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A Geography of the Eye: The Technologies of Virtual Reality

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Prologue

The current wave of interest in the phenomenon of cyberspace is heightened by promoters describing it as a new frontier, one open to exploration as well as colonization. Within the academy, and often just barely removed from the commercial hype, it has been conceived as 'a globally networked, computer-sustained, computer-accessed, multi-dimensional, artificial or "virtual" reality' (Benedikt 1992: 122). To date, no single technology or machine circumscribes this emerging technology/medium of virtual reality (VR) – a term confusingly interchanged with cyberspace but here understood as the technical means of access to the 'parallel', disembodied and increasingly networked visual 'world' named cyberspace. An increasing variety of virtual technologies offers windows on to this cyberspatial environment that also has been defined as one in which the user feels *present* (Biocca 1992a: 6), yet where things have no physical form and are composed of electronic data bits and particles of light.

Do cyberspace and VR have a *moment* of invention, do they represent a decisive break that sets them apart from TV and telephony from which they are partly cobbled, imagined and extended? Where might an account of the cultural trajectory informing the electro-mechanics of VR arbitrarily begin, given that much of the 'buzz' surrounding it is concerned with asserting its novelty, thereby to author and secure its future, rather than acknowledging a past? Much interesting writing about cyberspace and VR assumes the technology as a given. However, it is useful to examine the human agency that makes this technology possible. What follows is an attempt to do so, a narrative informed by three assumptions, first, that the technology represents an instance of an ongoing (Western) motivation to alter conceptions of space; second, that its development is inflected by a desire on the part of a disembodied, alienated subjectivity for transcendence

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of bodily limits; and third, that this cybernetically achieved transcendence – as reflected in the 1980s cyberpunk desire to leave the body or 'meat' behind and float as pure data in cyberspace – is also a vehicle for merging a hyper-individuated modern consciousness into a larger whole.[1]

My decision to treat VR as a machine to realize such desires for bodily transcendence (see note 12) is not intended to promote any particular metaphysics, though I do believe that many current materialist analyses of the technology miss the mark in failing to address the importance of metaphysics to virtual consumers. Though military advantage, followed closely by global financial and data services, drives VR's invention, appeals to metaphysics, however subtle, remain important in promoting the technology. Such appeals would fail if they did not tap a pervasive cultural longing. Key VR inventors themselves evince various aspects of this yearning – often cloaked in a belief in progress. Geographer Eric Sheppard (1993: 4, 12) finds that no single path determines technological development; information technologies are composed not only of machinery but also of the institutional and intellectual infrastructures that invent, deliver and package them. What follows tries to keep Sheppard's caveat in mind. I offer a necessarily selective and critical review. I agree with David Depew (1985) that history is criticism. A narrative history of VR is somewhat ironic given the technology's tendency to foreclose narrative/time in favour of spectacle/space, a consideration taken up in the discussion of science fiction below.

The roots of yearning for a virtual world are anchored by an ongoing Western belief in vision as the most noble organ and sensual metaphor for *extending* understanding. This belief has helped set the stage for an emblematic virtual world of visual language that promises 'transcendence' and affectivity in images, something denied us to date by our physical embodiment. Imaginary transcendence is made more desirable by a rational/empirical system of belief and knowledge organization that denies holism between mind and body, one in which mind centres meaning, and partitions itself from the body, which is then judged an artifact, hence worth superseding. At least since Descartes this dynamic has operated on an imaginative level. VR extends this in suggesting that surpassing bodily limits might now incorporate a spatial dimension.

The late medieval crisis of confidence and faith experienced by 'Europeans' following the débâcle of the Crusades helped ferment an intellectual re-evaluation of certain fundamental attitudes undergirding medieval Christian belief. Whereas if 'in the beginning was the Word', Samuel Edgerton (1975) suggests that a shift towards the privileging of vision as a metaphor for understanding/truth arose during this era, along with a demand for the development of a more powerful science of explanation and conquest of nature. As artifacts such as the Hereford and Ebstorf *Mappaemundi* (maps of the world) reveal, medievals possessed adequate vision, though it was arguably a more 'synaesthetic' or place-inflected one than is the case today (see Barfield 1977; Ong 1977). The purer form of

vision based on Euclidean geometric principles that Roger Bacon, for example, proposed, was intended to provide a less sensually cluttered access to Divine inspiration in face of loss by Crusaders to the Infidel, one interpreted by Christian thinkers as resulting from a failure of devotional technique and the subsequent 'faulty access' to God's instruction and command. Roger Bacon's *Opus Majus*, written during the 1260s, entreats papal authority to redirect intelligent Christian inquiry/entreaty in accord with a *visionary perspective*. Placing vision directly on an axis of truth, Bacon recommends elevating the status of geometry as a means of accessing

> the *ineffable* beauty of the divine wisdom . . . [so that] after the restoration of the New Jerusalem we should enter a larger house decorated with a fuller glory. Surely the mere vision perceptible to our sense would be . . . more beautiful since we should see in our presence the form of our truth, but most beautiful since aroused by the visible instruments we should rejoice in contemplating the spiritual and literal meaning of Scripture. (Edgerton 1975: 18; emphasis mine)

If Divine wisdom – the Word – was unspeakable, then perhaps mortals instead might elevate the status of Logos' *depiction*. Bacon seeks to meld geometry with vision. In a sense, the history of vision in western culture is a history of how sight has been colonized by mathematics and number. Geometry is a visual language. Bacon wishes to enhance vision with geometry to make it more Divine, but what he really is doing is breaking vision down into mathematics. Depicting God's Word more purely through use of representational geometric 'picture language' is an abstract activity inheriting much from a disembodying Platonic correspondence theory of truth. Only when seekers of knowledge emerge from Plato's Cave freed of their 'corporeal shackles' can they attain the lucid and ideal realm of 'active thought'. Then they may experience clear vision of real things only present to the 'mind's eye' (Heim 1993: 88).

Bacon was not the first to recognize the power of vision, as the exit from Plato's metaphoric Cave makes clear. In his *Metaphysics*, Aristotle had argued that '[Seeing], most of all the senses, makes us know and bring to light many differences between things' (Brenneman *et al.* 1982: 79). Ptolemy's *Geographia* – a culmination of this early (and quite modern) geographer's efforts to represent a systematized relationship between the different features of the earth – is evidence of a second-century AD optical understanding of the world, as are Al-Kindi's and Al-Hazen's theories of optics from the eighth and ninth centuries AD (see Lindberg 1976).

More recently, Heidegger notes that the propensity of visual perception is *curiosity* – a state of desiring inquisitiveness that may be contrasted to the more meditative state of *wonder*, and a trait of immense value, one becoming to the analytical, logical Western science that Bacon may be seen to call for, and one that later techniques such as Renaissance perspective painting appear to engage with and build upon, and which even today helps direct the 'shape' of virtual vision. Heidegger notes that, depending on emphasis in translation, *theoria* means either vision and/or truth, as in a

watching over truth (1977: 163–4). As VR theorist Frank Biocca makes clear, as a technology, VR,

> is being refined so that it comes closer and closer to optimally matching the parameters needed for powerful perceptual illusions in each sensory channel . . . [w]e live in a visual culture...when we want information, we '*look* into it' . . . it is not surprising that a significant part of virtual reality development has tried to create better illusions for our eyes. (1992b: 30–1)

Linguist Benjamin Whorf speaks directly to Roger Bacon's argument. 'It is as though European speech tries to make time and feelings visible, to constrain them to possess spatial dimensions that can be pointed to, if not measured' (Whorf 1952 cited in Tuan 1977: 393). Seeing is relatively objective. It does not involve the emotions deeply (Tuan 1974). One sees as an onlooker. Visual perception is more abstracted than the other senses. A conception of space, though not entirely reliant on the eye (one may imagine an acoustical space or the intimate environment of touch) nevertheless, in the West, is tied to vision. As Tuan notes, visual space is bounded and static, a frame or matrix for objects. Visual space is the farthest removed from our bodily sense and covers the largest 'area' experienced by any sense (Tuan 1977: 399). 'In particular, attendance to the purely visual region in the distance excludes awareness of the affective region [closer to the body]' (ibid.: 400). We gaze into a distant and open future. 'What is ahead is what is not yet – and beckons' (ibid.). This 'forward' direction of vision Tuan also detects in the 'space' of progress – a conceptual destination that, I would suggest, was sought by Bacon both in his need to put the Crusades débâcle 'behind' him and in his need for renewed spiritual 'direction'.

Bacon's papal correspondence is a call for what VR theorist and promoter Howard Rheingold (1991: 69) labels the age-old quest for 'intellectual augmentation'. However conceived, this enduring wish has called upon a variety of communications practices in its quest to take on greater meaning and form. Today this means telematics or information technology (IT) – the synthesis of telephony and digital computation. It can be argued that VR, by blending visual communication with mechanisms that allow human gestures to be read by machines, is part of this will towards intellectual augmentation, which in the West has been defined as a *good* since at least the time of Bacon, if not Plato. But if for Bacon, the beauty of Divine wisdom remained ineffable (and it should not be assumed he ever meant this beauty to be approximated in speech), VR proposes that the 'ambiguity of invisible meanings that attends audio speech [will be] replaced by the unambiguous topology of meanings beheld, [that] we will truly *see* what we mean' (McKenna 1991: 232). Reduction, McKenna seems to say, is revelation. Extrapolating from Heidegger's etymological distinction noted above, VR extends visual theory in the sense of extending the purview of truth-as-vision.

Bacon's thirteenth-century papal entreaty offers an arbitrary departure point for the progressive elevation of vision's status in the 'West' – an

elevation that sets the stage for the visually-referent communications technologies that follow.[2] At first these are print-based, alphabetic support for an individualized narrative of progressive selves. Yet in the (re)turn towards more iconic visual languages for the depiction of information, there is an echo of a pre-Baconian, medieval way of grasping reality. Both print-based and more purely visual 'languages' or 'picture writing' in which messages *seem* detached from words (see Bolter 1991: 46) depend on optics and the eye, yet picture writing's telematic manifestation may mark something of a return to a less linear, hence apparently more synaesthetic grasping of experiential reality. In order to achieve 'intellectual augmentation' virtually, VR proposes we merge with the object of our gaze that until now has kept us as modern subjects at its beck and call, alternatively enraging us to conquer it as an object or to worship it as God.

Early flight simulation and computation devices

Almost as soon as World War II began, the US government funded development of flight simulators. The research was difficult and time consuming, yielding truly successful results only in 1960, in time for the American space programme. Yet by 1940 it had already been more than a generation since the first major air accident had occurred in 1908 during a trial flight for the American War Department. Flight's power and danger made a training machine to safely simulate it desirable, and designs had been patented as early as 1910 (Woolley 1992: 42). In 1930 Edwin Link patented the Link trainer. In this early version, the pilot entered a mock-up cockpit equipped with controls through which a plane's pitch, roll and yaw could be mimicked. Link's machine, with its pneumatic devices and early hydraulic servomechanisms, was sufficiently evolved to imitate movements experienced in flight, as well as the sensation or force transmitted through physical contact with the joystick.

As Woolley recounts, during the 1930s the breakthrough research of Vannevar Bush had permitted the mechanization of differential equations that were to allow the mathematical modelling of flight. During World War II Link and others worked to physically reproduce Bush's mathematical model, and to marry the promise of Bush's differential analyser (an early analogue computer) to the basic physics of simulation. As applied to flight simulation, the initial challenge they addressed can be expressed as how the 'north–south' movement of the joystick could be integrated with its 'east–west' movement in such a way that moving the stick between any two compass directions would afford the trainee an adequate simulation of the resistance experienced by performing the actual motion in the air.

During this same period, designers improved the illusion of what a pilot might see from the 'cockpit's' windscreen. However, it required invention of the digital computer, born of the war's logic of necessity, with its ability to process the complex algorithms upon which the 'mechanics' of simulation rest, and at previously unimaginable speeds, to realize adequate simulation. ENIAC (Electronic Numerical Integrator and Computer), unveiled in 1946, had been developed at the University of Pennsylvania to process the complex ballistic tables required to predict missile and bomb trajectories. It was soon grasped that ENIAC might provide the advanced computation necessary for simulating flight – that digital computers might exemplify what mathematician Alan Turing called *universal machines*, ones where it would be 'unnecessary to design various new machines to do various computing processes' (Turing 1950: 441).

Vannevar Bush also theorized the personal computer but as a hypertextual extension of the individual self, and with a choice of words strikingly similar to the contemporary description of the human/machine interface called the cyborg. Bush's machine infects and enhances the body, and is predicated on the non-mechanical electrical dynamics of the body for its functionality. In a discussion entitled 'Memex instead of Index', Bush, director of Roosevelt's Office of Scientific Research and Development (Nelson 1972: 440), writes:

> Consider a future device for individual use, which is a sort of mechanized private file and library. *It needs a name*, and, to coin one at random, 'memex' will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. *It is an enlarged intimate supplement to his memory* . . .
>
> In the outside world, all forms of intelligence, whether of sound or sight, have been reduced to the form of varying currents in an electric current in order that they may be transmitted. Inside the human frame exactly the same sorts of processes occur. *Must we always transform to mechanical movements in order to proceed from one electrical phenomenon to another?* (1946: 32, emphases added)

In 1944 researchers at MIT's Servomechanisms Lab, using digital equipment similar to ENIAC, successfully demonstrated that a light-sensitive, hand-held wand-like detector, when pointed at a television-like screen adapted from radar technology, could select or 'highlight' individual bouncing dots pre-programmed to move like bouncing balls across this early version of a monitor. By applying the language of mathematics, these researchers had simulated people interacting with concrete things, thereby also blurring the distinctions between symbol and fact. The experiment had also demonstrated that human interactions with simulations were a possibility worth further investigation. The work of other researchers at this time (Bush 1946; Weiner 1948; Turing 1950) served to strengthen the idea that such human/machine interactivity creates 'an ambiguous boundary between humans and interactive "intelligent" machines' (Biocca 1992a: 8).

Inventions and cultural forces

VR theorist Myron Krueger remarks that the rapid evolution of the computer *vis-à-vis* earlier technologies – when contrasted with the *lack* of

evolution of the human form – led him to theorize 'that the ultimate interface between the computer and people would be to the human body and human sense' (1991: 19).

However, as alluded to above, the almost exponential enhancement in computing capacity from the early 1950s onwards – a key factor in making VR conceivable today – must be understood as part of a 'package' of ongoing cultural and technological changes. The manufacture of the stereoscopic display is a necessary development. Rheingold (1991: 64–6) suggests that Wheatstone's 1833 stereoscope forms the first link in a chain leading directly to today's head-mounted VR display units. The stereoscope and its modern entertainment and informational descendants such as the Viewmaster and stereoscopic photography are based on separate dual images, each depicting 'the same scene from slightly different perspectives corresponding to human interocular distance' (Rheingold 1991: 65). When these are presented separately to each eye, our visual sense merges the two views into a single 3-D scene.

Edwin Land's pioneering work with light-polarized lenses advanced the apparent cohesion of stereo images, and was necessary for the creation of colour 3-D film. Mid-1950s Hollywood features such as *Dial M for Murder* required viewers to don special lenses to perceive the hallucinatory effects provided in the Hitchcock film in which a pair of scissors that Ray Milland uses to threaten Grace Kelly seem to fly out from the screen to menace the audience too, disrupting the 'traditional' spatio-emotional relationship between viewer and screen. Though these experiments in three-dimensionality were cumbersome, and abandoned following the financially successful 1954 launch of wide-screen Cinemascope, the manner they conceive to technically manipulate the apparent spatial relationship between image representation and human perception in order to involve audiences more directly with the images before them is a direct conceptual progenitor of the computer-driven 'ultimate interface' Krueger describes.

During the same period, experiments in stimulating the nervous system with three-dimensional images, binaural sound and odour were conducted by entrepreneur inventor Morton Heilig. His 1956 'Sensorama Simulator', conceived as an entertainment (Krueger 1991: 66), and influenced by the heightened cinematic effects of the Cinerama process (an even more *wrap-around* competitor of Cinemascope, and which may be imagined as an individualistic precursor of the IMAX and IMAX/OMNIMAX installations at science parks and museums), offered the sensation of real experience through the multi-mediated use of 3-D images, sound and scent. In 1953 Heilig had suggested that:

> The screen will not fill only 5% of your visual field as the local movie screen does . . . or the 25% of Cinerama – but 100%. The screen will curve past the spectator's ears on both sides and beyond his sphere of vision above and below. In all the praise about the marvels of 'peripheral vision', no one has paused to state that the human eye has a vertical span of 150 degrees as well as a horizontal one of 180 degrees. . . . Glasses . . . will not be necessary. Electronic and optical means will be devised to create illusory depth without them. (Heilig 1992: 283)

Heilig anticipates cultural critic Mark Dery's observation that 'in virtual reality, the television swallows the viewer, headfirst' (1993: 6). He continued work on his concept, in 1960 patenting his 'Stereoscopic Television Apparatus for Individual Use', a 'head-mounted display that a person could wear like a pair of exceptionally bulky sunglasses' (Rheingold 1991: 58). Heilig's work in sensory immersion remained marginalized, in part because it was located within an entertainment milieu, in part because of lack of funds. VR theorist Brenda Laurel (1993) writes of the conceptual breakthrough realized by researchers at MIT's Media Lab, who in the late 1970s and early 1980s became aware of the qualitative difference induced when an individual sensorium was *surrounded* rather than, as with film/TV/video, facing a screen at a distance. She finds the vanishing *interface* that this implies, 'broke new ground in bringing our attention to the nature of the effects that immersion could induce' (1993: 204). Heilig had already been there. Perhaps unfortunately for him, at the wrong time and place.

Heilig's creativity notwithstanding, it is Ivan Sutherland who is credited with synthesizing directions in which the idea of simulation might lead (Krueger 1991; Woolley 1992; Biocca 1992a). Affiliated variously with MIT, the cybernetics think-tank at the University of Utah, and the federal Advance Research Projects Agency (ARPA) project, Sutherland's 1965 meditation on virtual affectivity – 'The ultimate display' – anticipates and informs subsequent VR research and development.

> A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland. . . . There is no reason why the objects displayed by a computer have to follow the ordinary rules of physical reality. . . . The ultimate display would . . . be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland in which Alice walked. (1965: 506–8)

It would seem that metaphors of violence and transcendence underpin VR from the moment of its conception.

New media are informed first by the technologies and conventions of the past. Sutherland writes that 'the force required to move a joystick could be computer controlled, just as the actuation force on the controls of a Link Trainer are changed to give the feel of a real airplane' (1965: 507). Here the 'father' of simulation models his ultimate display on flight simulation. This is not surprising, for Sutherland also founded Evans & Sutherland, a leading flight simulation company. Neither, given Sutherland's prestigious *vita* of computer science background and Defense Department support, should one be surprised that this publicity-shy individual is now called the 'father' of VR. Heilig's earlier and obscured entertainment-directed research previews the Nintendo-directed escapism of current VR arcade games such as 'Dactyl Nightmare'.[3] Though Sutherland's conceptual

Computers are intended to be virtual machines in this manner. My screen simulates the thoughts I set down, but in its logic predicated on abstract mathematics, there is no necessary reason, as Sutherland grasped early on, why it need only simulate the actual or the real.

Turing's 'universal machine' – a machine that can be many different machines, or 'none of the above' – is a first step in conceptualizing the electro-mechanical simulation of our selves, and one, I suggest, that is empowered by a Western belief that to take the measure of all things is to be all things. Representation supersedes reality because to achieve widespread recognition it must imply the universally coded standards and legal measures that also reliably undergird stable political organisms. Yet in the very naming of these devices and concepts – *ultimate* display, *universal* machine – a metaphysics suggests somehow having come to an end or an irreducible element. The stability of a particular form of social relations is naturalized or accorded timeless universality.

As early as 1962 Sutherland had developed 'Sketchpad', an interactive program that allowed a user holding a lightpen to make designs on a screen that then could be stored, retrieved and superimposed atop one another (Sutherland 1963; Rheingold 1991: 90). Sketchpad demonstrated that computers could be used for more than swift number crunching. It suggested they could introduce a new form of what might be called by some a 'truth situation', by others a 'power situation'. The lightpen 'drew'/transmitted the circle its holder first described with the arc of his or her bodily motion, and the computer simulated this action as a circular line onscreen. In a sense, the lightpen guided the human hand into (a conceptual integration with) the computer technology. If 'the ultimate display' was a prototype of VR hardware, the earlier Sketchpad provisionally inaugurated a conceptual pathway for inscribing what later would be seen on the stereoscopic TV sets within the 'display'. It did so by reading human motion. No substantive training was demanded of the user. Of Sutherland's contributions in this regard, pioneer computer and virtuality theorist Ted Nelson writes:

> You could draw a picture on the screen with the lightpen – and then file the picture away in the . . . memory . . . magnify and shrink the picture to a spectacular degree . . . Sketchpad . . . allowed room for human vagueness and judgement. . . . You could rearrange till you got what you wanted, no matter for what reason you wanted it . . . a new way of working and seeing was possible. The techniques of the computer screen are general and applicable to everything – but only if you can adapt your mind to thinking in terms of computer screens. (Nelson 1977: 120–3 as quoted in Rheingold 1991: 91)

Nelson notes that 'a new way of working and seeing was possible'. The claim of novelty can be partially challenged by noting that Sketchpad (or the mouse–screen–hand interface of a Macintosh computer) is only a sophisticated way to sketch and erase – what anyone reasonably skilled at drawing would do on paper. What does seem novel, as people who use graphics technologies with whom I have spoken attest, is that they allow/facilitate a disavowal/displacement of authorship/artisanship. Stated otherwise, users feel less anxiety about drawing on computer, as though one is not committing in the same way as one does on paper. The claim of novelty cannot be organized only around the technological mechanics of drawing (media as environment) – though the medium is different – but also around the process and relationships it engenders (media as language) that also may be thought of as effecting a shift away from a set of moral attitudes towards creativity partly reified by print technology. As N. Katherine Hayles notes, the body and the book are formed on a 'durable material substrate. Once encoding [on either] has taken place, it cannot easily be changed', and 'electronic media . . . receive and transmit signals but do not permanently store messages, books carry their information in their bodies' (1993: 73). I infer that Hayles makes certain assumptions about the specific materiality of paper, as well as of flesh, in her assertions.

Though innovations ranging from the computer mouse to such text-graphics applications as Hypertext generally are believed to be no older than their 1980s commercialization, it was during the early to mid-1960s that these computational advances were made at Douglas Englebart's ARPA-funded 'Augmentation Research Center' in California. With the mouse, 3-D gestural input becomes a command language for computers. In Hypertext, users perform 'automatic link-jumps' (Nelson 1972: 442) from one document to another by selecting specific icons on the screen. Collapsing and expansion of multiple onscreen cut-and-paste documents is made possible along with the use of text-enhancing graphic imagery. All of these functions imply virtual activity, and are precursive conceptual inventions that permit VR technologies. Ted Nelson has continued to defend and extend Vannevar Bush's original concept of hypertext and personal computing – the Memex – profiled above.

Rheingold notes that the direct manipulation interfaces, developed by Englebart and others at the Xerox Corporation's Palo Alto Research Center (XEROX PARC), remained relatively unutilized until Steve Jobs, Apple Computer's whiz-kid, toured this facility. If one seeks proof that Turing's 'ultimate machine' lies waiting to be discovered within the imagination, Jobs's popularization of computing through marrying algorithmic power to graphic interfaces offers fair example. Since the first Apples were marketed in 1984, applications have proliferated. These software packages are instances of the machine within a machine. They trade on the power released in the merge between computation and the graphics programs computation makes possible.

The cluster of scientists working at XEROX PARC exemplifies a partial shift from military to civilian-business research that had resulted from the Mansfield amendment drafted during the Vietnam war. This legislation sought to limit ARPA funding to weapons-related research, yet in causing certain scientists to leave ARPA-funded labs, it stimulated the invention of personal computing on the part of those who disagreed with US foreign policy orientation (Rheingold 1991: 85).

genius should in no way be minimized for its contribution to making cyberspace conceivable, military support for his work must be recognized, particularly following the surprise of Sputnik in 1957, and the 1958 American response both in the formation of ARPA, with its mission to synthesize technological superiority and computational abilities (Brand 1987: 162), and in the space agency NASA. Heilig's self-funded work had inverted the 'commonsense' temporally determined hierarchy often thought to exist between military-industrial invention and later socially diverting entertainment spin-offs.

Sutherland's 1968 paper 'A head-mounted three dimensional display' accompanied the 3-D head-mounted computer graphics display he constructed at the MIT Draper Lab in Cambridge MA (Stone 1992a: 95), 'that allowed a person to look around in a graphic room by simply turning their head. Two small CRTs (cathode-ray tubes) driven by vector graphics generators provided the appropriate stereo view for each eye' (Krueger 1991: 19). Financed by ARPA, the Office of Naval Research and Bell Labs, the display marked a step in realizing the vision Sutherland had expressed in the 1965 paper 'The ultimate display'. 'Our objective . . . has been to surround the user with displayed three-dimensional information . . . objects displayed appear to hang in the space all around the user' (Sutherland 1968: 757).

In resorting to a head-mounted display Sutherland and Heilig sought to overcome human perceptual awareness of certain technical limitations of conventional film and TV that necessitate retention of distance between these technologies and viewers. The two men build on earlier stereoscopic research designed to foster an illusion of three-dimensionality. Without stereoscopy, each eye would see the same scene, which would appear flat, like a painting, instead of reflecting our more 'curved' sense of vision made available via the slightly different perspective 'take' that we receive through each eye from the ambient world around us. As well, when we move our bodies in the physical world, our point of view alters. As of yet, this is restricted within these virtual media. Biocca notes, 'we are not inside the space of the video image, only the camera is. We are spectators, not actors' (1992b: 32). It should be noted that Biocca's distinction ironically parallels the distinction made by human geographers between the 'inside' position of an individual experientially 'in place' and an 'outsider' who consumes/views a landscape composed by its frame (Cosgrove 1984). Extrapolating from Biocca, only the camera as metaphor for the eye freed from the body is at home *in* the image. Yet Biocca fails to address what happens imaginatively when the 'space of distance' between viewer and technology is collapsed. Though the conceptual world of cameras and images remains empirically distinct from the viewer's perception of same, the literal collapsing of space between the viewer and immersive technology may also facilitate a key goal of VR: the merger of spectator/camera and actor/viewer.

The introduction of head-mounted displays altered the perceptually

defined relationship Biocca notes between spectators and image/scene (or landscape). By means of a tracking device connected to a computer, binocular vision and motion cues now could be generated and continually adjusted to provide the sense of parallax that is one of the sensed 'truths' or biases of our vision. Still, because of the physical weight of its auxiliary technologies, Sutherland's original display had to be suspended from above (Biocca 1992b: 37). Neither could it yet provide a truly emotionally real sense of the *surround environment* which was its inventor's main goal. Two tiny TV screens covered each eye of the participant donning the display and offered the viewer a stereoscopic computer-generated picture. Tracking sensors monitored individual position and movement in a kind of reverse application on to the body of flight simulation technology's replications. Sutherland's intention was to make the objects in the computer-generated space accessed via the TV screens not only visible but tangible. He reasoned that the application of geometrical laws to reproduce size and shape could be extended to the application of physical laws to reproduce qualities such as mass and texture (Sutherland 1968; Woolley 1992: 55). The programming that lay behind the sense of resistance experienced through manipulation of a flight simulator's joystick could be applied to simulate the sensation of pushing and weight; in other words, the rudiments of touch.

Other than flight simulation and momentary stimulation and novelty, how were subsequent plausible uses for this proto-technology first conceived? A slight digression permits making a link between Turing's (computing) 'universal machine', how Turing's machine is applied, and Sutherland's 'ultimate display'. The latter exemplifies an aspect of Turing's 'machine' – a concept depending on deductive, Aristotelian logic to solve mathematical problems (Sheppard 1993: 3), and originating in a philosophy of mathematics associated with the symbolic logic advanced by Alfred North Whitehead and Bertrand Russell (see Bolter 1984: ch.5).[4] Turing's abstract, immaterial machine is 'a machine that can be lots of different machines' (Woolley 1992: 67). When personal computers were first developed in the early 1970s their eventual poly-utility, except for certain thinkers such as Sutherland and Ted Nelson (1973), was unsuspected, Bush's and Turing's prescient remarks notwithstanding or forgotten. Many 'machines' reside within the PC, itself devolved from the more powerful forms of computation it has subsequently absorbed and displaced. Today the machine that processed the words you read on this page might, in another setting, have helped design a building, provided access to geographically distant information, or maintained the files and financial accounts of a commercial establishment. Such a comment is now commonplace. The personal computer can exist on its own or as networked into a communications matrix. But the PC can also be understood as an aspect of an abstract process of mind that has found physical expression. Bolter defines a Turing machine in this way: '[b]y making a machine think as a man, man recreates himself, defines himself as a machine' (1984: 13).

However, ongoing R&D within the academy by others willing to accept the restrictions placed on ARPA disbursements remains central to this story. During the early 1970s the University of North Carolina (UNC) emerged as a major centre in VR research, specializing in medical and molecular modelling, and architectural walk-through or computer-aided design (CAD). The first graphic manipulator was created there. When its user moved a mechanical manipulator in the lab, a graphic manipulator onscreen also moved. If this onscreen image was used to 'pick up' another object represented on screen, the user felt its weight and resistance as well (Krueger 1991: 19). In the late 1980s the Human Interface Technology Lab was started at the University of Washington in Seattle (UW-S). The connection with Boeing serves to underscore VR's continuing links with flight simulation.

Contemporary VR research occurs within a complex and intertwined hybrid of profit-driven private consortia such as Autodesk or Apple; entrepreneurial activity that circulates between quasi-military facilities such as NASA's Ames Human Factors Research Division at Mountain View, California; and schools such as MIT, Carnegie-Mellon, Stanford, USC, UC Berkeley, UNC and UW-S. The move away from military applications in the 1970s is relevant, but NASA remains the engine of much research initiated by radicalized scientists who withdrew from the military orbit during the 1960s. The contemporary space programme has clear military implications. In passing, it is worth noting that NASA's mission has always assumed a taking leave of the earth. Accessing cyberspace – a 'place' no less predicated on conceptually leaving the 'space' of this earth than 'cosmic' space flight – seems poetically congruent with NASA's broader 'mission'.

Inter-bureaucratic rivalry also plays a role. Since the late 1970s, it has been the US Air Force, specifically the Wright-Patterson Base near Dayton, Ohio, that has spearheaded head-mounted display design. Directed by Tom Furness, a series of heavily funded projects into human perception and optics led to the development of visual displays far more sophisticated than any currently in commercial usage (Krueger 1991: xiv) and which form the basis for the VR guidance systems used in the American air war upon Iraq.[5] Wright-Patterson's placing of a million-dollar price tag as the cost of one of these displays in response to a request from NASA's Ames facility for a share in the technology spurred the less financially endowed Ames operation to devise its own display from existing technologies such as flat-screen CRTs. But NASA since has gone much further than duplicating a head-mounted display on the cheap. The DataGlove™ – originally acquired from the private company VPL (Virtual Products Limited) which subsequently re-engineered its usage for video games (Krueger 1991: xvi) – and full-body input devices developed by a consortium of Ames and its subcontractors more fully integrate the human form into virtual space than the earlier airforce head-mounted displays. The sophisticated precision of the virtual war games technology the airforce has since developed, one that has borrowed heavily from NASA's lead, illustrates the continuing synergistic effects generated by this tax-funded competition between state agencies, healthy or otherwise.

Visual perception theorist James Gibson (*The Perception of the Visual World*, 1950; *The Senses Considered as Perceptual Systems*, 1966) asserts that how we navigate our 3-D world and handle things within it shapes our vision and how we see the world (in particular, Gibson 1966: ch.13). Scientists at Ames were intrigued by his cognitive theories, and sought applications. The DataGlove™ that manipulated a virtual object in cyberspace simulated Gibson's belief that we literally grab on to our world and make it part of our experience. The extension of the user's virtual arm and hand into cyberspace was theorized as allowing for a kind of mapping of the dimensions of the virtual world on to internal human perception structuring processes. Such a connection forms the basis of *telepresence* – 'experience of presence in an environment by means of a communications medium' (Steuer 1992: 76) – which is computational power in abundance that allows the robot or hand (the virtual body and/or its parts in cyberspace is sometimes called a *puppet*) to serve as the servo-body of the person wearing the wrap-around sensing mechanisms. The link between the human body and the robot is informational; remote control is at hand. The entertaining and transcendent possibilities of telepresence notwithstanding, this emerging technology is thought to be central to the engineering of a space station constructed by semi-autonomous robots (ibid. 1991). But perhaps something more important is also at work here. This is the coming to be of a view that the body itself is only informational – a kind of reduction implied in Michael Heim's description of cyberspace as Platonism as a working product, one where 'the dream of perfect FORMS becomes the dream of inFORMation' (1993: 89). I would note that *information* is a series of rules and routines useful insofar as capable of being acted *upon*. Body-as-information equates with a formula by which contingency and surprise, wisdom and judgement have all been explained away.

Writing about the links between text, body and VR, N. Katherine Hayles notes that people 'have something to lose if they are regarded solely as informational patterns, namely the resistant materiality that . . . has marked the experience of living as embodied creatures' (1993: 73). Though she notes the potential for loss, she also observes that the interactions between people and these machines increasingly are based on exactly this kind of reductive patterning that would have bodies materially correspond to sets of signals.

> 'Functionality' is a term used by virtual reality technologists to describe the communication modes that are active in a computer–human interface. If the user wears a DataGlove, for example, hand motions constitute one functionality. . . . Functionalities work in both directions . . . they both describe the computer's capabilities and also indicate how the user's sensory-motor apparatus is being

> trained to accommodate the computer's responses. Working with a VR simulation, the user learns to move her hand in stylized gestures that the computer can accommodate. In the process, changes take place in the neural configuration of the user's brain, some of which can be long-lasting. The computer molds the human even as the human builds the computer. (1993: 73)

Mapping the virtual world on to human perception, and linking text, body and VR, are two ways of describing what also may be stated otherwise. Though VR may well afford simulated access to a virtual and digitized community of representations – arguably a 'global public sphere' achieved at the loss of embeddedness and context – given the individuated manner in which the technology is being developed and will be accessed, the conflation between the conception it affords the user and this user's own perceptivity needs to be acknowledged and theorized. Extending Heilig's Sensorama in surrounding the user's vision, the frame of earlier visual technologies, from landscape painting to TV, recedes from view and with it a degree of awareness of our separation from the machine. Positioning the machine and user in close spatial proximity allows the latter's active perception to collapse into the active conceptions contained within the technology. Part of an emerging 'informational imperialism', immersive technology suggests that the conceptions it proposes are at one with the user's perception, thereby suggesting that the subject's independence is a fiction.

Like a braided desert stream whose channels rejoin downslope, it is at NASA that the majority of the developments and institutional players noted above are brought together. Unlike many universities, NASA thrives on a kind of backdoor publicity (Rheingold 1991; Stone 1992a) and many of the writers most involved in popularizing VR were permitted their first glimpse of cyberspace after hours or via a friend at Ames.[6] Not only has beleaguered NASA taken care to make known in a way beneficial to its interests the cutting edge of its research, it has done so in a way that encourages the use of VR by medical and educational professionals. NASA's relatively open sharing of intellectual property (compared to the airforce) is asserted to be for everyone's benefit.[7] A recent example will suffice. Time lag remains a problem for VR. Overcoming its effects virtually, as with film, depends on presenting framed snippets of reality at such a speed that they blend into the illusion of realistic motion. But within VR the coordinates of the depicted space have to be recomputed each time a frame is changed, every thirtieth of a second. The demands of reality create a bottleneck for VR. NASA's cooperation with freelancers and other industry players has meant that even what appear to be the most farfetched experimental computer architectures receive support from NASA, for perhaps it will be an employee at a small software design company, for example, who will make the significant conceptual breakthrough in computational logic. Current international private sector research on transputers, much of it British, partly sponsored by NASA,

may succeed in refining such computer architectures, so that they become capable of juggling the vast ocean of data bits required to synthesize eye–hand real-time coordination in cyberspace at sufficient speeds to overcome the disorienting and reflexivity-inducing perception of time lag, an experience within which the user's ironic subjectivity may still be found.

The space of science fiction

The advances in computation noted above form a pool of techniques from which VR technologies can draw, select, refine and redeploy. What of the so-called entertainment dimension of virtual technologies? In its ties with the Western quest for transcendence, whether this be an out-of-body or off-the-planet experience, this facet equally sustains the will to develop VR, and is set forth most eloquently in the pages of science fiction (SF). It might seem ironic that much of the impetus for popularizing virtuality originates in print form. But it might equally be argued that, ih a spatial fashion, the novel also echoes Turing's ultimate machine;[8] it remains a virtual form until we give it meaning and intentionality.

In his fascinating study of the interplay of the production of SF, postmodern academic theory and virtual technologies, Scott Bukatman (1993) has coined the term Terminal Identity to refer to the birth of a new subjectivity at the interface of the body and the TV/computer screen. Within technology's increasing pervasion of concepts of the self, Bukatman identifies a growing belief that (hyper) individualism can merge with virtual technologies yet current notions of humanity somehow be retained. Bukatman asserts that narrative form now gives way to spatialized concerns that engage our fixation with the distances, and proximities between embodied humanity and the electronic machines invented to facilitate an interpenetration of individuated subjectivity and global capital flows.

SF addresses how these technologies inflect our being in the world, constructing 'a space of accommodation to an intensely technological existence' (Bukatman 1993: 10). Replacing modernist visionaries such as Vannevar Bush, SF is now the prescient mind that has first plausibly imagined the virtual world now under contract to be built. As the Holodeck on the starship Enterprise in *Star Trek – The Next Generation* discloses, as a cultural technology SF fosters the belief that technology might now offer humanity a 'wrap-around' alternative space to the present reality of embodied existence. SF has always been an ideological narrative or 'discourse'. Its constructed visions and overt use of metaphors of space in its descriptions of power relationships are segues into the contemporary 'geographic imagination' and part of the apparatus facilitating technology's social acceptance.

Both Bukatman and Hayles argue that contemporary SF has turned away from an earlier interest in utopian futures and antipathy towards

technology as the 'other'. They also note its discarding of narrative in advancing the history of any one protagonist from one place within the novel to the next. Narrative histories are set aside in a turning to techniques that feature description of the merger of people and their technologized worlds.[9] As Hayles writes, the new science fiction is so successful because it is honest to its thematic. The novels 'embody within their techniques the assumptions expressed explicitly in [their] themes' (1993: 84). Such an authorial move could only be possible when '[t]he posthuman is experienced as an everyday lived reality as well as an intellectual proposition' (ibid.).

Heidegger's extended essay on the development of 'World Picture' (1977) traces a Western belief that the world is best understood as if it were a picture. A picture such as a landscape painting relies on the technique of a bounded representative space closed to what our lived world might disclose. In accepting technique as a defining metaphor for the world we are reduced to being only agents – Men at Work – oblivious to our surroundings and what they might tell us. However plausible SF might seem, it is a variation of 'world picture', a construct. To choose to model VR on SF is to conceptualize a concept based on an earlier concept. This may well be imaginative and creative but also implies a feedback loop shut to exterior influence. The merger of people with their technologies is a merger of people into concept. The 'posthuman' has dispensed with the non-formulaic body in favour of codes, languages and cultural productions – a contemporary and less hopeful reformulation of the story of Exodus as a flight from the 'oppressive limits' of the body, and redemptive deliverance into the promised 'land' of dataspace – or its more unworldly eventuality that the body would have died and gone to heaven, the self remembering, in this extended return, that in the beginning was the WORD.

In the case of William Gibson's *Neuromancer* (1984), a sci-fi vision revealed in text format offered researchers following in the footsteps of Sutherland *et al.* a framework for further imagining the virtual world gridded within the 'ultimate display'. Peter Fitting writes that, 'Gibson's cyberspace is an image of a way of making the abstract and unseen comprehensible, a visualization of the notion of cognitive mapping' (1991: 311). It is hard to overstate the impact of this book. Scarcely a thing written about VR neglects to pay it homage. Allucquere Rosanne Stone, one of the most considered of academic theorists writing about VR, argues that this novel demarcates the boundary between an information technology epoch extending from the 1960s until the book's publication, and the virtual reality and cyberspace epoch that ensues (1992a: 95). She believes this one novel

> reached the technologically literate and socially disaffected who were searching for social forms that could transform the fragmented anomie that characterized life in Silicon Valley and all electronic industrial ghettos. In a single stroke, Gibson's powerful vision provided for them the imaginal public sphere and refigured discursive community that established the grounding for a new kind of social interaction. (1992a: 95)

Earlier I noted the movement and fluidity of personnel within the field of VR research. Stone argues that the widespread background anxiety this had promoted within the VR research community created a need that *Neuromancer* filled. In delivering to this spatially fragmented community – defined as much by e-mail, bulletin board services (BBSs), and the Internet as by any face-to-face geography[10] – a plausible future, based on the dynamics within which researchers themselves were located, the novel gave voice to a virtual community identity which was in turn to suggest broad new avenues of research.

> The critical importance of Gibson's book was partly due to the way that it triggered a conceptual revolution among the scattered workers who had been doing virtual reality research for years: As task groups coalesced and dissolved, as the fortunes of companies and projects and laboratories rose and fell, the existence of Gibson's novel and the technological and social imaginary that it articulated enabled the researchers in virtual reality – or, under the new dispensation, cyberspace – to recognize and organize themselves as a community. (Stone 1992a: 99)

Hayles's identification of two literary innovations deployed in *Neuromancer* can be read against Stone's thesis about the novel's appeal to spatially isolated hackers. Hayles finds these innovations, 'allow subjectivity . . . to be articulated together with abstract data' (1993: 82). The first – 'pov' for point of view – is the mechanism by which individual consciousness, in the novel, 'moves *through* the screen to become the pov, leaving behind the body as an unoccupied shell. In cyberspace point of view does not emanate from the character; rather the pov literally *is* the character' (ibid.: 83). Cyberspace is the data landscape in which the pov can take place. Awareness is joined to data, the latter are thereby humanized, subjectivity computerized, 'allowing them to join in a symbiotic union' (ibid.: 84).

The alteration of spatial relationships between viewers and what they see reflects parallel changes in technology. With live theatre the viewer remains at a distance from the action on stage, a distance traditionally reinforced by the proscenium. She places or situates herself imaginatively within one of the characters performing, yet a critical distance of subjectivity is maintained within this temporary spatial relationship. Cinema effects a more extensive projection of subjectivity and augments a subjective narcissism in suggesting that our self-interest may more fully lie elsewhere than the body's spatial coordinates.[11] With VR the vestige of distance is collapsed into the emblematic and representational space occupied by the pov, a space that is both landscape and subjectivity. The *frisson* of transcendence and pleasure of virtual control over a pre-defined world notwithstanding, an entirely informational, hence commodifiable representation of the self is made available for corporate and individual *use*. Along the way the self has become 'other' even to itself.

Earlier in this chapter, I critiqued Terence McKenna's reduction of

sensual experience to the visual. The Californian sage of psychedelics and virtuality offers a most succinct and ahistoric understanding of the move from narrative to virtual spectacle and its potential impact on the modern subject.

> A world of visible language is a world where the individual doesn't really exist in the same way that the print-created world sanctions what we call 'point of view.' That's really what an ego is: it's a consistently defined point of view within a context of narrative. Well, if you replace the idea that life is a narrative with the idea that life is a vision, then you displace the linear progression of events. I think this is technically within reach. (cited in Rushkoff 1994: 58)

It is in *Neuromancer* that 'cyberspace' – the novel's second innovation, according to Hayles, and the immaterial space that sets the stage for the places within which the vision McKenna seeks would be played out – is first depicted. The novel also debuts Gibson's now-famous 'consensual hallucination' (1984: 51) as one aspect of highly mediated social relations taking place in an intensely corporatized world predicated upon overwhelming inequality and punctuated by a series of altercations among humans, human-machines and machines that occur in material and virtual reality. The most cursory scan of writings on VR makes clear that this concept has been latched on to with an astonishing, almost feverish tenacity, and that within the American VR community at least, that consensuality has come to be equated summarily with equality. It is intriguing that so widely excerpted a concept has been so wrenched from the context in which it was located, for though the term is indeed employed, it refers to some kind of polymorphous freedom not for individuals but for *data*: 'cyberspace . . . a consensual hallucination experienced daily by billions of legitimate operators . . . by children being taught mathematical concepts . . . a graphic representation of data abstracted from the banks of every computer in the human system' (ibid. 1984: 51). For Fitting (1991: 302–3), consensual hallucination is the novel's most striking concept, and it is here that the disappearance of direct, unmediated experience is, as Hayles suggests, demonstrated, even darkly celebrated. For a consensual hallucination is always a mediated one, never ethically experienced face to face. It is also one where the tension between positive and negative uses of technology has dissolved, along with the meaning of distinguishing between human and non-human – a duality already threatened in 1962 with respect to human/computer interactions following the unveiling of Sutherland's Sketchpad.

There is also a larger-scale dissolution of distinctions at play here and it touches on the already noted shift from narrative to spectacle under way in SF. Narrative has been a requisite artifact in the construction of the modern nation-state (Hobsbawm 1990; Anderson 1991). In a post-national infomatics, narrative gets in the way of data, and cyberspace becomes both the new spatial metaphor and actual location of global power – one for which any isolated junkie might consider giving up their body in exchange for wired, fibre-optical entry and communion 'therein'.

Suggesting that science can inform fiction, as well as the other way around, Benjamin Woolley argues that Gibson extended Sutherland's 'looking glass into a mathematical wonderland' to the entirety of information. 'With cyberspace as I describe it you can literally wrap yourself in media and not have to see what's really going on around you' (W. Gibson, cited in Woolley 1992: 122).

It is intriguing that although this novel has been taken up as a kind of holy grail justifying the bionic makeover of people into cyborgs – machine/human syntheses – there is a general (though not complete) failure to note a broader thematic at work. While the premise of the text has been interpreted as a radically dystopian consumerist future where 'perception and experience are similarly contaminated' and paralleled with 'remarkable new technologies and commodities [that] exist alongside the shabby and outmoded products they have replaced' (Fitting 1991: 301–3), I find that it is Gibson's detailing of the exponential mutation of two giant corporate AIs (Artificial Intelligences) into Gods which centres the real action. In traditional humanist sci-fi such a change always is associated with a monster (technology = evil other), based I would suggest on a dynamic similar to Bruce Mazlish's (1967) understanding of Frankenstein's monster as technology spurned. It then comes to pass that the humans must fight it and whether they win or lose, the battle between self and other is the primary moral locus that occludes any possibility of interchangeability between the two. Similarly, earlier research on Artificial Intelligence was predicated on *replacing* human faculties, a concept now largely superseded by what Heim (1993) identifies as a cultural theorizing of (personal) computers as *components* of our identity – a notion entirely consonant with the now trendy cyborg.

In *Neuromancer*, the 'heroes', dimly aware that they play and live within a society where embodied human integrity and history are *passé*, battle against establishment forces in order to allow this mutation to take place. The eventual fusion of the two AIs is a meta-joining of both sides of a capitalist cybernetic brain by an evolved fibre-optic *corpus callosum*. Technology may be seen to use its creators here to attain the state of union only it has been existentially capable of imagining, thereby to achieve a kind of returning. But this time the God is not the imaginary and therefore absolute and naturalized technology of older religious belief, but a systematic technology that humans have loved and set free. Paul Virilio (1994) points to this in noting that all technologies converge towards a *deux ex machina*. '[T]echnologies have negated the transcendental God in order to invent the machine-God. However, these two gods raise similar questions.'

Gibson's AIs mutate into something unintended – 'a vast mind engulfing the whole of the Matrix. A god for Cyberspace' (Grant 1990: 47). If there is merit to Larry McCaffery's assertion that postmodernism is a condition that 'derives its unique status above all from technological change' (1991: 3), then as Grant argues, '[i]f technology is to be our method of

transcendence, Gibson seems to be saying, we should not be surprised to discover that our technology might have a greater potentiality for transcendence than we do' (1990: 47).

A less charitable, more materially-rooted understanding of the human–machine relations influenced by Western physics and technology is offered by Lewis Mumford. 'Machines – and machines alone – completely met the requirements of the new scientific method and *point of view*: they fulfilled the definition of "reality" far more perfectly than living organisms' (1934: 51; emphasis mine).

Neuromancer suggests that transcendence is to be achieved by machinic and virtual means. This argument is given weight by the novel's assumption that the human body is 'meat' – 'obsolete, as soon as consciousness itself can be uploaded into the network' (Stone 1992a: 113). In the aftermath of the novel's impact, Gibson has seemed less than comfortable with his creation. In 'Academy leader' he has written:

> Assembled word *cyberspace* from small and readily available components of language . . . preceded any concept whatever. Slick and hollow – awaiting received meaning.
>
> All I did: folded words as taught. Now other words accrete in the interstices. . . . These are dreams of commerce. Above them rise intricate barrios, zones of more private fantasy. (1992: 27–8)

As accurate a critique of the ambition wedded to mathematical creativity within the VR community as this may be, by 1992 cyberspace was no longer a concept awaiting meaning. The company Autodesk, for example, was founded by members of the community Stone identifies above who had been excited to build aspects of what they had first gleaned from the novel's pages. The discourse of cyberspace has been taken up by others, academics included, and reflects in part a 'widespread desire to come to grips with the cultural implications of new electronic technologies' (Biocca 1992a: 17), Gibson's caveat aside.

Neuromancer is book one of a trilogy that includes *Count Zero* (1986) and *Mona Lisa Overdrive* (1988). Though *Neuromancer* has been the focus of academic interest and virtual imagining to the degree that there is now a 'received truth' that the later novels cannot compare to the first's *tour de force*, it is the third novel, incorporating Gibson's awareness of the cultural processes *Neuromancer* has helped set in motion, that offers a more mature version of his VR futureview. Arguably, the possibility of entering a cyberspatial *aleph* is the most entrancing concept *Mona Lisa Overdrive* details. Seeming to 'sample' from both Jorge Luis Borges's aleph, and German mathematician Georg Cantor's definition of transfinite numbers and theory of infinity, the *aleph* is 'an approximation of everything' (Gibson 1988: 128), a place that is not a place, yet a complete synthesis of experience that feels as though it is. Cantor's work on set theory led him to posit that the cardinal number of a set of real numbers is larger than the aleph-null; in other words the possibility exists for exponentially expanding

worlds of mathematical numbers to exist or nest within even larger such worlds, an approximation not dissimilar to Turing's machines within machines, or PCs and software. But Cantor was able to deduce from this what he called the power of the continuum, one that, 'is not denumerable, not algebraic, hence transcendental' (Reese 1980: 79). In *Mona Lisa Overdrive*, past fiction – allusions to Borges's magic realism – and the mathematics informing cybernetic theory coalesce. Two passages from *Mona Lisa Overdrive* are reproduced to provide a glimpse of the vision that the virtual research community has found so arresting. They suggest the ability of virtual technologies to fill a vacuum in meaning left by the explanation, and hence denigration, of the old Christian God. In the novel's suggestion that virtual technology might fill this vacuum, an opening is offered to inventors and programmers who might themselves share in the power of creation, and achieve a heady antidote to their alienated sensibilities. The first passage traces a future 'history' of virtual environments and might be read as a research agenda, or a comforting myth to virtual researchers that their endeavours will surely succeed, the 'death' of narrative notwithstanding.

> There's no *there, there*. They taught that to children, explaining cyberspace. She remembered a smiling tutor's lecture in the arcology's executive creche, images shifting on a screen: pilots in enormous helmets and clumsy-looking gloves, the neuroelectronically primitive 'virtual world' technology linking them more effectively with their planes, pairs of miniature video terminals pumping them a computer-generated flood of combat data, the vibrotactile feedback gloves providing a touch-world of studs and triggers. . . . As the technology evolved, the helmets shrank, the video terminals atrophied. (1988: 40)

Terminals which atrophy have already learned from their human inventors. The cyborg dynamic infects and inflects the machine and the human equally.

The second passage is a didactic exchange between one of the 'fractured selves' contained within the cybernetic/alephic god and a human 'construct' seeking her cyborg origin and basis for identity. It can be read as a contradictory blend of moral cautionary tale and tantalization of the VR research community Gibson has helped identify. The god speaks first.

> 'the mythform is usually encountered in one of two modes. One mode assumes that the cyberspace matrix is inhabited, or perhaps visited, by entities whose characteristics correspond with the primary mythform of a "hidden people". The other involves assumptions of omniscience, omnipotence, and incomprehensibility on the part of the matrix itself.'
>
> 'That the matrix is God?'
>
> 'In a manner of speaking, although it would be more accurate in terms of the mythform, to say that the matrix *has* a God, since this being's omniscience and omnipotence are assured to be limited to the matrix.'
>
> 'If it has limits, it isn't omnipotent.'
>
> 'Exactly. Notice that the mythform doesn't credit the being with immortality, as would ordinarily be the case in belief systems positing a supreme being, at least in terms of your particular culture. Cyberspace exists, insofar as it can be said to exist, by virtue of human agency.'
>
> 'Like you.'

'Yes. . . .'
'If there were such a being,? she said, you'd be a part of it, wouldn't you?'
'Yes.'
'Wouldn't you know?'
'Not necessarily.'
'*Do* you know?'
'No.'
'Do you rule out the possibility?'
'No.' (1988: 107)

Altered States

Several strands now synthesize a virtual world. One is hard/soft/wetware – computer technology and technical ingenuity. A second falls under the 'cultural software' umbrella of 'arts and entertainment'. Both appear equally important to the genesis of any extant VR commodity or intellectual property now before us. A third strand touches directly on the notion of transcendence implied at various points above. The turn to VR by prominent individuals involved in the promotion of psychedelic drugs speaks to a larger shift in interest from illegal to legal commodities as forms of release from material reality (as well as the progressive commoditization of experience), but also to a continuing cultural interest in the juncture between meaning and identity such as these intersect with transcendence, magic and their symbolic/desirable forms. Such a focus has broadened interest in VR away from its more purely military and entertainment applications, and also nudges a research agenda which in engineering a space for what is arguably either a disembodied subjectivity or a newly emerging quasi-material cyborg, partly following Gibson, fosters and foresees a utopian moment when the material body will be forgotten. Psychedelia meets the Gulf War head on at this juncture in cyberspace. Gibson's not-quite-dystopian future is as addiction prone as the present. A mind-numbing array of legal and not-so-legal substances are indiscriminately consumed by all manner of people residing this side of the interface in equal measure to the amount of time large portions of the population spend jacked-in to a VE Gibson calls Stims. Stims offer a brave new television in which users experience somatic merger with the emotions and memories of cybernetically reconfigured media celebrities courtesy of electrodes implanted at the base of their skulls. In the (very near) future, Gibson suggests, celebrity status will be Divine, a potential eventuality that extends and complements terrain explored by John Fiske (1993) in his study of Elvis, celebrity status, and the popular grasp of science.

In arguing the connection between the will to VR and psychedelia, Terence McKenna notes that 'technology has already proven that it is the drug most palatable to the Western mind' (1991: 233). In a society of addiction, he wonders if VR will be judged by administrators as a safe and harmless substitute for drugs, but on a level more germane to this review he notes that the synaesthesia facilitated by VR echoes the hallucinogenic

reality where vocal performances are experienced visually and tactilely; further, that like the quality of a drug, the altered consciousness implicated by VR will be no better than the *quality of the codes* – the underlying software or language upon which it will depend and through which it will be conveyed.

Rheingold investigates the mainstream media interest that has conflated VR to an electronic LSD, suggesting that such concerns override more real applications of the technology such as modelling radiation therapy for cancer patients, or walk-through CAD architectures (1991: 354). Such mainstream interest, Rheingold suggests, stems from a more general problem in American society about how to handle ecstasy, as in *ex-stasis*. In this, I find he supports a claim that transcendent imagining, wishing to enter a dream state, is one of the key drivers of this technology. He raises the possibility that people will use cyberspace to get out of not only their bodies but also their minds, and argues as to the good of this, by comparing VR favourably to the inappropriate contexts within which real-time addiction takes place in contemporary society. Kelly's (1994) 'hive-mind' – his belief that the Internet's exponential growth discloses a yearning for 'one planetary soul' – speaks to the continuing need for community once met by an earlier religion supplanted by Virilio's 'machine-God'. In all of this there is no space for the body. This is *ex-stasis* – out of the body's stance and into the visibilized world of language, fibre-optics and trance.

Epilogue

In his discussion of the relationship between GIS (Geographic Information Systems) and social theory Eric Sheppard observes that:

> A critical history of the possibilities opened up by GIS requires an investigation of the *silences* in GIS technology; of the many things that it has not been developed to do, of the alternative paths that were not pursued, and why. . . . The proper question is not whether the technology is better now than before, but whether it is better than it could have been if other paths had been pursued. (1993: 5)

Sheppard's caveat might well be appended to Frank Biocca's observation that 'a developmental logic' – a set of goals for the medium's future – already exists to circumscribe the various versions of cyberspace under development (1992b: 25). The need for limits, standards and conventions will condition the spectacle of cyberspace equally as the editorial decisions forced by the narrative form of this chapter. If anything is implicit in the present paper, it is that ideologies or developmental logics that underlie the intention behind technologies then get built into the technologies themselves. The limitations of each technical form constrain and empower what they do. Here lies a difficulty in a shift from metaphoric understanding based on narrative to one based on images and living in visions. The

importance of a temporal dimension that is implied in narrative is set aside in a programmed illusion of a potentially infinite, spatialized present. If, for example, *Neuromancer* gave voice to a virtual community, it did so in a print format arguably closer to orality than the VR 'picture writing' which is part of its fascination.

It is worth recalling the connection between voice and orality and by implication that people may only really come into a fuller knowledge of things when they physically speak to each other about them. 'Giving voice to' admits that it takes time for someone first to have spoken, others to listen, later to rebut, reply and circulate. To give voice implies a discursive community different from the politically neutralizing isolation that telematics, however extensive of the self, may well imply.

Yet to date resistance to unwanted political use of technologies most often has been theorized around an implicitly unitary individual situated at a remove from the (misused) technology under review. VR as a transcendence machine that delivers the overly atomized modern individual into a merger of subjectivity and landscape, a scene in which he or she potentially may communicate with other disembodied selves gathered in a virtual room but situated anywhere around the globe, challenges traditional notions such as that of Gramsci's organic intellectual – concretely positioned in relation to both allies and enemies – with respect to how opposition of a technology's undesirable implications might be constructed.[12]

While virtual social organization might take on a more collective organization, not unlike some of the more progressive understandings advanced by the cyberpunk counterculture, this *form* of resistance would depend on mediated standards and hence a central power. Such an ambiguous eventuality might demand a painful and lengthy reconsideration of the modern distinctions erected between humans and their technology, even between existence and communication. Are they worth retaining within what, politically, might become an extended struggle over codes? Do 'we' value the space of individual subjectivity, or has the weight of responsibility placed upon it become such that certain individuals would gladly give it over to an electronic hive-mind based on the 'truth' of propositional logic – one wherein the 'correspondent' representation has become more real than the real?

Finally, just who is this 'we'? Who is so eager to give up their subjectivity to the hive-mind planetary soul? Would this be an illegal Latina maid working under the table in Westside, LA? Would it be a gay Colombian man who cannot claim refugee status lest he be deported back to Cali death squads? I think not. Most of the world still struggles to attain the space to practise a subjectivity a certain Western male bourgeoisie would discard as an outmoded Enlightenment commodity, content instead to face itself online, and tell itself collectively that it subsumes the larger totality, that its cartoon-like representation of the human and spatialization of social relations are aesthetically complete.

Notes

1. Kevin Kelly, promoting his vision of society modelled on the collective intelligence of the beehive – as HiveMind – writes that 'a recurring vision swirls in the shared mind of the Net, a vision that nearly every member glimpses, if only momentarily: of wiring human and artificial minds into one planetary soul' (1994: 24). In passing I note the similarity to Durkheim's *conscience collective*, defined in *The Division of Labour* as 'a set of beliefs and sentiments common to the average members of a single society [which] forms a determinate system that has its own life' (in Lukes 1972:4). Like the emerging (post)modern forms of IT, networked communications sytems/VR, the *conscience collective* is only realized through individuals yet is distinct from individual conscience. It inheres in a 'psychic type of society', is 'diffused throughout the whole' of that society, is 'indpendent of the particular conditions in which individuals are placed' and 'results from fusion of individual impressions' (Lukes 1972: 4). Durkheim's critics disliked the metaphysical nature of the concept (see Gane 1988), pointing out that it blurred distinctions between the moral, the religious and the cognitive. In this it anticipates the 'electronic sublime' (Carey and Quirk 1970) which telematics achieves in its marriage of computation to telephony. The networked conflation of morality, religion and cognition parallels the collapse of, and helps set up a need to rethink the categories of culture and information, between culture both as a commodity and a form of life that thereby resists the reduction implied by commodity.

2. I would note the Renaissance invention of camera obscura, the period's rediscovery of Ptolemaic perspective, the codification and application of perspective techniques by Alberti, da Vinci and others, the development of cartographic mapping and the landscape idea which depend on enframement and visual techniques to extend the spatial power of the user/subject, and, over time, magic lanterns, the camera, cinema, television and video as precursors of newer fibre-optical technologies which further extend the power of the eye.

3. 'Within' the space of this game, pterodactyls swoop down through an illusion of three-dimensional space to snatch unwary players engaged in killing one another, and who are then carried 'high' into the air to be dropped to their 'death' on the cartographic chessboard surface 'below', but who then experience immediate 'resurrection' so that the virtual killing may resume.

4. Turing (1950) asserted that 'at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted' (1950: 442). A machine that imitates human intelligence may provide little or no useful service (Bolter 1984); there are already plenty of humans to do human tasks. Instead (shades of Marx) the 'Turing machine' has come to be seen by subsequent inventors and assorted 'technotopians' as a kind of defining technology (metaphor) of the age, one that reorganizes the way humankind relates to nature. Humans become 'information processors', nature 'information to be processed'. Within the 'world' of the 'Turing machine', computation is 'nothing more than *to replace discrete symbols one at a time according to a finite set of rules*' (Bolter 1984: 47 – synopsis drawn, in part, from Bolter 1984: 10–14, 43–7).

5. For a chilling account of these applications in action see Sterling (1993).

6. Though with personnel movement from NASA to educational institutions this may now begin to change, as exemplified by Hayles's testimony: 'From my experience with the virtual reality simulations at the Human Interface Technology Laboratory [at the University of Washington – Seattle] and elsewhere, I can attest to the disorienting, exhilarating effect of feeling that subjectivity is dispersed throughout the cybernetic circuit' (1993: 72).

7. Politicized social relations renders NASA keen to construct and preserve legitimacy in the taxpaying public's eye. More so than in the case of the US Air Force, there are regular Congressional movements to dismantle, downsize or restructure the agency. It behoves NASA to air its successes widely, given concerns with industrial espionage and national security.

8. When Turing's cybernetically influenced model of reality is applied in this way a certain impoverishment of vision inherent in it is revealed. As Pagels notes (1988: 94), mathematics formalizes objects in space; human perception always functionally relates objects to their roles – a difference I take as similar to that between geographic conceptions of absolute and relational space.

9. Though within this earlier formula, traditional SF managed to comment on social relations. This passage from Heinlein's *Beyond This Horizon* (1942), a description of a computer, is strikingly descriptive of today's global cyberspatial data flows: '[t]he manifold constituted a dynamic abstracted structural picture of the economic flow of a hemisphere' (cited in Kurland, 1984: 200).

10. This 'community' corresponds to an alternative definition of cyberspace offered by Heim (1993: 32): 'the broad electronic net in which virtual realities are spun'.

11. In 'Visual pleasure and narrative cinema', Laura Mulvey invokes the Freudian 'scopophilic' pleasure of looking and being looked at to locate her argument that a fascination with film is reinforced by pre-existing fascinations already at work within the individual subject (1975: 6). Though she thereby acknowledges a certain historic specificity, it is restricted to the individual level by her psychoanalytical take. VR and other 'psychotechnologies' also trade at this level. Mulvey relies on a Freudian conception of narcissism as fascination with the human form wherein (self) identity ironically is located in an act of self-recognition with a corresponding image. VR and IT promote self-extension. All communication promotes this within an understanding of what it is to be human. However, following McLuhan (1964: 51) who argued that the West's cultural bias is evident in its misinterpretation of the Narcissus myth as meaning only an injunction against a false self-love achieved through reflection and image, I want to note the *narc*otic in *narc*issism, and the numbness that results from an unwise over-extension of the self into exteriorized image, such as body-as-information. In identifying self-interest with the screen, the cinema is also an anodyne for an overtaxed subjectivity perhaps too closely identified with reproducing the demanded stability which is a precondition of the state's existence (see Deleuze and Guatarri 1987). In a post-national culture such stability seems increasingly less central to global selves.

12. At the outset I named VR as a machine to realize desires for transcendence. Deleuze and Guattari (1987) and Raulet (1991) write of 'desiring machines' – at the very least as a subset of a 'collective assemblage of enunciation, a machinic assemblage of desire' (Deleuze and Guattari 1987: 23) that would allow us to 'arrive at the magic formula we all seek – PLURALISM = MONISM – via the dualisms that are the enemy, an entirely necessary enemy, the furniture we are forever rearranging' (1987: 20–21). These passages echo Durkheim's *conscience collective* discussed in note 1. They also well describe the merger with a collectivity the modern Western(ized) self may seek within VR. Access is individuated. 'We' are all together online, yet home alone via the 'dualism' of binary logic, the 'furniture' of mathematical codes which permit the constant 'rearranging' of picture language within VR's representation and emblematic 'space'. Yet a 'desiring machine' already has swallowed the subject that Deleuze and Guatarri also identify as representationally coeval to the state. Even an intermediate stage of political agency such as the man-machine cyborg seems unavailable to their approach for those who would choose not to cede subjectivity to the machine at this historical juncture, given the appetite implicit in 'desiring machines'. Raulet grasps that desiring machines efface locality within a seamless web of *network* – the rhizomal structure Deleuze and Guattari privilege. Desiring machines, ironically, are an anthropomorphisis that occludes humanity, let alone a reconsideration of the political complicity of subject re: the state. Though rhizomes are an ideal metaphor for the content/form of modern IT and telematics, rhizomes-as-metaphor reproduces the power of representation Deleuze and Guattari seek to undermine. I argue that although representative forms are essential to communication, their excessive use is worth resisting and that VR's current developmental trajectory manifests many aspects of such excess. Machines *for* transcendence intends to skirt the metaphysics that swirls around these issues by suggesting a relationship *between* human agents and technology equally as I acknowledge that technology now inflects human *existence*.

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6

The Coming of Cyberspacetime and the End of the Polity

Dan Thu Nguyen and Jon Alexander

> In addition to the conditions under which life is given to man on earth, and partly out of them, men constantly create their own, self-made conditions, which, their human origin and their variability notwithstanding, possess the same conditioning power as natural things.
>
> Hannah Arendt, *The Human Condition* (1958: 9)

Cyberspace and virtual reality are compelling ideas. Here literary fantasies and technological feats meet to project whole universes at the human–machine interface. However, they have so far proven unsatisfying for critical political analysis. The field of study has no recognizable boundaries or parameters within which social scientists could use traditional approaches to formulate criteria for analysis. A manic frenzy characterizes changes in the electronic world, and thus analysis often reduces to piecemeal descriptions of segregated facets of the whole. This phenomenon's components operate in ways that render obsolescent all previously analysable and easily understandable relationships. In particular, relationships one has with the self – the technology of the self or self-construction – and social relationships between people, and relations between humans and their tools, all become in new ways problematic. We need to understand the choices people are making *de facto* every day in living 'wired' lives and sharing a universal discursive space. We are equipping our world with a social nervous system similar to those in our own bodies. What then is becoming of us, individually and collectively? As we shall see, on the Internet, boundaries – temporal, spatial, associative and identity-forming – all dissolve.

We have achieved the human dream of transcending materiality at an unforeseen cost. Our civilization's goal of wisdom (perfect knowledge) has warped into a deluge of information. While valid knowledge is inescapably human because it resides tacitly and actually in bodies, machine-readable information is technical. Technology abstracts us from our existence as physical beings in the world. We ignore the boundedness of experience that leads to knowledge. Without limits, we have just information and data. This alters the old relationship between knowledge and power. Without knowledge, what happens to power? Without body-centred