cultronix

Colonizing Virtual Reality
Construction of the Discourse of Virtual Reality, 1984-1992

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Introduction

New technologies do not appear from nowhere as a mystical spark of inspiration from the mind of one individual. Nor are they inevitably accepted for their self-evident benefits. A technology emerges through a process involving broader cultural, linguistic, institutional and technological contexts. One clear illustration of this process can be drawn with the appearance of "virtual reality" in 1989, and the subsequent popularization of the idea through the media.

On June 7, 1989 the computer-aided design software company Autodesk and the eclectic computer company VPL announced a new technology called "virtual reality."[1] In marketing this new technology (which represented a major shift in thinking about the nature of computers), the developers and promoters drew on a range of tropes:

> VR is shared and objectively present like the physical world, composable like a work of art, and as unlimited and harmless as a dream. When VR becomes widely available, around the turn of the century, it will not be seen as a medium used within physical reality, but rather as an additional reality. VR opens up a new continent of ideas and possibilities. At Texpo 89 we set foot on the shore of this continent for the first time.
> *--VPL Research at Texpo 89, in Rheingold, p.154.*

The above quote draws several analogies to introduce Virtual Reality. The statements do not describe the nature or features of an actual product--they introduce the new idea by comparison to familiar, comfortable cultural icons. They compare VR with "a work of art," "a dream," "an additional reality" and a "new continent." With just a few words they have invoked the traditions of art and representation, psychology and metaphysics, ontological philosophy, discovery, colonization and the frontier.

This quote is characteristic of the manner in which a new technology (or product, idea, institution, religion) is introduced. VR originated within marginal subcultures: from science fiction, cyberpunk, and computer hacker culture, and from institutions including NASA, computer companies, and the military. Perceiving much wider applications than flight simulation and remote control, researchers coined the term "virtual reality," and promoted it as a paradigm shift for computers, and even for the whole society. The shift, though, was not into empty terrain: it was into such existing fields as entertainment, art, architecture, design

and medicine. While proponents claimed the idea of VR was new, they positioned it as a natural and inevitable outgrowth of the past by making connections to familiar values, ideology and myth. They emphasized its unique advantages over other technologies, but packaged it in familiar cultural wrapping, constructing a historical narrative with VR as its necessary conclusion. They then projected VR's development into a utopian future. Moving from marginal cultural tributaries into the cultural mainstream, though, VR itself had to change; it needed to remove its uncomfortable associations with social criticism, drugs and insanity.

Methodology

This essay will analyse the cultural processes by which computer-generated immersive technologies known as "virtual reality" and "cyberspace" came to mainstream attention and acceptance. This process is independent of actual technology development, especially in the case of VR (because working systems are still rare). It is parallel to, but not synonymous with, the development of the "reality industrial complex"2 --the growth of institutions researching and marketing VR systems.

The objects of study are documents written about virtual reality. These include VR researchers' internal papers, magazine articles, promotional material, conference papers, journal articles, scholarly essays, books and articles posted to the Usenet news conference *sci.virtual.worlds*. From a close critical reading of the content, and, as importantly, the way the content is structured and presented, I intend to explore the nature of the process of discourse formation: that is, the development of a language terrain3 around virtual reality. Building a discourse involves establishing a (broadly) shared terminology and agreement about the nature of the discipline. As I will show, between 1984 and 1992 "virtual reality" and "cyberspace" underwent a transformation from marginal, speculative concepts into a (relatively) mainstream, institutionalized discourse.

The tools I will use in this analysis will borrow from several disciplines: literary theory, sociology, anthropology, cultural studies, poststructuralism, history and historiography. To discuss the texts I will look at stylistic issues, such as use of metaphor and analogy, word choice, narrative structures, tone, and the implied audience. The structuring of narratives--the stories used to explain phenomena--is particularly important.4 I will also use broader categories, such as the construction and evocation of cultural myth.5 Another important concept, from literary origins, is that of tropes: clusters of meaning associated with a phenomenon, or networks of cultural connections. *Trope* is a broader and more ephemeral category than *discourse*. I will show how proponents of virtual reality consciously associated VR with existing myths, positioning VR in the context of preexisting cultural tropes to naturalize the new discourse.

I will consider the impact of social, political and economic influences using sociological categories--notably class, power and ideology.6 Although the socioeconomics of VR is not the central theme of this paper, the analysis would not be complete without placing VR in a context of these broader power relations. VR is a very expensive technology, and has emerged within institutional contexts: NASA, military researchers, video game manufacturers, universities, software and hardware developers, and entertainment industries. The role of ideology is significant as a backdrop to these economic developments.

The term "Virtual Reality" is particularly powerful because it can attach to a broad range of meanings. The nature of virtual reality technology also brings up related issues about simulation, hyperreality and "post modern" society. This paper will not directly address these issues, though it will make apparent the significance of the emergence of this technology at this time.

The aim of this paper is to provide some insight into both the technology and the culture from which it emanates. This will focus on the US, but also other Western countries and Japan. I have selected some common themes in the rhetoric associated with Virtual Reality, and illustrate them with examples. I will try to keep an historical basis apparent to show the process over time by which the ideas become negotiated and accepted. The language changed over time from the early stages, characterized by fantastic claims about the possibilities of VR, until around 1991, when a more cautious but self-confident mode became more common. The amount and breadth of the publicity which Virtual Reality attracted between 1989 and 1992 is evidence of the success of the ideas in finding cultural resonance.

A Brief Chronology

Virtual Reality developed from fiction in 1984 to a rich discourse and a marketed technology by 1992. Commentators on virtual reality often observe that virtual reality seemed to emerge independently in several places at once--that is hard to identify one origin.7 This in itself indicates how suited to its cultural context VR was when it emerged. While there are many precursors to today's virtual reality systems, the publicity VR has attracted is unprecedented. By as early as 1991 the industry was established.

Virtual reality emerged from several contexts: the computer industry, the military, NASA, science fiction, the arts, and counterculture. Science fiction has featured visions which have been identified as precursors to virtual reality.8 The idea of "jacking in" to a dataspace originated in William Gibson's 1984 novel *Neuromancer*. This novel introduced the term "cyberspace": the "consensual hallucination" of high-definition immersive graphical representation of data. Technical precursors to current systems include the head-mounted displays built by Ivan Sutherland in the late 1960s, and developed further in military and aerospace applications, such as McDonnell Douglas's 1979 VITAL helmet. 9 From 1982 Thomas Furness II developed the Air Force's "super cockpit" virtual environment systems. In these cases (up until 1989) these systems had limited publicity and were applied to specialized (expensive) uses. VR also represents an extension of graphics-based computer interfaces which have been broadly accepted in the Apple Macintosh and Microsoft Windows.

The VIVED project was a cheaper, smaller-scale virtual environment system developed at NASA. Michael McGreevy established the VIVED (Virtual Environment Display) project in 1985, and had created an immersive computer graphics simulation system by 1987. In October that year *Scientific American* featured VIVED--a minimal system, but one which demonstrated that a cheap immersive system was possible. It attracted some attention in computing circles.

The commercial development of VR systems began around 1988, with VPL and Autodesk. For the first time, they saw a mass market for immersive systems. Inspired by the NASA's VIVED, VPL started developing a virtual reality system which combined DataGlove input with head-mounted displays. Computer Aided Design company Autodesk started developing cheap VR software.

1989 saw VR appear on the public agenda, and it soon had a high profile. Over the summer of 1989 Autodesk had invested an intense development effort. An article "Is it live or is it Autodesk" was published in the Fall 1989 issue of the esoteric cyberpunk magazine *Mondo 2000*. *Rolling Stone* featured an interview with Jerry Garcia where he mentioned virtual reality10 . In April the *New York Times* featured an article about virtual reality and Jaron Lanier.11 In July, VPL and Autodesk launched their VR projects in "Virtual Reality Day," and they were greeted enthusiastically. Jaron Lanier was on the cover of the *Wall Street Journal* with a headline comparing VR to "electronic LSD." In August VPL and Autodesk

demonstrated their products at SIGGRAPH 89, the large annual computer graphics conference, where was also a session on "Virtual environments and interactivity."12 The success was quite dramatic. Many people greeted VR with excitement and enthusiasm. It struck a cultural chord.

By 1990 the research infrastructure had broadened, and more detailed explorations of the possibilities appeared in the media. Early in the year John Perry Barlow's in-depth article "Being in Nothingness" appeared in *Mondo 2000*. This was important enough to stir the imagination of its readership--mainly computer and cyberpunk subcultures. Bob Jacobson and Tom Furness founded the Human Interface Technology Lab (HITL) was established at the University of Washington. They established a conference on the academic computer network, Internet, called "sci.virtual.worlds." Another company, Sense8, was formed as a break-away from Autodesk's cyberpunk initiative. Mattel began mass marketing the powerglove, a cheap VR-like video game controller developed in conjunction with VPL.

1991 saw exposure of VR to a much wider audience, particularly with Howard Rheingold's book, *Virtual Reality*. By this stage twelve universities were offering VR subjects and there were 400 systems in world (most in Japan).13 British company W Industries released the first commercial VR entertainment system, "Virtuality" and formed a partnership with Horizon Entertainment14 to market the VR games in the US. In May the US Senate had a hearing about virtual reality.15

In 1992 the movie *Lawnmower Man* brought VR even wider exposure. The film cashed in on (and reinforced) VR's popular profile. Regular articles appeared in magazines, and several books had been released. 16 The Usenet newsgroup *sci.virtual.worlds* continued to grow. By 1992 there were 5 companies marketing complete VR systems, and 62 companies working on related technologies.17 By this stage, promoters started making some qualifications to the excessive claims of the early days. They were a little embarassed about the more outrageous claims, and could not deliver anything approaching some of their wild promises. This was, however, in itself a sign that they were starting to take themselves seriously.

Virtual reality is now widely recognized as a credible technology, and has a tangible discourse. It has this identity even though very few people have experienced it, and in spite of the lack of actual demonstration of the claims about its revolutionary potential. VR has gone from being a speculative vision to being broadly perceived as almost an inevitable development. It has attracted significant investment and research. In this essay I will try to establish why and how. This essay will analyse some of the persistent themes associated with VR which have helped it gain its profile.

Coming in from the margins

Military

The first fully-fledged application of head-mounted displays was in "Darth Vader" helmets developed in the early 1980s by the US Air Force. Funding for the project came from the enormous "Star Wars" military build-up during the Reagan presidency. Thomas Furness III started building a prototype at the Wright-Patterson airbase in Ohio, in 1982.18 He saw that fighter planes were becoming so complex and powerful they threatened to exceed the capabilities of human beings to use them effectively. A fighter pilot's tasks had become so complex and demanding new ways of controlling the flight and weapons became necessary. The new systems they created would allow pilots to access flight data in less abstracted, more intuitive forms. Informed by an analysis of the way humans use visual and auditory cues to determine spatial orientation, new systems were designed to make the controls fit humans better.19 The computers combined radar, control and weapons data into a simple graphical

form, representing the aircraft's position, speed, underlying landscape and target in symbolic form on the head up display. This was combined with auditory cues, also designed to simulate 3D space.

In 1982 Furness demonstrated a working model of the Visually Coupled Airborne Systems Simulator (VCASS). The second phase "Super Cockpit" project developed the system even further. These developments did not attract widespread publicity, even though this research was technically significant. While the Super Cockpit was a very high-resolution, fast virtual display, the publicity did not compare with that which the cheaper, inferior VPL and Autodesk versions would in 1989. The narrow and focussed purposes of the heads-up display--to make the pilot more effective in combat situations--reflected the institution's goals. To become a marketable technology, though, the set of possible applications would have to be expanded, and the public profile would have to be inverted: from secrecy to aggressive publicity.

Furness saw the possibilities for wider applications of the virtual world technologies, and, in the late 1980s sought to develop it beyond the military realm.20 He foresaw applications in industry, with virtual welders' masks and automotive design, in medicine, with virtual interfaces in operating theatres, in education, with virtual libraries, and entertainment, with interactive TV. He was excited about future possibilities: "It will be a wonderful and exciting future--welcome to the virtual world." 21 In 1989 he became director of the Human Interface Technology Lab at the University of Washington, which would become one of the centres of growth in virtual reality.

The military origins of many current technologies is imprinted in their very form. The history of investment decisions is implicit in many nonmilitary applications of computer technology. This is most clear in the proliferation of "shoot-em-up" games and flight simulators in current VR applications.22 Many video games involve flying jet fighters, shooting and bombing targets. These are common not only because players like these games, but also because weapons guidance and tracking research for military uses has filtered down into games.

Science fiction

> Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts...A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding...
> *--p. 67 Gibson (1984) Neuromancer*

This quote from *Neuromancer* is invariably cited by VR proponents as an inspiration for the new technology.23 Virtual reality had its origin to a great extent in the imagination of science fiction writers and readers. The ideas of hyperspace from *Star Wars*, transporter beams from *Star Trek*, cyberspace from Gibson, and many others were familiar fantasies. Science fiction is often a critical and oppositional fictional form, however. The ostensibly alien setting licences writers to discuss contemporary social issues without referring directly to what they criticize. Sci fi often presents dystopic visions of alienation and struggle against impossible problems. Extending the consequences of social trends can be more incisive than overt criticism. Sci fi in its critical mode can show that things perceived as natural and normal are in fact cultural constructs. *Neuromancer* was intended as social criticism, rather than prediction. As Gibson himself says it is not really a prediction at all:

> What's most important to me is that it's about the present. It's not really about an

> imagined future. It's a way of trying to come to terms with the awe and terror inspired in me by the world in which we live.
> *--William Gibson, "High Tech High Life. William Gibson and Timothy Leary in Conversation", Mondo 2000, Fall #7 (1989)*

The setting of *Neuromancer* is a desperate criminal underworld. Huge faceless corporations dominate an underclass. It is a hellish world where simulation is the only remaining reality. Plastic surgery is customary--people customize their bodies for beauty and function. Designer drugs can, for a price, provide any state of mind. The economy has become entirely ephemeral and imaginary--a "consensual hallucination," with no connection to peoples' lives. Technology is alienating and out of human control. The main character, Case, is a frustrated addict of cyberspace--as punishment for stealing from his corporate employers his nervous system has been sabotaged by neurotoxins, so he cannot "jack in." Gibson's fiction is not a prediction of some ideal technological dystopia--it is social criticism of the processes of alienation in contemporary society. Gibson saw massive social inequities, huge corporations, and an economy based on ephemeral computerized network space, and extended the tendencies into a possible future. Many fans of science fiction, though, do not read it as criticism, or at least they put this element aside. They enjoy it for its sense of fantastic possibilities--for the imaginative technologies it seems to predict. It is somewhat ironic that Gibson's dystopic nightmare has become inspiration for computer scientists to create the entity he feared (it's just like a twist in a science fiction plot, really).

Cyberspace, which embodied Gibson's fears, is now being built from his blueprint. The first virtual environments were created at NASA in the mid 1980s. Michael McGreevy incorporated science fiction visions into the NASA research in the mid-80s on VIVED (Virtual Visual Environment Display). Interfaces similar to Gibson's cyberspace decks in conception were relevant for NASA in remote manipulation and tele-presence. In 1988 John Walker launched the Autodesk "Cyberpunk Initiative." He invoked Gibson in a white paper called "Through the Looking Glass: Beyond User Interfaces." In it he proposed a project to produce within sixteen months a "doorway into cyberspace." The project's motto was "Reality Isn't Enough Any More." Walker ignored the element of social criticism in the fiction.

Randal Walser, manager of Autodesk's Cyberspace Project, directly referred to Gibson's model of the cyberspace deck in 1991. Walser's acknowledged goal was to replicate the fictional machine, or get as close as possible to it:

> In William Gibson's stories, starting with *Neuromancer*, an instrument called the 'deck' is used to 'jack in' to cyberspace. The instrument that Gibson describes in small enough to fit in a drawer, and directly stimulates to nervous system. While Gibson's vision is beyond the reach of today's technology, it is nonetheless, today, possible to achieve many of the effects alluded. A number of companies and organisations are actively developing the essential elements of a cyberspace deck...
> *--Walser, Randal "The emerging technology of cyberspace" in Helsel & Roth (1991), op cit p.37*

Gibson's vision of cyberspace was broken up and reassembled in a different context. Science fiction works can be informed by a critical and imaginative edge characteristic of the fringes of a culture. The US cultural mainstream tends to appropriate subcultural products into its corporate organization. In the case of science fiction, what became the VR industry accepted imaginative suggestions, while ignoring the ironic and critical context. The elements which were excessively critical or unacceptable were stripped off, reinterpreted or ignored. The ideas are repackaged, their critical challenges neutralized, and attached to more comfortable discourses.

By 1992 cyberspace had become almost inevitable--ignoring the critical nature of Gibson's original fiction. And so Michael Benedikt in *Cyberspace: First Steps* (1992) comfortably speculates "...the creation of cyberspace is not only a good, but necessary, and even inevitable step."24 He claims cyberspace solves the information overload produced by the proliferation of information technologies. Benedikt explores in some technical and phenomenological detail how cyberspace could be implemented, with only a passing acknowledgment that Gibson had not actually liked the idea of cyberspace much at all.

Counterculture

VR emerged partly as a product of a dialectic between the growth of Silicon Valley high-tech industries and the social and political ideals of the Californian counterculture. The counterculture, established in the 1960s around Civil Rights and anti-Vietnam War movements, has continued in various forms since. Building a new reality inside a computer is a new form of technological utopianism. When changing social reality seems too hard, why not create a new reality? They envisioned technologies which could be so powerful they would force the mainstream to change its perceptions about reality.

The Cyberpunk movement appeared as a self-conscious subculture in the mid 1980s, at the intersection of alternative culture and technology. When VR splashed onto the scene, Cyberpunk was the centre of the ripple in the cultural pond. The term "Cyberpunk" was first coined by Bruce Bepkie in a short story.25 It represented a merging of science fiction and bohemia26 --high-tech comes to alternative lifestyle culture. It was socially critical, invoking individualistic heroes rebelling against a faceless, corrupt system. It envisioned virtual reality bringing new kinds of human understanding. Cyberpunk was important in the early stages of the development of virtual reality. The magazine *Mondo 2000* was the biggest cyberpunk publication in the late 1980s, and became a platform for Virtual Reality. Topics included high-tech developments, mind-expansion, science fiction, hackers, alternative music, alternative health, drug culture and sexuality. VR was naturally very attractive to this audience.

It also became popular in dance music culture. For example an interview with the band Deee Lite in *Mondo 2000* referred to the connection between VR and tropes of social awareness, freedom and love. Of course there were necessary references to the 1960s and Woodstock.

> DMITRY: Wigtock is...a festival of like 8000 people in Tompkins Square Park run by the notorious drag queen Lady Bunny. It's a real celebration of freedom and expression and individuality...with social awareness.
> LADY MISS KIER: We should have a Virtual Reality program of Wigstock so everyone can experience it...very much like drifting into cartoon land in broad daylight. It's gorgeous. And it's basically--well, I'm not going to say it's drug free, that's a little naïve--but it doesn't rely on Ecstasy. And love is really the theme that comes up onstage throughout the day.
> *"Like Tapping into the Soul of a Deep Program" Mondo 2000, Issue 3, Winter 1991*

The main spokesperson for the liberating potential of virtual reality in 1989 and 1990 was Jaron Lanier. For a while he was the most prominent promoter of VR in the press. Since 1992, though, he has disappeared from the limelight. His unconventional appearance (dreadlocks and a beard) differentiated VR from corporate computing. In a 1990 interview in *Mondo 2000,* Lanier spent half the interview diagnosing the moral and spiritual crises of Western civilisation, what he called "Thre American stupor," and the other half praising virtual reality:

> In Virtual Reality there's no question your reality is created by you. You made it...I think being in that mode of realizing how active every moment in life is will break through the stupor.

He argued "Virtual reality is the first medium to come along which doesn't narrow the human spirit..."27 and "All you can do is be creative in Virtual Reality..." He said VR would free the imagination of the masses, "help people to communicate" and bring a new kind of spiritual understanding.

The faith in computers as liberators has deep roots in US and California. Virtual reality is the battlecry of latest generation of technological advocates. In previous cases, however, dreams of social change have not been fulfilled. Successive visionaries have envisioned technological solutions to the political questions of social movements. By ignoring the political questions, though, the process of implementing the ideas has often transformed their visions into caricature. Buckminster Fuller promoted technologies which could better use and distribute world resources. He inspired the geodesic dome at the EPCOT Centre at DisneyWorld, a sanitized, artificial, hyperreal corporate utopia.28 Marshall McLuhan was optimistic that "...the electronic age is literally one of illumination." In 1964 he predicted that in the automation age teachers "may well become the only group" of employees. 29 The cuts in education spending during the 1980s in the pursuit of high tech military technology were an ironic inversion of McLuhan's optimism. Daniel Bell announced "post industrial society" in 1967, where technology would bring leisure for all.30 While falling employment has indeed become a feature of society since, the fact that it has most often been involuntary is an unfortunate twist. Stewart Brand's 1973 Computer Lib cried out for "COMPUTER POWER TO THE PEOPLE," and foresaw computers as personal rather than corporate. The term "personal computer revolution" has become accepted as a fair description of the growth of computers in the 1980s. This is a term which began as metaphor has become accepted as literal. Computers have indeed become more widespread, but the domination of the industry by large corporations has continued. The technology has not been socially revolutionary.

A similar shift is occurring with VR and cyberpunk: the component of social criticism is dropping away, and the enthusiasm has been transformed into entrepreneurial fervour. Cyberpunk defines itself as marginal, esoteric, oppositional--a counterculture. As such it must keep moving, redefining itself, shifting its identity.31 There was a tension between the oppositional and peripheral nature of cyberpunk and the VR marketers' goals of breaking into mainstream. While cyberpunk had energy and imagination, mainstream industry had capital. So, for example, it wasn't until Atari marketed Jaron Lanier's hit video game, *Moondust*, that Lanier had the capital to start VPL. VPL grew especially from the DataGlove contract with NASA in 1985, the sale of complete VR systems to universities and researchers from 1989, and the PowerGlove contract with Nintendo in 1990. In 1988 and 1989 VR was strongly associated with the cyberpunk subculture. However, for VR to grow it needed to move away from this marginal context. The best illustration of this process is how the association between VR and psychotropic drugs changed as VR became more mainstream.

Drugs, dreams, metaphysics and insanity

> The closest analog to Virtual Reality in my experience is psychedelic, and, in fact, cyberspace is already crawling with delighted acid heads. The reason Jaron resents the comparison is that it is both inflammatory (now that all drugs are evil) and misleading. The Cyberdelic Experience isn't like tripping, but it is as challenging to describe to the uninitiated and it does force some of the same questions, most of them having to do with the fixity of reality itself.
> *--John Perry Barlow, 1990 "Being in Nothingness"*

Much of the early publicity about VR was focussed on "electronic LSD." Researchers claim most of this came from the press rather than the researchers themselves.32 But the links between drugs and cyberspace are explicit in *Neuromancer*, and drug mythology is a significant influence in the subculture from which cyberspace emerged.33 Timothy Leary, notorious advocate of mind-expanding drugs in the 60s, was involved with early promotions of VR. In 1989 Autodesk used Timothy Leary in an early promotional film. Leary was enthusiastic because he thought VR could break down the "straight" idea of a Real World or an Absolute Reality like he had claimed LSD could, but without the stigma attached to 'drugs'.34 At this stage the discourse of VR was still marginal (or even oppositional) to the mainstream culture. It was centred in a subculture where drug-taking was acceptable. The links between the drug culture in the 60s and VR in the 90s was quite direct. Stewart Brand, who had organized the San Francisco Trips festivals of 1966, organized the Cyberthon at SIGGRAPH in 1990.35 The mainstream culture was, predictably, not receptive to the psychedelic connotations. It was alienated by the perceived links with drugs and deviancy:

> When Timothy Leary, a resurrected 1960s bogey man, gave his blessing to VR, mainstream America and Europe shuddered. They had seen this before--the typical self-indulgent, hedonistic, Californian drop-out scene. Virtual Reality attracted the attentions of self-styled 'cyberpunks', and 'hackers', and suspicions were confirmed.
> --*Sherman & Judkins (1992), p32*

Stories appeared in the mainstream press warning of the dangers of addiction to VR experience, and troubled by the potential psychic damage VR might cause. The actual danger of addiction to VR had no clinical basis--the technology barely existed. The debate resulted largely from the metaphors used to talk about the technology, and from the associations the technology had with the Californian drug subculture. The cyberpunk enthusiasm for "cyberdelic" experiences was echoed in inverse by the anti-drug fraternity.

When companies like VPL, Sense8 and the HIT Lab started marketing VR gear from mid-1989, and claiming 'serious' uses, they started to try to change these perceptions about the technology. They moved the discourse away from the subculture which originated it--distancing it from the drug allusions:

> No. No. No. Look. Virtual reality affects the outside world and not the inside world. Virtual reality creates a new objective level of reality. You enter it in a waking state. There's a clear transition. You can't really abuse the stuff."
> *Lanier, p.45, Mondo 2000, June 1990*

And Bob Jacobson in 1992 was still keen to counter the perceptions about VR's association with drugs:

> Externally, we still have to deal with a popular press that is lazy, inaccurate, and sensation-seeking, which two years after the *Wall Street Journal* coined the genre, cannot resist the "electronic LSD" story. This week, our own Seattle *Times*, usually the most stuck-in-the-rut paper in the Pacific Northwest, chose the e-LSD theme to try and break out of its Sunday-morning literary straitjacket. Only the readers didn't know how hackneyed were the writer's breathless warnings about virtual addiction; everyone else, from writer to publisher, had been informed. But the article ran anyway.
> *--Robert Jacobson, "Where In The (Virtual) World Are We? Building A Virtual Worlds Industry" at "Virtual Reality 92," September 24, 1992*

The connection with drugs was not invented by the media. It was initiated by Leary and others, and re-interpreted by the media. To reach a mainstream market VR developers had to

deny these associations, and move away from the counterculture from which VR had emerged. Meanwhile, the counterculture saw the shift of the technology and became cynical about its mass marketing, and VR lost its attraction for those who had seen it as a means of social change. The developers had to make it palatable and attractive to the mainstream, and demonstrate VR had serious applications such as medicine, architecture and design. It also had to place itself and its particular significance in history.

Making History:

Edison and the Wright Brothers, Microsoft and Apple

> And there was that loincloth-and-machete sense of enterprise which one might have experienced in the Wright Brothers' Akron Bicycle Shop or Jobs' garage in Mountain View....By June they had an implementation which, though clearly the Kittyhawk version of the technology, endowed people with an instantaneous vision of the Concorde level.
> *--Barlow, John Perry (February 1990), "Being in Nothingness"*

> VR is now at the Wright Brothers stage, the thing's sputtering and popping and just barely getting off the ground-and everyone's trying to predict what moon-rockets will be like.
> *--Jeremy Wolff (24 June, 1990), "Inside Virtual Reality"*

> In terms of VR history, putting my hands and head into Sensorama was a bit like looking up the Wright Brothers and taking their original prototype out for a spin.
> *--Howard Rheingold, (1991) p.50*

> The Wright Brothers could not have imagined their Kittyhawk machine developing into the stealth bomber or becoming the main shrinking agent in the global village...
> *--Sherman & Judkins (1992) p.13*

> Just like the Wright brothers' airplanes, today's VR technology is crude compared to what can be envisioned, but it's good enough for us to get off the ground and into the air for an exciting experience.
> *--Pimentel & Texeira (1993) p.241*

Emerging from margins, VR needed to demonstrate its viability as an industry, and its potential for investors. A critical part of this process is placing the significance of the technology in historical context. Developers began to foster a perception of VR as the early stage of a potentially a huge industry. To do this, it compared the early incarnations of VR technology with the early stages of other significant technological developments--retroping historical success stories. One of the most common comparisons was flight, and the Wright Brothers. Comparing the early stages of VR with the early models of aircraft does two important things. First, it accounts for the problems of current models of VR, with their slow frame rates, low resolution fuzzy graphics and slow response times. The Wright Brothers aircraft were equally flimsy.

Second, as a narrative, it implies that a fully operational technology is inevitable. The way the story is constructed is that these early models will be superseded, and will change the world, just like flight. The Wright Brothers is a natural comparison, because the "Story of Flight" always begins there, and the significance of flight is apparent. The reference to this historical narrative implies these developments are only a matter of time.

The claims about VR's promise appeal particularly to the American entrepreneurial spirit, which is itself reinforced by re-telling "road-to-success" narratives, including the one about the Wright Brothers. These stories relate the triumph of individual brilliance, persistence and vision. They draw attention to the possibilities for exploiting a young technology at ground level. In fact, whether VR develops or not depends on funding. How it develops will be affected by which projects get support, and how much support. This in turn, relies on the attitude of investors (and markets) to the technology. If these narratives are accepted both by investors and markets, VR could become a self-fulfilling prophesy.

Other technological success stories have also been used: Gutenburg and the printing press; Edison and the light bulb; Alexander Graham Bell and the telephone; Henry Ford and the motor car, and the phenomenal growth of companies like Apple and Microsoft.36

After the initial burst of enthusiasm about virtual reality in 1989 and 1990, the pace of the industry slowed down. Developers tried hard to show confidence that VR would succeed. For example, Autodesk's Randall Walser explained to a conference audience in 1992 that the slow progress on cyberspace being broadly adopted was to be expected:

> Comparing the emergence of cyberspace to the emergence of other industries, it is clear there's nothing exceptional about a cyberspace industry, exceptional as cyberspace itself may be. It took over ten years for the movie industry to emerge from the time the enabling technology of filmmaking was invented...
> *--Randall Walser, "A de facto anti-standard for cyberspace," A speech at Meckler Virtual Reality Conference, Fairmont Hotel, San Jose, California, September 23-25, 1992*

Virtual reality is an industry which exists because of its success in attracting investment. Unlike the security for developers which came from the blank cheques written for military projects, commercial research and development is precariously dependent on investors' whims. Walser was painfully aware of this, and tried to mobilize enthusiasm of investors by warning them of the dangers of losing opportunities. He argued cyberspace had not been developed as quickly as had been predicted because of a lack of "will" to develop the new kind of systems. Occassionally he lapsed into pure sales pitch:

> What I'm suggesting is that cyberspace entrepreneurs have a unique opportunity, today, to change the rules of the game in the computer industry. While I'm skeptical of revolutionary proposals to leapfrog today's computer industry in a near time frame...I do believe that cyberspace entrepreneurs can accelerate the evolutionary processes that will eventually lead not just to new rules, but to a whole new game.
> *-Walser, Randall, ibid*

What are the implications of VR, and how do they compare with flight, the car, electrification or the telephone as agents of social change? VR technologies (immersive navigable computer simulations with head-mounted displays and multiple input devices) do not compare in significance with the development of print, light bulbs or flight. VR is one part of a broader set of computing and communications technologies which have developed in the past ten years. VR would not have been possible if the computer operating systems and graphics, portable displays, communications protocols and infrastructure, input and tracking devices, had not been available. Each of these new technologies are very significant, and the combinations they will be put into are likely to have deep social impacts. Focussing particularly on VR is misleading, because it tends to ignore the significance of each component of the enabling technologies. They also overplay the significance of head-mounted displays, for example, which are too cumbersome and expensive to be likely to have long-term, widespread appeal. Grouping all technologies under one title tends to gloss

the strengths and limitations associated with each.

"Virtual reality," however, has become a cultural handle which attaches to a diversity of new ideas and technologies. While it is an inaccurate and misleading term, it is widely used, and has assumed a meaning in its own right. It has changed popular impressions of what technology can and should do. One of the sources of its strength was its ability to absorb other cultural meanings to inform its own development.

Science

The goal of VR is to fool people's senses into believing they are in the artificial "environment," so developers naturally looked to psychology and physiology for ideas on the way processes of perception operate. For visual "realism" various VR systems have taken into account factors such as stereo-optical vision, accommodation, spatial and motion depth cues and perspective.37 Virtual reality's current strength and vitality came partly from its openness to outside influences. The process of borrowing from elsewhere was quite often troublesome, though. The subtleties of the original fields were often lost in translation.

In a 1988 paper, "Harnessing virtual space," Thomas Furness III began with some observations about human perception. His subheadings included: "Humans are spatial beings," "Humans have two visual systems," and "Humans have two brains." His background in perception helped inform the design of the new hardware and software. Unlike other computer interface designs, which built systems to perform computational tasks, Furness began with the user and built the hardware to suit. Interface design and information display was a major field by the mid-1980s. In this paper for the Society for Information Display, he set out some of the conclusions he had reached. Using biological ("The focal visual system is mediated by the fovea of the retina...") and technical terminology ("we discern the orientation of sound sources with an accuracy of about 1 degree in the azimuth plane and 5-10 degrees in the medial (or frontal) plane..."), Furness implied his speculations about virtual space systems were scientific. Somehow, though, the language does not quite fit the actual application. While the applied systems developed in the Super cockpit may have been effective, the connection with theoretical science is more distant than Furness would like to acknowledge. Applied science borrows the language, and some of the conclusions of basic science, but abandons some of its critical insight and scepticism. The observations about the nature of human perception are oversimpified and taken out of context.

For example, he refers to the functional differentiation of the brain cortexes, and split visual system. He fails to demonstrate the relevance of these observations, or to acknowledge the speculative nature of these theories. The main value of scientific discourse to Furness is to give his claims an air of authority.

Aukstakalnis and Blatner's late 1992 book *Silicon Mirage* opens by examining how human senses operate, and moves on to how virtual reality should be designed to be sensitive to these issues. The book goes into some detail describing physiological and psychological mechanisms of human perception. It is a more mature work than Rheingold's 1991 *Virtual Reality* or *Glimpses of Heaven, Visions of Hell.* There is a more considered analysis of many of the more outrageous claims about the technology. It is a well researched synthesis of the computer and biological/psychological discourses. But, like Furness's paper, it suffers from oversimplification and a failure to connect the science with the application convincingly.

Romantic Historical Narrative

Virtual reality claimed to be both a science and an art (possibly to escape rigorous examination as either). Proponents often identified VR with a Western tradition of

technologies (and techniques) which represented or simulated "reality." Many introduced VR by relating histories of the traditions of representation and art which had lead up to VR. The claims about virtual reality are reminiscent of claims about the wide screen formats Cinerama and Todd-AO, released in the early 1950s.38 Cinerama claimed to be the first medium which allowed the audience to truly participate in the fictional world. Its promotions implied the co-presence of the audience and the art: a spectacle so absorbing that "You're in the show with Todd AO...You live it. You're a part of it" 39 Similar claims are now made about VR. Although the perceptions about what characterizes "immersion" or "audience involvement" have changed, the claims are quite similar. "Realism," which each time is sold as an absolute, is a cultural construction which changes depending on the place, time and technology.

The resemblance between wide screen and VR continued in marketing techniques. In each case the new technology was introduced by placing it in a historical framework. The historical narrative was structured in a romantic mode, where the lines of history converge on the technology. The history not only describes the pre-cursors to the technology in an ascending curve, but it places the innovation as the cathartic moment: the climax of the drama. In the case of Cinerama, the film *This is Cinerama* introduced the new, very large-screen format in September 1952.40 It began with a thirteen minute narration by newsreel commentator Lowell Thomas in black and white, standard width 35mm. He traced a history of art from cave paintings to frescoes, to moving pictures:

> Artists, photographers and motion picture cameramen...have worked since the dawn of history to give the illusion of depth, dimension and space...to convey the sense of living motion...

He continued to discuss the limitations imposed on artists by the frame, and the inadequacy of previous technologies. He constructed a historical narrative which drew a line of causation from the beginning of art inexorably toward Cinerama. Before Cinerama, artists were frustrated by the constraints of the frame and the distance of the audience from the artwork. Cinerama was the culmination of all previous developments, and the answer to all the problems: at the climax of the lecture, he said, "Ladies and gentlemen, this is Cinerama..." The curtains in the cinema opened to three times their previous width and the panoramic screen was filled with the view from the front of a rollercoaster carriage, in full colour, accompanied with stereo sound.

Quite often Virtual Reality has been similarly been located in at the apex of a similar historical narrative:

> Throughout history, attempts have been made to capture the essence of an experience and distil it in some form to make it available for us to enjoy and analyse...
> --*Pimentel & Texeira (1993) p.19*

This kind of historical narrative is so common it often evades being read as a construction. Using the authority of so-called historic objectivity, speculation is presented as description. By talking about developments in historical order, the writer eludes issues of scale and context. For example, the claim that virtual reality will have major social significance is given authority by these historical comparisons:

> Just as the alphabet and the printing press changed the way people thought, virtual reality will shape our notions of community, self, shape and time.
> --*Pimentel & Texeira (1993), p.240*

Linear history always oversimplifies processes of causation. In each case, the history is written in a way which privileges a central character or theme: in this case virtual reality.

History as a cultural text is not neutral. Metaphor influences the meanings associated with the history, but the text does not acknowledge that it is in fact a construction.

There are many historical metaphors used to which VR has been compared. Some other common examples include social Darwinism ("The Evolution of Cyberspace,"41); childbirth ("Still, everyone realized that a baby this size would be bound to occasion some labor pains,"42); space exploration "Blastoff at NASA,"43); palæontology ("stone age"); and "The tip of the iceberg." ("The first step on a long journey. The infancy of the technology,"44 As Aukstakalnis and Blatner comment: "There's almost no way to circumvent using a cliché to describe where we are right now in relation to the future of virtual reality."45 The following sections will examine in detail another common metaphor: the frontier.

Not every narrative fulfils its implied structure. Another example of historical narrative abour VR, which broke slightly from the traditional form, is Barlow's "Being in Nothingess" which traces a history of symbolic communications from when "the Sumerians started poking sticks into clay and claiming that the resulting cuneiform squiggles meant something..." The history continues through the Greek and Egyptians and to Don Quixote. From Cervantes "any experience could be plucked from its holy moment in time and pressed like a flower in a book, to be reconstituted in the imagination of the reader." But, Barlow said, the inadequacy of the descriptive power of words and symbols is frustrating. The twentieth century has also seen the formation of a huge "DataCloud," says Barlow--an unending stream of meaningless statistical information which defies analysis from its sheer quantity. Interestingly, Barlow's narrative stops short of the expected conclusion (that VR would be the solution to these frustrations). He modestly asserts: "Virtual Reality is probably not going to cure this nonsense any more than television...has done...If it won't contain the DataCloud, it might at least provide some navigational aids through it."

The historical narrative was useful for proponents of virtual reality. It communicated a sense of scale and importance, and created an aura of intellectual authority. It posed historical problems which proponents duly showed that VR could solve. It projected a future of VR as a natural extension of the historical process which they described. The history was an important foundation, but it remained crucial that the discourse move into more tangible applications, and colonize the mainstream.

Cyberspace and the Frontier Myth:

Columbus, the Frontier and Neil Armstrong

In 1989 VPL laid claim to the "new continent" of virtual reality. The "new frontier" analogy is a reference to the history of discovery and colonization of the United States. It conjures images of strong, independent men forging frontiers into a heroic wilderness with the promise of unlimited prosperity and freedom. The analogy to colonization is quite pertinent.

The idea that VR researchers were "pioneers," involved in "colonization" appeared quite often, particularly in the year after VR's first public appearance. It was not only because VR was new that made this analogy popular: it was the nature of the technology of cyberspace. The head-mounted binoptical display is designed to provide an experience of 3D space, and the experience of immersion and navigation create another new kind of space to explore--a new frontier.

Cyberpunk magazine *Mondo 2000* headed its Summer 1990 edition "The Rush Is On! colonizing Cyberspace." The major article, by John Perry Barlow, "Being In Nothingness," is subtitled "Virtual Reality and the pioneers of cyberspace." Barlow describes VPL as "the other trading post on VR frontier..."(p37) The article is rich with cultural allusions. Barlow

makes a direct comparison to historical events:

> 'I think this is the biggest thing since we landed on the Moon,' says Jaron Lanier, the dreadlocked CEO of VPL Research. (Who was 9 years old in 1969). I don't choke on that one. Indeed, I'd take it a bit farther, guessing that Columbus was probably the last person to behold so much useable and unclaimed real estate (or unreal estate) as these cybernauts have discovered.
> *--John Perry Barlow, (1990) "Being in Nothingness," p.37*

Researchers claimed a moral responsibility to fulfil an historic destiny, comparing themselves with historical precedents, like the original White colonizers of North America:

> As pioneers, we are obligated to pursue the development of virtual interface technologies in a systematic way and leave a technology base and tools as a legacy for others to build upon.
> *--Thomas A Furness III, "Creating better virtual worlds"*

The theme of the frontier is familiar to Americans. The idea can be traced largely to historian Frederick Jackson Turner, who in 1893 argued that the American character was formed by the process of struggle on a series of frontiers.46

A central component of the frontier myth is the importance of space. Turner's history gave primacy to geography as a formative forces on the American people.47 "The factor of time in American history is insignificant when compared with the factors of space and social evolution..."48 The frontier thesis captured the imagination of many historians of the day. Since then the idea has been absorbed into popular mythology. For Turner and many since, the 19th century Western frontier represented freedom to move and opportunity to grow and prosper. Writing in the 1890s, just after the frontier was deemed closed, he feared this end of the frontier would be an end to American prosperity and opportunity. This implied a need to find further frontiers to maintain the nation's strength and vitality. The frontier has been used since as a metaphor for freedom and progress, and has been applied to many phenomena. Space exploration, especially, in the 1950s and 1960s was often called "the new frontier."

The idea of virtual reality as a cyberspace establishes its continuity with these previous frontiers. The comparison associates the new technology with freedom, opportunity, progress and individualism. VR and cyberspace find particular resonance within US culture because of its spatiality. Text-based hypermedia cannot claim the same. VR researchers were conscious of the significance of this, and emphasized it:

> A property common to all virtual worlds, however, is their spatiality. Information within these worlds is presented in three (or more) dimensions.
> *--Robert Jacobson, 1991, "Bringing virtual worlds to the real world: toward a global initiative" from sci.virtual.worlds*

Barlow extended the frontier metaphor,

> ...the presence of such unclaimed vastness seems to elicit territorial impulses from psychic regions too old to recognize the true infinity of this new frontier. Disputes appeared like toadstools in the rich new soil of cyberspace.
> *--John Perry Barlow, "Being in Nothingness"*

There is no boundary to separate accurate description of the nature and function of the technology from potentially distorting allusions to cultural myths. New ideas have to be introduced with old language. Therefore metaphor needs to be used. While this brings a semiotic power to help communicate complex ideas, it inevitably transmits a broad range of

meanings over which the speaker has less control. The VR interface certainly may be very useful for manipulating 3-D objects in a way that is more "intuitive" than keyboard commands or a mouse. It may also allow interaction with a more natural seeming experience through its graphical representation of space. However, it remains essentially a computer with its attached peripheral devices, and not a real metaphysical or ontological challenge.

What tended to happen, though, were claims that what had been metaphor had become literal truth. Rather than saying VR was *like* a new reality, developers started claiming it was *actually* another reality. Jaron Lanier argued VR went beyond being a medium: "It's not even a medium,. It's a new reality."49

> The computer is a map you can inhabit...Virtual reality is a new landscape, not a new map. That's what makes it completely different from computers.
> --Jaron Lanier (1990), "Life in the DataCloud," Mondo 2000, p.49

> It seems clear that "virtual reality" is not simply a metaphor for this new environment, but a legitimate description.
> *--Meredith Bricken (1989), "Inventing Reality" p.8, HITL paper, HITL-M-89-2.*

Claiming authenticity for the metaphor is an important way of making the technology appear natural and relevant. By appealing to the US cultural imagination's attraction to space, and perceived opportunity, they attracted attention to the technology. Once the connection had been made, VR proponents tried to reposition the tropes (reality, space) from a relationship of metaphor to synonymity.

Another cultural undercurrent VR taps is the value placed on direct experience versus abstraction. This prejudice can also be traced to the frontier myth: Turner argued that the American character became different from Europeans through the process of forging the frontier. The characteristics of the frontiersman were: "coarseness and strength combined with acuteness and inquisitiveness...that masterful grasp of material things...these are the traits of the frontier."50 Turner identified, and thereby reinforced, a tendency in US culture to value direct experience over "book-learnin'" and action over contemplation. This is a cultural value, not a feature of human nature. Popular heroes from Daniel Boone to Rambo have embodied these attributes and reinforced the stereotype.

A central tenet of VR is that is experiential. Unlike other types of computing, which require symbolic abstraction, VR allows dealing with computers to be a direct experience--therefore something familiar and attractive.

> Because the participant is both physically and perceptually involved with the environment, the process co-ordinates the cognitive, the psycho-motor, and the affective domains of experience. The importance of experiential learning has been acknowledged for over one hundred years.
> *--Meredith Bricken, "A description of the virtual reality learning environment"*

Randall Walser from Autodesk was another who emphasized the experiential nature of VR, for example in a 1990 paper "Elements of a cyberspace playhouse." His choice of the "playhouse" analogy in itself emphasized the physical nature of this kind of interaction with a computer. The playhouse was Walser's somewhat far-fetched vision of a shared computer-generated space to play games and interact with others. He argued that virtual reality emerged at this time because of what he said was the recent breakdown of the dualistic division between mind and body. He referred to Mark Johnson's book *The Body in the Mind*, which, Walser said, challenged the Western separation of abstract thought from physical experience:

> The new perspective on human/computer interaction is due in part to recent advances in computer graphics and simulation, and in part to reductions in the cost of key user interface technologies. The new perspective was precipitated, though, by the growing realization in the scientific community that the basis of rationality is not in the world, as had been supposed, but in the human body.
> *--Randall Walser, "A Cyberspace Playhouse", Proceedings of National Computer Graphics Association, Annaheim, March 19-22, 1990*

The new paradigm, he said, placed a central role of the human body in human thought and self-perception, rather than ideals of rationality and Platonic truths. The means by which we come to understand the world--our senses and our body--are critical to the nature of this understanding. What do you know, it's just like VR! Walser borrowed intellectual credibility by claiming the new technology was "precipitated" by developments in the "scientific community," rather than in the imagination of Californian cyberspace entrepreneurs. He was quite imaginative in claiming that completely unconnected intellectual work demonstrated the necessity for his inventions. The link between the two developments are pretty tenuous, but did serve Walser's purpose.

VR transcended two of the most serious limitations of interacting with a computer simulation: the lack of a sense of space, and the distance from direct experience, by claiming their technology could create a new form of space and a new kind of experience. The language of Lanier, Walser, Gullichsen and Rheingold fostered the perception that VR can provide direct experience rather than encoded or mediated knowledge. They conjure up a new kind of computer pioneer-hero. The metaphors "exploration," "interaction" and "immersion," central to virtual reality, emphasize engagement, involvement, control and action. While not literally true (these activities are all contained within the computerized virtual (metaphorical) world), the terms denote activities which are literal and direct. This paradoxical quality of virtuality: being neither entirely literal nor metaphorical, gives the term its power. Computers cannot make space or provide a synthesized experience identical with direct experience. Until VR, computers were not associated with direct engagement, because they were conceived of computers as tools. VR confronted the limitations of computers by facing them head-on.

Colonizing the Mainstream:

VR and Other Discourses

The term "colonization" is appropriate to virtual reality another way: the colonization of other discourses. To construct their discourse, virtual reality proponents had to establish a shared terminology and set of assumptions. They did this by incorporating and adapting the language of other discourses. Michel Foucault used the term *colonization* to mean the coming to dominance of certain ways of viewing the world, and this has clearly happened with virtual reality.51 VR is a computer-based technology, but as a discourse it has attempted to colonize a range of older, traditionally non-computer-based discourses: among them design, art, entertainment, communications and even philosophy. It claims to have an "enabling technology" which can do old things better. This process involves re-troping (changing the meanings associated with) both the technology and the traditional discourses. To do this, VR proponents had to attempt to change the perceptions people had about computers, and about other discourses with which computers had not previously been associated. Over time, there have been shifts in who is talking about VR, and in what terms. In the early stages it was mainly the cyberpunk subculture and computer people introduced the idea. Journalists (notably Barlow and Rheingold) helped bring attention to the technology. Researchers in other fields, such as architecture, the arts, entertainment and even philosophy have also taken up the discourse.

Databases, Weapons Delivery, and Nuclear Physics

The meanings associated with computers have changed significantly over time. The early computers were built in the 1950s in large institutions--the military, universities, and corporations. They were very expensive and inaccessible. Consequently, the work they were used to perform tended to be related to specific objectives such as calculating weapons trajectories, physics equations, or keeping track of data collections. For example, nuclear physicists relied on computer power to track the complex equations needed for nuclear power plants or weapons. Therefore until the late 1970s computers tended to be associated with these monolithic, purposive applications. The discourse of computing was highly technical, closed and specialized. The general public were often mystified by computers, and sometimes feared them.52 Some utopian futurists, as discussed earlier, foresaw utopian possibilities of computers and automation leading to a leisured, post-industrial society.53

One of the biggest popular influences on perceptions about computers was media theorist Marshall McLuhan.54 His broadening of the definition of a medium, and his technological utopian vision of the global village were the major contributions which have influenced computer developers. Researchers cite McLuhan as someone who changed their idea about computers: "The computer is a medium! I had always thought of it as a tool."55 Computers are now commonly considered media.

The personal computer "revolution" fulfilled McLuhan's prophesies. It changed computers from specialized, enormous machines in institutions, to multifunctional, accessible, portable equipment. From the Altair, Sinclair and the Apple released in the mid-70s, to the IBM PC and Apple's Macintosh in the early 80s, computers moved into people's everyday lives.56 Computers in the West are now on office desks, and in many homes. This has changed the cultural values associated with the computer. For example, the BBC TV documentary *The Thinking Machine* compared the history of computers with the history of the book. They pointed out books were once the property of an elite few (manuscripts in monasteries), but with the printing press books became cheaper and universally accessible. The choice of this analogy of the book in itself demonstrates the shift of meanings and tropes around computers. In the late 1980s and early 1990s the pace of development, the breadth of adoption of computer systems, and the growth of companies was so dramatic that computer industry had enormous self confidence. In this atmosphere it seemed anything could be possible.

In his original 1988 Autodesk white paper, "Through the looking glass," John Walker placed VR as the natural conclusion of the progression in human-computer interaction. His historical narrative described the way people interacted with their computers. The story began with batch cards, then to VDU screens, menus, icons, and finally to VR. At every step in this history a new barrier was breached. This narrative is constructed with the intention of showing that VR is the inevitable and logical conclusion to a historical process. The drama is based on the central character, the ideal computer user. This user has to overcome a series of barriers to find perfect interaction with the computer. Over the time from the first computers, the user returns several times in a mythical challenge, but with each step, a new barrier appears: the countertop, the terminal, the menu hierarchy. Finally, in the cathartic moment, the ideal user, equipped with virtual reality, transcends the final barrier of the screen. He lives happily ever after at one with the computer.

The biggest success of computers outside business has been games, from "Pong" and "Space Invaders," and increasing in sophistication and power since. These have been popular, especially with teenage boys, but have never been broadly accepted in the same way film or television have. They tend to be perceived by many as a frivolous waste of time, rather than respectable entertainment. The huge success of Sega and Nintendo home entertainment systems have provided hard economic evidence of the saleability of computer entertainment,

and in fact, the videogames industry has been a major contributor to virtual reality research.57

It is in this context of changing meaning of the computer which VR emerged. VR stretched the tropes around computing some notches further than even the most self-confident software developer or games designer. VR researchers were aware they needed to extend the perceptions about computers. They claimed VR was a paradigm shift in computing:

> Any technology which has the audacity to call itself a variety of reality must also propose a paradigm shift. In essence, a paradigm shift expands the potential of an entire discipline...Computers are not just symbol processors, they are reality generators.
> *--William Bricken (1990) "Virtual Reality. As unreal as it gets"*

Video games technology has been re-badged with a new and more fashionable tag: virtual reality. The term has become so loosely used that it is often applied to almost any interactive graphics system. The technical differences between VR and video games technologies are quite small, but proponents of serious VR have tried hard to distinguish their systems from the games. They called themselves "scientists"58 , and emphasized the practical relevance of their applications. This was a significant shift, but in language and paradigm more than in the actual technology: they claimed VR could be a gateway into another reality. Jaron Lanier from VPL was quite aware of the nature of the task: "Remember we're doing cultural alchemy here. We're introducing a new talisman into Western Civilization."59 McLuhan was referred to regularly by Lanier60, Bricken61, Benedikt62, Randal Walser63, and Rheingold.

Researchers knew they needed to position their newly formed discourse into fields perceived as socially valuable so VR could absorb the credibility by association. Constructing the historical context was important, but VR needed to find itself a way into other disciplines by demonstrating its relevance in practice. Some of the common directions they headed toward were entertainment, communications, design and medicine.

Hollywood, TV and Disneyland

> It's Disneyland for epistemologists.
> *--Barlow, Being in nothingness (op cit)*

> My idea of virtual reality is that, in the long run, it's going to shut down television.
> *--Jaron Lanier, "Life in the DataCloud," Mondo 2000 #2, Summer 1990, p.44-54*

> It's truly a quantum leap in entertainment technology and has been hailed as the greatest advance in leisure since the invention of moving pictures.
> *--W Industries CEO Jon Waldern, Press release, Orlando, Florida, 12th November, 1991*

When VR moved in the direction of entertainment it found fertile ground to colonize. To succeed it had to establish why it was superior to existing technologies, and that it was relevant and credible in this context. The major claim VR made was its interactivity. VR can create a world to explore, and viewers become participants-they become artists. In practice this is yet to be proven convincingly. By building the historical narratives, as was discussed earlier, VR aimed to make associations with much broader range of cultural traditions than previous computer-based systems.

Many computer developers looked outside their discourse for inspiration.

Theodor Nelson had been claiming since the early 1980s that computing was a branch of

film-making.64 In 1991 Brenda Laurel, a software designer with a background in theatre, released Computers as Theatre, comparing the tasks for interface design with Aristotelian dramatical principles. Virtual reality was often compared with Alice in Wonderland, and Alice Through the Looking Glass. It was compared with Cinerama and film.

Virtual reality has been reasonably successful in having its claims to being the "next big thing" accepted. It has found some institutional support from other areas. The entertainments industries (especially video games and film) have become involved. The Powerglove, VPL's cheaper version of their Dataglove, was marketed by Mattell as part of video games systems from late 1989 until 1991. Video games manufacturers Sega and Nintendo have VR research projects underway, though costs are too high for mass marketing complete systems yet.65

George Lucas, who made the hugely successful Star Wars movies, invested much of the money into developing broader entertainment systems. In 1985 the Lucasfilm Games division started developing "Habitat," a prototype networked virtual multi-user environment for the Commodore 64 computer.66 LucasArts' special effects division, Industrial Light and Magic, spawned Rebel Arts & Technology, now a significant researcher in the VR field. They have used the infrastructure and funds developed in film making, and from the amusement ride, SpaceRace. They have also been funded by the military-the commando pod project with Hughes Aerospace. They are currently developing multi-user virtual reality games systems that may be networked across the US, and even the world. 67

In 1992 VPL and MCA Ltd (the parent company of Universal) were developing VR experiences called "Voomies,"68 associating the experience with film in name, implying in fact that it is even better. They intend to build interactive virtual reality theatres, possibly in Universal Studios in Los Angeles.

The W Industries "Virtuality" system, developed in Britain, is the only successfully broadly marketed consumer-oriented system. The company was founded in Leicester in October 1987 by John Waldern and others with backgrounds in graphics and flight simulation, including Marconi Radar Systems Ltd. In developing VR they succeeded in getting funding from a wide range of sponsors in entertainment related fields. In 1989 they were 75% bought out by a leisure industry company. Before that company went bankrupt, W Industries, had been bought by the company that owned Wembley stadium, maintaining the links to entertainment. In November 1990 they released a stand up virtual reality system, and a sit-down version the following March.69 In November 1991 Horizon Entertainments, a division of the Edison Brothers Store retail chain, began distributing W Industries' Virtuality system throughout the US. The sites where it was installed in 1992 included the UC Student Union at Berkeley, California, the Forest Fair Mall in Cincinnati, Ohio, casinos in Las Vegas, the Universal Studios Tour in Los Angeles, and the Cineplex Odeon/Chelsea Theatre in New York City.70 These systems hardly delivered on the promise of creativity and exploration, though. The games include a driving game, flying a Harrier jump jet, and a game where two players try to shoot each other while dodging pterodactyls flying overhead. New social phenomena emerge in familiar environments and institutions, and take familiar forms.

Other media capitalized on the attention VR had attracted. Virtual reality appeared in children's books, dance parties in England,71 many TV and print news stories, magazine articles, TV games shows,72 and documentaries. The film Lawnmover Man, based on a Stephen King story which had nothing to do with VR, took up the theme in 1992. The film featured impressive computer graphics, and an absurd plot about an obsessed scientist artificially increasing the brainpower of the village idiot. This film further expanded the profile of VR technology. In May 1993 another TV program featuring virtual reality as a central theme, Wild Palms, screened on American television. The process was circular-publicity attracted more publicity. It didn't always do much to help people understand

the technology, but this was irrelevant to the box office.

Medicine, Science, Architecture

Further than entertainment, though, VR aimed from early on to be accepted as viable for a range of more serious applications. VR's claims that it would be of major significance needed to be backed up with actual examples of working systems. These examples had to be suited uniquely to VR's strengths, and demonstrably superior to other applications. They had to be of enough value to justify their cost. It was crucial that the applications be outside the current discourse of computing.

VR researchers understood that successful colonization of the discourses of science and architecture could bring huge rewards. The University of North Carolina have been particularly active in trying to demonstrate practical uses of VR. Two projects suited these needs well: the design of Sittersen Hall, and molecular docking, with force feedback. These demonstrated the viability of VR systems outside their discourse. Sittersen Hall, the new computing science building, was being built on UNC campus. The computing department whose building it would be, decided to apply VR systems to that process, and built a virtual version of the building as a demonstration. Much is made of the fact that a planned partition was moved once it became clear in virtual space that the area would feel too confined. This served as a demonstration of the viability of VR in architecture.

The molecular force feedback system presents graphical representations of molecules. The user can manipulate the molecules on the screen by moving a robot arm. The arm reacts to the pressure applied by the user in accordance with the way the molecules attract and repel one another. It is therefore possible to design new molecules in a more intuitive way. This application was designed to demonstrate the usefulness of VR in theoretical science. It positioned VR in a new discourses outside the field of computing (and video games). Medical imaging, which has along history from the X-ray to the CAT scan, could benefit from a 3D intuitive interface. VR as an industry could benefit from the research funds medicine attracts, and has set its sights on that. Applications for disabled people have also been considered. Other claims, like Lanier's argument that VR could help minimize pollution by having people work from home rather than commute[73] is a bit less credible.

This colonization has been quite productive. Many university researchers have bought VR systems. By mid 1991, besides the early adopters at the U of W and UNC, the University of Central Florida, the University of Alberta, Syracuse University, the University of Virginia, and MIT all had VR research projects underway.[74] Around the same time the U of W's Human Interface Technology Lab had gathered support from many companies in a consortium including Alias Research; The Boeing Company; Digital Equipment Corporation; Franz, Inc.; the Port of Seattle; Sun Microsystems; US West Communications; VPL Research; Microsoft; Fujitsu; Insight; and Matsushita Electronics. While most publications about VR are still written by computer people, or journalists, increasingly other groups are being involved. Among the more notable is Cyberspace, First Steps (1992), which is edited by Michael Benedikt, an architect. The book also includes chapters by another architect, a philosopher, a sociologist, and an anthropologist, as well as a number of computer people.

Several companies are applying VR to specific problems. Boeing use it in aircraft design and simulation. Japanese household appliance company, Matsushita, use VR to help customers design their own kitchen. UCLA architects and urban planners used VR as a tool in the rebuilding of LA after the riots of April 1992.[75]

Digital Colonization of the Analog Dataspace

Another process of colonization associated with cyberspace is what I call the digital colonization of the analogue dataspace. By envisioning a world where all information is infinitely accessible irrespective of place, the implication is that absolutely everything can and should be represented in digital form. The technologically built global village, newly incarnated as cyberspace, implies a potential that VR could be a new space for liberation and universal understanding, with access to all wisdom and truth anywhere at any instant: "Inclusion and unconstrained realities."[76]

Undoubtably one new factor which has contributed to the growth of VR is the Internet, which developed in parallel with VR. Internet is the international academic packet-switched network which started as ARPANet in California in the early 1980s. It has grown to include literally millions of on line users at universities, and companies around the world. The Human Interface Technology Lab started the news group sci.virtual.worlds in 1989. Anyone connected to internet can, with appropriate software, read and send "postings" to this news group. Many more people read articles than send them. This provided a forum for discussion about VR and surrounding issues for many developers from around the world. It clearly lead to quicker development of the discourse than otherwise would have been possible. The postings keep all readers of the group in touch with broad developments in the field much more quickly than any other form of publication. It allowed for cross-fertilisation of ideas from around the world. It quickly propagated agreement on terminology. It also filtered unacceptable ideas. The notorious practice of "flaming" on internet soon sets straight people who deviate from the agreed line. "Flaming" is a term used to describe tirades of opinion which some users send in response to opinions with which they disagree. Much of the research for this essay was done through the sci.virtual.worlds newsgroup and its archives. The newsgroup in itself powerfully demonstrated the power of using information which is accessble through the global network. However, there are limitations to what is possible though internet, and necessary political issues which can easily be ignored.

The dream of all information being universally accessible compels its converts to undertake a never-ending quest to record everything in a digital and network-accessible form. The inspiration can be seen, for example, in Project Gutenburg, an internet site which has digitized several works of literature deemed to be significant. The database can be searched from anywhere on the Internet. Users input specific words or phrases, and a full text quotation of any text in which the search criteria appear will be returned. There are many similar on-line databases, such as "Dialog" and "Compuserve," which value themselves for their comprehensiveness. Many charge fees for the search. The claim to comprehensiveness is quite misleading. Anything which is not entered is rendered non existent. The cost of building and maintaining the databases effectively censors unfashionable ideas-they never get put onto the databases. The process of electronic marginalisation is difficult to document, but it is magnified by the impression some may have that information available through these kinds of database is comprehensive.

While it is possible to represent text, sounds, still and motion graphics and 3D modelled objects digitally, not all knowledge or all experience can fit this form. Meanings change with context, and digitisation tends to remove information from its context. Standardisation of the manner in which information is presented will impose a culturally loaded form on what really are diverse data. Its consistent form (whether that is ASCII text, graphics, or a fully graphical matrix) imposes a homogeneity of form which implies similarities where there are none. Types of knowledge which cannot be codified and digitized will become invisible in virtual space. Directory structures, field definitions and graphical representations inevitably impose meanings on all the information that is available.

The terms "frontier" and "colonization," used uncritically by VR proponents, are not universally accepted as favourable. Tropes are often ambiguous and may be contested and

re-interpreted. One people's heroic advance of progress is another's invasion and genocide. The advance of the western frontier involved the annihilation and disenfranchisement of native American communities. Colonialism and its heroic connotations have been challenged recently, particularly by the ancestors of ignored people who were the unacknowledged victims of colonialism. Of course virtual reality will not mean trampling on pre-existing territories. However, there is a danger that this virtual space will alienate minority perspectives in a similar way: not from direct policy, but by the economics and practice of access to the technology. From under a head-mounted display it is easy to ignore the people outside the cyberspace: excluded by economics, language and subculture. The level of diversity of opinion and perspectives within cyberspace is a product of who has access.

Social class is an equally potent division in virtual reality as it is in social reality. In spite of the claims that everyone is the same in virtual worlds, access to technology and necessary skills will effectively replicate class divisions of the rest of reality in the virtual spaces. The socially underprivileged will be excluded not by evil tyrants, but by the invisible hand of economics.

Language barriers are not transcended by cyberspace. Non-English speakers are effectively excluded from much of the activity on global networks because English is so predominant. The arguments that the graphical nature of virtual reality, and the emergence of real time translation will overcome language barriers are making naïve assumptions about the power of the technologies. Language will always be a divider, to the benefit of dominant languages.

Already on the international academic network, Internet, it is evident there is a dominance of users from the US. Needless to say, it is only available to those with access to computers, and who know how to use the,. If this is an alternative reality, a crucial issue is who creates that reality. This means not only access to the information within cyberspace, but access to inputting and changing that information. The world views contained within cyberspace will be a consequence of who gets to down-load the information there. Therefore the diversity of people who have access is crucial. These considerations should temper some of the utopian rhetoric about cyberspace's liberating potential.

Virtual reality can be an extension of a tendency in western capitalist societies to commodify human experience. The World Travel and Tourism Council claimed tourism is the world's biggest industry, generating 5.5% of the world's GDP.77 The sex industry sells quick and convenient sexual experiences.78 Drug industries essentially market the experience of intoxication (the Budweiser beer company have sponsored virtual reality demonstrations). In each case experience is demarcated, prepared and sold as a commodity. Package tours, tourist complexes and amusement parks pre-package experience-they transform serendipity to certainty, maximising tourists' satisfaction and minimising their inconveniences. Skiing, parachuting, bungie jumping, hang gliding, paraflying and joy flights are highly commodified extraordinary experiences, designed to allow the customers to transcend their prosaic everyday lives. The nature of the experience should reliably be as engaging and exciting as possible. Like other commodities, though, rarity increases value--so achieving some form of monopoly is attractive. Virtual reality (as a concept, rather than current application) promises to be a commodity absolutely controllable and saleable. It will efficiently give only the experiences intended, with few side effects (which may result in expensive litigation). And because it is accessible only through expensive (proprietary) hardware it can be charged for by the minute.

These criticisms do not say that the technology will be catastrophic or particularly regressive in itself. VR's social consequences will not be an exception to other social patterns. It has been sold as though it were exceptional--spiritually enlightening, socially liberating, and qualitatively different to other technologies. It is neither a panacea nor a calamity. It will tend

to reinforce existing inequalities, and propagate already dominant ideologies. Diversity of ownership and access are the base political issues relating to these technologies, but these tend often to be passed over. It is always assumed there will be technical solutions just around the corner.

Conclusion

Virtual reality's recent emergence as a discourse shows that the process of a technology coming to acceptance involves more than just creating better hardware and software. VR originated as a marginal technology associated, on the one hand, with the military, and, on the other, with science fiction and the cyberpunk counterculture. It was taken up by computer companies as a product-but in the process of its development and promotion it changed to better suit mainstream values.

VR's appeal has largely been due to its marketing. It proposed a paradigm shift: that computers can be "reality generators," not just symbol processors. This shift allowed VR to become associated with a far broader range of cultural tropes than computers had been before. The VR fraternity gave their technology a history, writing narratives which fitted VR at the apex of the historical process. To give a sense of cultural scale, they compared their technology with others, such as flight, the telephone and the printing press. By emphasising the spatial and experiential nature of VR, proponents tapped into US cultural traditions-which I have related to the myth of the frontier. Meanwhile they tried to broaden the range of areas to which the technology could be understood to apply--colonizing discourses. It has also enriched itself by being informed by other discourses. The excessive claims about VR seen around 1989 have been tempered, and VR now has a solid infrastructure of developers, and a receptive public. This success can partly be attributed to the technology itself, but as this essay has shown, the process is more complex and is strongly connected with the cultural context into which the technology was introduced.

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