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Understanding New Media: Augmented Knowledge and Culture
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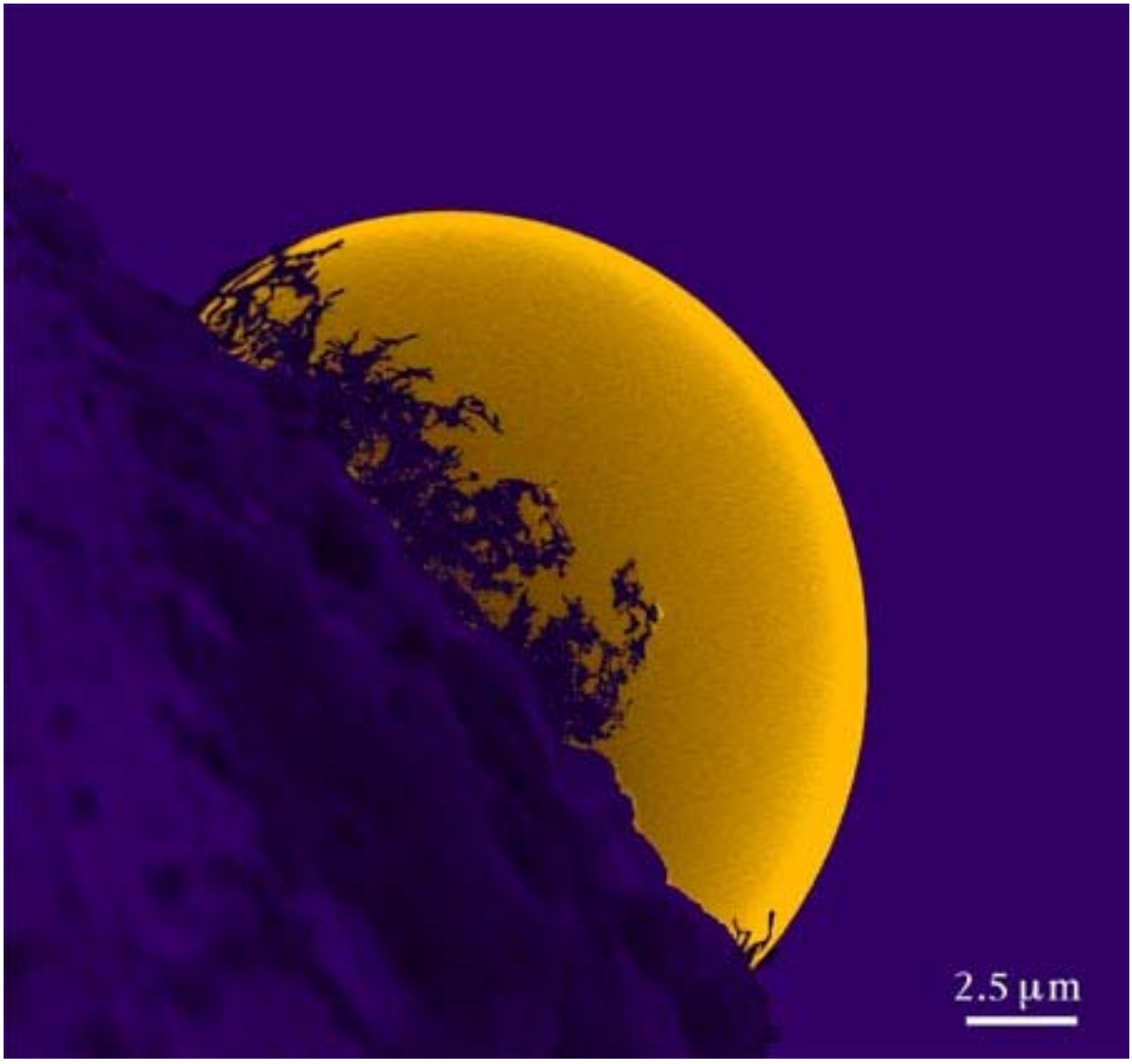
To the Student Team at the McLuhan Program (1990-1996)

Andrew, Avenindra, Brendan, Björn, Colin, Daniel, Darren, Darius, Darwin, **David**, David F. and S., Du, Effi, Eitan, Eric D. and M., Gijs, Greg, Hameed, Hasan, Hormoz, Hugh, Jeff, Jeremy, Jon, **Jonathan**, John, **Jordan**, Jimmy, Marc, Michael, Ming, Olivier, Perseus, **Rakesh**, Rani, Ronodev, Sam, Sanjeev, Sascha, Sean, Steve,
Tony, Wen, William

who taught me to see how the present can transform our past to help the future.



Nano-Landscape, Courtesy: Hitachi, Viewseum

Consider for a moment…how unevenly technology has impacted the various fields of knowledge in the twentieth century.…The sciences are utterly dependent on advanced technologies…..But what of the humanities? During this same time what has happened to them?….The scholar of literature or history works exactly as his predecessors did a hundred years before….Because no new technology assists them. No one has ever developed a new technology for the benefit of historians- until now.

Michael Crichton, *Timeline*.[1]

Introduction

The Internet is growing quickly. An estimated 1.4 billion gigabytes of information were produced in 1999.[2] In July 2000, Cyveillance claimed that 7 million new pages are added each day and that the Internet had surpassed 2.1 billion pages.[3] Companies such as Intelliseek and BrightPlanet say this is only the surface web and speak of a deep web with more than 550 billion online documents,[4] which includes all the databases and intranet materials not available through simple web pages. In 2000, it was claimed that only about 1 billion of these pages had been catalogued by standard search engines. By January 2004, Google had indexed over 2 billion pages. That number doubled in February 2004 and as of 1 April 2004 there were 4,285,199,774 indexed pages. In 2000 there were no indexed images.[5] In April 2004 there were 880,000,000 indexed images.

The number of users is growing quickly.[6] When the Internet began (1968 in Britain, 1969 in the United States) it was an experimental method linking a few scientists. By 1989 there were 100,000 hosts. In 1990, Tim Berners Lee and Robert Cailliau (CERN) introduced the hypertext transfer protocol (http) that began the World Wide Web (WWW). By 1992, the number of hosts had increased to 1 million. The advent of browsers, beginning with Mosaic in 1993 (then Netscape), transformed the Internet from a platform for geeks to a new tool for the world. In 1995 there were approximately 5 million users. In the autumn of 1995 Microsoft Explorer came out.[7] By 1996 there were 50 million users. By 2000, there were 211 million. The so-called dot.com bust did not change this trend. By 30 March 2004, there were 804 million users.[8] New estimates claim that the Internet will rise to 940 million by the end of 2004.[9] If so, sometime in 2005 the Internet, in terms of personal computers, will affect over one billion persons. In Denmark there are predictions that by 2008, 100% of the population will have personal computers and cell phones .[10]

The languages of the Internet are also changing quickly.[11] In 1995, most users were in the United States and the Internet was over 90% English. By June 2000,[12] English had dropped to 51%[13] and was now one of 32 major languages on the Internet.[14] In 2004 English accounted for 35.8%, Chinese was the second language of the Internet at 14.1% and Asian language sites outnumbered those of North America.[15] Some predict that Chinese will be the primary language of the Internet within three to five years.

In 2000, there were 300 million cellular phones worldwide. In April 2004, there were 1.32 billion global mobile users.[16] Cellular phones are becoming Internet enabled and will soon outnumber Internet connections by computer.[17] This is introducing new forms of communication. In 2002, users sent 366 billion short texts as messages as Short Message Services (SMS).

While it is still the case today that over three billion persons on our planet have never yet made a telephone call, or seen a television, enormous, recent advances in technology mean that the Internet Society's slogan of Internet for everyone can literally become a reality in the next generations. From such a global view, the United States represents around 4% of the world's population.[18]

While the United States is already planning an interplanetary Internet linking Earth with Mars and other planets by 2008,[19] the full consequences of the Internet for planet earth are relatively unexplored. To be sure, many speak of the computer revolution as if it were something that has already happened, as if it began with Vannevar Bush's article (1945),[20] with the founding of the ARPANET (1969), or with the establishment of the World Wide Web (1989). Meanwhile, others speak of the computer revolution as if it were something which is nearing completion,[21] as if it consisted mainly in the use of personal computers and resulted primarily in the production of Word files, Power Point presentations and CD-ROMS. As always there are some who claim that the Internet is mainly hype or even unimportant.[22]

Our approach differs from the above in three ways. First, we believe that the revolution underway today needs to be seen as part of a larger control revolution, which has been underway for well over a century. Here we follow the important work of scholars such as Beniger and Matellart. Second, the revolution now underway has scarcely begun. The mass media may speak of Internet speed as days, months or years, but the full changes will take at least a century to reveal deeper implications of the so-called revolution. Third, the revolution in new media, which most persons assume is only about computers and the Internet, is not really about computers as such: it is about a re-organization of all knowledge. Matellart has explored some aspects of this problem showing that the rise of universal communication systems is linked with the rise of universal claims to knowledge.[23] We go further to suggest that the systemic approach of computing is permeating every dimension of society.

We begin by examining the technology itself. An opening chapter traces developments in size and speed; examines basic changes in the functions of computers from devices to calculate and write, their expansion to include multimedia and intermedia, becoming methods to interact with, to augment and delegate knowledge. As a result, computers are increasingly multi-purpose, multi-functional devices, serving as a telephone, fax machine, camera, video-conferencing unit, and as personal digital assistants. Some predict that they will soon become instruments for synthetic reason, intelligent machines, even spiritual machines.

A second chapter examines some consequences of wireless communication: mobility through cellular phones, which will permit us to operate devices from anywhere at anytime. A third chapter explores developments in miniaturisation. In the past decades, computers have kept shrinking from a desktop, to a portable, a laptop, and more recently to handheld devices. Wearable computing is becoming a reality. At present, there are initiatives on at least four fronts to reduce the size of computers to the nano-level of billionths of a meter.

Within the next two decades the computer will become invisible. Herein lies a first paradox. Computers are about making things visible. They help us to visualize processes, concepts and many things, which we cannot see. Yet, as they develop, computers are becoming part of the furniture, disappearing into the woodwork. When the technology is mature, our chief means of rendering things visible will be invisible.

The next three chapters consider the material implications of computers; exploring how these innovations are re-structuring the physical world. As computers disappear into their environments, they are changing 1) the means and meanings of production 2) the roles of transactions and services and 3) the institutions where they are housed. This includes obvious consequences of computers for e-business and e-commerce. Again there is a paradox: the implications of computers for the material world entail a new emphasis on virtuality. This entails much more than a simple substitution of the real by the virtual. It involves many new interplays between real and virtual.

Chapters seven to nine explore the organizational implications of networked computers, which have little to do with the physical machines and entail instead their underlying, logical principles. These principles, which have become closely linked with systems theory, are having profound effects on our theories of organization and knowledge management, focussing our attention so much on process, that we are in danger of losing sight of the importance of content. Chapter nine explores possible implications thereof for learning. These represent unexpected side effects of the new media which, as Marshall McLuhan has taught us, are often as important as the media themselves, all the more so because they are often unnoticed.

Chapters ten to twelve examine the intellectual implications of computers for networked content; showing how they are changing our approaches to knowledge itself, in terms of personal, collaborative and enduring knowledge. The final three chapters of the book explore some of the immaterial, philosophical and spiritual implications of networked computers. Although the book as a whole focusses on what is possible and particularly on the positive potentials of networked computing, chapter thirteen examines some of the challenges and dangers involved. These include a need for interoperability of content; the dangers of privatisation of knowledge; dangers which are linked with re-definitions of real versus virtual; truth versus viewpoints; inner versus outer; public versus private, and the need for a new public good.

Chapter fourteen turns to the challenge of synthesis. To claim that the Internet is solely about e-commerce is to limit attention only to a material dimension. The rise of the open

source movement; the emergence of virtual communities are but two expressions of spiritual dimensions in the context of computers. In the long term, intellectual and spiritual implications are more important than technological, material, and organizational consequences. Only an integration of all these dimensions will unleash the full potentials of networked computers. The concluding chapter claims that networked computers challenge us to re-define all our fundamental concepts, what it means to know, even what it is to be human.

One of the underlying themes of this book is that there are a number of competing goals and visions for these new media. Potentially, these goals and visions are as myriad as the number of users. In fact, while goals and visions are abundant, ability to make them happen requires great political power, incredible economic investments and/or profound spiritual visions, which can unite the efforts of hundreds of millions and potentially billions of individual users.

On the political front we discern three main goals. One focusses primarily on profit; a second includes human dimensions and a third seeks a more systematic integration of persons and technology. We shall suggest how these very different goals lead to three quite different visions. One seeks an information highway (United States). A second seeks an information society (Europe). A third aims at a knowledge society (Japan). On a strictly economic front, is a fourth goal, which seeks to develop profit on a global basis. Authors such as Korten have described some of these dangers in *When Corporations Rule the World.*[24] Finally, there is an emerging international vision which recognizes the importance of working together, sharing, in order to achieve something better.

These visions affect the whole of society. They affect the production and distribution of goods; interactions of persons in the organisational worlds of business and government; education and training and ultimately ideals of knowledge and truth. These visions are competing, yet need not exclude each other. Indeed this book combines aspects of all four visions in order to arrive at a new synthesis. We need somehow a combination of the American profit motive, the European historical and multicultural, social motive and the Japanese quest for a new kind of knowledge, which combines ancient samurai concepts such as *kaizen* with the latest technological advances.

Any such attempt to sketch major trends risks becoming of caricature.[25] The United States is a collection of over 290 million individuals. Its history of civil war reminds us that a single vision has never completely dominated the country. Today, the United States is certainly many things. The same country, which has developed Echelon, the new international spy initiative, which is watching all of us, has also seen the development of the Electronic Frontier Foundation. The country of proprietary software and hardware solutions has developed the European open source idea into a movement.

The same country, which sometimes acts as if computers and Internet were mainly a US phenomenon, has permitted the development of the Internet Society as a global organisation. The same country, which sometimes acts as if they can ignore standards (because they assume that their own practice will define that of the world), has played a

role in the development of global standards through bodies such as the International Standards Organization (ISO), and International Tele-communications Union (ITU). And at the same time the United States has made Silicon Valley into a world symbol for new electronic media.

The same is true in Europe and Japan. The European Union, which is one of the leaders of world science through organisations such as CERN (Organisation Européenne de Recherche Nucléaire), is also a combination of many cottage industries and age old traditions. Within Europe there are significant differences between countries such as Britain, France, Germany, Italy etc. The same Japan, which leads the world in some combinations of knowledge theory, robots and aspects of computers (e.g. display screens), also has very complex traditional strands.

To reflect all these complexities at every turn would lead far beyond the confines of a book. Characteristics such as the profit motive, particularly evident in America, are also evident in Europe, Japan and around the world. Hence, our characterisations of the United States, Europe and Japan will function as three personae in a complex play, knowing that they represent aspects of their peoples without pretending to be them.

By the same token, we are very aware there are many other visions. Canada is not the same as the United States. In Asia, there are other significant voices such as China, India, Malaysia and Korea. One must not forget the role of the other continents, Africa, South America and other countries such as Australia. While their importance is duly acknowledged, to survey all possible currents and developments throughout the world is beyond the scope of this book.

Essentially we see five major consequences of networked computers. A first is technological. They lead to invisibility. A second is material. They lead to virtuality. A third consequence is organisational. They lead to systemicity. A fourth is intellectual. They can lead to a new contextuality. Finally, at a philosophical level we suggest that they could lead to a new spirituality. Each of the four visions have their own take on these issues. Can their seeming contradictions be united into a larger vision? This book offers a possible answer, or at least the outlines of a new approach. It also points to emerging areas for new research.

The title is a conscious hommage to the late Marshall McLuhan's *Understanding Media* (1964, reprint, 1994). Since then there have been a series of books on *Understanding New Media*: Compaine (1984) emphasized electronic distribution of information; Whitehouse (1986) focussed on mass media; Fidler (1997) examined their effects on journalism; Monaco (1999) offered a Dictionary; Grusin and Bolter (2000) have emphasized remediation. Where McLuhan focussed on books, radio and television as extensions of man, we explore new media as extensions of the human spirit, how they can augment our knowledge, culture, our spiritual horizions.

The field of new media poses particular problems. Abbreviations, jargon and statistics are annoying but unavoidable. Therefore they are used as sparingly as possible. Those

interested in new media want to get to the point without distractions. They find footnotes and references irritating. Therefore, the text is written such that it can be read independently and there are footnotes for those who wish to pursue some of the myriad strands in this complex field. Books for further reading are listed separately by themes (Appendix 9).

Revolutions have curious spinoffs. There are the actual developments and then their meanings: interpretations; considerations of consequences, implications, musings, moral, ethical, philosophical and religious. Inevitably these go in two opposite and often opposing directions. On the one hand, some inevitably see such developments as a starting point for their own utopias. Meanwhile, others inevitably see the same developments as the beginning of new dystopias, scenarios of doom and gloom, prologues for the end of days.

We tend to the former of these two extremes. We try to give a lay of the land, to introduce a whole range of emerging fields including mechatronics, holonics, molectronics, biocommunication, neuromorphic engineering and bio-mimetics. We try to see the possible good in what is evolving. We try also to point to genuine challenges, hurdles and problems along the way. We try *not* to moralize on everything that could go wrong with the Internet, with global corporations, nano-technology, bio-technology, the human genome, or electronic warfare.

Aside from the inherent dangers of trying to predict the future,[26] the reasons for our optimistic approach are simple. First and foremost, those who see the dangers of computing are producing shelves of books on these themes. The problems they discuss are very real and very important and we shall cite them, especially in the appendix for further reading.

At a deeper level, almost everyone is afraid of computers in some way. I remember a very distinguished lady in Los Angeles in the 1980s who went to computer courses and spent an entire lesson learning not to be afraid to turn the machine on and off. Many of us are afraid that they will function, that the work we do on them is not lost, that they do not corrupt our children and ourselves and so on. We fear what we could do with them and what they could do to us. We fear what we might find with them and what we might not find with them.

It often takes children to remind us that there is nothing to be afraid of at all. Children turn computers on and off the way older persons flick a light switch. This was the case with me. My uncle had worked on computers in a bank in Rotterdam in the 1930s. I dreamed about them in 1961 and started writing on the subject in the late 1970s. Even so it was teenagers and students in the early 1990s who helped me experience how computers can be a source of hope rather than fear. In a spiritual sense this book is a testament to what they taught me: a story of new hope, a story of how computers can lead to dynamic and augmented knowledge, augmented culture and can lead ultimately to the theological virtues.

Acknowledgements

This book was initially to be a paper for INET 2000. I began writing, soon found that I had written 92 pages, and felt as if I were scarcely past the introduction. Theoretically that was far too long for a paper, but the committee generously accepted it anyway as the longest contribution to INET in the first year of the new millennium. So my first thanks go that committee which included Steve Cisler, Jean-Claude Guedon, David Lassner and George Sadowsky. I thank them especially because they encouraged me to develop what at the time was still rather half-baked, which as my mentor Kenneth Keele always pointed out, is the first step to being fully cooked.

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The physical book was written in a year. The metaphysical ideas behind this book go back almost forty years.[27] First thanks go to my parents and my relatives, especially Gerrit and Gina Adema, Mother Superior, Sister Ancilla Veltman, and Sister Dr. Dr. Maria Laeta Veltman. Second, thanks go to my teachers notably: at York University (Professors Brayton Polka, Theodore Allan Heinrich and Dean Sidney Eisen), at the University of Toronto (Professor Stillman Drake, Father Leonard Boyle, Professor Natalie Zemon Davis), at the Warburg Institute (Professors A.I. Sabra, Sir Ernst Gombrich, Charles Schmitt, B.A.R. Carter), at Oxford (Dr. Alistair Crombie). Third, thanks go to the individuals who supported my post doctoral research, namely, at the Wellcome Institute (Dr. Kenneth Keele and Dr. Noel Poynter); at the Herzog August Bibliothek (Dr. Sabine Solf, Professor Paul Raabe, Professor Walter Killy, Professors Wolfgang Paul, Dr. Heinrich Pfeiffer, Dr. Thomas Berberich) at the Getty Institute (Professors Kurt Forster, Françoise Forster Hahn, Dr. Herb Hymans).

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The book was to have published in Germany but the translator died unexpectedly at 34 and that project was abandoned. In September, 2003 at the Digital Resources in the Humanities Conference (Cheltenham), Dr. Frits Pannekoek (Calgary) suggested that the University of Calgary Press might be interested. I am very grateful to him, to Walter Hildebrandt, Director of U. of C. Press, and his staff for their patience in making the manuscript into a published book.

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NOTES

One of the problems with the Internet at present is the non-permanence of websites. In most cases they do not stop existing: they "simply" move their address. My own experience has been that by noting titles and keywords that lead to that site, one can use Google to arrive at the new site. For this reason, when there is not a specific author and title, references to websites in the notes are typically preceded by keywords that may help one in cases of changed addresses. In some rare cases a website may be correct, does not allow direct access but does allow access via Google. The correctness of all websites was tested in April 2004.

In the interests of historians of the web with access to earlier versiosn, in cases where a website is no longer working, I have put the site in brackets with the word formerly).

Introduction

[1] Michael Crichton, *Timeline*, New York: Ballantine books, 1999, pp. 141-142.

[2] AG Automatiseringsgids. See: http://www.automatiseringsgids.nl/ for 27 October 2000: "Vorig jaar werd er wereldwijd een informatiewolk van 1,5 exabyte, ofwel 1,5 miljard gigabyte, geproduceerd. Volgens de universiteit komt dat neer op 250 megabyte voor elke mens op deze aardbol." UNESCO (lecture by Abdelaziz Abid, Amsterdam Maastricht Summer University, 11 July 2001), estimates 1.5 billion gigabytes of which 90% is stored in digital format. Stuart Feldman (IBM) noted at INET 2002 that one hour of the world's disc production amounts to a petabyte and that annually this leads to 10 exobytes of new information.

Jeffrey Harrow in RCFoC for 30 October 2000 cites Hal Varian's and Peter Lyman's report, "How Much Information".

See: http://www.sims.berkeley.edu/how-much-info/index.html

to claim that the information created in 1999, assuming it were all digitized is:

- Optical storage (music and data CD and DVDs) - 83 terabytes.
- Paper - 240 terabytes.
- Film (still, movies, and medical images) - 427 petabytes.
- Magnetic storage (camcorder tapes, disk drives) - 1.693 exabytes.

That's a grand total of 2.1 exabytes of new information produced that year. Yet if that sounds like a lot, Varian and Lyman found that the growth rate of such information is 50% each year! Where does the Internet fit into this? The "surface Web" (html pages) consists of 2.5 billion documents growing at the rate of 7.3 million pages -- per day! Overall, there's 25 to 50 terabytes of html data on the Web.

[3] Cyveillance report, 10 July 2000.

See: http://www.cyveillance.com/us/newsroom/pressr/000710.asp

[4] "Web Is Bigger Than We Thought, *San Jose Mercury News*, 28 July, 2000,
See: http://www.nua.ie/surveys/?f=VS&art_id=905355941&rel=true
Mark Frauenfelder, "Deep-Net Fishing," *The Industry Standard Magazine*, June 18, 2001. See: http://www.techinformer.com/go.cgi?id=490878.
Mike Nelson (IBM) at the INET 2001 Global Summit claimed that in the next 9 years there will be a 1 million fold increase in information. This amounts to the equvalent of 550,000,000,000,000,000 pages.

[5] UNESCO claims that individual information (e.g. personal homepages) is now over 2,600 times larger than published information.

[6] Robert H'obbes' Zakon, *Hobbes' Internet Timeline v7.0*.on the Internet Society site:
See: http://www.zakon.org/robert/internet/timeline/
Another look at the history of the Internet is given in the present author's "American Visions of the Internet."
See: http://www.mmi.unimaas.nl/people/Veltman/publications.htm

[7] Brian Wilson, Internet Explorer (Windows)
See: http://www.blooberry.com/indexdot/history/ie.htm
For a claim that browsers were invented earlier at Bath, cf. the modest article:
How we invented the web.
See: http://www.cs.bath.ac.uk/~pjw/media/web.htm

[8] Figures for these latest results differ considerably. For instance, World Internet usage statistics claimed 740 million users for March 2004.
See: www.internetworldstats.com
Global Internet Statistics claims 729 million users but in its lists for individual languages cites 287.5 million English and 516.7 non-English which amounts to 804.2 million users.
See: http://global-reach.biz/globstats/index.php3

[9] Global Internet Statistics. See: www.glreach.com/globstats/index.php3

[10] Statistics of household appliances.
See: www.hgo.dk/year2031/ statistik.htm

[11] Much is often made of the time it took to reach 50 million users. For instance, John Chen, CEO and President of Sybase noted in his keynote at WWW10 (May 2001) that it took:

Radio	38 years
TV	13 " "
Cable	10 " "
Web	5 " ".

It bears noting that in 2000 alone there were over 120 million new internet connections and that in the first 5 months of 2001 there were a further 50 million. This is a new scale of development. For an indicator of global differences cf. the Information Society Index.
See:
http://www.worldpaper.com/2001/jan01/ISI/2001%20Information%20Society%20Ranking.html

[12] In June 2000 there were an estimated 134 million users in the United States out of 332.7 million worldwide.
On 25 November, 1999, in an Internet search for the term computers, Yahoo found 416 categories and 26,891 sites; Lycos found 2,111,279 sites; Hotbot found 2,386,510 and Altavista found "about 10,363,216." Internet is connecting computers almost everywhere.

According to Wired Magazine, in November 1999 there were there were an estimated 205 million Internet sites. Five months later, in March 2000, there were over 300 million sites. In November 2000 there were 369 million.

[13] Global Internet Statistics by Global Reach.
See: http://www.glreach.com/globstats/index.php3

[14] Global Internet statistics as in previous note. One ambitious site allows one to: Translate between 1482 language pairs.
See: www.tranexp.com/InterTran/FreeTranslation.html.

[15] World Internet usage staistics as above. For other predictions
See: http://www.infoworld.com/articles/hn/xml/01/04/27/010427hnasia.xml

[16] Latest Mobile, GSM, Global, Handset, Base Station, & Regional Cellular Statistics.
See: http://www.cellular.co.za/stats-main.htm. A Panel disussion on the future of telecommunications, www.intranet2000.net conference, Paris, Cité des Sciences, 29 March 2000 predicted that there would be 1 billion by the end of 2003.

[17] At INET 2000 (Yokohama), Vint Cerf estimated that by 2006 there will be 900 million PCs, plus 1.6 billion mobile connections, for a total of 2.4 billion Internet users This may be too optimistic. In March 2004, Epaynews.com claimed that by 2007 there would be 1,450 million users by 2007 of 56.8% would be wireless.
See: www.epaynews.com/statistics/mcommstats.html

[18] In 2000, the US population, including those abroad was 275.1 million according to "Monthly Estimates of the United States Population: April 1, 1980 to July 1, 1999, with Short-Term Projections to November 1, 2000."
See: http://www.census.gov/population/estimates/nation/intfile1-1.txt
In 2000, the world population was 6 billion a ccording to David Levine's world population clock.
See: http://www.ibiblio.org/lunarbin/worldpop

[19] There is now an Interplanetary Internet Project.
See; http://www.ipnsig.org/home.htm
This was the subject of a keynote and a half day tutorial at INET 2001 (Stockholm).
See: http://www.isoc.org/inet2001/CD_proceedings/T90/INETPlenary_files/frame.htm
This is linked with the development of Space Communications Protocol Standards (scps).
See: www.scps.org

[20] Vannevar Bush, "As we may think," *Atlantic Monthly*, Boston, July 1945.
See: http://www.theatlantic.com/unbound/flashbks/computer/bushf.htm
For other visions of the future see: "The Wired Diaries 2000," *Wired*, January 2000, pp. 69 –103.

[21] For a suggestion that persons use the internet and then leave it Cf. Sally Wyatt, "They came, they surfed, they went back to the beach: why some people stop using the internet", (Prepared for the Society for Social Studies of Science conference, San Diego, October 1999). Under the heading: Virtual Society? the social science of electronic technologies:
See: http://virtualsociety.sbs.ox.ac.uk/text/reports/surf.htm

[22] Ulrich Briefs, for instance, claims that the Information society is largely a myth, that it promises rationality, jobs, qualified work, a healthy environment, more freedom for citizens, democracy and more diversity of media, but does not deliver. Ultimately, he

claims, it is unions who are the real losers. Ulrich Briefs, "Mythos Informations-Gesellschaft," *Zeitschrift Marxistische Erneuerung*, Frankfurt, Nr. 41, March 2000, pp. 81-93. Cf. Peter Glotz, "War das Internet bloss eine Hysterie?, *Tages-Anzeiger*, 27 December 2002, p. 65.

[23] Armand Matellart, *Mapping World Communication, War, Progress, Culture.* Minneapolis: University of Minneapolis Press, 1994; Ibid., *The Invention of Communication*, Minneapolis: University of Minneapolis Press, 1996.

[24] David Korten, *When Corporations Rule the World*, West Hartford, Conn.: Kumarian Press, 1995.

[25] An article in Wired (april 2001, pp. 162 ff) identified twelve Gigatrends:

1. The Protein Hunters	custom drugs
2. Personal Fabrication on Demand	desktop factoires
3. Plague Years	super bugs
4. The Next Wave	open sea satellite company
5. Debugging Democracy	online ballots
6. Disposable Corporations	
7. The New Hot Medium Paper	
8. P2P Health Care	
9. Global Marketplace	always on stock exchange
10. Borderless Bureaucracy	
11. Micropower goes Macro	generating own power
12. Turn on the Light	optical networking

[26] Rein de Wilde, *De Voorspellers. een kritiek op de toekomstindustrie*, Amsterdam: De Balie, 2000. Cf. Appendix 9.

[27] This background is described at further length on the website of MMI.
See: www.mmi.unimaas.nl under research, under SUMS, in an article "How it all began."

Chapter One Computers