

VIRTUAL REALITY

Beyond Cartesian Space

Sally Pryor and Jill Scott

Indented text is from a diary kept by Jill Scott while visiting Virtual Reality (VR) research centres in the United States in 1990; non-indented text is by Sally Pryor.

Seeing Reality

At the University of North Carolina at Chapel Hill (UNC) they encourage me to 'hop in'. I am given a yellow ball whose magnetic field tells the computer its position and orientation in space. I put on the heavy VPL EyePhones and the room suddenly disappears. It is replaced by the interior of a geometric, plastic-looking, green and pale blue room. If I point the ball, my body seems to move forward in the room. The EyePhones sit heavily on my cheeks, forcing my eyes open even wider to gaze closely at the rather bad resolution.

Floating ahead of me is a cluster of protein molecules. My first response is to move around and become orientated. The magnetic tracker on my head tells the computer how my head is positioned, so I can look up and down and around the room. There is a slight lag as the frames try to keep up with my movement, but I am really tricked into thinking I am inside the room.

I turn around to look at another floating cluster which represents a drug called mucotracyne. I can grasp this with my tracker ball by placing an arrow over the image; when I press the cursor button the drug follows the movement of my hands. I then try to complete the required task – that is to dock the drug into

the protein cluster so that it fits tightly. I do this successfully and with surprising ease. The task's completion gives me new confidence. I 'hop out'. It is nice to see everyone again but it is surprising to have to re-orientate myself to the natural light of my surroundings.

I ask to see more . . .

Since the word 'reality' is used extensively in discussions of Virtual Reality (for example in VPL's product, 'Reality Built for Two'), it would be appropriate to look at the way reality is represented and manipulated in a virtual world. When the user 'hops in' to Virtual Reality (VR), she enters a computer-generated world which usually consists of objects in a three-dimensional space. The user enters this space through viewing a series of images (on the EyePhones for example) and perceiving sound and other sensory information (such as force feedback) that give the impression that she is interacting and moving within it. The visual images are calculated by computers, based on the view of this space that would be seen by a camera attached to the current position of the viewer's head. Each object in the space has been defined as a three-dimensional (3-D) shape located within a 3-D Cartesian space, that is, a grid calibrated with X, Y and Z axes (Fig. 1). Objects have also been numerically described in terms of position, orientation, movement, shape, colour, surface qualities, behavioural

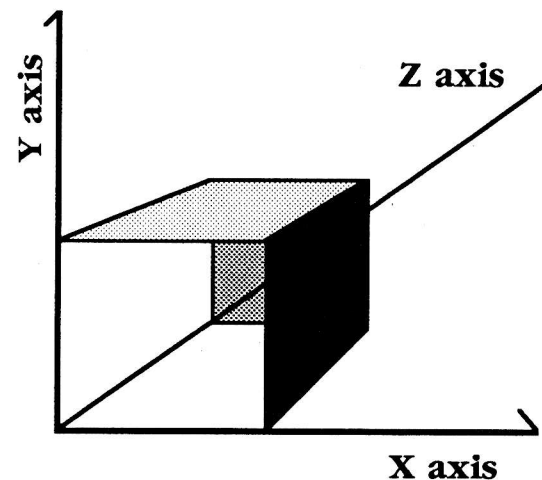


Fig. 1 The Cartesian Coordinate System

characteristics and so on. These parameters can change with time, interactions and context.

This space has certain limitations. Artificial shapes are easier to digitise (that is, to convert to a digital description) than natural ones. Whereas a cube could be described by the location in 3-D space of eight points and six faces, a rock or a human face is much more complicated. It is much easier to work with manufactured, regular objects than those of the natural world, which is possibly what Laurie Anderson meant when she said, 'There's no dirt in here' after experiencing VR.¹ In order to give the user the impression of moving and interacting within a space, VR systems must calculate and display a new image up to sixty times per second. As a virtual world becomes more complex, the time required to compute and deliver a response becomes longer: one frame of a contemporary, state-of-the-art, 3-D computer-generated animation can take as much as thirty minutes' computer time to calculate. It is clear that compromises and simplifications must be made in order to approximate a 'real-time' response. Various strategies are being used to make this computation fast enough to simulate 'real time', but for a while we must accept rather simplistic imagery and sluggish responsiveness in VR.

For these reasons alone, current state-of-the-art VR worlds are not convincing enough to be seriously confused with the 'real thing'. More importantly, the representation of 'reality' in VR is actually a highly specific view of the world, a view which unthinkingly assumes a Western tradition and ideology. VR rests on an unstated foundation of conventions such as Cartesian space, objective realism and linear perspective. It is easy to assume these conventions to be neutral and transparent, to be part of the way everybody sees reality, but in fact they are deeply rooted in an historical philosophy that privileges perspective, with its implications of detachment, objectivity and observation. This positions the Self behind a 'camera' looking at a window on the world, separate and distinct from his/her environment. VR adds something unique to this familiar approach in that the detached viewer is mapped back into the space and is able to interact with it to some extent, but this sense of separation between viewer and the represented world still lingers.

Interacting with the World

... I hop in again. I spontaneously walk toward the door in the artificial room and simultaneously walk toward the real door in

the actual room. My intuitive response causes strange things to happen. Voices tell me I have ventured outside the range of the magnetic polhemus sensor near the computer. I trip over some cables and it reminds me that I am connected. Restricted by being connected. Soon, I become used to the fact that my head and my hands are moving me in this artificial space, not my feet. It takes a while to register. It also takes time to sort out exactly how to place my body, but the system is hampered by magnetic interference outside my control. Now it is flashing, I obviously tilted my head too far. Interesting to be so concerned about the body's exact position in space!

... They tell me the addition of sound and force feedback will make the worlds much more convincing. Later at VPL I am given the chance to test this for myself as samples from a sound library are triggered with the completion of certain visual tasks. It is true, the sound really helps me to feel transported into the particular worlds.

I wonder what it would be like to add the sensations of smell, touch and taste?

How does the user relate to the world in VR? Not so long ago, input and output were terms that described the information that went into and out of a computer. Today these terms are also used when referring to the information going into and out of the person who is in VR.² This information is classified into categories such as visual (what the user sees), auditory (sounds and the user's voice), haptic (touch, temperature, pressure), proprioceptive (current body configuration), vestibular (orientation, movement, acceleration), olfactory (smell) and taste. Thus in a virtual world, a person sees, hears and feels things that encourage her to believe that she is within this world and that it is responding to her.

At the current state of VR development, the primary inputs to the user are visual, auditory and, to a lesser extent, haptic (such as force feedback devices which give the impression of weight or pressure). The primary outputs come from magnetic tracking devices which measure the user's movements and from haptic devices (such as buttons or joysticks) which record touch and the exertion of force. In the experiences Jill relates above, for example, she communicates with the virtual world through the tracker ball. She moves through its space via head and hand movements, not her legs. She sees herself represented in this

world in a rather disembodied way – as an arrow cursor – the most minimal representation of oneself in VR.

Devices such as the data glove and data suit enable not only a wider range of inputs from the user's body but also the construction of more complex images, increasing the amount of computation required. Although these images can approximate to the way the body appears in 'real' life, they do not do so necessarily. Moving a data-suit-clad arm could lead to the sight in VR of one's arm moving, someone else's leg kicking, an octopus tentacle waving, a wave breaking – there are endless possibilities. The Challenger astronaut Judy Resnick operated a mechanical arm which was controlled from within a space shuttle but was capable of lifting solar panels and performing other tasks outside the ship. Her job involved looking at a monitor and manipulating sensitive electronic controls to manipulate this arm, her training involved learning to experience this gigantic arm as an extension of her body. In a similar way, VR represents a kind of extension and re-mapping of the body, a de-naturing of its organic, holistic nature and a reconstruction of it in 3-D space as digital cyborg (part machine, part human). This represents a kind of uncoupling of oneself, an interception and substantial manipulation of a presumed space between thinking and doing, mind and body. VR gets under your skin.

Metaphysics, the Body and Technology

Now I am poised on the top of a roller coaster path which winds in a hilly way before me. This world responds only to my head movements. The visuals simulate the sensation of riding in the first car of a roller coaster whose tracks meander dangerously, gliding toward me. Up and down I go, I cannot help bending at the knees as I slide down. 'Do I look ridiculous from out there?' 'Yes,' they all say. Would children mind if their body moved in such a silly way responding to the motion of the graphics?

I imagine how strange it would be to look in through the door of a Virtual Reality game parlour with the cable-connected bodies and terminals. Perhaps Virtual Reality could make them feel sick? This roller coaster is certainly a stomach test.

The technicians change programmes to another game. I'm in a maze of rooms with an elevator. I immediately bang into the wall, disoriented. I use the arrow to fly around. 'Turn around,' they yell. As I turn, a simple diagram of a flying bird comes towards me, its mouth opening and closing aggressively. It's trying to eat

me. 'Point backwards at yourself', they yell. I immediately zoom away from the bird.

What are the metaphysics of this body in virtual space? Answering this question means considering its origins. Despite recent philosophical and scientific theories,³ a dualist tradition permeates the metaphysics of science and technology which is especially apparent when the mind and body are conceptualised. The influence of René Descartes lingers on. For Descartes, the mind/body split was a reality. The body was defined by its capacity to occupy space whereas the mind was conceptual, based on Reason. Thus the body was spatial and not conceptual; mind was conceptual but not spatial. Subjectivity, that is, the sense of being 'I', was identified with the conceptual side of this opposition, the mind, thus relegating the body to the status of an object, outside of and distinct from consciousness. This binary opposition is commonly associated with a number of other binary pairs: self and other, subject and object, culture and nature, reason and emotion, male and female, public and private. The mind is associated with culture, rationality, the self, even the masculine; body is correlated with nature, the emotions, the object and, of course, the feminine. Elizabeth Grosz adds that 'Within this structure the opposed terms are not equally valued: one term occupies the structurally dominant position and takes on the power of defining its opposite or other ... by negation.'⁴ These dualistic values emerge from a logocentric presupposition that being, language and knowledge are self-evident, neutral and transparent terms rather than social and cultural constructions. They are a powerful, almost unstated, subconscious framework for so many Western philosophical, scientific and technological traditions.

There has always been an intimate relationship between the latest technology and how human beings are conceptualised. Descartes, for example, thought a sick man was like a badly-made clock. This mechanical metaphor is now shifting to one based on computers or robots, spreading from its birth in scientific and technical circles as the use of computers proliferates – the input/output model for the user in VR is one such example.⁵ What does it mean to be like a computer? The computer is made of software (programmes) and hardware (the physical components), categories which align themselves all too easily along the dualistic mind and body model. Linking software to mind and hence to the Self, we derive a concept of the Self as software, as a disembodied set of rules, processing, instructions and knowledges. Hans Moravec, director of the Mobile Robot Laboratory at Carnegie

Mellon University, postulates a post-biological world, in which a human mind is freed from its brain and loaded into self-improving, thinking machines that he calls 'mind children'.⁶ He talks of our 'uneasy truce between mind and body' and recommends that 'human thought [be] released from bondage to a mortal body'. Moravec considers the essence of himself to rest in 'the pattern and process going on in his head and body, not the machinery supporting that process ... the rest is mere jelly'.

Leaving aside the assumption of the mind residing in the brain and the question of whether a mind/body separation is actually possible – it seems highly unlikely – this idea of a disembodied, cerebral self exerts a seductive appeal. Western socialisation involves experience of sexism, racism, power and control and produces an ambivalent and highly-gendered combination of feelings – such as fear, loathing, pleasure and desire – around the notion of the body. It is not surprising that the body, subject to vulnerability, pain and mortality, can become something from which it seems desirable to escape. Could you feel pain if you had no body? Could you experience racism or sexism? A somewhat disembodied self, mediated via telepresence (see Rebecca Coyle, pp. 148–65), might be appropriate in environments such as hazardous radioactive situations, modern warfare or in space, where the body is truly obsolete. But it would not be much fun when holding your baby, to cite just one activity. My experience of the computing and high technology world is that it is populated by men like Moravec who are strongly identified and involved with their thoughts and ideas, and not so much with their bodies. Without being particularly aware of it, they reproduce the mind/body split in the technologies they produce.

Remapping Oneself, Interaction, Symbiosis

The introductory segment of the Body Electric software at VPL offers a pre-selection room where simply designed computers sit on a table. I can fly through the monitor screens into the world of my choice. Even though the ease of getting in through these screens is restricted by magnetic tracking, they still show the potential for a greater element of choice. This awkwardness of movement really needs solving. The technicians tell me about the use of an optical tracker instead of a magnetic one and how this, in combination with better response (refresh rate) and better resolution and sound makes the interaction more convincing.

... I enter a space where a mirror is hanging. As I move my head an x moves with me in the mirror. 'That is you', one technician yells. I play with my x clone in delight. The technicians tell me not to go through the mirror because I will shrink. Shrink in what way? I have to try it as the comment doesn't compute. I find myself in a replica of the same room I left. The response to everything is suddenly very slow so I fly backwards, out again. The contact points vary again. Suddenly I feel like the computer may have control over me. Resistance starts to build up inside my real body. I tear off the EyePhones and hop out quickly. I have a splitting headache ...

The development of VR seems to reflect this fantasy of a disembodied self and a dualistic world view. It is as if the user is assumed to be separate from her (Cartesian) world. Her view of it is mediated through the detached eye of a camera, delivering objective realism and linear perspective. The only place she cannot see is inside her head. Her body is mapped back into this world, but in a semi-abstract sense that uncouples her from her real body even while the dominant impression is of her body acting within and around the virtual space. In VR the user becomes a source and a consumer of a variety of information. She becomes a kind of computer, or more accurately, a cyborg. Naturally there are both positive and negative aspects to this. Working with a computer is a somewhat disembodied process – eyes, mind and hands are the only things directly involved. Sore shoulders, headaches and Repetitive Strain Injury (RSI) soon alert you to the folly of ignoring bodily sensations for too long, although it is extremely easy to do. Personally, I long to transcend the limitations of keyboard and mouse and express myself with the computer by involving my body more. I have a fantasy of wearing a data suit and doing dance movements not only to tell the computer what I want it to do (find a file, start another programme and so on) but also to create an image, an animation or music. I want the computer to read body language. Since VR implies this might be possible it might allow communication with the computer to become much more intimate, more personally involved.

There are potential applications of VR which are very interesting and would be socially useful. An example is implied by Jaron Lanier's story of teaching himself juggling in VR by slowing down time – this has fascinating implications for people with physically challenged bodies.⁷ As a scientist, I find the possibilities for visualisation and manipulation of complex processes thrilling. As an artist, I can imagine

VR enabling an art-form involving the audience in a truly unique way. As a teacher, I can see immense benefits for students, particularly as they can learn at their own pace. But as a human being, am I willing to work in strong magnetic fields, to be so intimately connected to the machine? Has anyone investigated the effects of VR technology on our not yet obsolete bodies?

Broadly speaking, communication between people and computers will be the most fruitful application of VR but, as with the telephone and more recently, electronic mail, it will be disembodied information that is exchanged. Certain frustrations will remain, for example trying to communicate with one's intimate partner over a long-distance phone call, you can talk all you can afford but there are some things you cannot communicate through speech. VR could alleviate this by enabling communication through a kind of body language which will extend the possibilities considerably. Interacting with people in VR will certainly be fruitful and exciting, but it will still be disembodied numbers that will be exchanged. This cannot be the same as communicating in person.

Virtual Bodies/Virtual Sex

In a new world, I can grab a silly character and throw it around the room. This slippery little yellow toy creature squeals with delight but as I pick it up it stops yelling, like a baby. When I drop it, it makes a loud thud. It seems to scream with delight especially when it is thrown against the wall, and I am reminded once again of the violence VR is capable of procuring under the guise of entertainment. . . .

They tell me that sound in combination with force feedback will really change things especially in relation to interacting with others in VR. They demonstrate a world they are currently making. I watch transfixed as the technician manipulates a ball on the monitor. A sexual sigh happens as repeatedly it is slogged slowly into another object and extracted again. With simultaneous sound the ramifications for sexual interface are considerable.

The concept of Virtual Sex (VS) sneaks around the periphery of many discussions about VR, although developers are uncomfortable with the fascination this topic arouses. It is mentioned at least once in many general articles about VR and whole features are being written about it, accompanied sometimes by a picture of a current sex symbol, who

would presumably be 'invited' to the VS session.⁸ This writing is mostly overexcited speculation, as the technology has not advanced much past simple interaction with a virtual body, such as the enormous so-called sex goddess conjured up by VPL for a visiting, nameless Hollywood director.⁹ According to the story, as related in chapter 9, he enjoyed flying around her enormous nipples and then moved on to something else. . . . The terminology of VS is puzzling. When a man has intercourse with a blow-up doll, it would be more likely to be called masturbation than sex. However, sexual activity in VR is being called Virtual Sex or Teledildonics rather than masturbation, which is what it actually resembles. The user enacts sexual activity with (say) Julia Roberts in VR, but the images he sees are not directly connected to the device(s) that are providing sexual stimulation, although they may seem to be.

The excitement about VS makes uneasy reading. It seems to perpetuate the well-documented objectification of bodies, particularly women's bodies, in pornography. Many assumptions are made in these effusive articles – the equivalence of a 'sensitive' interactive system with a living partner, the importance of the penis in sexual pleasure, the notion that women would find VS as desirable as men would, that VS represents a sensible solution to loneliness and isolation, the threat of AIDS and so on. A look at contemporary computer-based pornography is not reassuring. *Macplaymate*, a widely circulating, Macintosh-based programme, offers the user a selection of implements (hand, dildo, surrogate partner) with which to disrobe and stimulate a 'woman'. 'She' is there as a graphics image, displayed in a Playboy-type pose, to have things done to 'her' and to make the user feel powerful and excited – click with the mouse button to remove 'her' shirt and bra . . . and so on. To be thrilled by the idea of VS, I would need to be sure that *Macplaymate* is not its 'father', but if involvement of the lucrative pornography industry can be assumed, VS is more likely to encourage notions of power over, detachment from and objectivity towards other bodies (mostly female) than to help resolve our complicated ambivalence about real bodies and intimacy. Al Goldstein, publisher of amongst other things *Screw Magazine*, has described his desire for a robot lover: 'My fantasy is to . . . phase the wife out of the picture, to come home and hear a robot greet me . . . My wife knows she's on the way out. She's like a buffalo. She knows she's here temporarily until technology catches up.'¹⁰ While being Al's wife does not seem like a bad job to lose, his comment articulates a movement that, together with developments in Reproductive Technology, has

profound implications. If, through the development of these technologies, women's bodies were ever to be made redundant for sexual intercourse and for creating new life, discrimination against women (mediated as it is through presumed ties to the body) would have no basis. Alternatively, there might be no socially perceived role for real women at all.

Virtual Conclusions

... I find myself inside a kitchen with all the appliances and cons intact. I can open the refrigerator (clunk) take out the rather unappetizing pizza (swaab) from the shelf and put it on the table. I can carry the plates to the kitchen sink where taps can be turned on and off (sound of water), and generally busy myself with a tidy up or a mess. We find out that this VR world is the only one we have seen designed by a woman. A fair amount of detail has been given to the structure and the mobility of objects within the kitchen but I still manage to slip up and collide with the pizza. I make a joke about wishing to change the velocity, to clean up in fast mode and the technicians say they are working on it.

... I fly above the artificial world of Vancouver Harbor where 'vehicles' are ferries slowly leaving from one dock and travelling to another. The water is in simulated motion and there is a simulated Revolving Restaurant Tower on one of the Headlands. As I move toward the Restaurant I can hear voices of the clients inside. If I go down onto the dock I hear seagulls and the horns of the ferries. I ask whether I can dive into the water. 'Sure can,' the technician replies. I go through the surface with my own squeal accompanied by a pre-recorded splash. I don't exactly have the feeling of floating but a couple of simple-looking fish swim by. I like this world a lot. It seems easier for me to interact in my own time and space. I fly out, WOOSH, and try to fly as high as possible into the sky. The landscape shrinks below me to the size of a tabletop miniature set.

... We talk about the fact that VR may replace TV, but I am concerned about VR becoming the cause of a new type of couch potato. Unless it remains very interactive and allows the spectator to participate in the creation of new worlds, VR will remain a novelty. At VPL, Jody Gillerman and I talk about the hyperbole which promotes VR as invention, the ultimate VR computer able to control the existence of matter. Unless it can help us solve the

shocking conditions of the planet, why would we want it to take so much control?

The popular and the computer press are leaping on the VR bandwagon with an understandable but rather disturbing euphoria. VR can be seen to represent a retreat from direct experience of the senses, the body, each other and our (polluted) environment. Is this really a solution to the problem of modern life – to turn a blind eye to what is happening and to what we are doing to this world by re-mapping ourselves into digitally-mediated, synthetic fantasy worlds?

It is hard to comprehend fully the development and implications of VR: aside from its technical complexities, it engages with potent philosophical constructs. Supposedly dualist alternatives, such as mind and body, culture and nature, self and other, inside and outside, presence and absence, reality and fantasy, sex and love are open for re-inspection. VR has the potential to change definitions of reality, of presence, of point of view and of identity – the question is, how will those definitions be changed?

When Francis Bacon wrote in the sixteenth century, 'We will place nature on the rack and torture her secrets out of her', he articulated an approach to the world that defines Women, Nature and the Body as mysterious Others, in opposition to and separated from the Self. Although contemporary philosophy has moved far beyond this dualist model, its conceptual framework lingers, particularly in the world of technological development. As we have seen, VR may be used to re-assert rather than question or dismantle it. In this light it is impossible to ignore the involvement of military and space applications in the development of VR and for this reason it is very important to extend debates about VR and about its development. We all, not a select few, have to decide what relationships we want to have with computers, what we want them to do with, to and for us. Donna Haraway points out that information technologies are bringing far-reaching changes in the way that boundaries are conceived and constituted. 'There are ... great riches for feminists in explicitly embracing the possibilities inherent in a breakdown of clean distinctions between organism and machine and similar distinctions structuring the Western self. ... Any objects or persons can [now] be reasonably thought of in terms of disassembly and reassembly.'¹¹ This violation of boundaries can be seen as a liberating opportunity to discard oppressive constructs and/or as a chance for new but equally restrictive definitions.

Virtual Reality is located at a major point of intersection between

Humans and Computers: it makes disturbingly intimate symbioses possible. This is an important historical moment. Can we use this opportunity to dismantle oppressive dualistic divisions or will the limited variety of people involved with technological development unwittingly reinvent or re-erect them, becoming 'ghosts lost in the cosmos of their own abstractions'?¹² This re-encoding of dualisms is, as we have seen, intrinsic to VR technology. We are not compelled to perpetuate this model of the world in VR, but it could happen very easily.

... I can hear the sounds of the technicians talking 'outside' who try to orientate me 'inside'. My brain is having some trouble differentiating between the real and the artificial. Could this be dangerous?

... Later another artist, Sally, and I discuss other societies' different attitudes toward time. We in the West have been trained to exist in linear time, a stressful habit we have adopted for convenience and progress, while some other societies exist in polychronic time with flexible schedules and simultaneous constructs, or in circular time where all history is fiction because all things return to a former state. I think we tend to exaggerate this in the form of narrative film, where the plot unfolds in a linear construction. By comparison, in VR, I am able to move in this type of simultaneous time as I can move in simulated real time, backwards and forwards, up and down, by choice. I ask Sally if she thinks interactive experiences of simultaneous time may influence our approach to time in real life. She agrees the very term 'real-time' sounds like a paradox. Perhaps there will be no effect as we disconnect from the fiction of electronic space and time and lock back into the 'rush hour' of reality. I would like to try to experiment with the notion of circular time. We talk about savouring the moment or just the fact of being in VR without having any tasks to do. Perhaps it could become a great device for meditation after all.

Thanks to Rebecca Coyle for her assistance on this chapter.

NOTES

1. Laurie Anderson quoted in 'Brave New World' by Stephen Levy, in *Rolling Stone*, vol. 448, October 1990.
2. Richard Holloway, University of North Carolina at Chapel Hill, 'Virtual Reality and Art', a paper given at the Second International Symposium on Electronic Art, Gronigen, Holland, 1990.
3. Poststructuralist theories (for example the work of Jacques Derrida) and chaos theory.
4. Elizabeth Grosz, *Sexual Subversions* (Sydney: Allen and Unwin, 1989), p. 27.
5. Sally Pryor, 'Thinking of Oneself as a Computer', *Leonardo*, vol. 24 no. 5 (1991).
6. Hans Moravec, *Mind Children* (Cambridge: Harvard University Press, 1988), p. 4.
7. Stephen Levy, 'Brave New World', in *Rolling Stone*, vol. 448, October 1990.
8. See for instance Howard Rheingold's 'Teledildonics: Reach Out and Touch Someone' in *Mondo 2000* no. 2, Summer 1990.
9. Stephen Levy, 'Brave New World'.
10. Quoted by Geoff Simons in *Silicon Shock* (Oxford: Blackwell, 1985), p. 130.
11. Donna Haraway, 'A Manifesto for Cyborgs: Science, Technology and Socialist Feminism in the 1980s', in *Australian Feminist Studies*, Autumn 1987, p. 29.
12. Robert Romanyshyn, *Technology as Symptom and Dream* (London: Routledge, 1989), p. 101.