specific combinations of materials, practices and ideas drawn from disparate contexts (see, for example, Gabilondo, 1995; King, 1995; Hall, 2003). The cyborg metaphor can be used in this sense as an explicit recognition of the limits to formalist or teleological architectural discourses rooted in purified and neatly demarcated conceptions of cultural change. Following Latour's admonition that we have never been modern, we could argue that we have always led a cyborg existence since virtually every human endeavour has involved a combination of disparate cultural and technological skills ranging from the origins of language to the latest developments in materials science. But if we abandon any historical or geographical specificity to the cyborg idea we risk diluting its analytical utility as a means to engage with the cultural and technological complexity of the contemporary city.

The complexities of human agency in the cyborg city point to the intersection between technological change and the reformulation of the public sphere inherited from the industrial city. But can the cyborg idea help us to understand the changing dynamics of infrastructure provision in relation to a digitized or diffuse conception of the public realm? If the interactions between human and synthetic sentience have eroded the idea that 'conscious agency is the essence of human identity' (Hayles, 1999a: 288) then this contradicts many of the insights of cultural history that have focused quite specifically

14 For explorations of the significance of hybridity for the understanding of relations between nature, culture and the production of space see, for example, Bingham (1996), Wolch (1996), Luke (1997), Swyngedouw (1999; 2004), Kull (2001), Murdoch (2001), Whatmore (2002) and Latour (2004).

on the co-evolution of material realities *and* systems of cultural meaning. The arguments made by Alain Corbin (1986), for example, over the evolution of olfactory perception locate these changes precisely within the context of a more individuated experience of modernity within which communal experiences begin to acquire a different set of meanings. What Catherine Hayles and the other 'post-human' theorists are in a sense suggesting is that new forms of 'distributed cognition' are creating a more integrated rather than individuated system of sensory perception that directly challenges the established trajectory of modern consciousness and experience.

Post-human political discourse is grounded within the context of the decline of meta-narratives, the erosion of the public realm and the radical indeterminacy of the human subject. If the 'autonomous self' can be regarded as an illusory and highly restricted (socially and historically) realm of human experience, we are still left with the uncertainty of delineating the characteristics of the human subject in a cyborg society (Callard, 1998; Hayles, 1999a: 286). If the body-city interface is conceptualized as a non-Cartesian space, then the distinction between mind and body and between the material and the virtual becomes extensively blurred. But what happens when the human subject is increasingly merged with the fabric of the city itself? Whilst it is easy to accept that our hybridized interactions with space involve a greater role for 'silicon, copper and magnetic subsystems' (Mitchell, 2003: 168) it is much harder to conceive of ethical judgements as a digitized process of remote interactions with not only other humans but also non-human machines and networks. The physicist Michio Kaku, for example, describes a world emerging between 2020 and 2050 in which computers as we know them will be superseded by an invisible network with the power of artificial intelligence (see Broderick, 2002). But even if an interconnected skein of nanotechnology were to extend into all aspects of everyday life (at least in the hyper-connected nodes of global cities) the problematic distinction between human and non-human forms of sentience would remain unresolved. The rapid co-evolution of what Gregory Bateson has termed 'distributed cognition' between human and artificial intelligence exposes an emerging disjuncture between the virtual realm of information production and the relatively finite reserves of human attention capable of engaging with the proliferation of sensory stimuli (see Hayles, 1999a: 287). In the final instance, however, the notion of 'distributed cognition' advanced by Bateson and other advocates of artificial intelligence, blurs the boundary between sentience and non-sentience, and between bodies and machines, and results in a digitized ontology that delimits rather than extends the possibilities for the reconfiguration of urban experience. The increasing significance of non-human decision-making marks a radical technological intrusion into those spheres of human cognition that both Frankfurt School and Heideggerian philosophical traditions have sought to protect. With distributed cognition the built space of the city has not only become part of the human body but has begun to impinge upon the process of thought itself.

Phantom spaces and the public realm

The pervasive dilapidation of urban infrastructures, and especially those physical networks associated with the growth of the modern industrial city, is intimately connected with questions surrounding the state of the public realm and its future prospects. The marginal spaces of the post-industrial city are now littered with technological relics: the twisted combinations of metal and concrete which cluster along rivers and major rail intersections and extend beneath the surface of the city can be likened to what William Gibson describes as the 'semiotic ghosts' of yesterday's tomorrows (cited in Dery, 2002: 303). These 'anxious landscapes', to use the historian Antoine Picon's (2000) term, are emblematic of a new kind of urban form which finds its logical counterpart in the new shopping malls, corporate atria and other quasi-public spaces that characterize the post-industrial city. Yet even before their neglect and abandonment these complex assemblages of physical artefacts, technical expertise and

accumulated cultural meaning had begun to fade from collective consciousness and were no longer an integral part of the 'social imaginary' of the modern city (see, for example, Castoriadis, 1987; Taylor, 2004). From the middle decades of the twentieth century these vast infrastructural networks gradually disappeared from view as part of the 'taken-for-granted' world of everyday life (see Williams, 1990; Garver, 1998; Kaïka and Swyngedouw, 2000). These centralized and quasi-universal systems embedded within urban space, which Stephen Graham and Simon Marvin (2001) have referred to as the 'modern infrastructural ideal', represent a constituent element within the socio-spatial structure of modern societies ranging from gender relations to the political delineation of the nation-state. These vast infrastructure networks can be interpreted as a concrete manifestation of what Habermas (1998) has termed 'normative universalism' yet we know comparatively little about the cultural and political dynamics of their decline in comparison with their growth and development.[15] The routinization of spatial regulation in the modern era contributed towards a gradual detachment of modern infrastructure from the legitimating ideals that made the political and administrative transformation of urban space historically possible (see Ingram, 1994: 253). These municipal networks required incessant inputs of capital and human labour in order 'to prevent the entropic disintegration of frail material circuits' (Otter, 2002: 14) and have been especially vulnerable to the protracted fiscal crisis facing the modern state since the 1970s. Despite their evident technical and fiscal frailty, however, these technological structures retain a crucial role in delineating not only the practical possibilities for urban governance but also in defining the ideological and metaphorical parameters of political discourse. Yet in the absence of comprehensive failures such as power blackouts or spectacular corporate corruption scandals, the politicization of networks remains largely restricted to their human interface rather than to their complex patterns of ownership and control.

The cyborg city is widely perceived as a post-metabolic city in which the exchange of information has supplanted the role of material exchange to become the dominant dynamic behind the shaping of urban space. In a sense the idea of urban metabolism has moved closer to the original nineteenth-century emphasis on material transformation or *Stoffwechsel* as post-industrial cities take on an increasingly alchemic function of producing wealth out of abstract rather material transactions. The last 20 years has seen an accelerating process of dematerialization or 'derritorialization' driven by the spread of informatics, increased capital mobility and the fracturing of place-bound identities, yet the implications of this urban transformation for the public sphere remain extensively occluded in the cyborg literature. The sociologist Konstantinos Chatzis (2001), for example, asks what possibilities for collective thought and action might exist in the fractured and heterogeneous spaces of the cyborg city and berates Latour and Mitchell for their avoidance of these political questions. In a similar vein the architectural historian Christine Boyer (1996) asks what the political implications of cyborg urbanization are for the future of the public realm and remains sceptical that digital connectivity can take the place of a concrete public sphere (see also Dean, 2001). The public sphere of the industrial city was defined by human labour in terms of its political delineation and physical expression. It was both a tangible form and a metaphorical space through which a progressivist, albeit partial, conception of urban politics could be articulated in the public arena. Yet the public sphere engendered by the industrial city was deeply flawed, both in theory and practice, and proved highly unstable under the combination of political, economic and social pressures that emerged during the 1970s and 1980s. A cyborgian public realm, à la Latour, might, for example, include a whole variety of non-human organisms, yet-to-be-named assemblages of things and multitudinous chains of agency, but would this 'parliament of pipes' and other assorted quasi-objects actually represent a political advance over an anthropocentric public

15 On the evolution of modern infrastructure networks see, for example, Hughes (1983), Abriani (1988), Callon (1991), Dupuy (1991), Picon (1992), MacKenzie (1996), Latour and Hermant (1998), MacKenzie and Wajcman (1999), Jacobson (2000) and Melosi (2000).

sphere grounded in some workable variant of inter-subjective understanding? A more fruitful avenue might be to explore the variety of actually existing grassroots organizations currently mobilizing in disparate urban spaces around issues such as social justice, shelter rights and access to sanitation (see Appadurai, 2002). In some instances international networks and novel institutional structures have emerged which both confound the limitations of the bourgeois public sphere — especially within the context of the megacities in the global South — and also challenge the new constellations of political and economic power now concentrated in international financial institutions such as the World Bank. Yet the enrichment of civil society cannot in itself act as a viable substitute for a functional public realm which is connected to the development of democratic institutions (see Sennett, 2000; Calhoun, 2002), including those very structures of urban governance which enabled the historic development of the technological networks which comprise the fabric of the modern city.

The territorial and administrative structures associated with the industrial city have been displaced by an increased plurality and simultaneity of different spatial forms. 'At the end of the twentieth century', suggests Paul Virilio (1991: 15), 'urban space loses its geopolitical reality to the exclusive benefit of systems of instantaneous deportation whose technological intensity ceaselessly upsets all of our social structures'. Virilio lies in the vanguard of an urban literature that posits a radical diminution in the traditional role of cities as focal points for social and economic life. When taken to extremes, however, the 'deterritorialization' arguments appear to deny any clear role for space in the constitution of power. The Japanese architect Kuniichi Uno (2001: 1020), for example, suggests that 'contemporary power possesses no center but only borders', whilst the economist Francis Cairncross (1997) declares the end of location as an important factor in global capitalism. Over 15 years of research, however, has demonstrated that an overemphasis on the deterritorialization of space and power is misplaced because spatial dispersal within the global economy has paradoxically necessitated the recombination and re-concentration of power in specific places and locales (see Castells, 2000; Sassen, 2001). Yet this influential body of literature on networks and the paradoxical enhancement of spatial propinquity tends to overlook the marginal spaces where unequal power relations, violence and social exclusion are most powerfully manifested (see, for example, Tadiar, 1995; Simone, 2001; 2002; Robinson, 2002). The dominant use of the network metaphor within the 'global city' literature is characterized by an extensive degree of economic and technological determinism within which the role of human agency is systematically downplayed. The very idea of the network is trapped within an epistemological myopia that privileges issues of quantification and scale over the everyday practices that actually enable these networks to function (see Smith, 2003a). An emphasis on cyborg urbanization extends our analysis of flows, structures and relations beyond so-called 'global cities' to a diversity of ordinary or neglected urban spaces. The cyborg city is, in other words, closer to an interpretative analytical framework that can connect analysis with the cultural and ideological realm of everyday life and include those 'unconventional' urban landscapes that have emerged outside the core metropolitan regions of the world economy and where incongruities and displacements are an even more pervasive feature of the urban experience.

From virtual space to concrete space

There is an implicit disjuncture between the technological sophistication associated with various manifestations of the virtual city and the state of dilapidation and disinvestment experienced in the concrete city. In one sense this reflects the widening gulf between 'wired' and 'wireless' technologies that is extensively downplayed in flow-based, digitized and nomadized accounts of urban change. The bifurcated geographies of post-industrial cities are characterized by global citadels of connectivity encased within a

wider landscape of neglect and social polarization. The multi-lane flyovers of Manila, Mumbai and the other megacities of the global South, for example, enable a literal as well as metaphorical lifting of the new middle-class elites out of the congestion and poverty of the city below. The emerging nodes of hyper-connectivity and premium service provision in the financial districts of cities such as London and New York similarly ensure that core trading and managerial functions can withstand outside pressures and uncertainties. The centralized modes of universal service provision associated with the development of the modern city have been replaced by a new logic of differentiation and exclusion. Many former sites of service provision have merged or melted into a proliferating zone of urban 'non-space' that is disconnected from contemporary patterns of economic production (see Augé, 1995). And the hidden city, exemplified by nineteenth-century water and sewer networks, now faces the prospect of extensive collapse with far-reaching fiscal and public health implications. The role of urban infrastructures has been altered within an emerging reorganization of territoriality marked by a progressive dislocation between urban spaces and those administrative and governmental structures associated with the emergence of the modern city and the nation state.[16]

Despite the conceptual lineages between the cyborg and various manifestations of the virtual or digital realm, the metaphor does not necessarily conflict with materialist readings of urban space. The idea of the cyborg is especially useful in this regard by emphasizing the shifting interrelationship between 'wired' and 'wireless' technologies and the interdependencies engendered by these evolving structures and relationships. The cyborg metaphor allows us to conceptualize the interaction between social and biophysical processes that produce urban space and sustain the possibilities for everyday life in the modern city. In the case of water, for example, we can explore the linkages between the volatility of global capital markets and the concrete dynamics of the hydrological cycle through 'the production of hybridized waters and cyborg cities' (Swyngedouw, 1996: 80; see also 1997b; 1999). The idea of the cyborg city, as used by Erik Swyngedouw, is simultaneously an analytical framework and an imaginative strategy that 'opens up a new arena for thinking and acting on the city' (1996: 80). In contrast to the 'electromonadic cyborg' of Mitchell (2003: 62), the cyborg is used in a relational way by Swyngedouw to illustrate the hybridized socio-ecological relations that underpin the production of space rather than the experience of the technologically-enhanced urban citizen. We encounter the political economy of the cyborg city in a way that is largely absent from the more technologically orientated literature. A materialist reading of the cyborg city can be used to illuminate different facets to the history of capitalist urbanization: the interaction between trade in specific commodities, for example, and the cyclical pulse of capital combine to produce successive cycles of investment in the built form of the city. The cyborg metaphor goes further than the neo-Marxian tradition in its engagement with the inherent messiness and indeterminacy of urban space. Yet it is not inconsistent with neo-Marxian conceptions of relations between material and abstract space since the cyborg is at root both a materialist concept and an idealist construct that eschews a purely phenomenological or fragmentary worldview through its recognition of multiple and interconnected collectivities of agency. The relational or dialectical cyborg, with its explicit engagement with different forms of capital — ranging from tangible manifestations to speculative abstractions — provides a significant alternative to neo-organicist models of urban space.

A materialist reading of the cyborg metaphor can also be extended to the micro-political realms of power that characterize the structuring and use of private space in the modern home. The technological sophistication of the contemporary city has led towards an intensification of the dependence and co-evolution between urban societies and urban technological networks. There is clearly a periodicity to this process so that

16 See, for example, Swyngedouw (1997a), Brenner (1998; 2000), Graham (2000), Jessop (2000) and Graham and Marvin (2001).

what Mitchell has characterized as the 'Me++' complex of the cyborg city has superseded the 'auto-house-appliance complex' of the Fordist era which replaced in its turn the earlier waves of technological diffusion through the interior spaces of the nineteenth-century industrial city (see Nantois, 2002). The latest wave of digital architecture conceives of self-organizing robotic assemblages within the modern home, for example, which will blur the distinction between architecture and furniture to create new kinds of interactive and ergonomic spaces (see Schumacher, 2002). Yet the impact of this emerging edifice of domestic technologies on the comportment of the human body remains uncertain. The evolution of domestic space entails its own geometries of power through the disciplining effects of modern technologies on human behaviour. We encounter not only the physical infrastructure of spatial connectivity, but also the social networks and institutional forms which enable these structures to function. The development of the cyborg city is thus intimately related to the evolution of modern forms of governance or 'governmentality', to use Foucault's term, in which human conduct is shaped indirectly in order to conform to modern conceptions of rationality.[17]

The evolution of human-technological systems is a reflexive process in which the shaping of space begins to reflect modern aspirations for mobility, privacy, salubrity and other characteristic features of the emerging cyborg city. In this sense technologies play a role in producing the body as a discursive field rather than simply through the prosthetic modification of biological limitations (see Grosz, 1992). Consider, for example, the evolutionary phase of the relationship between the body and the development of modern plumbing systems in the second half of the nineteenth century. The processes involved the extension of public water networks into the private spaces of the home; the inculcation of new washing habits; the spread of new fashions in plumbing and interior design; the construction of elaborate sewer systems to dispose of increasing quantities of waste water; and the intensification of bourgeois ideologies of domesticity.[18] A simultaneous transformation in modes of human interaction with water and social attitudes towards the body found its logical endpoint in the modern bathroom: a private space that marks a clear manifestation of indirect social control of the type that Foucault explored in relation to the bio-politics of the modern body (see Osborne, 1996). A critical theme which emerges from this discussion is whether the evolutionary dynamic of virtual networks in the contemporary city is fundamentally different from that engendered by the waves of physical infrastructure embedded in the modern city. Katherine Hayles (1999a: xiii) suggests that the cyborg form emerges where 'the enacted and represented bodies are brought into conjunction through the technology that connects them' but the longer-term implications of continuous surveillance and technological interdiction for the bio-politics of the body remain uncertain.

Representing complexity

The cyborg metaphor allows for the simultaneity of concrete and imaginary perceptions of urban infrastructure so that the categories of the 'real' and the 'virtual' become interconnected facets of urban experience. The cyborg metaphor is, in other words, peculiarly suited to an understanding of the contemporary metropolis not only as a morphological entity entwined with various technical and aesthetic discourses, but also as an abstract and inter-subjective realm through which political and cultural ideas become constituted or 'fleshed out' in parallel with the concrete development of the city.

17 For greater detail on debates surrounding 'governmentality' and the modern state see, for example, Gordon (1991), Law (1994), Barry *et al.* (1996), Dean (1999) and Rose (1999). On subjectivity and architecture see also Wigley (1990).

18 On social and cultural histories of modern plumbing see, for example, Giedion (1948), Hamlin (1998), Lahiji and Friedman (1997), Laporte (2000) and Kaïka (2004).

Some of the most significant insights into the modern city have combined markedly different intellectual registers to powerful effect: consider, for example, Walter Benjamin's combination of Marxism with Jewish mysticism, Georg Simmel's account of the alchemy of money or Henri Lefebvre's distinction between representational space and spaces of representation. The intellectual tensions that emerge from these conceptual juxtapositions are not indicative of an analytical incoherence but actually signal an urban discourse that is closer to the complexity of its object of inquiry than any 'purified' or mono-disciplinary approach can provide. Writing and thinking about cities can aspire to the kind of 'border writing' suggested by Emily Hicks (2001) where edges, interactions and confusions between different codes and symbols take precedence over aspirations towards cultural homogeneity or the binary 'real' versus 'unreal' distinctions of literary genres such as 'magic realism' which effectively sever culture from politics. The cyborg concept enables us to make better sense of urban and industrial landscapes that are produced through the interaction between ostensibly contradictory systems of social and cultural signification.

Urban infrastructures are not only material manifestations of political power but they are also systems of representation that lend urban space its cultural meaning. We can conceive of urban infrastructures as modes of cognition as well as processes underpinning the restructuring of urban space. The development of the cyborg metaphor has coincided with the re-emergence of urban infrastructure as a discursive field permeated by crisis, uncertainty and political contestation. The association between the cyborg metaphor and the rediscovery of the jumbled mass of pipes and wires that constitute the hidden city reminds us that the technological fascination of the cyborg city, exemplified by the tubular nightmare of Terry Gilliam's *Brazil* (1984), owes as much to late modern sensibilities in architectural design than to any putative shift towards 'dematerialization' in the postmodern city.[19] The aesthetic dimensions to the cyborg city are related to the scale and complexity of urban infrastructures as forms that transcend our conceptual grasp of urban space to produce a cognitive hiatus that is given its clearest expression in science fiction cinema and literature. 'Unthinkable complexity', writes William Gibson, 'Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding . . .' (Gibson, 1984: 51). In this now classic passage from *Neuromancer* Gibson suggests, like Mitchell, that the city can be conceived in terms of a neurological analogy but he goes further than this in his representation of the future city as a structure lying beyond any rational mode of comprehension. A similar sense of overwhelming complexity is portrayed in the opening sequence of Ridley Scott's *Blade Runner* (1982) where the camera pans across a seemingly limitless expanse of flickering lights to show an urban galaxy representing Los Angeles in the year 2019. For Fredric Jameson the proliferation of dystopian technological fantasies since the 1970s is indicative of an exhaustion of utopian thought through the displacement of concrete conceptions of possible urban futures. These anxious landscapes may even represent a late imperial vision of Western cities after the fall — invaded by other cultures and life forms — so that urban monstrosity can be read as a fear of cultural as well as technological miscegenation (Jameson, 1982). In taking such a position, however, Jameson fails to allow the cyborg perspective to be read as a form of social and political allegory that serves to extend our imaginative grasp of urban space (see Bukatman, 1993; Wolmark, 1994). We are fascinated by the cyborg landscape because it tells us something about ourselves as well as about the complex changes underway in the structure and meaning of contemporary cities.

19 Examples of the late-modern 'wired city' include the work of Archigram, Archizoom and Superstudio. By the 1970s a sense of unease about urban technological networks had evolved into a 'techno-fetishist' vision of urban space encased in a hyphal network of giant ducts, wires and pipes that manifested in the late modern architecture of the exoskeleton exemplified by Richard Rodger's designs for the Lloyds building in London and the Pompidou Centre in Paris. See Picon (1998), Armstrong (2000) and Mitchell (2003).

These cognitive polarities between concrete and imaginary space can be explored with reference to the aesthetic categories of the sublime and the uncanny that have begun to permeate critical writings on urban and industrial landscapes.[20] The deployment of a neo-Kantian reading of the sublime in order to develop our understanding of urban complexity leads in a rather different direction from the 'non-representational theory' developed within post-structuralist urban discourse. The geographer Nigel Thrift (2000b: 222), for instance, elaborates on the distinction between concrete spaces and their 'ghostly correlates' but there remains a conceptual hiatus between the analytical scope of non-representational theory and the experiential and sensory realm of modern consciousness. To what extent, for example, are the post-human transcendence of the body and the neo-Kantian spatio-temporal transcendence of the body conceptually incommensurate? Does the concept of the sublime extend across both these cognitive and conceptual realms or is it best conceived as a philosophical anachronism in relation to the post-human subject and the 'distributed cognition' of the cyborg city? There are clearly difficulties with a conception of the sublime that relegates inexplicable dimensions of human experience to a non-cognitive sphere of spatio-temporal transcendence. A modified conception of sublimity in the cyborg city might allow a less optically centred account of aesthetic wonder to incorporate a wider variety and depth of sensory stimuli as part of a more inclusive and responsive intellectual strategy for the interpretation of urban complexity. Rather than a romantic longing for an 'organic unity' (Rajchman, 2000: 22), the contemporary city needs a conceptual vocabulary that can give expression to the unknown, the unknowable and what is yet to come.

Conclusions

It may appear arcane — abstruse even — to utilize the idea of the cyborg as a means to explore the contemporary urban condition. Yet a cursory glance at the recent literature shows that the earlier incarnations of the cyborg as an isolated yet technologically enhanced body have proliferated into a vast assemblage of bodily and machinic entanglements which interconnect with the contemporary city in a multitude of different ways. The richness of the cyborg concept allows us to negotiate a multiplicity of spaces and practices simultaneously and in so doing develop epistemological strategies for the interpretation of urban life which come closer to any putative 'reality' than those approaches which long for the mechanistic or deterministic simplification of their object of study. Unlike some of the other conceptual tools currently in vogue — whose deployment of the 'post' prefix denotes an ending or culmination of a predetermined sequence of developments — the cyborg offers a sense of continuity in our critical appreciation of the intersection between different and often contradictory modernities.

The idea of cyborg urbanization has emerged as a way of conceptualizing the body-technology nexus that underpins the contemporary city, but also as a corrective to those perspectives which seek to privilege the digital or virtual realm over material spaces. The cyborg concept can in this sense be enlisted into an intellectual project to 're-materialize' the city and establish substantive connections between the body, technology and space. But what kind of city is envisaged by this shift of emphasis towards the corporeal dimensions of urban experience? And, more importantly, what kind of political implications are bound up with the deployment of the cyborg concept in urban discourse? This article has identified a series of ways in which the idea of the cyborg intersects with urban politics: the neo-Marxian analysis of the commodification of the

20 For more details on the spatial dimensions to the sublime and the uncanny see, for example, Lyotard (1982; 1989; 1994), Deleuze (1984), Vidler (1987; 2000), Crowther (1992), Boyd Whyte (1993), Nesbitt (1995), Riese (1998), Patterson (1999), Freyssinet (2001), Demos (2003), Royle (2003) and Kelley (2004).

body, nature and space (and the circulatory dynamics between these elements); the post-Cartesian promotion of an ever-widening orbit of affinities and networks between the human and the non-human; the technophile anticipation of a liberating conjunction between the body and ever more sophisticated assemblages of technological networks; and the recurring allegorical trope of urban dystopias within which to foreground a critique of the contemporary city. I want, however, to emphasize one strand in particular: the potential for cyborgian conceptions of the city to emphasize the continuing political salience of the public realm. By doing so I wish to differentiate a historically grounded conception of the cyborg city from those morphological constructs associated with neo-organicist conceptions of urban hybridity. Whilst the idea of the cyborg is rooted in the recognition of spatial complexity, it also serves to emphasize unitary dimensions to the experience of space exemplified by the development of vast technological networks. A materialist reading of the cyborg city points to a critical reformulation of the public sphere which can encompass a different set of urban realities and a new range of epistemological themes. In a sense, therefore, the current challenge is to expose the elision between the technological and the political so that the cyborg city is opened up to contestation through a renewed connection between urban governance and the public realm.

The very fact that the cyborg is difficult to pin down in any fixed or categorical sense is a testament to its intellectual fecundity as a focus for extending urban thinking beyond conventional polarities. What I have attempted to do here is to develop the idea of the cyborg as part of a more nuanced vocabulary for the critical interpretation of cities. The cyborg concept, when used in conjunction with other key terms such as neo-organicism, rhizomatic space and distributed cognition, begins to enable a more precise discussion about the technological characteristics of contemporary cities. I have sought in particular to develop a relational and materially grounded reading of the cyborg as an intrinsic dimension to the co-evolution of social and technological systems. I have suggested that the concept raises issues that extend beyond the development of urban technological networks to encompass expanded conceptions of the human subject, changing conceptions of the public sphere and new ways of interpreting urban landscapes. Most notably, however, the distinction between 'city' and 'non-city' becomes extensively blurred under cyborg urbanization to produce a tendential landscape exhibiting different forms of integration between the body, technology and social practices. Viewed in this way the city is both a tangible entity but also a relational construct so that we cannot disentangle the one from the other. Yet, neither Haraway nor Latour is able to satisfactorily resolve the tension between expanded conceptions of agency (or affinity) and the need to contextualize technological networks within the bio-political dynamics of power that enable modern cities to function. There is, in other words, a conceptual lacuna at the heart of cyborg discourse emanating from the historicity of the body-technology nexus and its relationship to an ideological sense of the city as a functional whole. The blurring of agency in the cyborg city — which fundamentally contradicts the idea of modernity as a movement towards greater degrees of cognitive and sensory individuation — raises the prospect of a technically mediated public sphere but not in the sense of a digitized public realm. Part of the political challenge facing the hybrid city and its multifarious entanglements between the 'real' and the 'unreal' is to construct new kinds of autonomous spaces within which it is possible for different conceptions of the city to take shape. The emergence of the cyborg at a time of infrastructural crisis is more than coincidental since the concept simultaneously engages with both the renewed recognition of urban vulnerability and the theoretical hiatus facing the study of the city as a polymorphous web of different social practices, imaginative constructs and material elements.

Although the cyborg city represents a challenge to universalist conceptions of space, it is rooted in modernist discourses of cultural and political critique. A tendency towards the idea of the cyborg as a radical fusion of the body and technology can be discerned well before the term 'cyborg' began to acquire its current panoply of potential meanings

and applications. The fantastical conjunction of human and machine, for example, predates the emergence of the cyborg as a named artefact and is an integral element in the critical vocabularies of cultural modernism that emerged as a counter discourse to the technological fervour of twentieth-century modernity. Unlike Haraway, however, I have emphasized those aspects of technological monstrosity which allow us to explore those contradictory aspects to modernity which can find no straightforward articulation. By enlisting the cyborg as a conceptual tool in urban discourse we can develop an imaginative response to the unknowability of the city and its power to generate cultural energies that ultimately impact on wider social and political processes. If the clearly defined human body of the industrial city has been replaced by the technologically diffuse body of the cyborg city, then what kind of bodily occlusions are implicated in this shift? How do the poorly paid workers within the interstices and margins of the global economy — the hidden bodies of late capitalism — struggling under the yoke of what Alain Lipietz once described as 'bloody Taylorization' fit into an enlarged and more sophisticated conception of the human subject? The undifferentiated 'we' of the more speculative and futuristic urban literature tends to overlook the emerging disparities in access between 'wired' and 'wireless' infrastructures exemplified by the infrastructure crisis facing the rapidly growing cities of the global South: new communications technologies may be increasingly ubiquitous but the numbers of people without adequate access to safe drinking water or effective sanitation have grown inexorably over the last quarter century. The cyberslums of the future will be the living embodiment of the contradictions inherent in a technologically rather than politically driven strategy for the creation of more socially inclusive cities. If monstrous representations of the cyborg city represent allegories for wider social injustice then we need to explore those forms of political monstrosity that have generated imaginary monsters. In dreams, after all, it is fear that creates our monsters rather than monsters that create our fear.

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References

Abriani, A. (1988) Dal Sifone alla città [From the siphon to the city]. *Casabella: International Architectural Review* 54.2/3, 24–29.

Agamben, G. (1998) *Homo sacer: sovereign power and bare life*. Translated by D. Heller-Roazen, Stanford University Press, Stanford.

Akira, A. (2001) Untitled. In G. Genosko (ed.), *Deleuze und Guattari: critical assessments of leading philosophers*, Volume III, Routledge, London.

Alaimo, S. (1994) Cyborg and ecofeminist interventions: challenges for an environmental feminism. *Feminist Studies* 20, 133–52.

Alexander, C. (1964) *Notes on the synthesis of form*. Harvard University Press, Cambridge, MA.

Allison, A. (2001) Cyborg violence: bursting borders and bodies with queer machines. *Cultural Anthropology* 16, 237–65.

Amin, A. and N. Thrift (2002) *Cities: re-imagining the urban*. Polity Press, Cambridge.

Appadurai, A. (2002) Deep democracy: urban governmentality and the horizon of politics. *Public Culture* 14.1, 21–47.

Armstrong, R. (2000) Cyborg architecture and Terry Gilliam's *Brazil*. *Architectural Design: Architecture and Film II* 70, 55–7.

Augé, M. (1995) *Non-places: introduction to an anthropology of supermodernity*. Translated by John Howe, Verso, London.

Ballard, J.G. (1975) *High-rise*. Cape, London.

Balsamo, A. (1996) *Technologies of the gendered body: reading cyborg women*. Duke University Press, Durham, NC.

Barry, A., N. Rose and T. Osborne (1996) (eds.) *Foucault and political reason: liberalism, neo-liberalism and rationalities of government*. Chicago University Press, Chicago.

Bauman, Z. (2004) *Wasted lives: modernity and its outcasts*. Polity, Cambridge.

Benedikt, M. (ed.) (1991) *Cyberspace: first steps*. The MIT Press, Cambridge, MA.
Bingham, N. (1996) Object-ions: from technological determinism towards geographies of relations. *Environment and Planning D: Society and Space* 14, 635–57.
Biro, M. (1994) The new man as cyborg, figures of technology in Weimar visual culture. *New German Critique* 62, 71–110.
Bostic, A.I. (1998) Seeing cyborg through the eyes of popular culture, computer-generated imagery, and contemporary theory. *Leonardo* 31, 357–61.
Boundas, C.V. (1996) Deleuze-Bergson: an ontology of the virtual. In P. Patton (ed.), *Deleuze: a critical reader*, Blackwell, Oxford.
Boyd Whyte, I. (1993) The expressionist sublime. In T. Benton (ed.), *Expressionist utopias: paradise, metropolis, architectural fantasy*, Los Angeles County Museum of Art, Los Angeles, CA.
Boyer, C.M. (1996) *Cybercities: visual perception in the age of electronic communication*. Princeton Architectural Press, New York.
Brenner, N. (1998) Between fixity and motion: accumulation, territorial organization and the historical geography of spatial scales. *Environment and Planning D: Society and Space* 16, 459–81.
—— (2000) The urban question as a scale question: reflections on Henri Lefebvre, urban theory and the politics of scale. *International Journal of Urban and Regional Research* 24, 361–78.
Broderick, D. (2002) Racing towards the spike. In D. Tofts, A. Jonson and A. Cavallaro (eds.), (2002) *Prefiguring cyberculture: an intellectual history*, The MIT Press, Cambridge, MA.
Bukatman, S. (1993) *Terminal identity: the virtual subject in post-modern science fiction*. Duke University Press, Durham, NC.
Burke, M. (1998) Cyborg city. Film notes listed at www.yle.fi/d-projekti/arkisto/saa/99kyber.html (accessed 2 January 2004).
Cairncross, F. (1997) *The death of distance*. Harvard Business School Press, Boston.
Calhoun, C. (2002) Imagining solidarity: cosmopolitanism, constitutional patriotism, and the public sphere. *Public Culture* 14.1, 147–71.
Callard, F. (1998) The body in theory. *Enviroment and Planning D: Society and Space* 16, 387–400
Callon, M. (1991) Techno-economic networks and irreversibility. In J. Law (ed.), *A sociology of monsters: essays on power, technology and domination*, Routledge, London.
Canguilheim, G. (1992) Machine and organism. In J. Crary and S. Kwinter (ed.), *Incorporations*. Zone, New York.
Castells, M. (2000) *The rise of the network society*. Second edition, Blackwell, Oxford.
Castoriadis, C. (1987) *The imaginary institution of society*. Translated by K. Blamey, The MIT Press, Cambridge, MA.
Chatzis, K. (2001) Cyborg urbanization. Review of B. Latour and E. Hermant (1998) *Paris ville invisible*; J.W.T. Mitchell (1998) *E-topia* and A. Picon (1998) *La ville territoire des cyborgs*. Translated by Karen George. *International Journal of Urban and Regional Research* 25, 906–11.
Chu, K.S. (2002) The unconscious destiny of capital (architecture in vitro/machinic in vivo). In N. Leach (ed.), *Designing for a digital world*, Wiley-Academy, Chichester.
Clayton, J. (1996) Concealed circuits. *Raritan: A Quarterly Review* 15, 53–69.
Corbin, A. (1986) *The foul and the fragrant: odor and the French social imagination*. Harvard University Press, Cambridge, MA.
Coyne, R. (1999) *Technoromanticism: digital narrative, holism and the romance of the real*. The MIT Press, Cambridge, MA.
Crowther, P. (1992) *Les immatériaux* and the postmodern sublime. In A. Benjamin (ed.), *Judging Lyotard*, Routledge, London.
Dean, J. (2001) Cybersalons and civil society: rethinking the public sphere in transnational technoculture. *Public Culture* 13.2, 243–65.
Dean, M. (1999) *Governmentality: power and rule in modern society*. Sage, London.
De Landa, M. (1994) Virtual environments and the rise of synthetic reason. In M. Dery (ed.), *Flame wars: a discourse of cyber culture*, Duke University Press, Durham, NC.
—— (1998a) Meshworks, hierarchies, and interfaces. In J. Beckman (ed.), *Virtual dimension*, Princeton Architectural Press, New York.
—— (1998b) Deleuze, diagrams, and the genesis of form. *ANY: Architecture New York* 23, 30–4.
—— (2002) Deleuze and the use of the genetic algorithm in architecture. In N. Leach (ed.), *Designing for a digital world*, Wiley-Academy, Chichester.
Deleuze, G. (1984) *Kant's critical philosophy: the doctrine of the faculties*. Translated by

H. Tomlinson and B. Habberjam, Athlone, London.
—— (1988) *Foucault*. Translated by Seàn Hand, University of Minnesota Press, Minneapolis.
—— (1993) The fold — Leibniz and the baroque. *Architectural Design* 19, 16–21.
—— and F. Guattari (1986) City/state. In J. Crary, M. Feher, H. Foster and S. Kwinter (eds.), *Zone 1/2: the contemporary city*. Zone Books, New York.
—— and F. Guattari (1987) *A thousand plateaus: capitalism and schizophrenia*. Translated by Brian Massumi, Athlone, London.
Delpech, L-J. (1972) *La cybernétique et ses théoriciens*. Casterman, Paris.
Demos, T.J. (2003) The cruel dialectic: on the work of Nils Norman. *Grey Room* 13, 32–53.
Der Derian, J. (2001) *Virtuous war: mapping the military-industrial-media-entertainment network*. Westview Press, Boulder, CO.
Dery, M. (2002) Memories of the future: excavating the jet age at the TWA terminal. In D. Tofts, A. Jonson and A. Cavallaro (eds.), *Prefiguring cyberculture: an intellectual history*, The MIT Press, Cambridge, MA.
de Vries, G.W. (1993) Deleuze en de architectuur: aanzet tot een gebruiksaanwijzing [Deleuze and architecture: a preliminary guide]. *Archis* 11, 54–65.
Di Cristina, G. (2001) *Architecture and science*. John Wiley, London.
Doel, M. and P. Hubbard (2002) Taking world cities literally: marketing the city in a global space of flows. *City* 6, 351–68.
Downey, G. (2001) Virtual webs, physical technologies, and hidden workers. *Technology and Culture* 42, 209–35.
Dumit, J., G.L. Downey and S. Williams (1995) Cyborg anthropology. *Cultural Anthropology* 10, 2–16.
Dupuy, G. (1991) *L'Urbanisme des réseaux. Théories et méthodes*. Armand Collins, Paris.
Featherstone, M. and R. Burrows (eds.) (1995) *Cyberpunk/cyberspace/cyberbodies*. Sage, London.
Feenberg, A. (2000) Will the real post-human please stand up. *Social Studies of Science* 30, 151–7.
Formenti, C. (1999) Il cyborg bulimico. *Aut Aut* 289/90 (January to April), 43–7.
Fox, M. (2000) Pre-persons, commodities or cyborgs: the legal construction and representation of the embryo. *Health Care Analysis* 8, 171–88.
Frampton, K. (1996) *Tectonic culture*. The MIT Press, Cambridge, MA.
—— (2003) Organic organ-i-city. In D. Gans and Z. Kuz (eds.), *The organic approach to architecture*, Wiley-Academy, Chichester.
Franklin, S. (1995) Science as culture, cultures of science. *Annual Review of Anthropology* 24, 163–84.
Freyssinet, E. (2001) On the sublime. *Architectural Research Quarterly* 5, 249–53.
Gabilondo, J. (1995) *Postcolonial cyborgs: subjectivity in the age of cybernetic reproduction*. In C.H. Gray, H. Fugueroa-Sarriera and S. Mentor (eds.), *The cyborg handbook*, Routledge, London.
Gandy, M. (2002) *Concrete and clay: reworking nature in New York City*. The MIT Press, Cambridge, MA.
—— (2004a) Rethinking urban metabolism: water, space and the modern city. *City: analysis of urban trends, culture, theory policy, action* 8.3, 371–87.
—— (2004b) Lagos trotz Koolhaas. *Bauwelt: Stadtbauwelt* 164, 20–31.
Gans, D. and Z. Kuz (eds.) (2003) *The organic approach to architecture*. Wiley-Academy, Chichester.
Garver, T.H. (1998) Serving places. In S. Greenberg (ed.), *Invisible New York: the hidden infrastructure of the city*, Johns Hopkins University Press, Baltimore.
Gauzin-Müller, D. (2002) *Sustainable architecture and urbanism: concepts, technologies, examples*. Birkhäuser, Boston.
George, F.H. (1977) *The foundations of cybernetics*. Gordon and Breach, London.
Gibson, W. (1986) *Neuromancer*. Harper Collins, London.
Giedion, S. (1948) *Mechanization takes command*. Oxford University Press, Oxford.
Gille, D. (1986) Maceration and purification. In J. Crary, M. Feher, H. Foster and S. Kwinter (eds.), *Zone 1/2: the contemporary city*. Zone Books, New York.
Gordon, C. (1991) Governmental rationality: an introduction. In G. Burchell, C. Gordon and P. Miller (eds.), *The Foucault effect: studies in governmentality*, Harvester Wheatsheaf, Hemel Hempsted.
Graham, S. (2000) Constructing premium network spaces: reflections on infrastructure

networks and contemporary urban development. *International Journal of Urban and Regional Research* 24, 183–200.
—— (2003) Lessons in urbicide. *New Left Review* 19, 63–77.
—— (2004) Switching cities off. War, infrastructure, geopolitics. Paper presented at the conference *Urban Vulnerabilities*, University of Salford, 29–30 April.
—— and S. Marvin (2001) *Splintering urbanism: networked infrastructures, technological mobilities and the urban condition*. Routledge, London.
Gray, C.H. (1997) The cyborg soldier: future/present. In C.H. Gray, *Postmodern war: the new politics of conflict*, Guilford Press, New York.
—— , H.J. Fugueroa-Sarrieraand and S. Mentor (eds.) (1995) *The cyborg handbook*. Routledge, London.
Greco, D. (1995) *Cyborg: engineering the body electric*. Mac and Windows (electronic hypertext), Eastgate Systems.
Grosz, E. (1992) Bodies-cities. In B. Colomina (ed.), *Sexuality and space*, Princeton Architectural Press, New York.
—— (2001) *Architecture from the outside: essays on virtual and real space*. The MIT Press, Cambridge, MA.
Guattari, F. (1993) Machinic heterogenesis. In V.A. Conley (ed.), *Rethinking technologies*, University of Minnesota Press, Minneapolis.
Habermas, J. (1998) *The inclusion of the other: studies in political theory*. Edited by C. Cronin and P. De Grieff, The MIT Press, Cambridge, MA.
Hacking, I. (1998) Canguilhem amid the cyborgs. *Economy and Society* 27, 202–26.
Halacy, D.S. (1965) *Cyborg: evolution of the superman*. Harper & Row, New York.
Halberstam, J. and I. Livingston (eds.) (1995) *Posthuman bodies: unnatural acts*. Indiana University Press, Bloomington, Indianapolis.
Hall, S. (2003) Creolization, diaspora, and hybridity in the context of globalization. In O. Enwezor, C. Basualdo, U.M. Bauer, S. Ghez, S. Maharaj, M. Nash and O. Zaya (eds.), *Documenta 11_Platform 3. Créolité and creolization*, Hatje Cantz, Ostfildern-Ruit.
Hamlin, C. (1998) *Public health and social justice in the age of Chadwick*. Cambridge University Press, Cambridge.
Haraway, D. (1984) Lieber Kyborg als Göttin! Für eine sozialistisch-feministische Unterwanderung der Gentechnologie. *Argument-Sonderband* 105, 66–84.
—— (1991a) [1985] A cyborg manifesto. In *Simians, cyborgs, and women: the reinvention of nature*. Free Association Books, London.
—— (1991b) The actors are cyborg, nature is coyote, and the geography is elsewhere: postscript to 'cyborgs at large'. In C. Penley and A. Ross (eds.), *Technoculture*, University of Minnesota Press, Minneapolis.
—— (1992) Promises of monsters: a regenerative politics for inappropriate/d others. In L. Grossberg, C. Nelson and P. Treichler (eds), *Cultural studies*, Routledge, London.
Häring, H. (1962) [1982 edition] *Das andere Bauen*. Edited by J. Joedicke, Karl Krämer, Stuttgart.
Hayles, N.K. (1999a) *How we became posthuman: virtual bodies in cybernetics, literature, and informatics*. The University of Chicago Press, Chicago.
—— (1999b) The condition of virtuality. In P. Lunenfeld (ed.), *The digital dialectic*, The MIT Press, Cambridge, MA.
Hicks, E.D. (2001) Derritorialization and border writing. In G. Genosko (ed.) *Deleuze und Guattari: critical assessments of leading philosophers*, Volume III, Routledge, London.
Hughes, J. and S. Sadler (eds.) (2000) *Non-plan: essays on freedom, participation and change in modern architecture and urbanism*. Architectural Press, Oxford.
Hughes, T.P. (1983) *Networks of power: electrification in Western society 1880–1930*. Johns Hopkins University Press, Baltimore, MD.
Ingram, D. (1994) Foucault and Habermas on the subject of reason. In G. Gutting (ed.), *The Cambridge companion to Foucault*, Cambridge University Press, Cambridge.
Jacobson, C.D. (2000) *Ties that bind: economic and political dilemmas of urban utility networks, 1800–1990*. University of Pittsburgh Press, Pittsburgh.
Jameson, F. (1982) Progress vs. utopia; or, can we imagine the future? *Science Fiction Studies* 9, 147–58.
Jencks, C. (1993) *Heteropolis: Los Angeles, the riots and the strange beauty of hetero-architecture*. Academy Editions, London.
Jessop, B. (2000) The crisis of the national spatio-temporal fix and the tendential

ecological dominance of globalizing capitalism. *International Journal of Urban and Regional Research* 24, 323–60.
Kaïka, M. Interrogating the geographies of the familiar: domesticating nature and constructing the autonomy of the modern home. *International Journal of Urban and Regional Research* 28, 265–86.
—— and E. Swyngedouw (2000) Fetishising the modern city: the phantasmagoria of urban technological networks. *International Journal of Urban and Regional Research* 24, 120–38.
Katavolos, W. (1961) [1987 edition] Organics. Reprinted in U. Conrads (ed.), *Manifestos of 20th century architecture*, The MIT Press, Cambridge, MA.
Keller, E.F. (2002) Marrying the premodern to the postmodern: computers and organisms after WWII. In D. Tofts, A. Jonson and A. Cavallaro (eds.), *Prefiguring cyberculture: an intellectual history*, The MIT Press, Cambridge, MA.
Kelley, M. (2004) *The uncanny*. Walther König, Cologne.
King, A.D. (ed.) (1995) *Re-presenting the city: ethnicity, capital and culture in the 21st century*. Macmillan, London.
Kinnard, J. (1998) Contextualizing the city: the bricoleur and the weaver. *Harvard Architecture Review* 10, 17–23.
Kitchen, R. (1998) *Cyberspace: the world in the wires*. John Wiley, New York.
Koolhaas, R. (1990) Die Inszenierung der Ungewissheit. Rem Koolhaas im Gespräch mit ARCH+. *ARCH+*. 105/6, 68–72.
—— (1995) The generic city. In Office of Metropolitan Architecture, R. Koolhaas, B. Mau and J. Sigler (eds) *S,M,L,XL*, The Monacelli Press, New York.
—— (2002) *Fragments of a lecture on Lagos*. In O. Enwezor, C. Basualdo, U.M. Bauer, S. Ghez, S. Maharaj, M. Nash and O. Zaya (eds), *Documenta 11_Platform 4. Under siege: four African cities. Freetown, Johannesburg, Kinshasa, Lagos*, Hatje Cantz, Ostfildern-Ruit.
—— /Harvard Project on the City, S. Boeri/ Multiplicity, S. Kwinter, N. Tazi and H.U. Obrist (2001) *Mutations*. ACTAR, Barcelona.
Kull, A. (2001) The cyborg as an interpretation of culture-nature. *Zygon* 36, 49–56.
Kurokawa, K. (2001a) Toward a rhizome world or 'chaosmos'. In G. Genosko (ed.), *Deleuze and Guattari: critical assessments of leading philosophers*, Volume III, Routledge, London.
—— (2001b) *The philosophy of symbiosis from the ages of the machine to the age of life*. Edizioni Press, New York.
Lahiji, N. and D.S. Friedman (eds.) (1997) *Plumbing: sounding modern architecture*. Princeton Architectural Press, New York.
Lalvani, H. (2003) Genomic architecture. In D. Gans and Z. Kuz (eds), *The organic approach to architecture*, Wiley-Academy, Chichester.
Laporte, D. (2000) *History of shit*. Translated by Nadia Benabid and Rodolphe el-Khoury, The MIT Press, Cambridge, MA.
Latour, B. (1993) *We have never been modern*. Harvester Wheatsheaf, New York.
—— (2004) *Politics of nature*. Translated by C. Porter, Harvard University Press, Cambridge, MA.
—— and E. Hermant (1998) *Paris ville invisible*. Les Empêcheurs de Penser en Rond/La Découverte, Paris.
Law, J. (1994) *Organizing modernity*. Blackwell, Oxford.
Leach, N. (ed.) (2002) *Designing for a digital world*. Wiley-Academy, Chichester.
Lefebvre, H. (1971) *Vers le cybernanthrope*. Denoël/Gonthier, Paris.
Lock, M. (1996) Death in technological time: locating the end of meaningful life. *Medical Anthropology Quarterly* 10, 575–600.
Luckhurst, R. (1997) *The angle between two walls: the fiction of J.G. Ballard*. Liverpool University Press, Liverpool.
Ludlow, P. (ed.) (1996) *High noon on the electronic frontier: conceptual issues in cyberspace*. The MIT Press, Cambridge, MA.
Luke, T.W. (1996) Liberal society and cyborg subjectivity: the politics of environments, bodies, and nature. *Alternatives: Social Transformation and Human Governance* 21, 1–30.
—— (1997) At the end of nature: cyborgs, 'humachines', and environments in postmodernity. *Environment and Planning A* 29, 1367–80.
Lunenfeld, P. (ed.) (1999) *The digital dialectic*. The MIT Press, Cambridge, MA.
Lykke, N. and R. Braidotti (eds.) (1996) *Between monsters, goddesses and cyborgs: feminist confrontations with science, medicine and cyberspace*. Zed Books, London.
Lynn, G. (1998) *Fold, bodies and blobs: collected essays*. La Lettre Volée, Bruxelles.

—— (1999) *Animate form*. Princeton University Press, Princeton, NJ.
Lyotard, J-F. (1982) Presenting the unpresentable: the sublime. *ArtForum* 20, 36–43.
—— (1989) Complexity and the sublime. In L, Appignanesi (ed.), *Postmodernism: ICA documents*, Free Association Books, London.
—— (1994) *Lessons on the analytic of the sublime*. Translated by E. Rottenberg, Stanford University Press, Stanford, CA.
MacKenzie, D. (1996) *Knowing machines: essays on technical change*. The MIT Press, Cambridge, MA.
—— and J. Wajcman (eds.) (1999) *The social shaping of technology*. Second edition, Open University Press, Milton Keynes.
Marras, A. (1999) Hybrids, fusions, and architecture of the in-between. In A. Marras (ed.), *ECO-TEC: architecture of the in-between*, Princeton Architectural Press, New York.
Massumi, B. (2001) Sensing the virtual, building the insensible. In G. Genosko (ed.), *Deleuze und Guattari: critical assessments of leading philosophers*, Volume III, Routledge, London.
Melosi, M.V. (2000) *The sanitary city: urban infrastructure from colonial times to the present*. Johns Hopkins University Press, Baltimore.
Mitchell, W.J. (1998) Cyborg civics. *Harvard Architecture Review* 10, 164–75.
—— (2003) *Me^{++}: the cyborg self and the networked city*. The MIT Press, Cambridge, MA.
Murdoch, J. (2001) Ecologizing sociology: actor-network theory, co-construction and the problem of human exceptionalism. *Sociology* 35, 111–33.
Nantois, F. (2002) *La revolution informationnelle en architecture (de 1947 à nos jours): de la cybernétique au cyberspace*. Unpublished PhD thesis, Université Paris 8 — Vincennes Saint-Denis.
Negroponte, N. (ed.) (1975) *Soft architecture machines*. The MIT Press, Cambridge, MA.
Nesbitt, K. (1995) The sublime in modern architecture: unmasking (an aesthetic of) abstraction. *New Literary History* 26, 95–110.
Osborne, T. (1996) Security and vitality: drains, liberalism and power in the nineteenth century. In A. Barry, T. Osborne and N. Rose (eds.), *Foucault and political reason: liberalism, neo-liberalism and the rationalities of government*, UCL Press, London.
Otter, C. (2002) Making liberalism durable: vision and civility in the late Victorian city. *Social History* 27, 1–15.
Papanek, V. (1995) *The green imperative: ecology and ethics in design and architecture*. Thames and Hudson, London.
Patterson, R. (1999) Trauma, modernity, and the sublime. *Journal of Architecture* 4, 31–8.
Pearson, D. (2001) *New organic architecture*. Gaia, London.
Picon, A. (1992) *L'invention de l'ingénieur moderne. L'école des ponts des chaussées 1747–1851*. Presses de l'École des Ponts des Chaussées, Paris.
—— (1998) *La ville territoire des cyborgs*. Les Éditions de L'Imprimeur, Paris.
—— (2000) Anxious landscapes: from the ruin to rust. *Grey Room* 1, 64–83
Poole, K. (1998) Civitas oecologie: infrastructure in the ecological city. *Harvard Architectural Review* 10, 126–45.
Rabinbach, A. (1990) *The human motor: energy, fatigue and the origins of modernity*. University of California Press, Berkeley, CA.
Rajchman, J. (2000) *The Deleuze connections*. The MIT Press, Cambridge, MA.
Rauterberg, H. (2002) Die Kunst im Chaos. *Die Zeit* 4 April, 35.
Riese, U. (1998) Landschaft: die Spur des Sublimen. In H-W. Schmidt and U. Riese (eds), *Landschaft: die Spur des Sublimen*, Kerber Verlag, Bielefeld.
Robbins, E. (1998) Thinking the city multiple. *Harvard Architectural Review* 10, 36–45.
Robins, K. (1995) Cyberspace and the world we live in. In M. Featherstone and R. Burrows (eds), *Cyberspace, cyberbodies, cyberpunk: cultures of technological embodiment*, Sage, London.
Robinson, J. (2002) Global and world cities: a view from off the map. *International Journal of Urban and Regional Research* 26, 531–54.
Rose, N. (1999) *Powers of freedom: reframing political thought*. Cambridge University Press, Cambridge.
Royle, N. (2003) *The uncanny: an introduction*. Manchester University Press, Manchester.
Ruano, M. (1999) *Ecourbanismo: entornos humanos sostenibles*. Gustavo Gili, Barcelona.

Sassen, S. (2001) *Global city: London, New York, Tokyo*. Second edition, Princeton University Press, Princeton, NJ.
Schaub, J.C. (1998) Presenting the cyborg's futurist past: an analysis of Dzigo Vertov's Kino-Eye. *Postmodern Culture* 8, 40–53.
Schöffer, N. (1969) *La ville cybernétique*. Tchou, Paris.
—— (1973) *La tour lumière cybernétique*. Denoël/Gonthier, Paris.
Schroeder, R. (1994) Cyberculture, cyborg postmodernism and the sociology of virtual-reality technologies: surfing the soul in the information age. *Futures* 26, 519–28.
Schumacher, P. (2002) Robotic fields: spatialising the dynamics of corporate organisation. In N. Leach (ed.), *Designing for a digital world*, Wiley-Academy, Chichester.
Sennett, R. (2000) Reflections on the public realm. In G. Bridge and S. Watson (eds), *A companion to the city*, Blackwell, Oxford.
Senosiain, J. (2003) *Bio-architecture*. Elsevier, Amsterdam.
Simone, A. (2001) Straddling the divides: remaking associational life in the informal African city. *International Journal of Urban and Regional Research* 25, 102–17.
—— (2002) The visible and invisible: remaking cities in Africa. In O. Enwezor, C. Basualdo, U.M. Bauer, S. Ghez, S. Maharaj, M. Nash and O. Zaya (eds.), *Documenta 11_Platform 4 Under Siege: four African cities. Freetown, Johannesburg, Kinshasa, Lagos*, Hatje Cantz, Ostfildern-Ruit.
Slessor, C. (1997) *Eco-tech: sustainable architecture and high technology*. Thames and Hudson, London.
Smith, R.G. (2003a) World city actor-networks. *Progress in Human Geography* 27, 25–44.
—— (2003b) World city topologies. *Progress in Human Geography* 27, 561–82.
Sofoulis, Z. (2002) Cyberquake: Haraway's manifesto. In D. Tofts, A. Jonson and A. Cavallaro (eds.), *Prefiguring cyberculture: an intellectual history*, The MIT Press, Cambridge, MA.
Springer, C. (1991) The pleasure of the interface: language and sexual cyborg imagery in technological culture. *Screen* 32, 302–23.
Stabile, C. (1994) *Feminism and the technological fix*. Manchester University Press, Manchester.
Stone, A.R. (1991) Will the real body please stand up? Boundary stories about virtual cultures. In M. Benedikt (ed.), *Cyberspace: first steps*, The MIT Press, Cambridge, MA.
Sukopp, H., M. Numata and A. Huber (1995) *Urban ecology as the basis of urban planning*. SPB Academic Publishing, Amsterdam.
Swyngedouw, E. (1996) The city as a hybrid: on nature, society and cyborg urbanization. *Capitalism, Nature, Socialism* 7, 65–80.
—— (1997a) Neither global or local: 'glocalization' and the politics of scale. In K. Cox (ed.), *Spaces of globalization: reasserting the power of the local*, Guilford Press, New York.
—— (1997b) Power, nature, and the city. The conquest of water and the political ecology of urbanization in Guayaquil, Ecuador: 1880–1990. *Environment and Planning A* 29, 311–32.
—— (1999) Modernity and hybridity: nature, regenerationismo, and the production of the Spanish waterscape, 1890–1930. *Annals of the Association of American Geographers* 89, 443–65.
—— (2004) *Social power and the urbanization of water: flows of power*. Oxford University Press, Oxford.
Sykora, K. (1999) *Unheimliche Paarungen: Androidfaszination und Geschlecht in der Fotografie*. Walther König, Köln.
Tadiar, N.X.M. (1995) Manila's new metropolitan form. In V.L. Rafael (ed.), *Discrepant histories*, Temple University Press/Anvil Publishing, Philadelphia/Manila.
Taylor, C. (2004) *Modern social imaginaries*. Duke University Press, Durham.
Teyssot, G. (1990) Cancellazione e scorporamento: dialoghi con Diller + Scofidio [Erasure and disembodiment: dialogues with Diller + Scofidio]. *Ottagono* 96, 56–88.
Thomas, D. (2003) From the cyborg to posthuman space: on the total eclipse of an idea. *Parachute* 112, 81–91.
Thrift, N. (1999) The place of complexity. *Theory, Culture and Society* 16, 31–69.
—— (2000a) Not a straight line but a curve, or, cities are not mirrors of modernity. In D. Bell and A. Haddour (eds), *City visions*, Longman, London.
—— (2000b) Afterwords. *Environment and Planning D: Society and Space* 18, 213–55.
—— (2004) Remembering the technological unconscious by foregrounding knowledges

of position. *Environment and Planning D: Society and Space* 22, 175–90.
—— and S. French (2002) The automatic production of space. *Transactions of the Institute of British Geographers* 27, 309–35.
Tofts, D., Jonson, A. and Cavallaro, A. (eds.) *Prefiguring cyberculture: an intellectual history*. The MIT Press, Cambridge MA.
Tomas, D. (1995) Feedback and cybernetics: reimaging the body in the age of the cyborg. In M. Featherstone and R. Burrows (eds). *Cyberpunk/cyberspace/cyberbodies*, Sage, London.
Tsouvalis, J. (2003) Cyborg. In D. Sibley, P. Jackson, D. Atkinson and N. Washbourne (eds), *Cultural geography: a critical dictionary of key ideas*, IB Taurus, London.
Turkle, S. (1995) *Life on the screen: identity in the age of the internet*. Simon and Schuster, New York.
—— (2002) E-futures and e-personae. In N. Leach (ed.), *Designing for a digital world*, Wiley-Academy, Chichester.
Uno, K. (2001) The enemy of architecture. In G. Genosko (ed.), *Deleuze und Guattari: critical assessments of leading philosophers*, Volume III. Routledge, London.
van Berkel, B. and C. Bos (1998) Diagrams–interactive instruments in operation. *ANY: Architecture New York* 23, 19–23.
Vidler, A. (1987) The architecture of the uncanny: the unhomely houses of the romantic sublime. *Assemblage* 3, 6–29.
—— (1990) Case per cyborg: protesti domestiche da Salvador Dali a Diller e Scofidio [Homes for cyborgs: domestic prostheses from Salvador Dali to Diller and Scofidio]. *Ottagono* 96, 36–55.
—— (2000) *Warped space: art, architecture, and anxiety in modern culture*. The MIT Press, Cambridge, MA.
Villani, T. (1995) *Athena cyborg. Per una geografia dell'espressione: corpo, territorio, metropolis*. Mimesis, Milan.
Virilio, P. (1991) The overexposed city. In *Lost dimension, translated by Daniel Moshenberg*, Semiotext(e), New York.
—— (1995) *The art of the motor*. Translated by J. Rose, University of Minnesota Press, Minneapolis.
—— (1997) *Interview with James Der Derian*. Translated by J. Der Derian, M. Degener and L. Osepchuk (http://proxy.arts.uci.edu/~nideffer/_SPEED/1.4/articles/derderian.html, accessed 22 December 2003).
Waldby, C. (2002) The instruments of life: Frankenstein and cyberculture. In D. Tofts, A. Jonson and A. Cavallaro (eds.), *Prefiguring cyberculture: an intellectual history*, The MIT Press, Cambridge, MA.
Whatmore, S. (2002) *Hybrid geographies*. Sage, London.
Wiener, N. (1948) *Cybernetics or control and communication in the animal and the machine*. The MIT Press, Cambridge, MA.
Wigley, M. (1990) La disciplina dell'architettura [The disciplining of architecture]. *Ottagono* 96, 19–26.
—— (1993) *The architecture of deconstruction: Derrida's haunt*. The MIT Press, Cambridge, MA.
Williams, R.H. (1990) *Notes on the underground: an essay on technology, society and the imagination*. The MIT Press, Cambridge, MA.
Wolch, J. (1996) Zoöpolis. *Capitalism, Nature, Socialism* 7, 21–47.
Wolmark, J. (1994) *Aliens and others: science fiction, feminism and postmodernism*. Harvester Wheatsheaf, New York.
—— (ed.) (1999) *Cybersexualities: a reader on feminist theory, cyborg and cyberspace*. Edinburgh University Press, Edinburgh.
Wood, M. (1998) Agency and organization: toward a cyborg-consciousness. *Human Relations* 51, 1209–26.
Woods, L. (1996) The question of space. In S. Aronowitz, B. Martinsons and M. Menser (eds.), *Technoscience and cyberculture*, Routledge, London.
Zevi, B. (1950) *Towards an organic architecture*. Faber & Faber, London.
Zitouni, B. (2004) Donna Haraway and Bruno Latour: quid urban studies? Paper presented at the conference on *Techno-Natures*, University of Oxford, 25 June.
Žižek, S. (2002) From virtual reality to the virtualisation of reality. In N. Leach (ed.), *Designing for a digital world*, Wiley-Academy, Chichester.
Zylinska, J. (ed.) (2002) *The cyborg experiments: the extensions of the body in the media age*, Continuum, London.

