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Virtual Geographies

Bodies, space and relations

Edited by
Mike Crang, Phil Crang and Jon May

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Contents

List of illustrations
List of contributors
Acknowledgements

1 Introduction
MIKE CRANG, PHIL CRANG AND JON MAY

PART I
Embedding the virtual

2 Toward the light 'within': optical technologies, spatial metaphors and changing subjectivities
KEN HILLIS

3 The telephone: its social shaping and public negotiation in late nineteenth- and early twentieth-century London
JEREMY STEIN

4 Consumers or workers?: restructuring telecommunications in Aotearoa/New Zealand
WENDY LARNER

5 Transnationalism, technoscience and difference: the analysis of material–semiotic practices
LAURA CHERNAIK

6 The convergence of virtual and actual in the Global Matrix: artificial life, geo-economics and psychogeography
OTTO IMKEN

8 Geographies of surveillant simulation

Stephen Graham

Introduction: telematics and surveillant simulation

The history of technology demonstrates that, in the long run, interlinked changes across a range of technological systems tend to be more important than single technological innovations in facilitating social and spatial change (see, for example, Hall and Preston 1988; Beniger 1986). Thus, we might criticise the rather narrow preoccupation of much current social science work on virtual spaces, which tends to centre almost exclusively on the social construction of subjectivity in 'cyberspace' (for which read the Internet). Such a perspective, I would argue, often neglects the broader societal implications of a whole raft of current inter-linked innovations in computing and telecommunications.

In such a context, this chapter tries to connect a broad perspective on 'virtual geographies' with political-economic debates about surveillance, computerised simulation, and the socioeconomic restructuring of geographic space. My starting point is William Bogard's (1996) recent book, *The Simulation of Surveillance*. Computerised surveillance and simulation have both been subject to much debate within recent social theory and commentary (see Lyon 1994; Droege 1997). Approaches in social and cultural geography, and postmodern commentary more generally, however, have tended to separate treatment of surveillance from that of simulation. The former have usually drawn on the work of Foucault (1977) on the disciplinary and self disciplining underpinnings of modern societies (see, for example Squires 1994; Philo 1992), and on Jeremy Bentham's famous eighteenth-century writings on his Panopticon prison design (see Hannah 1997). The latter have drawn on Baudrillard's notions of the 'postmodern' shift towards hyperreality and orders of simulacra (see Baudrillard 1983; Kellner 1994; Soja 1989). Largely separate positivist debates on simulation, meanwhile, have addressed the technical issues surrounding the computerised simulation of everything from geographical systems (see Batty 1996, 1997a; Sui 1997), to planetary landscapes, biological mechanisms, human genetic processes, and cosmological space-time (see Hall 1993).

In contrast, Bogard's work is useful because it takes an holistic perspective of the *complex interactions* between computerised surveillance and simulation.

'It is simulation', writes Bogard (p. 9), 'that is the key to explaining the direction that surveillance societies are taking today, a movement that is more about the perfection and totalization of existing surveillance technologies than some kind of radical break in their historical development' (ibid.: 9). To him, computerised simulation and computerised surveillance are increasingly merging to be integrated systems of rapid, and invisible, social control. Thus, the closely allied disciplinary gaze of surveiller and the self-discipining practices of the surveyed analysed by Foucault and Bentham becomes decoupled and distanciated over space and time via telecommunications and computers. The surveiller 'no longer, properly speaking, *has* a gaze' (p. 57) as surveillance becomes predicated on both systems of computerised societal simulation and, increasingly, simulations of surveillance apparatus itself (with, for example, extending application of both real and mock CCTV cameras). Bogard analyses these interactions within a critical framework of the political-economic shifts that are underway in contemporary society. He thus balances his treatment of subjectivity and identity with a rich treatment of the implications of simulation and surveillance for social control, spatial structures and power relations.

To Bogard, the importance of broad, interacting technological systems is illustrated by considering the much-vaunted technological 'convergence' between computers, telecommunications, media, and bio-technologies based on the progressive digitalisation of information. Such technological blurring is potentially important for four reasons. First, it increasingly supports the interlinkage of wide ranges of terminal equipment across geographical distance into digital, multi-media 'telematics' networks able to deal with flows of digital data, sound, voice and (increasingly) still and moving images. Thus 'telematics societies' become technologically feasible, defined by Bogard as: 'societies that aim to solve the problem of perceptual control at a distance through technologies for cutting the time transmission of information to zero' (Bogard 1996: 9).

Second, advances in computing technology mean that the powers of digital technological systems for processing, manipulating, transmitting and storing data are increasing extremely rapidly. This means that systems supporting new orders of magnitude of automated data capture, monitoring and surveillance can be directly constructed to try and match vastly complex systems of social and economic behaviour extended across material spaces.

Third, computers are, in turn, moving from being essentially 'data crunching' devices to sophisticated visualisation and simulation devices, as is the case with Geographical Information Systems (GIS), digital mapping and remote sensing and Virtual Reality (VR) techniques within which whole, immersive, electronic environments become constructed (see Lister 1995; Druckrey 1994a). 'The transition from solid models to digitally-generated images has gone to completion in an astonishingly short time' (Stone 1994: 7). Computerised simulation and modelling systems now allow the huge quantities of data captured by automated surveillance systems to be fed directly into dynamic facsimiles of the time-space 'reality' of geographic territories (neighbourhoods, cities, regions, nations, etc.), which can in turn be fed into support new types of organisational change, spatial targeting, and urban and regional restructuring.

The final element of the technological jigsaw provides the geographical foundations for the fine-grained monitoring of the time-space dynamics of geographic spaces. This has been provided by rapid advances in geo-referencing technologies such as satellite remote sensing, the global web of Global Positioning Systems (GPS) satellites and digital telecommunications. GPS satellites can triangulate geographical locations, anywhere on the planet, down to one metre resolution levels. Together, these technologies allow locations and patterns of flow to be precisely defined, surveilled and virtually simulated against a global geometry of precise, digital, time-space coordinates (Abler 1993).

More and more powerful data surveillance thus becomes spatially visualised and operationalised through sophisticated GIS and, increasingly, Virtual Reality (VR) and computer monitoring technologies. Their development is fuelled by heavy research and development investment as geographers, surveyors and cartographers attempt to perfect the apparatus for 'cybercartography', 'cybergeography' and ever-more 'realistic' geographical simulations (Openshaw 1994; Pile 1994: 1818). New techniques which blend remotely-sensed data with digital maps and 3-dimensional virtual simulations further strengthen the connections between surveillance and simulation.

Ultimately, technological enthusiasts predict immersive, real-time, virtual simulations that are so intimately connected to surveillance systems that they can be taken to be 'mirror worlds', 'software worlds in a box' (Gelerntner 1991), 'intelligent environments', or 'virtual urban spaces' (Droege 1997). Gelerntner (1991) has predicted that, linked to a range of real-time surveillance inputs, software constructions will become such life-like metaphors for the 'real' world that they will be taken for 'software models of some chunk of reality, some piece of the real world going on outside your window'. In such 'Mirror Worlds', he writes, 'oceans of information pour endlessly into the model (through a vast maze of software pipes and hoses); so much information that "the model" can mimic the "reality"'s every move, moment-by-moment' (ibid.: 3). Indeed, it is widely argued that with current advances in GIS and virtual reality systems, simulated facsimiles will become more and more like the 'real' world. For Jacobsen (1994: 37), for example, 'the addition of virtual worlds to GIS will result in a hybrid technology, the living map, that enables users to naturally experience geospatial information and the world this information represents'.

Interlinked technological systems of data capture and surveillance, computerised processing and simulation provide multiple webs of highly capable, and speedy, systems of 'surveillant simulation'. These, argues Bogard, are actually less visible than the bureaucratic paper-based systems they're replacing (Bogard 1996: 3). Bogard's central argument is thus that surveillance systems can now provide the data inputs necessary to develop electronic simulations of 'reality' used by a number of powerful organisations such as the military, the state and large firms.

A good illustration of surveillant simulation comes from the military sphere, where, as Kevin Robins (1996: 55) suggests, 'surveillance and simulation feed off each other. And surveillance and simulation technologies together feed in to the control of a new generation of "smart", vision-guided strike weapons.' Thus, the first generation of Tomahawk cruise missiles carried internal programs with digital simulations of the terrain they were to follow to allow target identification generated by intense surveillance of sophisticated military satellites. Current versions of the missile have been upgraded to use the even more accurate Global Positioning System (GPS) satellites which allow global tracking and target acquisition to an accuracy of one metre.

But increasingly, I would argue, processes of computerised surveillant simulation characterise the operations of many large organisations in civil society and the private sector too, as military-standard control and communications webs are translated to civil markets. Of course, the surveillance of dominant states and organisations has long been based on simulations and socially-constructed categorisations, as with the use of cartographic representations to help create dominated colonial spaces (King 1996). But the computerised linkage between surveillance and simulation helps to reconfigure and intensify surveillance practices because simulations become continually updated representations cybernetically connected 'backwards' to extending webs of data capture and 'forwards' to (attempted) disciplinary and consumer practices. At the same time systems of surveillant simulation become less and less visible because of their complex, disembedded time-space geographies, based on instantaneous flows of images and data.

There are a widening range of examples where automatically-captured data and images are processed to produce electronic simulations of the 'real' world (visualised data bases, Geographical Information Systems, CCTV image banks, digital DNA scans, digital transaction and travel records, etc.). To the user organisations, these are then taken to *be* the 'real' world and are, in the next iteration, used to support the restructuring or targeting strategies of organisations, based on the fine-grained allocation of goods and services, or ever-more intimate patterns of social control and surveillance, in (near) real-time through the space-time fabric of nations, cities and regions (see Virilio 1993).

The growing nexus between systems of surveillance and those of simulation has major, but poorly explored, implications for geographical change, for social control, for patterns of inclusion and exclusion, for the development of visual culture, subjectivities, and for the spatial dynamics of the 'information economy'. This chapter attempts to start exploring these. It looks in detail at three areas where areas of surveillant simulation seem especially well-developed: in crime control and the electronic tracking of subjects; in retailing, banking and home telematics; and in road transportation.

Tracking, tagging, and CCTV: surveillant simulation as social control

My first example centres on the emerging links between surveillant-simulation technologies and crime and social control initiatives, particularly in cities. In these surveillant simulations the behaviour of human subjects can effectively be reduced to their time-space electronic trails or images, as their movements and behaviour are logged, tracked and, increasingly, mapped, using systems linking CCTV, computerised tracking systems, GISs and mobile and fixed phone networks. The rapid extension of such technologies across geographic space means that 'a person going about his or her daily routine may be under watch for virtually the entire time spent outside the house' (Squires 1994: 396). Tim Druckrey (1994b: 15) too notes 'the increasingly invisible dispersal of electronic tracking' technologies. Through wide-area systems, covering whole cities, regions, nations and international transport routes, the behaviour of human subjects may increasingly become aggregated into detailed time-space surveillant simulations offering radically new possibilities for tracking and social control.

A good example of the emergence of surveillant simulation as social control can be found in the wide-area public Closed Circuit Television (CCTV) camera systems now operating in the UK. More than 200 CCTV schemes are now in operation in the public spaces of the UK, most of which use analogue video technology backed up by radio, telephone and photographs of target subjects (Graham *et al.* 1996). Virtually every sizable urban settlement in Britain now has public CCTV; systems are also increasingly spreading to cover residential areas. CCTV is being seen as a new and cost-effective part of the local policy 'tool kit' for dealing with a range of urban problems – including the cutting of crime, improving consumer and business confidence in town centres and underpinning the economic competitiveness of urban areas. Wide area CCTV systems integrate state-of-the-art surveillance cameras – often with remarkable resolution and infra-red night time capability – via microwave or cable telecommunications links into systems for continuously surveying towns and cities. The extension of CCTV grids across urban Britain has been backed by the rhetoric of politicians and press, by heavy investment from government, police, local authority and public–private Town Centre Management (TCM) organisations and by considerable public support – though, in practice, such support remains far less unanimous than often presented in the media (see Norris and Armstrong 1997). Evidence is building that through CCTV people and behaviours seen not to 'belong' in the increasingly commercialised, and privately-managed, consumption spaces of British cities tend to experience especially close scrutiny. Research by Norris and Armstrong (1997), for example, shows that much of the scrutiny that results from CCTV tends to focus on young men who 'look' a certain way, and on certain minority groups, including ethnic minorities.

Currently, however, surveillance within CCTV is not linked to simulation;

rather, the human eye and brain of the operator, linked into police records and photographs, with all its subjectivity and discretion, become the route through which CCTV imaging is translated into disciplinary social action and attempted control. But technological developments towards the digitalisation of CCTV, seem likely to lead to much higher degrees of automation and a much greater reliance of linked surveillant-simulation techniques.

Analogue CCTV systems are crude compared to the digital systems now emerging which constitute much more sophisticated systems of surveillant simulation, with much greater control capabilities. Micro-cameras and digital facial recognition technology are developing fast, both for in-store security systems and wider city-centre networks, allowing much more extensive, automated, digital CCTV systems to be built. New, digital systems are algorithmically programmed to scan for certain 'unusual' events or targeted individuals or vehicles, thus withdrawing opportunities for human discretion in the tracking and monitoring of individuals. Digital CCTV will allow real-time, time-space searching for specific events to occur as well as retrospective, digital searching aimed at correlating behaviour patterns with patterns of crime (Norris *et al.* 1996).

Early examples of digital, algorithmic CCTV applications are already emerging. Certain UK rail stations now have 'smart' CCTV which automatically warns when specific crowd densities are met on platforms. The City of London now has an 'intelligent screen monitoring' algorithmic system for automated surveillance of its 'Ring of Steel' anti-terrorist cordon. Here, a stationary vehicle triggers an alarm in the control room as does a car heading down the street in the 'wrong' direction (Norris *et al.* 1996). In another example, Sydney airport will soon introduce a system which scans automatically and covertly for known illegal immigrants entering immigration (Norris *et al.* 1996). In a new experimental project, BT is also working with the Massachusetts Institute of Technology (MIT) and the major British retailer Marks and Spencer on a digital image and television-based computer system known as 'Photobook' which, using real-time cameras linked via advanced facial-recognition software to image databases of the faces of convicted shop-lifters, will alert security staff of the arrival of the presence of convicted shoplifters in Marks and Spencer stores. Accuracy is said to be 'greater than 90 per cent' (McKie 1994).

In the long run, BT anticipate major new telecommunications markets. For example, 'all commercial outlets in a town could be linked and an alarm be set off the moment a person who has been seen shoplifting in one store enters another' (McKie 1994). When backed by digitised face prints of the type now being developed by the UK's Driver and Vehicle Licensing Agency (DVLA), the potential for national face-recognition and monitoring systems in the UK operating through expanding CCTV seems a lot more than some paranoid dystopia (Davies 1995). The state of Massachusetts is already in the final stages of digitising the faces of its 4.2 million drivers, as a means of overcoming fraud (Davies 1995: 197). More prosaically, the designer of 'Photobook' dreams of a 'front door camera that announces the identity of the person outside' (Griffith 1996).

In the United States, the control and surveillance capabilities of telematics are being widely explored as tools for new methods of social control in cities, methods that go beyond the highly expensive option of simple incarceration in prisons. By 1991, over 4.3 million Americans had been under 'correctional supervision' at home (Gowdy 1994). The burgeoning costs of the American prison programme are leading to the widespread use of 'electronic tagging' for low-level offenders who are free to maintain some semblance of daily life through 'walking prisons' (Winckler 1991). 'Less dangerous offenders now are confined to the home, except to go to work and run errands, freeing jail space for more dangerous criminals' (Gowdy 1994).

Anklet transponders, linked to telephone modems, provide continuous monitoring of the location of offenders. Newer 'smart' systems promise a much more fine-grained and tailored control over their behaviour. For example, in a retailer, the 'arrival of an ankleted shoplifter would set off a silent alarm, and the system would identify the offender to the store management' (Winckler 1991: 35). When linked to wider urban surveillance systems, through city-wide radio networks – available by the year 2000 – the movements of all ankleted offenders could be correlated with the incidence of crime, in time and space, to help in conviction. 'Every place the offender went – and the time he or she was there – would be recorded and compiled and could then be cross-indexed against known crime scenes and times' (Winckler 1991: 35). Thus, within this GIS-based surveillance simulation system, the 24-hour electronic tracks of individuals could be correlated with time-space patterns of crime incidence to underpin unprecedentedly fine-grained mechanisms for social control.

Home teleservices, surveillant simulation and cybernetic consumption

My second case centres on the emerging linkages between surveillant-simulation systems and telematics applications in the sphere of consumption and, more specifically, the rise in retailing of home teleservices – interactive cable TV and phone, video on demand, etc. Here we need to consider the broader possible role of surveillant-simulation systems in mediating access to increasingly cybernetic, tele-based, consumption services, as technological trends seem likely to shift inexorably toward a consumption driven, 'information superhighway' dominated by very large media and consumption corporations (Mowshowvitz 1996). As trends towards home-based consumption based on telephone, the Internet, cable and broadband home networks, combine with the growing use of electronic cash (credit cards, smart cards and 'cyber cash' on the Internet), home-based shopping, banking and consumption systems are emerging which precisely monitor, in real-time, the consumption patterns of households. The much-vaunted experiments in interactive, broadband home telematics, such as the Time Warner interactive TV system at Maitland, Florida, are experimental precursors to the much wider roll-out of highly capable home media and consumption systems which are intrinsically based on building up surveillant simulations of consumers' behaviour (Burnstein and Kline 1995).

Rather than relying indirectly on aggregated or individual consumption data from the census and credit and information bureaus, as has been the practice in the postwar period (Pickles 1995), these systems actually build up their own surveillant simulations of *actual individual behaviours*, in real-time. Robins and Hepworth note that, 'it is in the nature of interactive telematics as process and control technologies that electronic transactions (television viewing, teleshopping, remote working) *must necessarily be recorded. The system is inherently one of surveillance and monitoring*' (Robins and Hepworth 1988: 169, emphasis added). Wilson suggests that the extension of such systems means that we are entering a new 'era of cybernetic' consumerism by integrating domestic, home-based and electronic/cash-free retailing and credit systems with logistics systems such as Just In Time (JIT) and with the information gained from junk-mail and on-line response. This leads inexorably to an extremely efficient 'cycle of production and consumption, since every consumptive activity will generate information pertinent to the modification of future production' (Wilson 1986: 26).

Whilst allowing for the freedom of choice that such systems offer consumers, individuals linked into these telematics systems are themselves engaged in generating 'Transactionally Generated Information (TGI)', so building up their own 'digital personas' – surveillant simulations for corporate use (Crawford 1996). This raises questions about how self-generated surveillant simulations, built up covertly and geared to the needs of large corporations, are also involved in the construction and control of subjectivities and identities. Who, in other words, owns one's digital persona; the subject, the data bureau or the Transnational Corporation? And what are the virtual geographies surrounding the data flows through which these surveillant simulations are continually constructed, updated, and refined? For Allucquère Rosanne Stone:

> out of the snail track of our passage through a world of myriad simultaneous opportunities for consumption, [providing corporations] build their own images of who we are, freed from the constraints of linearity of sense. Our doppelgangers are already free of the tyranny of localized subjectivity; they follow the geodesics of capital and of ideal citizenship. It's ourselves that haven't yet caught up.
>
> (1994: 7)

It is clear that the virtual geographies surrounding Transactionally Generated Information can have very real impacts on the material geographies of opportunity, constraint and restructuring. TGI is usually used for various

forms of exogenous social control by credit bureaus and consumer service organisations undertaking restructuring based on so-called 'Data Warehousing'. TGI allows firms to track real-time consumption habits, preferences and practices; to identify poor credit risk individuals, households and areas; to individually target and deliver direct marketing campaigns; and to build up commodified information packages for reselling within the lucrative 'information marketplace' (Crawford 1996; Mowshowvitz 1996).

Three examples help to demonstrate the virtual geographies and surveillant simulations surrounding on-line consumer monitoring. The first is the apparently humble case of the supermarket customer loyalty card – currently a key route to personalised surveillance and cybernetic customer targeting in the UK and US food retailing industry. Where previously firms had to rely on crude estimates, such cards provide the technological infrastructure for mass, continuous surveillant simulation of customers by the managing corporation. Each time a customer with a loyalty card buys goods their card is 'swiped' through the Electronic Point of Sale' (EPoS) terminal at the checkout. This allows an individual profile of consumption habits to be built up over time, which can then be aggregated to provide a real-time simulation of throughput through all stores. In turn, this can feed into ordering, logistics, storage and supply chain management. It also provides the raw material for 'mass customisation' and direct marketing. Massey (1996: 26) suggests that in the UK 'retailers like Safeway and Tesco can now build detailed pictures of spending patterns based on data gleaned from loyalty card/swipes. Eventually retailers will be able to target customers with offers specific to them – potentially setting special price details accessed by individuals using self-scanners.' Such cards illustrate the essentially ambivalent nature of consumer surveillant simulation. Whilst they give more affluent (targeted) users access to discounts and services directly customised to their consumption patterns, such practices also raise concerns. Where does customised service become a social intrusion? What are the impacts of the reselling of individual dossiers within the 'information marketplace', to support wider direct marketing for financial services and utilities? And what are the implications of direct surveillant simulation of consumer landscapes for retail geographies in the context of the spatial restructuring of grocery networks, the oligopolisation and internationalisation of markets and the increasingly careful exclusion of those groups and areas without the disposable incomes and bank accounts to make them attractive targets of customised services?

The second example, which hints further at the complex geographies and subtle processes of inclusion and exclusion that surround on-line consumer systems, comes from the integration of computer and telephone systems (known as CTI) in customer telesales centres. Such centres are now used by major retailers, banks, insurance companies, transport firms, airlines and utilities. Telesale centres service regional, national and even international markets from a single, technologically advanced, node – through the use of free or local call phone tariffs linked into corporate telematics networks. By automatically surveilling the source of incoming telephone calls, through a system known as 'Call Line Identification' (CLI) and linking this number into customer databases, such systems now allow callers to be sifted according to how 'good' a customer they are. In effect, the surveillance of the caller is automatically linked to a simulation of all known customers, to allow customers to be treated differentially. Thus, UK utilities are already able to answer the calls of 'good customers' (i.e. those that have paid their bills promptly) before 'bad customers' (those with a history of default who are queued), without either the operator or customer being aware that their prompt or slow service is directly shaped by automated surveillance systems linked to computerised databases. Such work processes also allow, of course, for intimate real-time work place surveillance. Managers can assess each individual worker's response rates and productivity levels and can secretly switch between telesales staff, listening in on calls.

The final example, that of video-on-demand technologies (VOD), is a much-vaunted system that allows consumers to 'order' selected videos and media products for personal transmission down phone or cable lines to their homes. Many VOD trials are currently in progress, with the hope that it will herald truly tailored and individual media consumption. But VOD systems also produce a continuous stream of information for a cable or telecommunications company about the detailed media and consumption preferences of individual households. For example, the telecommunications company, Bell Atlantic, are developing a computer system linked to VOD which will 'monitor the movies that a person orders and then suggest others with the same actors or theme'. The system would also 'enable advertisers to send commercials directly to customers known to have bought particular kinds of merchandise. Thus, people who bought camping equipment from a video catalogue might start seeing commercials for outdoor clothing' (Andrews 1994). In a similar way, 'real-time residential power line surveillance' (RRPLS) will use normal electricity wires and IT-based utility meters to build up unprecedentedly detailed profiles of the electricity use of households (Crawford 1996). Such is the sophistication of the technology that it can 'infer that two people shared a shower by noting the unusually heavy load on the electric water heater and that two uses of the hair dryer followed' (Crawford 1996: 57).

Road telematics: surveillant simulation as (differential) power over space

My third case is that of Road Transport Informatics (RTI). The control capabilities that new surveillant-simulation technologies bring are of central importance here in supporting a shift from 'dead', public, electromechanical highways, to 'smart', digitally controlled and, increasingly, privatised highways (Graham and Marvin 1996). Virtual electronic networks of automated sensors, CCTV, tracking and charging devices, computers and GISs are being

laid over established road transport networks helping to undermine their 'natural monopoly' characteristics and so allowing private firms to operate them profitably (Robins and Hepworth 1988). Road networks, with all their complexity of flow and pattern, increasingly become surveillant simulations supporting new practices of commodification, control and exclusion which provide the basis for strategies which differentiate groups according to the power over space they are seen to warrant. Whilst traditional toll systems already operate in many places, the emergence of 'intelligent highways' supports the translation of whole highway networks into computerised, commodified systems which can be managed flexibly and developed privately for profit. Essentially, Electronic Road Pricing (ERP) systems enable the commodification of road space, allowing it to be allocated at a price, within markets, for profit by private firms. Hepworth and Ducatel argue that ERP will 'create the physical infrastructure needed to privatise road space and will also create an institutional structure for administering a privatised road system' (Hepworth and Ducatel 1992: 92).

Within Road Transport Informatics (RTI) systems, people and their vehicles are effectively reduced to their moving image and signature. The central question raised by the development of the resulting 'intelligent highways' is whose 'intelligence' becomes embodied within the new road telematics systems? Currently, the development of transport informatics tends to be biased towards the need to minimise time-space constraints and increase transport and telecommunications access for the most powerful groups: the corporate élites, business traffic, land and property development interests and other 'road warriors' (Massey 1993). There are close linkages between the control of space that enhanced mobility brings, and the basis on which particular groups are allowed to have access to new technologies to overcome urban congestion. Swyngedouw argues that 'road pricing, or other linear methods of controlling or excluding particular social groups from getting control over space, equally limits the power of some while propelling others to the exclusive heights of controlling space, and thereby everything contained in it' (1993: 323).

An excellent example of how surveillant simulation becomes implicated in the construction of new, dualised, urban highway networks and systems of increased *differential* power over space can be found in the construction of a new, private, commodified, highway network (number 407) around Toronto (Campion Smith 1996). Built to ease congestion on the world's busiest highway, to which it runs parallel, in-car transponders will automatically charge all users of the highway around $1 per 11 km trip, without the necessity of stopping them. Tariffs will vary automatically, to peak around rush hour commuting periods, so ensuring that use of the highway never exceeds pre-defined limits. Thus the free movement of traffic on the highway can be guaranteed, overcoming the time and financial costs of congestion. Traffic patterns and flows will be continuously monitored and data will be aggregated into a simulation model of traffic on the highway. The simulation will be used to assess the appropriate tariffs through linkage with demand forecasts; ultimately, such surveillant simulation should allow a cybernetic linkage between tariffs and demand, so reducing the likelihood that congestion will occur even with rising demand and car ownership. Cars without transponders will be automatically photographed and their owners tracked and fined through linkage with data bases in Drivers Licensing authorities. By the year 2000 over $100 million per year is expected in tolls; and speed limits may even be higher on the highway than for other state highways. The consortium which built the road is now selling off all the key development sites along it to the highest bidder, for malls, affluent neighbourhoods, business parks, and logistics creating, in effect, a second-tier land-use transportation system for the élite interests in Toronto. Those without the ability to pay the tariffs, meanwhile, will remain trapped in the congestion and lower speed limits of Toronto's public highway system.

Bias and contingency in surveillant simulation

It has already been widely argued that, with the rapid emergence of superimposed grids of surveillance in retailing, consumer services, the media, the state and transportation 'the modern citizen is objectified as a life-path comprised of information, as a 'spatialised dossier' (Hannah 1997: 352). But this 'dossier' is far from reaching some omnipotent Panopticon, some all-seeing 'Big Brother'; it always remains incomplete, fragmented, patchy, and unevenly developed across and between the 'life-paths' of citizens. Thus, 'in "real life" we face a variety of normalising machines, imperfectly co-ordinated, and each with imperfect powers' (Hannah 1997: 353).

In contrast, the importance of trends towards the widespread application of surveillant-simulation techniques is that they support increasingly co-ordinated, extensive and *comprehensive* systems of surveillance and social control. Technological developments linking surveillance with societal simulation, and the increasing horizontal co-ordination between 'dossiers' and sites of surveillance (credit bureaus, banks, retailers, utilities, media firms, transport operators, state and correctional agencies), seem likely to prefigure a rapid intensification of co-ordinated, comprehensive surveillance. Above all, it is becoming more and more difficult to escape, to lift a phrase from Bruno Latour (1993: 121), from the 'skein' of technological networks that undergrid the apparatus of surveillant simulation. With their widening horizons of automated data capture and their instantaneous geographical reach, it would seem that 'we are in a generalized crisis in relation to all environments of enclosure. [. . .] Societies of control are in the process of replacing disciplinary societies' (Deleuze 1988a: 4). Three key questions emerge here, each of which has important implications for broader debates about virtual geographies.

Surveillant-simulation and dystopian urban futures

First, do trends toward surveillant simulation necessarily prefigure some wholesale shift toward societies of dystopian social control and segmentation (as is so often implied in cyberpunk science fiction and critical social theory – see Burrows 1997)? In general terms, it would certainly seem that electronic surveillant simulations are being constructed to support decision making, business restructuring decisions, social control and the development of further iterations of surveillance by service organisations within and across geographic space. Within the context of a political economy dominated by a profit-driven, liberalised/privatised and internationalising corporate environment, surveillant-simulation systems are emerging as crucial techniques for bolstering profitability, flexibility and responsiveness. For retailers, banks and utilities, for example, GIS surveillance systems are increasingly being woven into processes of business process re-engineering and service restructuring. This makes it possible to drive service plans and the 'roll out' of investment across cities according to tight geo-demographic targeting criteria.

As cybernetic loops monitoring citizen behaviour become more sophisticated (through retailers' customer information collection, mail order, consumer credit, profiling agencies, home telematics systems, road transport informatics, wide-area Closed Circuit TV, etc.), it is increasingly becoming possible to replace *aggregate* geo-demographic spatial data sets (say, at post-code or census tract level) with individual sets based on *actual citizen behaviour or consumption*. Thus, computerised simulations of the geographic space of cities and regions become possible, simulations which ever more closely resemble totally panoptic, real-time simulations of the city (the best example here being CCTV). Such panoptic and cybernetic networks thus start to resemble the command, control and communications webs already developed in the military. In the consumption field, the process of targeting only reaches its limit as service enterprises attempt to compete for market share within increasingly liberalised markets (whilst, of course, gradually easing out of less-profitable commitments or obligations covering poorer groups and areas).

Surveillant-simulation technologies are also being developed and applied within the context of a strong supply push from an increasingly globalised complex of media, telematics and 'correctional' industries. What Bob Lilley and Paul Knapper (1993) call the 'corrections commercial' complex – i.e. the fast-growing complex of security, military and prison corporations – who are, post-Cold War, attempting to colonise civil markets, are also key players in this supply-side push. They are being further supported by the broader debates about the supposedly world-improving momentum of the 'information superhighway', the imperative to apply telematics uncritically to every aspect of civil life, and the pervasive crisis of public confidence in home, street and transport security.

The result, in advanced industrial cities, as Mike Davis (1992) has suggested in Los Angeles, will be the emergence of urban landscapes made up of many superimposed layers of surveillant simulation. Each layer might have its own finer and finer mosaic of socio-spatial grids; its own embedded assumptions and criteria for allocating and withdrawing services or access; its own systems for specifying and normalising boundary enforcement, through electronically defining the 'acceptable' presence of individuals in different urban 'cellular' space-times; and its own cybernetic loops of system feedback, within which systems of surveillance become ever more integrated into systems of simulation. As people leave a stream of digital tracks through their daily lives, their electronic personas become embedded into a web of surveillant-simulation systems; 'each of us will become increasingly isolated in our own separate technological enclosure or cell' (Crawford 1996).

Disciplinary control within cities, then, comes to rely not just on the Foucauldian array of physical structures, disciplinary controls and urban planning practices (see Driver 1984) but on pervasive webs of electronic systems, which assert disciplinary control by 'distributing bodies/uses in space, allocating each individual/function to a cellular partition, creating an efficient machine out of its analytical spatial arrangement' (Boyer 1996: 17). The self-disciplining effects of surveillant-simulation practices, whereby subjects actively work to position *themselves* in relation to such practices, become based on a whole apparatus of consumer information systems, real and mock CCTV, infrastructure control systems as well as the traditional architectonic and urbanistic practices. As Virilio (1987: 16) argues, cities are shifting from a state where physical barriers and walls controlled access and 'belonging' to a state where 'the rites of passage are no longer intermittent – they have become immanent' and are woven as automatic, cybernetic systems, into the urban fabric. Such electronic systems, with increasing degrees of automation, also threaten to provide silent, invisible, and pervasive networks of cybernetic social control, with unprecedented potential for exclusion. Norris *et al.* (1996: 13) warn that:

> those who cannot pay will be excluded from motorways; known trouble makers from football grounds; the unsightly casualties of 'care in the community' removed from the decorous order of city streets and shopping malls; known shoplifters and fare dodgers excluded from shops and transport systems. . . . If the growing divide between those who have and have not and those who are included and excluded is intensified through the use of new technology, there is a real danger that our cities will come to resemble the dystopian vision so beloved by futuristic film makers.

Such fears, that surveillant simulation will prefigure and support socio-spatial systems that are more socially polarised and exclusionary through invisible, automated social judgements are thus very real. There seems little doubt that

systems of surveillant simulation are helping to underpin broad shifts towards more and more intensely polarised, even dualised, material geographical spaces, especially in cities (Burrows 1997; Graham and Marvin 1996; Boyer 1996).

The dangers of over-generalisation: contingency and appropriation

But, and this is my second question, is this the end of the story? Are the processes underway really so stark and simple? In fact, whilst acknowledging broad scale trends and biases, we also need to be wary of the dangers of over-simplified and generalised scenarios; of accounts that assume totalised, dystopian, geographic 'impacts' of surveillant-simulation techniques drawn from paradigmatic examples like Los Angeles (Amin and Graham 1997).

It is easy to read the accounts of Bogard or Mike Davis and assume the easy emergence of completely integrated, all-seeing surveillance. Such accounts, however, tend to dramatically oversimplify the reality of technological innovation, which is a great deal more 'messy', difficult, contingent and open to contested interpretations and applications (Thrift 1996a; Bingham 1996). We therefore need to be wary of easy generalisation and deterministic readings of technological 'impacts', whether they be utopian or dystopian in character (Graham and Marvin 1996).

As recent debates in Actor Network Theory (ANT) have demonstrated, the construction of new technological networks (including surveillant-simulation systems) will always be an essentially performative, socio-technical process involving the enrolling of complex hybrids of social and technical 'actors' across distance. This applies from the design of embedded algorithms, through the deployment and operation of telematics networks, to the ways in which such networks become involved in detailed changes of social practices. ANT provides a fully relational perspective which underlines the dangers of easy, deterministic generalisation. It is 'concerned with how all sorts of bits and pieces; bodies, machines, and buildings, as well as texts, are associated together in attempts to build order' (Bingham 1996: 32). Absolute spaces and times are meaningless here. Agency is a purely relational process.

Because of the ways they become linked into specific social contexts by human agency, technologies have contingent and diverse effects (see Collins 1995). Thus, what Pile and Thrift (1996: 37) call a 'vivid, moving, contingent and open-ended cosmology' emerges. The boundaries between humans and machines become ever-more blurred, permeable and cyborgian. And 'nothing *means* outside of its relations: it makes no more sense to talk of a 'machine' in general than it does to talk of a 'human' in general' (Bingham 1996: 17).

The importance of ANT is its implication that 'no technology is ever found working in splendid isolation as though it is the central node in the social universe. It is linked – by the social purposes to which it is put – to humans and other technologies of different kinds. It is linked to a chain of different activities involving other technologies. And it is heavily contextualised' (Thrift 1996a: 1468). The lesson of ANT is therefore that if we are to understand the virtual geographies of surveillant simulation we need to balance our macro, political-economic treatments with much finer-grained, micro-level treatments of how such technologies are socially constructed and their 'effects' contingent on social practice (Graham and Marvin 1996; Graham 1998b). A good example of this comes from CCTV. Far from being a technologically-determined process, Norris and Armstrong (1997: 4) have shown how the uses of urban CCTV are currently 'contingent on a whole range of social processes: whether the screens are being monitored, and if they are whether an incident is seen and then recognised as deviant; if it is seen, whether it produces a response and the nature of that response'.

The complex social appropriation of telematics also means that the same technologies can be constructed and appropriated differently by different interests, in different contexts and with varying results. Surveillant-simulation techniques might support resistance and transgression, as well as social control and regressive urban restructuring. Thus, community groups and activists might utilise GIS technologies to bolster their lobbying for improved services in their spaces. Ramasubramanian (1996), for example, outlines how GIS techniques were used in Milwaukee to prove that an insurance firm was effectively red-lining African-American census tracts in the city (itself using GIS techniques). And mass access to CCTV and video systems may actually help to make the exercise of public power more accountable on city streets (complementing, of course, the increasingly automated and algorithmic systems likely to be used by crime control agencies). Kevin Robins (1996: 139) suggests that, with the mass diffusion of consumer video, 'the city now constitutes a mosaic of micro-visions and micro-visibilities. With the camcording of the city we have the fragmentation and devolution of vision-as-control to the individual level.' Thus, attention needs to centre on the complex, ambivalent relations surrounding surveillant-simulation techniques and the many subjectivities they may represent – whilst, *at the same time*, being sensitive to the definite macro-level biases which still tend, overall, to shape their design, deployment and operation.

Virtual geographies/economic geographies

Finally, it is important that we consider how surveillant-simulation techniques become implicated in the elaboration and construction of new material geographies of employment, urbanisation, flow and development. Three points arise here. First, the proliferation of surveillance systems is about much more than flows of representations; the construction of virtualities and simulacra; of mechanisms for fine-grained control; of cybernetic processes of automation; and of community activism. It also fuels some of the fastest growing economic sectors of the 'information economy', with very different trajectories emerging for different places within informational divisions of labour (see Graham and Marvin 1996: ch. 5; Hepworth 1989).

Second, the economic flows and labour processes surrounding the growth of surveillant-simulation systems seem to accelerate the processes noted by Castells (1989, 1996), through which economic processes become more 'disembedded' from the physical and social landscapes which are their focus, operating instead through some telemediated 'space of flows' within 'Network Societies'. Thus, data warehousing and consumer marketing industries generate huge demands for sophisticated 'switched in' office space, located in places with good labour supplies, public subsidies and adequate transport, telecommunications and property infrastructures. Such back office, telesales and data processing zones tend to locate far from the main urban cores in lower-cost suburban, rural or even 'Third World'/Newly Industrialising spaces (Graham and Marvin 1996). The customer support infrastructures for utilities, telecommunications and transport firms now routinely operate on-line from cheap, distant, automated call centres far from the territorial 'patches' covered by their physical infrastructures. Customers ringing London Electricity, for example, are dealt with 250 miles north of London, in Sunderland. Lower level and routinised data processing functions may even be out-sourced to even more dispersed locations, employing (largely female) staff on pay per keystroke wages, sometimes in their own homes but more often within back office districts in peripheral cities like Milwaukee and Newcastle (Richardson 1994). Theoretically, flows of images from CCTV systems can now also be easily switched over broadband networks to cheap labour locations. The World Bank has seriously suggested that the CCTV systems covering US malls should be monitored in Africa to take advantage of low wage costs and offer 'developmental' benefits to the continent (Bannister 1994). Ironically, all these work processes employ their own surveillant-simulation techniques to support worker discipline and performance

Finally, though, higher value-added software industries which shape surveillant-simulation products and techniques require ongoing face-to-face innovation and the high level, multifaceted infrastructure and services of large, core, metropolitan regions. Such industries tend to cluster in creative 'information districts', either in campus-like sprawls around major metropolitan areas (as in the case of Silicon Valley) or, as with multimedia design, in gentrified inner districts in older urban cores (as with Trebica in New York and Soho in London – Castells and Hall 1994). Each, of course, also links into its own global geometries of flow by tying in high-level support personnel in newly industrialising, high skill nations like India (Castells 1996).

Conclusion

From this discussion three challenges for 'virtual geographers' become fairly clear. They must develop perspectives which can analyse how broad, interacting technological systems help reconfigure virtual and material geographies. They must balance notions of wide-scale, macro-level biases in technological development with analytical approaches which accommodate the contingency of social action. And they need to maintain holistic perspectives which don't over-privilege the 'social', the 'economic' or the 'cultural', but rather allow the multidimensional nature of virtual geographies to be unpacked and explored (see Lee and Wills 1997).

Note

A more extensive and detailed discussion of surveillant simulation, including more examples, and a broader theoretical discussion, can be found in Graham, S. (1998b) 'The spaces of surveillant-simulation: New technologies, digital representations, and material geographies', in *Environment and Planning D: Society and Space* (forthcoming).